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The Effects of the COVID-19 Pandemic on Sleep Health Among Middle Eastern and North African (MENA) Populations: A Systematic Review of the Literature

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Abstract

Objectives: This study sought to conduct a systematic review of the literature on the impact of the COVID-19 pandemic on sleep health among Middle Eastern and North African (MENA) populations, understudied geographic regions including with regards to sleep health.

Setting: A systematic literature search including multiple databases was performed on March 27th, 2022, using developed keywords

Participants: Studies were included if they (1) investigated one or more aspects/dimensions of sleep health as an outcome (e.g., sleep duration, sleep quality, sleep problems); (2) measured the impact of a COVID-19 pandemic-related domain (e.g., impact of quarantine, work from home, lifestyle changes, etc.); (3) focused on at least one MENA region population; (4) were peer reviewed; (5) included >=100 participants; (6) were written in English; (7) had full-text article publicly available.

Primary and secondary outcomes measured: Primary outcomes were sleep duration, sleep quality and sleep problems

Results: In line with PRISMA guidelines, 164 studies were included for data extraction. The Newcastle-Ottawa (NOS) scale for cross-sectional studies was used to assess the quality of the studies. Overall, the COVID-19 pandemic significantly impacted sleep duration, sleep quality, and presence and severity of sleep disorders in MENA populations, including adults, children, students, healthcare workers, and people with chronic illnesses. The directionality and strength of associations, as well as the determinants of sleep health, varied by sub-populations.

Conclusions: Longitudinal studies are needed to understand the longer-term impact of the COVID pandemic on the sleep health of MENA populations. Sleep health interventions and policy measures should be tailored to the need of each sub-population.

Trial registration number: PROSPERO registration number: CRD42022321128.

Keywords: COVID-19, Sleep Health, Middle East, Health behaviors, Pandemic

Introduction

The COVID-19 pandemic, which was announced as a Public Health Emergency of International Concern on 30 January 2020, and a pandemic on 11 March 2020, continues to affect people's lives around the globe. Given the nature of transmission of the SARS-CoV-2 virus, in addition to lack of medication or vaccines in the early response of the pandemic, many of the public health interventions to prevent the transmission focused on physical distancing. Such measures included quarantine and lock-down orders. In turn, this affected people's ability to do many social and physical activities, hence significantly impacting people's 24-h behavioral patterns. Further, pandemic-related stress also contributed to abrupt changes in lifestyle behaviors.[1, 2] For instance, Park et al., reported that COVID-19 has had a negative impact on healthy and active lifestyles, as well as mental health and quality of life, among a sample of adults in South Korea.

Emerging research is demonstrating that among the many health outcomes and health behaviors that may be affected by the pandemic is sleep health.[3-7] Prior studies among various populations have shown that the pandemic affected a variety of sleep health domains, including sleep quality,[8-10] sleep duration,[11, 12] and sleep disorders.[13, 14] For instance, in a longitudinal study in Spain, Martínez-de-Quel reported that perceived sleep problems significantly increased following the onset of the pandemic.[15] Similarly, among 400 students and university administration staff workers in Italy, the prevalence of insomnia increased from 24% prior to the pandemic to 40% during the pandemic. Similarly, difficulties in sleep initiation among the same sample increased from 15% to 42% from before to during the pandemic.[16] A systematic review conducted in July 2020 showed that the prevalence of sleep problems during the COVID-19 pandemic is high and affects approximately 40% of people from the general and health care populations.[17] In addition to the observed trend in sleep health outcomes, the pandemic may have exacerbated a number of stressors that can directly increase poor sleep health. For instance, emerging research has shown an increase in intimate partner violence (IPV) due to lockdown measures, as well as economic and psychological stress brough about by the pandemic.[18-20] In turn, IPV has been linked with poor sleep quality and sleep disturbances among different populations.[21, 22]

Among Middle Eastern and North African (MENA) populations, the burden of non-communicable diseases has drastically increased from 1990 to 2010.[23] The epidemiological profile of Middle Eastern countries closely resembles that of countries in western Europe, the USA, and Canada, with health loss from most non-communicable diseases, such as CVD and cancer, increasing over the past 20 years.[23] However, Middle Eastern populations are faced with multiple challenges when attempting to deal with such an epidemiological profile. Indeed, political turmoil, conflict, and corruption within states have led to challenges in implementing policies and laws, as well as adhering to them on a population-level.[24] Additionally, while Middle Eastern populations are facing an epidemiological challenge similar to that of the developed world, they continue to be understudied in public health research including sleep health research. In part, this is due to Arab countries having weak health information systems,[25, 26] which limits data availability and produces major challenges for sound research and evidence-based policy making.

In addition, MENA countries epidemiological profile is characterized by high burden of psychosocial problems, including depression and anxiety.[23] Noncommunicable diseases and

psychosocial problems, among other health outcomes, are consistently associated with sleep health.[27-31] Consequently, this exacerbation in poor sleep health that may be brought about by the pandemic can increase the risk of other undesirable health outcomes among populations. This issue is of increased urgency in areas with underdeveloped health research infrastructure where there continues to be lack of full understanding of the health of the population, as is the case in the MENA region.

Given the evident impact the pandemic had on sleep health worldwide, as well as the well-documented association between sleep health and the leading causes of morbidity and mortality, it is important to understand this association among Middle Eastern populations. This systematic review sought to summarize the evidence in the literature regarding the impact of the COVID-19 pandemic on aspects of sleep health among Middle Eastern adults. To the best of our knowledge, this is the first systematic review investigating sleep health among Middle Eastern populations in the context of COVID-19. Additionally, and while there are several reviews examining sleep health domains in developed countries,[32, 33] there continues to be a lack of reviews studying sleep health in Middle Eastern and North African countries, which collectively represent ~600 million of the word population. In fact, this systematic review would be the first to summarize the literature on the sleep health of Middle Eastern and North African populations, filling an important gap in the literature.

Methods

A systematic literature search was performed in accordance with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines.[34] On March 27th, 2022, we conducted a systematic literature review on multiple databases, including PubMed, MEDLINE, Embase, CINAHL, and Web of Science. A set of specific keywords and MeSH terms was developed and is shown in supplementary table S1. The protocol of this systematic review is registered with PROSPERO (international prospective register of systematic reviews) with the ID CRD42022321128.

Search Strategy and Selection Criteria

The authors developed a set of keywords relevant to the research question and the population investigated. Boolean operators were used to ensure full inclusion of words within the keywords used. Using Endnote referencing software, retrieved articles were entered and duplicates were identified and removed. Following that, articles were entered into Rayyan, a free web-tool for screening articles for systematic reviews. As shown in figure 1, title and abstract screening was conducted by two investigators (OT and YAA) independently. Next, full-text articles were accessed and screened in more depth. Conflicts were solved by discussion upon the conclusion of the screening process. The articles included were deemed eligible against the following criteria: (1) investigated an aspect sleep health as an outcome of interest (e.g., sleep duration, quality and presence of a sleep problem or disorder); (2) investigated a domain related to the COVID-19 pandemic induced lifestyle changes (e.g., lockdown, online schooling, etc.); (3) focused on at least one MENA population (supplementary table S2 includes a list of all MENA countries included); (4) were peer reviewed; (5) sample size >= 100 participants (6) were written in English; (7) had full-text article publicly available. Similarly, articles were excluded if they met at least one of the following: (1) were not written in English; (2) were not peer-reviewed' (3) did not have full-text available. Where multiple articles reported data from the same dataset, we selected the article with the largest numbers of variables included and excluded the other articles as duplicates.

Data Extraction

Data extraction was done in accordance with a tabulated form. Two reviewers (OT and YAA) collectively performed the data extraction into a template table. Conflicts were resolved through a discussion and where necessary, a third reviewer. Data was categorized based on sub-populations identified, including adults, children, healthcare workers, students, and people with chronic illnesses. Other dimensions collected for each study included: (1) the first author and year of publication (e.g., reference); (2) location of the study (city and/or country); (3) study population of interest; (4) study sample size; (5) study design; (6) sleep health measurement tool; (7) sleep health domains; (8) main findings summarized.

Data Presentation

All data extracted from identified studies were presented in a tabulated form organized according to the different sub-populations identified among MENA populations. This included: 1) adults; 2) children; 3) healthcare workers; 4) students; 5) people with chronic illnesses. Main summary

findings were presented in the tables, in addition to identifying specific factors that were associated with poor sleep health outcomes.

Quality Appraisal

Given that the majority of the studies identified were cross-sectional in design, The Newcastle-Ottawa scale (NOS) was used to assess the quality of the studies. Two reviewers (YAA and OT) independently assessed the risk of bias in all cross-sectional studies. Where necessary, conflicts in scoring were resolved by discussion. Only cross-sectional studies were scored against the NOS, yielding a total of 157 studies for risk assessment. The NOS was developed to assess the quality of nonrandomized studies according to different domains of the studies, including the study's design, content, and ease of use directed to the task of incorporating the quality assessments in the interpretation of meta-analytic results. In accordance with the NOS, the studies were scored against 7 different categories, including (1) selection (4 sub-categories, 4 stars maximum); (2) comparability (1 sub-category; 2 stars maximum); (3) outcome (2 sub-categories; 3 stars maximum). The full list of adapted questions from the NOS is attached as a supplementary file. Additionally, the results of the NOS assessment for our included cross-sectional studies are shown in supplementary table S3.

Ethical Approval

Ethical approval for this specific systematic review is not applicable since data utilized was collected from previously published research in the literature. All studies included in this review received ethical approval prior to data collection by their primary investigator.

Patient and Public Involvement

Patients and public were not involved in the design and conduct of this research

Results

3.1. Search results

As illustrated in figure 1, the systematic literature search yielded 683 studies from PubMed, 152 studies from MEDLINE, 285 studies from Embase, 63 studies from CINAHL, and 110 studies from Web of Science, resulting in a total of 1,293 studies. After removing duplicates (n = 338), 955 articles were screened independently by two investigators for title and abstract to determine relevance to our research question. This step excluded an additional 721 articles either because they did not investigate sleep health as one of the outcomes (n = 535), did not include people from the Middle East, (n = 153), or were not peer reviewed (n = 33). After this step, two independent investigators performed full-text screening on 234 potentially relevant articles. A total of 70 studies were excluded at this stage, mainly due to studies with unavailable full-text article (n=14), studies not reporting sleep health as an outcome (n=24), studies conducted explicitly outside the Middle East (n=24) or had a sample size of less than 100 participants (n = 8). As a result, a total of 164 articles were included in this review.

3.2. Study characteristics

The sample size of all included studies (n=164) ranged from 103 to 20,697 participants. Table S4 in the supplementary file presents a full list of all included studies and their extracted data. Furthermore, studies included were conducted across 17 Middle Eastern countries, including Turkey (n=44), Saudi Arabia (n=33), Iran (n=16), Israel (n=12), Jordan (n=12), Egypt (n=10), Oman, (n=6), United Arab Emirates (n=6), Lebanon (n=6), Kuwait (n=4), and Qatar (n=2). Only one study was conducted in each of the following countries: Bahrain, Palestine, Cyprus, and Iraq. Additionally, 11 studies included samples from multiple countries at once, including Syria, Yemen, Iraq, and others.

3.3. Quality appraisal

Most studies in this review were cross-sectional in design (n=156). All other study designs were longitudinal (n=8). Table S3 in the supplementary file presents the full NOS results for all studies assessed for bias, determined using the NOS protocol outlined in the Methods section. Most studies were moderate in quality.

3.4. Sleep health outcomes by sub-population

Data from all eligible studies was organized according to population type, with a total of five sub-populations. These included studies focusing on adults in the general population (n=74), healthcare workers (n=47), students (n=21), children (n=15), and people with chronic illnesses (n=7). For all populations, qualitative data synthesis was conducted with a focus on three main domains: sleep duration, sleep quality, and sleep disorders.

3.4.1. Adults

Across the studies conducted among adults (n=74), the sample size ranged from 103 to 14,171 participants.

Sleep Duration

Studies consistently reported that the pandemic negatively impacted the sleep duration of Middle Eastern adults, with 49.6% of participants reporting that they were sleeping less than 7 hours and 53.2% reporting 10 or more hours of sleep.[35] In Egypt, 23.1% of adults younger than 30 years old reported inadequate sleeping (< 6h/day).[36] In terms of determinants of sleep duration among adults, data from Jordan revealed an increased burden of short sleep duration among males compared to females. Similarly, participants with higher education levels reported decreased daytime sleeping hours. [37] In terms of relationship status, individuals who reported being single had significantly increased amount of sleep compared to married individuals.[37]

Sleep Quality

Sleep quality (SQ) was altered for both COVID-19 patients and healthy individuals.[38] The Pittsburgh Sleep Quality Index (PSQI) score during lockdown was predominantly influenced by sleep-onset latency, sleep efficiency, and total sleep time.[39] Factors associated with reduced SQ included changes in sleeping habits, anxiety, fear driven by COVID-19 news and lack of treatment knowledge, female gender, monthly income, isolation,[40] perceived income, hours spent outdoors, the number of familiar people with COVID-19, and history of depression.[41]

Sleep Problems

Most families reported disrupted sleep patterns.[42] When quarantine period started in Saudi Arabia, 1/5 experienced new-onset nightmares, more significant among females.[43] In a global cross-sectional study including a number of Middle Eastern countries, around 33.3% of respondents reported feeling lazy and less energized during the pandemic, as opposed to 4.7% before the pandemic.[44] The prevalence of insomnia, anxiety, depression, and obesity increased with increasing phone screen time among university students. Of all countries, Iran reported the highest prevalence of insomnia among adults (55.2%),[45] which affected fewer COVID-19 patients (50.5%) than control group patients (58.5%).[38] Finally, In a Turkey-based study among pregnant women, mild sleepiness was found in 88.2% of participants (n = 356), while severe sleepiness was reported in 11.8% of the same sample.[46]

3.4.2. Children

A total of 15 studies assessed sleep health among children. The sample size of studies ranged from 309 to 20,697 participants.

Sleep Duration

Most studies in the literature reported a change in the sleeping duration among children, with varying directions of change (e.g., increased or decreased duration). In Saudi Arabia and Jordan, decreased sleep was reported among children's populations.[47, 48] Moreover, sleep duration in

Israel increased for 13.4% of participants, decreased for 51.1%, and remained unchanged for 35.1%. Sleeping less than seven hours decreased from 41.4% to 5.4%, while sleeping more than 10 hours significantly increased from 4.8% to 49.7%.[49] In Iran 13.4% of children, mostly from urban areas, reported that they had 5 or fewer hours of sleep.[50]

Sleep Quality

In Tukey, 61.5% of children experienced sleeping changes due to the pandemic.[51] Almhizai et al., demonstrated that older participants woke up more frequently during their sleep compared to children.[52] In Israel, 41.4% of children developed sleeping difficulties.[53] Similarly, in another Israeli study, 60% of mothers reported that their child's sleeping patterns had changed drastically and reported higher levels of anxiety traits associated with sleep changes.

Sleep Problems

Sleep disorders were reported in all studies among children. In Turkey, the prevalence of sleep disturbances among children was 55.5% and significantly associated with 6–8 years of age and poor family relationships. The most common sleep disturbances were bedtime resistance (51.9%) and sleep onset delay (61.4%).[54] Sleep disturbances were more common in children of parents who felt helpless, apprehensive, and frightened during the pandemic,[54] and children whose parents were divorced.[52] The direct effect of trauma scores on sleep problems, the direct effect of sleep problems on chronotype scores and on oppositional defiant disorder (ODD) symptom scores were significant.[55]

3.4.3. Healthcare workers

A total of 47 studies assessed sleep health among healthcare workers in all Middle Eastern countries listed in the study characteristics, except Palestine, Cyprus, and Iraq. The sample size of studies ranged from 105 to 2,331 participants.

Sleep Duration

Sleep duration significantly decreased for HCWs in most countries, except Israel, where medical residents treating COVID-19 reported longer sleep duration.[56] In Egypt, both physicians on the front line and others were at risk of falling asleep, staying asleep, or sleeping excessively.[57] Furthermore, there was a statistically significant decrease in sleeping hours among HCWs with severe and extremely severe depression.[58] Those with higher levels of health anxiety related to COVID-19 were working more days weekly and had lower sleeping hours.[59] Female sex, age ≤30 years, attending emergency and night shifts, watching/reading COVID-19 news ≥2 h/day, and not getting emotional support from family, society, and hospitals were associated with a high likelihood of inadequate sleeping HCW in Egypt.[60]

Sleep Quality

Most studies reported poor and reduced SQ, as measured by the PSQI, with poor sleep quality prevalence ranging from 48.4%[61] to 96.1%[62]. Both, front line HCWs and non-front line HCW

reported poor SQ and/or had moderate-severe stress.[63] In Saudi Arabia poor SQ levels were highest among front line HCWs (emergency departments, intensive care units, and wards).[64] The most negatively scored components of SQ included sleep latency, duration, and efficacy. Poor SQ was more prevalent among females, nurses, hospital workers, frontline workers, individuals with <5 years of work experience, those with low social support, and individuals with increased traumatic stress levels.[65]

Sleep Problems

HCWs between 31-40 years-old treating COVID-19 were at higher risk of severe insomnia, compared to those above 40 years-old.[66] In Turkey, insomnia incidence was 1.5 times higher for HCWs in the frontline and significantly higher amongst those working in the "area of final diagnosis".[67] In a tertiary care hospital in Oman, the majority of HCWs (60.2%) aged 34.8 ± 5.7 years and with less working experience (11.9 ± 5.9 years) reported clinical insomnia during the pandemic.[68] Mean Insomnia Severity Index score in Turkey was significantly higher among HCWs working in COVID-19 clinics and intensive care units and among nurses.[65]

3.4.4. Students

A total of 21 studies with sample sizes ranging from 152 to 17,008 participants assessed sleep health among students.

Sleep Duration

Among a large cohort of medical and science university students in Jordan, 44.2% of participants (n = 1019) reported reduction in their sleeping hours.[69] Another study reported a statistical increase of total sleeping time from 6.6 ± 2.3 h/day to 8.3 ± 2.7 h/day.[70] In Israel, a significant reduction in sleep duration from lockdown to post-lockdown period for workdays and weekends was reported.[71]

Sleep Quality

Furthermore, 85.55% of students reported poor SQ and 67.9% were females. It was found that sleep disturbance and daytime dysfunction were poorer in students with higher BMI ranges.[72] In Saudi Arabia, 25.9% of a sample of students reported poor SQ, 22.7% felt tired during the day, 9.3% had nightmares and 5.2% had poor dreams.[73] Furthermore, extended quarantine negatively affected SQ of three-quarters of the undergraduate students in Jordan, with poor sleep quality reported in nearly half of the same sample.[74] Additionally, about a third of the same sample reported sleeping late and waking up more frequently.[74]

Sleep Problems

In Saudi Arabia, 22% of students had trouble falling asleep, 17.9% waking up during the night, and 8.8% waking up early in the morning.[73] Students reported a statistically high level of insomnia with a high level of depression, anxiety, and perceived stress. Undergraduate students reported statistically more insomnia symptoms with a lower level of psychological resilience.[73]

Furthermore, lockdown in Turkey led to sleeping later, waking up frequently and failing to fall asleep.[75] In Saudi Arabia, medical students reported Narcolepsy (51.6%), insomnia (31.5%), and Circadian Rhythm Sleep Disorder (22.4%) as the most prevalent sleep disorders. Furthermore, a statistically significant increase of night sleep interruptions was reported during COVID-19. In Jordan, students experienced increased insomnia, shallow sleep, nightmares, or insufficient sleep, and these disorders were reported in significantly more females than males.[76]

3.4.5. People with chronic illnesses

A total of 7 cross-sectional design studies assessed sleep health among the population with special conditions. The sample size of studies ranged from 145 to 2,223 participants. Those studies focused on a variety of chronic illnesses, including epilepsy (n=1), neurological conditions (n=1), cancer (n=1), musculoskeletal diseases (n=1), spine illnesses (n=1), rhematic disease (RD) (n=1), and multiple sclerosis (MS) (n=1).

Sleep Duration

In Saudi Arabia, 71.2% of patients with epilepsy experienced significant changes in their sleep.[77, 78] Almost half of them had been seizure-free in the three months prior to the pandemic. Furthermore, 9.6% of patients surveyed reported more sleep than usual, 2.6% reported less sleep, and 0.6% reported intermittent sleep.[77, 78]

Sleep Quality

Quality of sleep among different patient groups, as measured by PSQI, was affected during the pandemic. In Turkey, for patients with musculoskeletal pain, PSQI revealed a weak correlation with pain levels in all body parts.[79] Quality of sleep was found to be bad for 58.7% cancer patients.[80] Depression, anxiety, and defective SQ levels for pregnant women (mean age was 30.17 ± 5.47 years) who were previously in quarantine was significantly higher.[81] SQ among patients with MS patients was significantly impaired during the pandemic too.[82]

Sleep Problems

Although patients reported different experiences, a certain degree of sleep disorders was reported among almost all patients. In Jordan, Athamneh et al., reported that 37.5% of patients with chronic headaches reported changes in sleeping patterns during the COVID-19 pandemic.[83] Finally, the frequency of sleep problems in patients with RD was significantly higher than that of non-patients, but significantly lower than that reported in hospital workers.[84]

Discussion

This systematic review of the literature explored the impact of the COVID-19 pandemic on sleep health among populations in the Middle East. To the best of our knowledge, this is the very first systematic review on sleep health among any Middle Eastern population, and one of the first reviews to pool evidence on sleep health during the ongoing COVID-19 pandemic. The findings of our systematic review suggest that across all sub-populations (e.g., adults, children, students, healthcare workers, and people with chronic illnesses), the COVID-19 pandemic had a drastic negative? Impact on sleep duration, sleep quality, and prevalence of sleep disorders.

Sleep duration was negatively impacted in all populations investigated, whereby the prevalence of short or long sleep seems to have increased. Similarly, sleep quality in all populations decreased drastically. Studies reported a consistent association between sociodemographic variables (e.g., being single,[85-88] low education levels,[85, 87, 89-92] unemployment during the pandemic,[93] female gender,[40, 86] low social support[65, 94]) and poorer sleep quality. Furthermore, with regards to sleep problems, insomnia was the most reported sleeping problem across studies. Higher prevalence of insomnia and other sleep disorders were observed among younger participants, those with a diagnosed mental disorder, unmarried participants, and undergraduate students.[95] Moreover, women reported higher rates of insomnia compared to men. Interestingly, there was an observed positive association between lockdown duration and the prevalence of insomnia. Finally, and among people with chronic illnesses, reversal of sleeping pattern (e.g., initiating sleep after sunrise) was the most frequent change in sleep habits.[77]

When comparing different sub-populations in this study, HCWs' sleep health was the most impaired during the pandemic compared with other sub-populations. While in other populations sleep duration was affected with no specific trend, healthcare workers demonstrated predominantly decreased sleep duration. Furthermore, and in addition to reduced sleep duration, front line HCWs reported the lowest SQ. Among HCWs, being on the front-line, being younger, and having less experience working were all associated with increased insomnia prevalence. Nurses experienced emotional exhaustion, and burnout levels increased in line with insomnia.[96] Long shifts, busy working conditions, and less sleep disturbed their sleeping patterns and made HCWs feel tired.

Our findings are consistent with prior research in other populations.[6, 17, 97, 98] For instance, Jahrami et al., reported an increased burden of sleep problem during the COVID-19 pandemic in early 2021, with approximately 40% of the general population reporting sleep problems.[17]. Similarly, and consistent with our findings among Middle Eastern front-line workers, a meta-analysis conducted by Salari et al., showed that healthcare workers are more vulnerable to sleep disturbances during the pandemic.[98] This finding was associated with increased workplace stress and was shown in both nurses and physicians.[98]

The findings of this systematic review are important for public health policy and for directing intervention measures. Given that sleep is a risk factor for the leading causes of death including CVD, hypertension, diabetes, obesity, etc., interventions that promote sleep health are of high public health relevance, particularly in the current pandemic era. Such interventions can include

social and administrative support, workplace interventions,[99] providing education that emphasizes the importance of sleep behavior, encouraging promoting behaviors and relaxation strategies. The differences in impact and severity of sleep health problems among different sub-populations, as identified in this study, suggest that policies and interventions should be tailored to each population. Some authors have already suggested emergency management measures that should be taken to improve the quality of sleep in FLHCWs during a pandemic: strengthen exercise intervention, psychological counseling, drug intervention treatment strategies if necessary, and other.[100] Similarly, sleep problems in childhood are linked with impaired motor and cognitive skills, as well as with difficulties in academic activities, emotional regulation, quality of life, growth, body composition, and immune function.[101] A daily routine is a fundamental aspect of children's development of healthy behaviors and adequate energy levels. Interventions that focus on health promotion and advocating for healthy sleeping patterns among children, especially as it relates to other health behaviors development, should be implemented.

In addition to intervention efforts to address poor sleep among MENA populations, there is a strong need to understand barriers to adequate sleep among each sub-population. The current literature provides evidence regarding barriers to adequate sleep focuses primarily on western populations. This includes environmental factors (e.g., decreased green space),[102, 103] social factors (e.g., decreased social cohesion,[104] decreased safety),[105-107] and ambient factors (e.g., increased air pollution,[108-112] increased noise).[113] However, there continues to be a lack of data on this topic in the MENA region despite high prevalence of poverty, gender inequality, political turmoil, violence, and other factors that are strongly linked with PTSD and other psychological factors, which are known to affect sleep.[114, 115] The unique social, structural, and environmental context of the MENA region, in addition to the demonstrated exacerbation of poor sleep health by the pandemic, highlights why increased efforts to understand and address sleep health, particularly post-pandemic, is relevant for MENA populations.

Strengths, limitations, and future research

This review is the first systematic review of the literature regarding the effects of COVID-19 pandemic on the sleep health of Middle Eastern populations. Additionally, this paper provides a robust qualitative synthesis of data to include a wide scope of research on the topic published to date. This review covers a wide range of outcomes (e.g., any study that reported a sleep health related domain), includes only peer-reviewed articles as the source of information of high quality, and incorporates a wider scope of studies and populations. Despite those strengths, this study is not without noteworthy limitations that must be considered when interpreting our results. Firstly, most included studies are cross-sectional in design, which poses an intrinsic limitation given the design. For instance, it is not possible to establish causation with such studies. Additionally, most of the studies utilize self-reported surveys. Given the rapidly evolving situation with the pandemic (e.g., lockdown measures, changes in epidemiology of COVID-19, etc.), this approach seemed the most suitable to collect data rapidly. However, this introduces several limitations including self-selection bias, recall bias, and social desirability bias.[116-118] Another limitation specific to the design of this review is that it excludes studies conducted in languages other than English.

Furthermore, studies included in this review utilized different methods for assessing sleep health, which varied across populations. Mainly, this included subjective measures, including a variety of

tools to measure sleep health (e.g., Pittsburgh Sleep Quality Index, Insomnia Severity Index). In turn, this makes it challenging to compare results between different studies and different populations. Additionally, it is important to note that no study included in this review utilized objective tools to measure sleep health (e.g., actigraphy), and many studies utilized tools that do not have demonstrated validity or reliability in the context of sleep health measurement (e.g., surveys developed by authors of the study). Consequently, future research should focus on utilizing objective tools to measure sleep health. If not feasible, subjective tools with demonstrated reliability and validity are preferred. Finally, future research should continue to understand the long-term impacts of the abrupt change in lifestyle brought about by the COVID-19 pandemic on Middle Eastern populations.

Conclusions

This review sought to capture the currently available evidence in the literature on the impact of the COVID-19 pandemic on the sleep health of Middle Eastern populations. Given high burden of poor sleep that has been exacerbated by the COVID pandemic, there is a strong need for tailored interventions to improve sleep health. Finally, and considering that Middle Eastern populations continue to be severely understudied in public health, future research should continue to investigate and explore the impact of the COVID-19 pandemic on public health in The Middle East, including longitudinal studies utilizing objective measures to assess the impact of sleep on the health of MENA populations across their lives.

Declarations

Ethics approval and consent to participate

Not Applicable

Consent for publication

Not Applicable

Availability of data and materials

All data generated or analyzed during this study are included in this published article and its supplementary information files

Competing interests

The authors declare that they have no competing interests

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Authors' contributions

All authors contributed to revise work for important intellectual content, gave the final approval of the version to be published, and agreed on all aspects of the work, especially concerning its accuracy and integrity. Further specific activities have been distributed as follows: Y.A.A conceived the hypothesis. Y.A.A and O.T designed the studies. Y.A.A, O.T. and R.M performed the article screening and data extraction. Y.A.A, O.T and G.S performed the quality assessment. All authors (Y.A.A., O.T.., G.S., R.M., N.M., D.T.,) had access to data and verified it, and contributed feedback to drafts of the manuscript. Y.A.A and O.T shaped the manuscript with input from the entire team.

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Fig. 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) study selection flow diagram outlining the literature review process when searching for articles on PubMed and Web of Science.

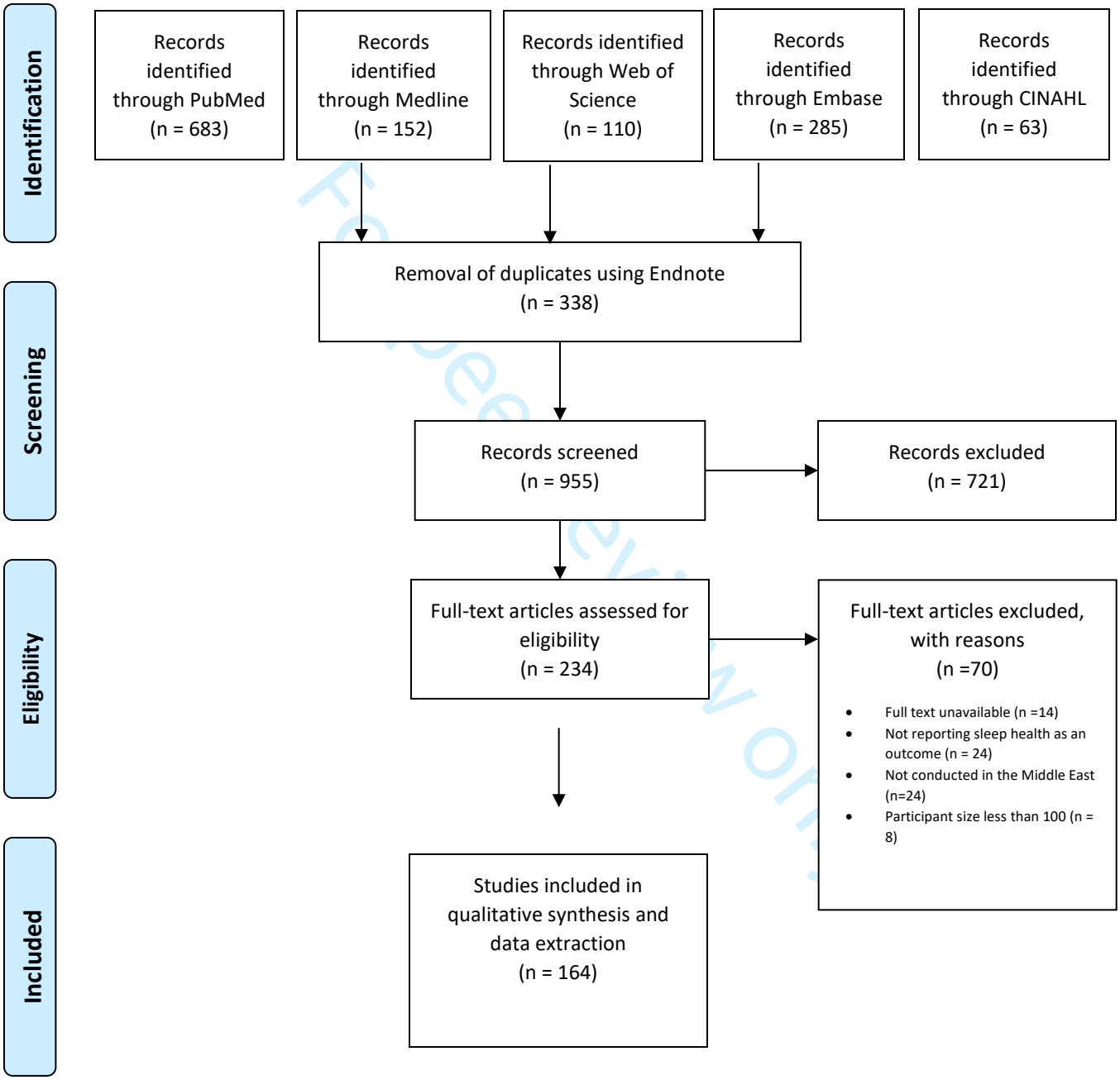

Table S1. Search keywords and MeSH terms developed for the literature search

Journal Databases Keyword Strategy
Search Keywords

1) Generic Exposure of Interest – COVID-19

('coronavirus disease 2019' OR '2019 novel coronavirus disease' OR '2019 novel coronavirus epidemic' OR '2019 novel coronavirus infection' OR '2019-ncov disease' OR '2019-ncov infection' OR 'covid' OR 'covid 19' OR 'covid 19 induced pneumonia' OR 'covid 2019' OR 'covid-10' OR 'covid-19' OR 'covid-19 induced pneumonia' OR 'covid-19 pneumonia' OR 'covid19' OR 'sars coronavirus 2 infection' OR 'sars coronavirus 2 pneumonia' OR 'sars-cov-2 disease' OR 'sars-cov-2 infection' OR 'sars-cov-2 pneumonia' OR 'sars-cov2 disease' OR 'sars-cov2 infection' OR 'sarscov2 disease' OR 'sarscov2 infection' OR 'wuhan coronavirus disease' OR 'wuhan coronavirus infection' OR 'coronavirus disease 2' OR 'coronavirus disease 2010' OR 'coronavirus disease 2019' OR 'coronavirus disease 2019 pneumonia' OR 'coronavirus disease-19' OR 'coronavirus infection 2019' OR 'ncov 2019 disease' OR 'ncov 2019 infection' OR 'new coronavirus pneumonia' OR 'novel coronavirus 2019 disease' OR 'novel coronavirus 2019 infection' OR 'novel coronavirus disease 2019' OR 'novel coronavirus infected pneumonia' OR 'novel coronavirus infection 2019' OR 'novel coronavirus pneumonia' OR 'paucisymptomatic coronavirus disease 2019' OR 'severe acute respiratory syndrome 2' OR 'severe acute respiratory syndrome 2 pneumonia' OR 'severe acute respiratory syndrome cov-2 infection' OR 'severe acute respiratory syndrome coronavirus 2 infection' OR 'severe acute respiratory syndrome coronavirus 2019 infection')

AND

2) Outcome of Interest - sleep health

('sleep' OR 'sleep' OR 'sleeping' OR 'sleep disorder' OR 'chronobiology disorders' OR 'disturbances of sleep' OR 'dyssomnia' OR 'dyssomnias' OR 'intrinsic sleep disorders' OR 'sleep disorder' OR 'sleep disorders' OR 'sleep disorders, intrinsic' OR 'sleep disturbance' OR 'sleep perturbation' OR 'sleep wake disorder' OR 'sleep wake disorders' OR 'sleep disordered breathing' OR 'apnea, sleep' OR 'apnoea, sleep' OR 'nocturnal apnea' OR 'nocturnal apnoea' OR 'obstructive sleep apnea' OR 'obstructive sleep apnea hypopnea syndrome' OR 'obstructive sleep apnea syndrome' OR 'obstructive sleep apnoea' OR 'obstructive sleep apnoea hypopnoea syndrome' OR 'obstructive sleep apnoea syndrome' OR 'obstructive sleep-disordered breathing' OR 'sleep apnea' OR 'sleep apnea syndrome' OR 'sleep apnea syndromes' OR 'sleep apnea, obstructive' OR 'sleep apnoea' OR 'sleep apnoea syndrome' OR 'sleep apnoea syndromes' OR 'sleep apnoea, obstructive' OR 'sleep disordered breathing')

AND

3) Population of Interest - Middle Eastern populations

('middle east' OR 'middle east' OR 'bahrain' OR 'cyprus' OR 'iraq' OR 'kuwait' OR 'saudi' OR 'saudi arabia' OR 'oman' OR 'omani' OR 'jordan' OR 'jordanian' OR 'bahraini' OR 'cypriot' OR 'lebanese' OR 'lebanon' OR 'kuwaiti' OR 'iran' OR 'iranian (citizen)' OR 'israel' OR 'israeli' OR 'gaza strip palestine' OR 'gaza strip' OR 'palestine' OR 'syrian' OR 'syrian arab republic' OR 'egypt' OR 'egyptian' OR 'yemen' OR 'yemeni' OR 'united arab emirates' OR 'emirati' OR 'turkey (republic)' OR 'turkish' OR 'eastern mediterranean region' OR ‘qatar’ OR ‘qatari’ OR ‘algeria’ OR ‘algerian’ OR ‘tunisia’ OR ‘tunisian’ OR ‘morroco’ OR ‘morrocon’ OR ‘libya’ OR ‘libyan’)

Table S2. List of countries considered in MENA definition in this study.

Country
Algeria
Bahrain
Egypt
Iran
Iraq
Israel
Jordan
Kuwait
Lebanon
Libya
Morocco
Oman
Qatar
Saudi Arabia
Syria
Tunisia
United Arab Emirates
Yemen

Table S3. Newcastle-Ottawa Scale for Bias Assessment

Study	Total Score	Selection				Comparability	Outcome	
		Representativeness of the sample	Sample size	Non-respondents	Ascertainments of exposure	Based on design and analysis	Assessment of Outcome	Statistical Test
Özenoğlu et al., 2021	6	*	*		*	*	*	*
Çolak et al., 2021	8	*	*		**	*	**	*
Abbas et al., 2021	6	*	*		*	*	*	*
Abdelghani et al., 2021	7	*	*		**	*	*	*
Abdoli et al., 2021	9	*	*	*	**	**	*	*
Alah et al., 2022	8	*	*	*	**	*	*	*
Abouzid et al., 2021	8	*	*	*	**	*	*	*
Abu-Elnenin et al., 2021	9	*	*	*	**	**	*	*
Ahorsu et al., 2020	8	*	*	*	*	*	**	*
Akbari et al., 2021	7	*	*		**	*	*	*
Akbarpour et al., 2022	6	*	*		*	*	*	*
Al Ammari et al., 2021	9	*	*	*	**	**	*	*
Al Maqbali et al., 2021	10	*	*	*	**	**	**	*
Al Miskry et al., 2021	9	*	*	*	**	**	*	*

Al Mukhaini et al., 2021	7	*	*		**	*	*	*
Al Ajlouni et al., 2022	8	*	*	*	**	*	*	*
Al Ajlouni et al., 2020	8	*	*	*	**	*	*	*
Al Musharaf et al., 2020	9	*	*	*	**	**	*	*
Al Mutawa et al., 2021	9	*	*	*	**	**	*	*
Al Rahamneh et al., 2021	6	*	*		*	*	*	*
Al Saleh et al., 2021	7	*	*	*	*	*	*	*
Al Anazi et al., 2022	6	*	*		*	*	*	*
Alboghdadly et al., 2022	6	*			**	*	*	*
Alfawaz et al., 2021	6	*	*		*	*	*	*
Alghamdi et al., 2022	6	*			**	*	*	*
AlGhufli et al., 2021	6	*			**	*	*	*
AlHadi et al., 2021	8	*	*	*	**	*	*	*
Alharbi et al., 2021	8	*	*	*	**	*	*	*
Alkhotani et al., 2020	8		*		**	**	**	*
Alhurishi et al., 2021	5				**	*	*	*
Ali et al., 2022	6	*		*	*	*	*	*

Ali et al., 2021	6	*			**	*	*	*
Aljemaiah et al., 2021	6	*			**	*	*	*
Aljuffali et al., 2022	9	*	*	*	**	**	*	*
Almhdawi et al., 2022	7	*	*		**	*	*	*
Almhizai et al., 2021	5	*			*	*	*	*
Almugti et al., 2021	7	*	*		**	*	*	*
Alnofaiey et al., 2020	7	*	*		**	*	*	*
Alomari et al., 2021	6	*	*		*	*	*	*
Alothman et al., 2021	9	*	*	*	**	**	*	*
Alqahtani et al., 2021	8	*	*	*	**	*	*	*
Alrashed et al., 2021	5				**	*	*	*
AlRasheed et al., 2022	8	*	*	*	**	*	*	*
Alshammari et al., 2021	4			*	*	*	*	
Alshekaili et al., 2020	7	*	*		**	*	*	*
Alshumrani et al., 2022	8	*	*		**	*	**	*
Alsulimani et al., 2021	6	*	*		*	*	*	*
Araç et al., 2020	7	*			**	**	*	*

Arafa et al., 2020	7	*	*		**	*	*	*
Arafa et al., 2021	7	*			**	**	*	*
Aslan et al., 2021	7	*	*		**	*	*	*
Athamneh et al., 2021	6	*			*	*	**	*
Aydin Sayilan et al., 2021	7	*	*		**	*	*	*
Şentürk et al., 2021	6	*			**	*	*	*
Büber et al., 2022	6	*			**	*	*	*
Badahdah et al., 2020	5	*			**	*	*	
Badri et al., 2021	7	*	*	*	*	*	*	*
Bar-zeev et al., 2022	6	*		*	*	*	*	*
Barbato et al., 2021	6	*			**	*	*	*
Bilgiç et al., 2021	6	*			**	*	*	*
Bağcı et al., 2021	8	*	*	*	**	*	*	*
Bucak et al., 2021	6	*			**	*	*	*
Bulut et al., 2021	7	*		*	**	*	*	*
Cahal et al., 2021	5	*			*	*	*	*
Cakmak et al., 2022	6		*		**	*	*	*

Chan et al., 2021	8	*	*	*	**	*	*	*
Cheikh Ismail et al., 2021	6	*			**	*	*	*
Cheikh Ismail et al., 2020	6	*			**	*	*	*
Cigiloglu et al., 2020	6	*			**	*	*	*
Coiro et al., 2021	6	*			**	*	*	*
Duran et al., 2021	7	*	*		**	*	*	*
Durmaz Engin et al., 2021	7	*	*		**	*	*	*
El Refay et al., 2021	6	*			**	*	*	*
Elghazally et al., 2021	6	*			**	*	*	*
Elgohary et al., 2021	6		*		**	*	*	*
Elkholy et al., 2021	7	*	*		**	*	*	*
Ellakani et al., 2022	5	*			*	*	*	*
Elsalem et al., 2020	5		*		*	*	*	*
Eren et al., 2021	7	*	*		**	*	*	*
Gol et al., 2021	7	*	*		**	*	*	*
Guc et al., 2022	8	*		*	**	*	**	*
Galali et al., 2021	5	*			*	*	*	*

Ghanamah et al., 2021	5	*			*	*	*	*
Gokseven et al., 2021	6	*			**	*	*	*
Goweda et al., 2021	5				**	*	*	*
Grande et al., 2021	7		*		**	**	*	*
Hadar-Shoval et al., 2021	7	*		*	**	*	*	*
Hammoudi et al., 2021	6	*			**	*	*	*
Hammouri et al., 2022	5	*			*	*	*	*
Hawari et al., 2021	6	*			**	*	*	*
Husain et al., 2021	6	*	*		*	*	*	*
Hussien et al., 2020	7	*	*		**	*	*	*
Iqbal et al., 2021	7	*	*		**	*	*	*
Jahrami et al., 2021	7	*			**	**	*	*
Jalal et al., 2021	8	*	*		**	**	*	*
Kamaleddine et al., 2022	5				**	*	*	*
Kandemir et al., 2021	6	*			**	*	*	*
Karabulut et al., 2021	5				**	*	*	*
Karahan Yilmaz et al., 2021	5	*			*	*	*	*

Karatel et al., 2022	6	*			**	*	*	*
Keskin et al., 2022	5				**	*	*	*
Khamis et al., 2020	6	*			**	*	*	*
Kheirallah et al., 2021	6	*	*		*	*	*	*
Kilani et al., 2020	6	*			**	*	*	*
Kolokotorni et al., 2021	6	*			**	*	*	*
Korkmaz et al., 2020	5				**	*	*	*
Lin et al., 2022	7	*	*		**	*	*	*
Lin et al., 2020	5	*			*	*	*	*
Maatouk et al., 2022	6	*			**	*	*	*
Mahamid et al., 2021	6	*			**	*	*	*
Masoumi et al., 2021	5				**	*	*	*
Mekkawy et al., 2022	6	*			**	*	*	*
Meo et al., 2022	7	*		*	**	*	*	*
Mosheva et al., 2020	6	*			**	*	*	*
Mousavi et al., 2021	7	*	*		**	*	*	*
Najafipour et al., 2021	6	*			**	*	*	*

Nakhostin-Ansaeri et al., 2021	6	*			**	*	*	*
Nakhostin-Ansari et al., 2020	5	*			*	*	*	*
Nashwan et al., 2021	5				**	*	*	*
Okudan et al., 2021	6	*			**	*	*	*
Oteir et al., 2022	8	*	*	*	**	*	*	*
Radwan et al., 2021	6	*		*	*	*	*	*
Ranjbar et al., 2021	6	*	*		*	*	*	*
Romdhani et al., 2021	7	*	*		**	*	*	*
Saadeh et al., 2021	7	*			**	**	*	*
Sadeghniiat-Haghighi et al., 2021	6	*			**	*	*	*
Salehinejad et al., 2020	6	*			**	*	*	*
Salman et al., 2021	6	*			**	*	*	*
Salman et al., 2021	6	*			**	*	*	*
San et al., 2021	5				**	*	*	*
Sarsak 2022	6	*			**	*	*	*
Seyahi et al., 2020	7	*		*	**	*	*	*
Sis Celik et al., 2021	5	*			*	*	*	*

Sultan et al., 2021	6	*	*		*	*	*	*
Tas et al., 2021	5		*		*	*	*	*
Tasdemir Yigitoglu et al., 2021	7	*	*		**	*	*	*
Toprak Celenay et al., 2020	6	*			**	*	*	*
Torkian et al., 2021	6	*			**	*	*	*
Torun et al., 2021	6			*	**	*	*	*
Ustuner Top et al., 2022	6	*			**	*	*	*
Yilmaz et al., 2021	6	*			**	*	*	*
Yalcin et al., 2022	8	*	*	*	**	*	*	*
Yeni et al., 2022	6				**	*	**	*
Yilmaz et al., 2021	8	*	*	*	**	*	*	*
Yilmaz et al., 2021	6	*			**	*	*	*
Younes et al., 2021	7	*	*		**	*	*	*
Youssef et al., 2020	7	*			**	**	*	*
Yurumez Korkmaz et al., 2021	6				**	**	*	*
Zach et al., 2021	7	*	*		**	*	*	*
Zarzour et al., 2021	6	*			**	*	*	*

Zengin et al., 2021	7	*	*	**	*	*	*
Zreik et al., 2021	6	*		**	*	*	*

Table S4. Results of full literature review, tabulated by sub-population

Adults							
Reference	**Location of Study**	**Population**	**Sample Size**	**Study Design**	**Sleep Health Measurement Tool**	**Sleep Health Domains**	**Main Findings**
Abouzid et al., 2021	Egypt, Jordan, United Arab Emirates, Kuwait, Bahrain, Saudi Arabia, Oman, Qatar, Yemen, Syria, Palestine. Iraq	5896 respondents were included. The participants were aged between 8–23 years (45%; 24–30, 20.5%; 31–40, 18.6%; 41–60, 13.6%;>40, 2.3%) and 62.8% were females	5896	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration.	Sleep duration	49.6% reported they were sleeping less than 7 h and the sleeping hours increased to 7–10 h. for 53.2%
Ahorsu et al., 2020	Qazvin, Iran	older adults (50 or older) with a mean age of 57.72 (SD = 7.31) 62% male	413	Cross-sectional study	Insomnia Severity Index (ISI)	Sleep disorder (insomnia)	fear of COVID-19 was a significant mediator (unstandardized coefficient = 0.360; LLCI = 0.112; ULCI = 0.664) in the association between perceived health status and insomnia, significant direct effects of perceived health status on fear of COVID-19 and insomnia (unstandardized coefficient of 1.621; SE = 0.378; p < .001) as well as a significant total effect on insomnia (unstandardized coefficient of 1.981; SE = 0.392; p < .001)
Akbari et al., 2021	Iran	adults (mean age 30±11 years, 54.3% female)	3,323	Cross-sectional	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality	Inactive participants (IPs) scored significantly lower (p < 0.001) on the global score of sleep-quality than active participants (APs) (mean ± SD, 6.04±2.95, 5.59±2.94, respectively). No significant differences in inactive subgroups. Significant differences in active subgroups (p=0.003) APs that maintained

							their activity levels had better sleep quality. Sleep quality after COVID-19: Sleep habits of 49.3% of individuals (APs= 49.5% and IPs= 49.1%) had changed, so that 39.8% of them slept later; sleep time of 44.6% of individuals (APs= 43.7% and IPs= 45.5%) had changed, so that 28.7% of them slept more; and a significant portion of them (APs= 36.7% and IPs= 42.2%) were dissatisfied with their sleep habit changes
Akbarpour et al., 2022	Iran	1223 individuals with a mean age of 39.82 ± 10.75 years participated in the study.	1223	Cross-sectional study	Insomnia Severity Index	Sleep problems (insomnia)	Prevalence of insomnia 55.2% Being married was associated with less risk for insomnia (OR= 0.69, CI-95%= 0.52-0.91).
Al Miskry et al., 2021	United Arab Emirates	737 participants: 60.7% (n = 447) university students, 27.4% (n = 202) faculty members, and 11.9% (n = 88) staff selected through the convenience sampling method. 72.6% (n = 535) of the participants were females, whereas 27.4% (n = 202) were males.	737	Cross-sectional study	Survey items developed by the study's author including questions on sleeping difficulties.	Sleep problems (sleep pattern disturbances)	19.5% experienced changes in sleep patterns
Al-Ajlouni et al., 2020	Jordan	mean age 37.35 (SD=11.01), with over 60% aged <40 years 52.9% male	1,240	Cross-sectional study	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality	over 60% of participants reported having experienced at least one sleep problem in the last week, and nearly half reported having had short sleep duration. Participants reporting mild anxiety were more likely to experience poor sleep quality (aPR = 3.01; 95% CI=2.07 to 4.35), short sleep duration (aPR = 1.35; 95% CI=1.17 to 1.56) and at least one sleep problem (aPR=1.41; 95% CI=1.27 to 1.56). Those reporting moderate anxiety were more likely to experience poor sleep quality (aPR=5.78; 95% CI=3.97 to 8.43), short sleep duration (aPR=1.73; 95% CI=1.47 to 2.04) and at least one sleep problem (aPR=1.56; 95% CI=1.39 to 1.75)

							compared with those reporting minimal anxiety. Corresponding to the dose–response relationship between anxiety and sleep health outcomes, those reporting severe anxiety were the most likely to experience poor sleep quality (aPR = 8.954; 95% CI = 6.12 to 13.08), short sleep duration (aPR = 2.23; 95% CI=1.91 to 2.61) and at least one sleep problem (aPR =1.73; 95% CI=1.54 to 1.95) P-trend <0.001 for all sleep outcomes
Al-Ajlouni et al., 2022	Jordan	60% less than 40 years old, mean age of 37.4 (SD = 11.0) 52.9% male	1,240	Cross-sectional study	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality	Participants who did not meet the guidelines for moderate-to-vigorous physical activity (MVPA) had higher prevalence of poor sleep quality (aPR = 1.68; 95% CI = 1.24–2.26), short sleep duration (aPR = 1.15; 95% CI = 1.00–1.31), and sleep problems (aPR = 1.22; 95% CI = 1.10–1.35)
Al-Musharaf et al., 2020	Saudi Arabia	A total of 638 young women, with a mean age of 22.0 years ± 1.9 years, were studied. More than half of the women (413; 60%) were undergraduates, and the majority of the sample was unemployed (579; 91%)	638	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep Quality Sleep duration	PHQ-9 score was positively correlated with the global PSQI score ($r = 0.25$, $p < 0.001$) and negatively correlated with the duration of sleep (h/day) ($r = -0.18$, $p < 0.001$) GAD-7 anxiety score was positively correlated with a higher global PSQI score (worse sleep) ($r = 0.178$, $p < 0.001$) and negatively correlated with duration of sleep (hours/day) ($r = -0.21$, $p < 0.001$) The stress score was positively correlated a higher global PSQI (worse sleep) ($r = 0.159$, $p < 0.001$) and negatively correlated with duration of sleep (h/day) ($r = -0.196$, $p < 0.001$).
Al-Mutawa et al., 2021	Kuwait, Qatar, Saudi Arabia, Bahrain, United Arab Emirates, and Oman	14,171 participants, 67.3% females and 60.4% younger than 35 years old. 64.2% from Kuwait	14171	Cross-sectional study	Insomnia Severity Index	Sleep problems (insomnia)	Insomnia among Omani participants was 48.4% UAE participants 66.7% Participants in UAE (AOR = 1.455; 1.209–1.750) and Kuwait (AOR = 1.412; 1.244–1.602) were 40% more likely to show insomnia symptoms than participants in Oman. Females were also shown to be more susceptible to insomnia during the pandemic since they were 55% more likely to report sleeping problems compared to males

							All age groups younger than 35 years old were about 3 times more likely to show insomnia symptoms than age group >65. The most susceptible age group was shown to be 18 to 24 years old with an adjusted odds ratio of 3.286. Divorced individuals were 31.5% more likely to have sleeping problems than married individuals. Students (AOR = 1.422; 1.227–1.647) were 42%, and unemployed individuals (AOR = 1.305; 1.171–1.454) were 30% more likely to experience sleeping problems. Non-smokers were also 36.5% less likely to report any sign of insomnia than smokers (AOR = 0.635; 0.578–0.698) participants with underlying psychological disorders were 2.1 times (AOR = 2.098; 1.831–2.404) and individuals with underlying medical conditions 34% more likely to experience any symptom of insomnia (AOR = 1.340; 1.218–1.474). Regarding the duration of lockdown, participants who were in no lockdown or experienced the lockdown for <7 days were 18.2% less likely to show insomnia symptoms (AOR = 0.818; 0.746–0.897) compared to those who were in lockdown for more than 30 days. Finally, participants who were never infected with COVID-19 were 18.1% less likely to experience sleep problems than those who contracted COVID-19 at least once (AOR = 0.819; 0.672–0.998)
Al-Saleh et al., 2021	Saudi Arabia	1641 respondents were included in the current survey. Male participants were 733 (44.7%) and 61.1% of the participants aged 35 years or more.	1641	Cross-sectional study	Survey items developed by the study's author including questions on sleeping duration.	Sleep duration	Daily sleep hours for less than 8 hours were recorded for 662 (40.3%) participants and family troubles was reported by 44% of the respondents. Poor sleep hygiene was significantly higher among males than females.
Alah et al., 2022	Qatar	1061 participants. Majority were men (757; 71.3%), 35 to 54 years	1061	Cross-sectional study	Survey items developed by the study's author	Sleep duration Sleep quality	488 (46%) reported an increase in sleep duration, 149 (14%) reported a decrease. The mean sleep duration increased significantly

		old (585; 55.1%), married (850; 80.1%), and have completed college or a higher degree of education (832; 78.4%). Over 50 nationalities were reported by participants with the most common being Indian nationality (56.6%). Only 37 (3.5%) Qatari nationals participated. 565 (53.3%) shifted to work from home.			including questions on sleep duration and sleep quality		from 6.90 h/d before to 7.78 h/d during home confinement (0.89 hour mean difference, 95% CI: 0.74 to 1.04, P<0.001). 165 (29.2%) of those working from home and 131 (26.4%) of those who continued working regularly reported poorer sleep quality during home confinement as compared with before.
Alfawaz et al., 2021	Saudi Arabia	Students, staff and faculty of King Saud University 47% (726) of the study participants were males and 53% (816) were females. A large proportion of participants were from the age-group of 20–45 years (1229, 79.7%) and most were educated either up to graduate or higher level (1434, 93%).	1542	Cross-sectional study	Survey items developed by the study's author including questions on sleep problems (insomnia).	Sleep problems (insomnia)	496 (32.2%) of the participants reported suffering from insomnia constantly (233, 15.1%) or sometimes (263, 17.1%) during lockdown.
Alghamdi et al., 2022	Saudi Arabia	Females (n = 236, 64.13%), single (n = 356, 96.74%), and in their senior year (n = 256, 69.57%). The mean age of the participants was 20.4 ± 1.6 years (range: 18–26 years)	382	Cross-sectional study	Generalized Sleep Disturbance Scale	Sleep duration Sleep quality Sleep problems (sleep disturbance, nightmares)	Most participants did not suffer from the presence of nightmares during the quarantine period (n = 251, 68.21%); however, (n = 52, 20.72%) experienced new-onset nightmares when the quarantine started. The presence of nightmares was more significant among females (n = 86; 73.8%) than males (n = 31; 26.5%, $\chi 2(1) = 6.5$; p = 0.010).) Male participants with statistically significant nightmares reported frequent early waking from sleep (n = 24, 58.54%) and frequent daytime sleepiness (n = 20, 48.78%). On the other hand, female participants with statistically significant nightmares reported frequent difficulty falling asleep

							(n = 92, 71.87%), frequent waking up during sleep (n = 84, 65.62%), and frequent daytime sleepiness (n = 72, 56.25%). The mean GSDS was 45.0 ± 14.9 (range: 12–130). There was no difference in the mean GSDS between males and females. The mean subjective reported sleep duration (total daily sleep time) was 7.98 ± 1.8 h; (range 4–15 h). There was a statistically significant difference in the mean sleep duration between males (mean = 7.7 ± 1.6 h) and females (mean = 8.1 ± 1.8 h; t(366) = −2.2; p = 0.029). Approximately 33.4% (n = 123) of the participants reported taking naps during the day (mean = 1.7 ± 0.96 h/d; range: 0–5 h/d). Most participants reported poor sleep quality (n = 226, 61.41%).
Alharbi et al., 2021	Saudi Arabia	3032 responses The majority of respondents (64.4%) were females.	3032	Cross-sectional study	The Insomnia Severity Index	Sleep disorder (insomnia)	Respondents who are younger, reported having a diagnosed mental illness, have never been married, and students had significantly higher ISI scores than others. The results of the regression model indicate that the most important factors associated with insomnia severity during the COVID-19 pandemic were the level of depression and anxiety, along with the respondent's intolerance of uncertainty, history of a sleep disorder, younger age, and whether they used emotion-based coping strategies.
Alharbi et al., 2021	Saudi Arabia	790 responses were included. The majority of participants were the Saudi population (n=735; 92.9%). Two-thirds of the participants were employed. A total of 27.5% were healthcare workers, 45.1% were enterprise or institution workers, and 27.5% were teachers or students.	790	Cross-sectional study	Pittsburgh sleep quality index score Athens sleep questionnaire	Sleep quality Sleep duration Sleep disorder (insomnia)	The overall Global PSQI was 6.67±3.82 for all participants The prevalence of insomnia and poor sleep quality were 54.4% and 55.5%, respectively. Saudi citizenship was associated with longer sleep duration (p=0.031). Female gender and being married were associated with worse global PSQI, sleep quality, sleep distribution, sleep latency, and daytime dysfunction. In terms of sleep duration, the male gender was worse than the female gender (p<0.001) The prevalence of insomnia was 430 (54.4%). Compared to non-Saudi participants, Saudi

							participants were linked to a greater prevalence of insomnia (45.5% versus 55%) the prevalence of insomnia was 61.3% in the single participants and 50.4% in the married participants.
Aljemaiah et al., 2020	Saudi Arabia	347 participants from Taif, Saudi Arabia n = 213 (61.4%) males and n = 134 (38.6%) females. The mean age was 35.5 years (s.d. = 10.3 years). The age range was 12 to 63 years.	347	Cross-sectional study	4DSQ scale	Sleep quality	Sleep disruption was reported during the initial phase of the lockdown as people's quality of sleep was severely reduced.
Allam et al., 2021	Egypt	A random sample of 336 staff members employed at Menoufia University age of the participants under the study ranged from 22 to 63 years (35.34±9.0), most of them were married and from urban residence (77.1% and 69%, respectively), and 51.2% were females.	336	Cross-sectional study	Survey items developed by the study's author including questions on sleep problems.	Sleep duration Sleep quality Sleep problems	Workaholics had higher risks than relaxed ones for sleep problems in terms of difficulty initiating sleep, difficulty maintaining sleep, and insufficient sleep (OR: 1.97, 3.39, and 2.23; respectively)
Alnofaiey et al., 2020	Saudi Arabia	340 (73.6%) had an age ranging from 23–30 years, 235 (50.9%) were females, 202 (43.7%) were from Taif city, 256 (55.4%) were residents, and 18.6% had an internal medicine specialty.	340	Cross-sectional study	Pittsburgh Sleep Quality Index (PSQI) scale.	Sleep duration Sleep quality Sleep disorders	Prevalence of sleep disorders was 43.9%, doctors in the age group of 31–40 years, associate consultants had a significant higher prevalence of sleep disorders. Medical interns and laboratory/pathology/microbiology doctors had a significant more difficulty in fall asleep during COVID-19, and internists and surgeons had a significant higher percent of those who used sleeping pills. Resident doctors had a significant higher percent of having trouble in staying awake, and residents and consultants had a significant higher percent of those who suffered decreased sleep duration. Sleep quality during COVID-19 was very good, fair good and very bad in 23.4%, 60% and 3.5% of HCW

							respectively. The study observed a negative impact of COVID-19 pandemic on HCW sleep quality.
Alomari et al., 2021	Jordan	1757 participants: The majority of the participants were women (69.4%), from a middle-income class (77.0%) while 51.6% held a bachelor's degree and 35.6% were unemployed.	1757	Cross-sectional study	Survey items developed by the study's author including questions on sleep quality, sleep duration, and sleep disorders.	Sleep duration Sleep quality	>50% (range: 53.1%–59.4%) of the participants reported an "increase" in sleep disturbance, nighttime sleeping, and total sleeping hours while 49.1% reported a "decrease" in daytime sleeping. Only age ($\chi 2 = 20.2$; $p = 0.0001$) was associated with changes in sleeping disturbances during COVID-19 confinement. Younger age ($\beta = -0.02$; OR = 0.98; $p = 0.05$) was associated with an "increase" in sleeping disturbance Only gender ($\chi 2 = 13.4$; $p = 0.001$) is an independent predictor of nighttime sleeping. Being a male is associated with a "decrease" ($\beta = 0.36$; OR = 1.4; $p = 0.006$) in nighttime sleeping hours. Being a male ($\beta = 0.34$; OR = 1.41; $p = 0.03$) and having a high school ($\beta = -0.70$ OR = 0.50; $p = 0.007$), two-year ($\beta = -0.67$; OR = 0.50; $p = 0.01$), and four-year ($\beta = -0.46$; OR = 0.63; $p = 0.05$) diplomas are associated with a "decrease" in daytime sleeping hours.
Alothman et al., 2021	Saudi Arabia	A total of 669 individuals attempted to complete the online survey, 554 participants completed at least 2 sections of the survey (82.8%), and 41.3% (n = 276) completed the whole online survey. The majority of the sample were female (83%)		Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality Sleep duration	Most had sufficient sleep duration (7.5 hrs ± 2.1), and also reported poor sleep quality (5.4 ± 2.4)
Alqahtani et al., 2021	Saudi Arabia	593 participants 7.7% were males, and 42.3% were females. The response from the age group of 20–30 years was 38.6%, 30.4% were between 31 and 40 years, 17% were in the	593	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality Sleep duration	The PSQI score (7.2) of the female respondents were higher than that of the males. The mean latency to fall asleep of the former was 42.51 (SD 31.6) min, which was longer than that of the latter. Although the mean PSQI score and the sleep latency of the age group 51 years were high, the mean sleep duration was the shortest.

		age group of 41–50 years, and 14% were 51 years. Most of the respondents were from Jazan (43.8%					The latency to fall asleep in the age groups of 41–50 years were higher, i.e., 45.13 (SD 34.3) min. The PSQI score and the latency to fall asleep of graduates and postgraduates were higher than those of the respondents with primary and high school education. The respondents with hypertension had the highest PSQI score of 8.09, followed by the subjects with asthma (7.74). However, the sleep duration of the subjects with hypertension was short. The subjects with asthma had the highest latency to fall asleep (55.61 SD 36.01 min) among the individuals with other comorbidities. Individuals with a family history of psychiatric disorders and sleeping pills had higher PSQI scores The presence of comorbidities was related to sleep duration (v2 = 12.13 [5], p = 0.03). Sleep duration affected males more than females (OR 1.92 [1.3–2.7], p = 0.001) and subjects aged 51 years (OR 2.49 [1.3–4.4], p = 0.002) Being worried/anxious of the infection significantly affected sleep latency (t = 2.3 [591], p = 0.018), sleep duration (t = 4.5 [591], p = 0.001), sleep efficiency (t = 2.7 [1.0], p = 0.005), and PSQI score (t = 2.84 [591], p = 0.005)
AlRasheed et al., 2021	Saudi Arabia	The study included 836 participants. The median age was 28 years, 624 (74.64%) were females, and 158 (18.90%) were healthcare workers.	836	Cross-sectional study	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality Sleep duration	Factors associated with poor sleep were recent changes in the sleep habits p = 0.004), anxiety or fear because of coronavirus news on social media p = 0.02), fear because there was no approved drug to treat COVID-19 p = 0.03), and unaware of the presence of chronic diseases p = 0.03). Female gender p = 0.02), fear or anxiety because of coronavirus news on social media p = 0.04), recent change in sleep habits (OR: 1.97 (1.15–3.39); p = 0.01), fear because there is no approved drug to treat COVID-19 p = 0.001), monthly income <1000 SR p = 0.01), and isolation p = 0.01) were

							associated with distress. PSQI and K10 scores were significantly correlated p < 0.001).
AlRasheed et al., 2021	Saudi Arabia	The study included a total of 353 participants; 88 were in isolation because they had current or suspected COVID-19 infection or because they had just arrived from abroad, with 265 non-isolated individuals serving as controls. The age of the isolated group was 28.6±9.8 (mean ± standard deviation) years versus 27.5±8.5 years for the non-isolated group, with males accounting for 37% in both groups	353	Cross-sectional study	Pittsburgh Sleep Quality Index (PSQI)	Sleep duration Sleep quality	The mean PSQI score was 8.5±3.6 and 8.4±3.5 for the isolated and non-isolated groups, respectively (P= 0.92). Poor sleep (PSQI ≥6) was reported in 235 (66.6%) Isolation was not associated with poor sleep (OR: 0.73 (95% CI: 0.41–1.3), P=0.29)
Alshumrani et al., 2022	Saudi Arabia	A total of 1091 participants were surveyed; 643 (58.9%) were COVID-19 patients. The mean age of the patients in the COVID-19 arm was 42.8 ± 15.2 years, with a male predominance of 61.1%.	1091	Cross-sectional study	Athens Insomnia Scale	Sleep quality Sleep disorder (insomnia)	The majority (58.1%) reported worsened sleep during the COVID-19 pandemic. Poor sleep quality was reported in 66.1% of the patients in the COVID-19 group (mean score of 6.9 ± 4.0) and 72.8% of participants in the control group (mean score 7.6 ± 4.3). Insomnia affected 50.5% of the patients with COVID-19 (mean score of 6.5 ± 5.5) and 58.5% of controls (mean score of 7.6 ± 5.5).
Arafa et al., 2021	Egypt	1629 participants, 48.1% were aged ≤ 30 years, 42.4% were men, and 20.0% were working in the health sector	1629	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration.	Sleep duration	inadequate sleeping (less than 6hrs/ day) (23.1%)
Badri et al., 2021	United Arab Emirates	574 older adults in Abu Dhabi About 60% were male and 40% were female. Most of them were	574	Cross-Sectonal study	Survey items developed by the study's author including questions on	Sleep disorders	The analysis took each of the ten psychological feelings as dependent variables, where time was treated as the only independent variable. and resulted in ten individual regression analyses. Sleeping disorders showed significance at the 0.05

		married (82.4%), while only (7.7%) were single. Around (3.1%) were separated, widowed, or divorced. About 40% were Emirati and 60% were non-Emiratis.			sleep duration.		level. The positive standardized coefficients and t-values note more negative development for sleeping for older adults, suggesting that time harms the development of the sleeping disorders.
Barbato et al., 2021	United Arab Emirates	international sample of foreign workers (n = 319) resident in the United Arab Emirates (UAE). The majority of participants were female (76%), European (69%) and highly educated (83% had a bachelor's or higher degree)	319	Cross-sectional study	Insomnia Severity Index	Sleep disorders(insomnia)	Insomnia symptoms were observed in 33% of participants, with 4% of participants showing severe symptoms. A higher reported prevalence of insomnia was observed among younger participants, females, and a more severe impact of COVID-19 in the home country.
Başkan et al., 2021	Turkey	Using the snowball sampling method for sample selection, 1.909 individuals aged 18-65 years living in Turkey. 69% of the respondents was female, 48.9% was married, 68.5% had moderate income, and 43.1% was civil servant. Of the participants, 78.6% was university graduate	1909	descriptive type research	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality	The PSQI score was 7.78±3.46, and 71.6% of the participants had poor sleep quality. A significant, positive and weak relationship was found between the total scores on PSQI and PSS ($p<0.05$)
Cheikh Ismail et al., 2020	United Arab Emirates	1012 participants, highest number of participants residing in Abu Dhabi (33.9%) and Dubai (32.5%) Females (75.9%), aged 26–35 years (29.1%), were married (56.4%), had no children (50%), completed a bachelor's	1012	Cross-sectional study	Copenhagen Psychosocial Questionnaire (COPSOQ-II) with modifications	Sleep quality Sleep duration Sleep disorder	Significant decrease in the percentage of participants who reported sleeping less than seven hours per night from 51.7% before the pandemic to 39% during the pandemic ($p < 0.001$) A higher percentage of participants reported poor sleep quality during the pandemic (28.1%) compared to before the pandemic (17.3) ($p < 0.001$), and sleep disturbances were also more common during the pandemic (60.8%) compared to before (52.9%).

		degree (54.1%), worked full-time (53.3%), and were working or studying from home during quarantine (61.6%).					30.9% of the surveyed participants reported feeling lazy and less energized during the pandemic, compared to only 4.7% before the pandemic ($p < 0.001$) Sleep disturbances increase was significantly higher in females ($p = 0.011$). Sleep duration and quality was most affected among participants aged 18–35 ($p < 0.001$).
Cheikh Ismail et al., 2021	Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Oman, Palestine, Qatar, Saudi Arabia, Syria, United Arab Emirates and Yemen.	2970 participants from 18 countries in the MENA region The largest proportion of respondents was from the United Arab Emirates (13·1 %), Jordan (11·9 %), Lebanon (11·5 %), Saudi Arabia (8·3 %) and Palestine (6·4 %). 28.4 % males, aged 18–25 years (29·6 %), were married (53·2 %), had no children (49·7 %), completed a university degree (48·5 %), worked full-time (44.8 %) and were working/studying from home during the lockdown (56.0 %)	2970	Cross-sectional study	Copenhagen Psychosocial Questionnaire	Sleep quality Sleep duration Sleep disorder	Although the percentage of participants who were sleeping <7 h per night decreased from 51·4 % before the pandemic to 36·6 % during the pandemic, the percentages of participants reporting poor sleep quality increased from 17·1 % before the pandemic to 29·2 % during the pandemic ($P < 0·001$). Moreover, a higher percentage of participants reported sleep disturbances during the pandemic (63·2 %) compared with before (53·1 %). As a result, 29·6 % of the participants reported feeling lazy and less energised during the pandemic, compared with only 4·7 % before the pandemic ($P < 0·001$)
Cigiloglu et al., 2020	Turkey	Of the 104 participants, 61 (58.7%) were men, and 75 (72.1%) were ages 65–74. With regard to health, 76.9% of respondents reported a history of at least one chronic disease	104	Cross-sectional study	Richards-Campbell Sleep Questionnaire	Sleep quality	None of the groups had a mean sleep score indicating very poor sleep quality (score: 0–25). As the monthly income and education level increased, scores for most of the sleep parameters also increased Found that depression and anxiety symptoms were associated with poorer quality of life and sleep quality.
Corio et al., 2021	Israel	2541 participants: Israel (N = 1969) and the U.S. (N = 572) Israeli sample: Age 40.4	2541	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	56% of the sample were poor sleepers A large majority of the sample (88.9%) reported that their sleeping habits had changed since the pandemic started in at least one of the 6 ways

		± 13.76, Female 55.1% (1085)					assessed. Almost 70% of the participants reported they were going to bed later, and almost 50% reported waking up later in the morning the strongest correlations were between use of sleeping medication and both depression (rs = .55, P < .001) and anxiety (rs = .57, P < .001), and between sleep disturbances and both depression (rs =.52, P < .001) and anxiety (rs=.49, P < .001). Participants who reported more COVID-related stress reported significantly poorer sleep quality, with moderate effect sizes
Duran et al., 2021	Turkey	405 participants, 70.9% of the participants were female, 29.1% were male. While 6.7% of the participants were single, 82.2% had undergraduate or higher degrees. 48.4% were continuing to work from their workplace, 15.1% were continuing to work from home, and 36.5% were not working at a job. 69.4% did not have children.	405	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	Mean sleep quality score was 6.39 ± 3.31. The prevalence of poor sleep quality was 55.1%. The sleep quality of the single participants and the participants with low education levels was poorer. The sleep quality of those who left work in the pandemic period was poorer than those who were working from home/office and those who were already not employed before the pandemic. The sleep quality of those not working in the field of health was better than healthcare professionals and those not working at all. The scores for psychological distress were negatively correlated with sleep quality levels.
Eren et al., 2021	Turkey	405 participants 67.9% (275) of the individuals participating in the study were women, and 34.6% (281) were under 20 years old. 68.4% (277) of the individuals are university graduates and high graduate, 67.2% (272) are single, 28.6% (116) have children.	405	Cross-sectional study	Pittsburg Sleep Quality Index	Sleep qualtiy	While 23% (93) of the participants had sleep problems before the COVID19 outbreak, 40% (162) had sleep problems after the COVID19 outbreak. It was determined that 183 (78.9%) participants with good sleep quality did not have sleep problems after the start of the COVID-19 outbreak, and 113 (65.3%) participants with poor sleep quality experienced sleep problems after the start of the COVID-19 outbreak. As a result of an increase in the state-trait anxiety scale score by 1 point, the risk of poor sleep quality increased 1.051 times (5.1%) A statistically significant relationship was found between PSQI classes and psychiatric diagnosis

							status (χ2=4.416, p=0.036). It was found that 226 people (97.4%) with good sleep level had no psychiatric diagnosis, and 12 people (6.9%) with bad sleep level had psychiatric diagnosis.
Galali, 2021	Iraqi Kurdistan	2137 participants included 74.9% (1,600) from Erbil, 22.3% (476) from Sulaimani, and 2.9% (61) from Duhok. Regarding gender, results showed that 43.4% (927) were male and 56.4% (1,210) were female.	2137	Cross-sectional study	Survey items developed by previous study "EBLC-COVID19 questionnaire" Including questions on sleeping behavior.	Sleep duration	During the pandemic, the percentage of people reporting sleeping between 7 and 9 hr per night increased from 44.8% to 53.6% and those reporting more than 9 hr sleep increased from 8.1% to 22.4%.
Gokseven et al., 2021	Israel	315 participants: 178 were female and 137 were male. The mean age was 71.5 ± 5.6 (min: 65, max: 94) years, and 26 participants were living alone.	315	Cross-sectional study	Survey items developed by the study's author including questions on sleep disorder.	Sleep disorder (Insomnia)	30.8% (n = 97) of the participants stated that they had difficulty falling asleep at night after the onset of COVID-19 infection
Hadar-Shoval et al., 2021	Israel	421 Participants. The sample comprised 295 women (70%), and participants had a mean age of 37.93 ± 16.47 years (range 18-90) and a mean education of 14.39±2.78 years. About 53.8% (n=226) lived in urban areas and 46.2% (n=194) in rural areas.	421	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	For the entire sample, sleep disorder (insomnia), as measured by PSQI, revealed poor sleep quality (6.82; above 5 is an indication of sleep disturbances).
Hammoudi et al., 2021	Lebanon	111 (18.8%) males, 480 (81.2%) females	591	Cross-sectional	Insomnia Severity Index	Insomnia levels	Regarding phone screen times among the university students, the prevalence of insomnia, anxiety,

				study	(ISI), Bedtime Procrastination Scale		depression, and overweight increased with increasing phone screen time. Female sex (adjusted odds ratio [aOR]=2.19, 95% confidence interval [CI]=1.27-3.77), overweight status (aOR=1.85, 95% CI=1.22-1.28), insomnia (aOR=1.06, 95% CI=1.02-1.10), and bedtime procrastination (aOR=1.03, 95% CI=1.00-1.07) were significant predictors of a phone screen time of ≥7 hours
Hammouri et al., 2022	Jordan	467 participants. 297 (64%) responses from females and 170 (36%) from males. The population age was between 18 and 103 years old and the mean was 33.9 years (SD 13.1).	467	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration.	Sleep duration	There is a significant difference in the increase in hours of sleep, where single people (59%) increased the amount of sleep more so than married people (43.4%). The respondents who increased their sleeping hours tended to have a younger mean of age for all significant pairwise comparisons.
Husain et al., 2020	Kuwait	415 adults participated in this descriptive cross-sectional study with a mean age of 38.47 ± 12.73 years; most of them were females, numbering 285 (68.7%).	415	Cross-sectional study	Survey items developed by the study's author including questions on sleeping habits.	Sleep quality	With regard to sleeping habits, results indicated significant statistical differences before and during the pandemic, there was a decrease in the percentage of participants who slept during the night and a marked increase in the percentage of participants who slept during the day (OR = 3.99 (95% CI 2.86–6.62), p < 0.001)
Hussien et al., 2020	Egypt, Jordan, and Saudi Arabia	General populations of Egypt (198 participants, 40% female), Jordan (148 participants, 36% female), and Saudi Arabia (358 participants, 42% female) were recruited.	704	Cross-sectional study	Survey items developed by the study's author including questions on sleep quality.	Sleep quality	53.7% of the sample reported sleep disturbances. A high DASS mean score was significantly associated with reporting disturbances in sleep
Iqbal et al., 2021	Saudi Arabia	397 questionnaires from the participants. The respondents were mostly of youth age (19-24 years), 66.5% of respondents were male, while there were 33.5%	397	Cross-sectional study	Pittsburgh sleep quality index	Sleep quality	While correlating the sleep patterns disturbance in individuals who had contact with COVID-19 patients, there was a significant sleep disturbance. The disturbance of sleep was in having problems falling sleep (p-value=0.024), having bad/horrible dreams (p-value=0.017), feeling cold at sleeping (p-

		females. Most of the participants did not contact any COVID-19 patients (75.1%, n=298)					value=0.038), and difficulty staying active during eating or driving (p-value=0.012). The sleep quality is poor due to the stay-at-home order, having a disorganized working schedule, and deprived lifestyle.
Karahan Yilmaz et al., 2021	Turkey	A total of 1120 individuals, 412 (36·8 %) male and 708 (63·2 %) females, participated in the study. The mean age was determined as 33·04 ± 11·04. Among those who participated in the research, 84·6 % of individuals were university/bachelor's/master's degree graduates.	1,120	Cross-sectional study	Survey items developed by the study's author including questions on sleep quality and sleep duration.	Sleep duration Sleep quality	During the pandemic period, 42·5 % of the individuals stated that they slept more and 40·2 % stated that there was no change in their sleep patterns. Daily physical activity durations were determined as 8·25 ± 1·77 h for sleep
Keng et al., 2022	86 countries	67% (n = 4959) of the participants were female	7,402	Longitudinal study	Survey	Question on sleep quality	COVID-related infection risk and perceived economic burden were both negatively associated with sleep quality during the previous week. (b = 0.67, SE = 0.01, p <.001) Those who reported high economic burden (top 10%) reported decreased sleep quality regardless of levels of perceived infection risk, b = -0.02, SE = 0.02, p =.325, whereas people perceiving low economic burden (bottom 10%) reported better sleep quality if their perceived infection risk was also low, b = -0.111, SE = 0.02, p <.001
Kilani et al., 2020	MENA region	917 males, 37.4 ±13.4 years old and 806 females 32.2 ± 11.5 years old	1,723	Cross-sectional study	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality	t-test analysis revealed a significant difference in mental wellbeing score based on sleep quality (t = -16.413, p < 0.001). A significant number of respondents (43%) reported poor sleep quality. Those with good sleep quality showed significantly better mental wellbeing (15.5 ± 3.4) in comparison with those with poor sleep quality (12.4 ± 4.2) (p <

							.001)
Kolokotroni et al., 2021	Cyprus	Out of 745 participants (sample of adults who resided in Cyprus during the Spring 2020 lockdown), 74% were female and median age was 39 years.	745	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	Overall participants reported significantly worse sleep quality score (4 v 5, p < 0.01) during lockdown. Regarding the individual PSQI score components (sleep latency, daytime dysfunction, sleep medication and sleep quality), all increased during lockdown (p < 0.01), demonstrating a worse sleep experience, except sleep efficiency, which marginally improved during lockdown (p < 0.01). a positive moderate correlation (r = 0.4064, p < 0.01) between differences in perceived stress and sleep quality index before and during lockdown, indicating that an increase in perceived stress was associated with worsening sleep quality. Overall support index score difference was negatively correlated with sleep quality index difference (r = − 0.2253, p < 0.01), showing that a decrease in the overall support index during lockdown was associated with worsening sleep quality.
Korkmaz et al., 2020	Turkey	61 (44%) females and 79 (56%) males participants The average age for female participants was 30.7 ± 6.2 and the average age for male participants was 35.6 ± 8.7	140	Cross-sectional study	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality	There was a positive correlation between the Beck Anxiety Inventory (BAI) scores and the PSQI and Problem Solving Inventory (PSI) scores of the participants and a negative correlation between the World Health Organization Quality of Life-BREF (WHOQOL-BREF) scores and the PSQI and PSI scores of the participants (p = 0.000, r = 0,508; p = 0.029, r = 0,184; p = 0.000, r = −0,360)
Lan et al., 2021	Israel	Studied the effects of lockdown in three cohorts: (1) 169 individuals from the general population; (2) 91 undergraduate students and (3) 39 women within fertility age.	299	Cohort study	Sleep logs Online questionnaire	Sleep duration Sleep quality Sleep disorders	In cohort (1) lockdown resulted in increased sleep duration (p<0.001), and delayed midsleep point during workdays (p=0.07) and weekends (p=0.02) largest change in sleep duration was shown in young people with late chronotype (p=0.04) and older subjects with early chronotype (p=0.04). In cohort (2), There were effects of lockdown

							(p=0.02) and chronotype (p=0.05) on sleep duration. Increased sleep during lockdown and in early chronotypes. Females slept more during lockdown (p=0.01) and students who work slept less (p=0.02). Midsleep point free days (MSF) was delayed during lockdown (p=0.001) with MSF of late chronotypes later than MSF of early chronotypes (p<0.001).
Lin et al., 2020	Iran	A sample of Iranian young adults (n = 1078 with 628 males; mean age = 26.24 years [SD ± 7.41])	1078	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	Insomnia was mutually and significantly correlated with psychological distress, problematic social media use, fear of COVID-19, COVID-19 misunderstanding. Problematic social media use was significantly associated with insomnia via both direct (B = 0.095; SE = 0.038) and indirect paths.
Lin et al., 2020	19 countries	N/A	N /A	Longitudinal study	Google trends	Sleep disorder (insomnia)	The countries with the greatest increases in searches for insomnia were Iran, Spain, the United States, and Italy; these countries exhibited a significant increase in insomnia searches on more than 10 of the 31 days observed. The number of COVID-19–related deaths was positively correlated to the number of days with an increase in searches for insomnia in the 19 countries (ρ=0.64, P=.003)
Lin et al., 2022	Iran	Sample of 10,843 participants (mean age = 35.54 years; SD = 12.00), 6751 were females (62.3%)	10843	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	Suicidal ideation was positively and significantly correlated with insomnia (r = 0.327; p < 0.001) Generalized trust was negatively and significantly correlated with insomnia (r = −0.100; p < 0.001) insomnia and fear of COVID-19 were positively and significantly correlated (r = 0.271; p < 0.001).
Maatouk et al., 2022	Lebanon	948 participants, divided into four groups: non-smokers not at risk (NSNR), non-smokers at risk (NSR), smokers not at risk (SNR), and smokers at risk (SR). A person at risk is	948	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration.	Sleep duration	NSNR significantly increased their sleep duration by 64.284 min per night (p < .001) SNR increased their sleep duration by 54.732 min per night (p < .001)

		an individual with a disease that could worsen the prognosis of a potential COVID-19 infection. Age mean: NSNR (26.52 years, standard deviation = 10.051), NSR (33.26 years, standard deviation = 15.672), SNR (29.55 years, standard deviation = 11.314), and SR (34.39 years, standard deviation = 12.193)					
Mahamid et al., 2021	West bank of Palestine	129 males and 237 females	366	Cross-sectional study	DSM-5 Level 2—Sleep Disturbance Scale	Sleep disorder(sleep disturbance)	Problematic internet use positively correlated with sleep disturbance ($r = .19$, $p < .01$), and negatively correlated with life satisfaction ($r = -.17$, $p < .01$). Moreover, life satisfaction negatively correlated to sleep disturbance ($r = -.25$, $p < .01$). Sleep disturbance explained statistically and significantly variance in problematic internet use ($B = .16$, $SE = .04$, $\beta = .20$)
Masoumi et al., 2021	Iran	Mean (SD) age was 28.8 (5.9) years. 119 females (60%)	200	Cross-sectional study	Mini-Sleep Questionnaire	Sleep duration and sleep quality	Sleep quality was 30%, worse in the pandemic period compared to the pre-pandemic states, The mean time to go to bed and wake-up time on weekdays in the pandemic were 35 and 24 min later than those in the pre-pandemic period respectively. The mean time to go to bed and wake-up time on weekends in the pandemic were 21 and 6 min later than those pre-pandemics. Before the pandemic, subjects went to bed on weekends 40 min later than on weekdays ($p < 0.0001$). In the pandemic, this difference decreased to 26 min ($p < 0.0001$). In both the pre-pandemic and pandemic periods, subjects woke up 96 min later on weekends compared to the weekdays ($p < 0.0001$). Before the pandemic, the

							mean sleep duration every night was 7 h and 22 min for the weekdays, which decreased to 6 h and 44 min during the pandemic. The difference signified a 38 min sleep debt every night. The night sleep duration on weekdays before the pandemic was 33 min shorter than the night sleep duration on weekends (p <0.0001). This difference decreased to 2 min during the pandemic.
Najafipour et al., 2021	Iran	Of 911 participants, 365 (40.1%) were men. Almost half of the participants (51.7%) aged over 55 years. Married people accounted for 80.4% of the samples, 72.7% were illiterate or have non-university education, and 67.6% were unemployed.	911	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration.	Sleep duration	42.8% and 58.8% experienced sleep time abnormality before and after the quarantine, respectively A high percentage of people experienced an increase in sleep hours (33.7%) The odds of an increase in sleep hours was higher in men and young people and lower in people with intense PA and higher levels of anxiety. The changes in the three variables were mostly related to the quarantine, although interaction between PA and sleep was also present. There was a negative relationship between anxiety and sleep hours and between PA and sleep hours both before and after quarantine.
Nakhostin-Ansari et al., 2021	Iran	675 people with a mean age of 40.28 years (SD=11.15) participated in the study. One-hundred and ninety-six (29%) were male, and 479 (71%) were female.	675	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	Three hundred and forty-two participants (50.7%) had subthreshold insomnia, 275 (40.7%) participants had moderate insomnia, and 58 participants (8.6%) had severe insomnia. Six-hundred and seventeen participants (91.4%) had DIS, 585 participants (86.7%) had DMS, and 520 participants (77%) suffered from EMA. The prevalence of these disorders was significantly different from each other (P<0.05), and DIS was the most common insomnia pattern. fear of COVID-19 was a risk factor for all patterns of insomnia (OR=1.19, 1.12, 1.02 for DMS, DIS, and EMA, respectively). Age was a risk factor for EMA (OR= 1.09), but it was a protective factor for DMS (OR=0.98). Self-employment was a risk factor for DMS (OR=1.61) and DIS (OR=1.59)

							Conclusion: Fear of COVID-19 is a major contributing factor to insomnia patterns. Investigation of COVID-19 fear in people with insomnia and the addition of attributed relieving or management strategies to conventional management of insomnia are reasonable approaches to improve the sleep condition of people in the pandemic.
Okudan et al., 2021	Turkey	37.88±12.44 years age, 346 (68.5%) females and 159 (1.5%) males	505	Cross-sectional study	Online survey	Quality of life (WHO Quality Of Life)-Bref version	27.5% (N.=142) informed that even they sleep enough time, wake up tired, while 22.1% (N.=114) cannot sleep enough time, and wake up tired.
Oved et al., 2021	Israel	Out of the 169 participants, 94 (55.62%) were women, and 75 (44.38%) were men. The age of the participants ranged between 20 and 80, with clear two main age groups: 20–40 and 60–80.	169	longitudinal study	Smartwatch data collection	Sleep duration Sleep quality	An increase was observed in sleep duration based on questionnaire responses (an average of 6.28 h versus 6.42 h, $p < 0.01$, Cohen's $d = 0.14$) and based on smartwatch records (an average of 7.03 h versus 7.12 h, $p = 0.05$, Cohen's $d = 0.14$), MSF (an average hour of 4.03 versus 4.12, $p = 0.02$, Cohen's $d = 0.13$) and MSW (an average hour of 3.43 versus 3.49, $p = 0.07$, Cohen's $d = 0.08$). No significant effects were found for stress, sleep quality and SJL.
Radwan et al., 2021	United Arab Emirates	2060 responses. Three-quarters (75.1%) were females, 31.7% were between 18 and 30 years old, 38.4% were between 31 and 40 years old, and 29.9% were older than 40 years. Over half of the study population (63.8%) were married and the majority had a university degree (76%).	2060	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration.	Sleep duration	Decreased sleep was reported by 20.8%. In terms of sleeping behavior, females were more likely to experience decreased sleep compared to males, whereas older adults (>40 years old vs. 18–30 years old) were less likely to experience decreased sleep during the lockdown.
Romdhani et al., 2021	49 countries	athletes (mean age: 25.1 (range 18-61) years, 1764 female (45%), 2427 team-sport (63%) and	3911	Cross-sectional study	Pittsburgh Sleep Quality Index (PSQI) and Insomnia	Sleep quality, Sleep disorder (insomnia)	PSQI (4.3 ± 2.4 to 5.8 ± 3.1) and ISI (4.8 ± 4.7 to 7.2 ± 6.4) scores increased from pre- to during lockdown ($p < 0.001$). PSQI was predominantly influenced by sleep-onset latency ($p < 0.001$; + 29.8%), sleep

		1442 elite (37%) athletes			Severity Index (ISI)		efficiency (p < 0.001; - 21.1%), and total sleep time (p < 0.001; - 20.1%), while ISI was affected by sleep-onset latency (p < 0.001; + 21.4%), bedtime (p < 0.001; + 9.4%), and eating after midnight (p < 0.001; + 9.1%) Athletes went to bed (+ 75 min; 5.4%; d = 1.14) and woke up (+ 150 min; 34.5%; d = 1.71) later during lockdown with an increased total sleep time (+ 48 min; 10.6%; d = 0.83). Lockdown-mediated circadian disruption had more deleterious effects on the sleep quality of individual-sport athletes compared with team-sport athletes (p < 0.001; d = 0.41), elite compared with non-elite athletes (p = 0.028; d = 0.44) and older compared with younger (p = 0.008; d = 0.46) athletes
Sadeghniiat-Haghighi et al., 2021	Iran	1,223 participants [827 (67.6%) female, mean age=39.82±10.75 years old]	1223	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	675 (55.2% [95%CI=52.40-57.98]) were categorized into the insomnia group. Insomnia was more prevalent in females (p=0.006), participants with 50 years old or higher (p=0.04), or high fear of COVID-19 (p<0.0001). Totally, 67.4%, 66.4%, and 55% of all participants had DIS, DMS, and EMA, respectively, in the current outbreak. Besides, 79% had impaired daily functioning, 51.6% had impaired quality of life, and 62% were worried about their sleep problem. Notably that a considerable percentage of individuals with normal ISI scores had at least one insomnia phenotype or impaired daily functioning and quality of life. Further analyses revealed a significant increasing trend in all four insomnia phenotypes prevalence with an increase in fear of COVID-19 (all p-values<0.0001).
Salehinejad et al., 2020	Iran	Healthy volunteers 137 females, mean age = 25.79 ± 7.31	160	Cross-sectional study	Pittsburgh Sleep Quality Index (PSQI), Quantitative sleep parameters, Morningness-Eveningness Questionnaire	PSQI: sleep quality, Quantitative Sleep parameters: about time to go to bed (clock), sleep onset latency time (in	PSQI: significant decrease of global sleep quality during quarantine (t = 6.95, p < 0.001. t-test showed that the time to fall asleep was prolonged during home quarantine as compared to the time before quarantine (t= 7.32, p < 0.001). The average sleep duration (in h) was significantly longer during quarantine, as compared to before quarantine as well (t = -3.65, p < 0.001). 85.6 % of the participants (137

						minutes), time to get up in the morning, and sleep duration Morningness-eveningness questionnaire: chronotype	of 160) reported at least 1 h delay to get up in the morning on average in home quarantine. The average delay to get up in the morning during home quarantine was 2.28 h. Results showed that participants' time to get up in the morning was significantly delayed during quarantine (t= 15.36, p < 0.001)
Salman et al., 2021	Kuwait	Data from 679 respondents (57.9% females and 42.1% males; 67.7% Kuwaiti nationals and 32.3% non-Kuwaiti nationals)	679	Cross-sectional study	Survey items developed by the study's author include questions on quality of sleep.	Sleep quality	Mental health was highly correlated with the quality of sleep Extremely severe depression was associated with having poor or very poor quality of sleep (1.75 times). Severe or extremely severe psychological distress was associated with having poor or very poor quality of sleep (2.20 times)
Salman et al., 2021	Kuwait	Among 679 respondents, 57.9% were female and 67.7% were Kuwaitis. Age group categories were represented relatively evenly, with 28.7% of respondents in their 20s, 29.3% in their 30s, 23.0% in their 40s, and 19.0% in the age range of 50 years or above. The average age was 37.7 (SD: 11.6).	679	Cross-sectional study	Survey items developed by the study's author include questions on quality of sleep.	Sleep quality	36.4% of respondents rated their quality of sleep as 'poor' or 'very poor'. Days of physical activity were positively correlated with 'quality of sleep' Sleep hours were positively correlated with good quality of sleep. Quality of sleep was negatively correlated with 'consumption of sugary drinks' and 'consumption of sweets and snacks', and positively correlated with 'the days of physical activity'.
Savci et al., 2021	Turkey	The final sample consisted of the remaining 103 older adults residing in a nursing home affiliated with the Istanbul Darulaceze Directorate of Hospice.	103	Correlational study	Survey items developed by the study's author include questions on sleep patterns.	Sleep quality	18.4% of the participants had change in sleep patterns during the pandemic.

		The inclusion criteria for the study were as follows: be over 65 years old, voluntarily agree to participate in the study, have a Standardized Mini Mental Test Score of 24 or higher, residence within the nursing home for at least one year, and speak and understand Turkish.					
Şentürk et al., 2021	Turkey	254 (55.3%) males and 205 (44.7%) females. The age of the participants ranged from 24 to 60 years (M=35.64, SD=6.84) and mean age was 35.64±6.84	459	Cross-sectional study	Jenkins Sleep Scale (JSS)	Subjective sleep quality	Poor sleep quality is a predictor of depression (β=0.378, p<0.001), of anxiety (β=0.373, p<0.001) and stress (β=0.324, p<0.001)
Sultan et al., 2021	Saudi Arabia	Three hundred thirty-eight individuals responded to the survey. Participants were 267 females (79%) and 71 males (21%) with a median age of 40 which ranged from 30 to 44 years.	338	Cross-sectional study	Survey items developed by the study's author include questions on sleep duration and sleep quality.	Sleep duration Sleep quality	The percentage of participants who used to sleep more than nine hours daily increased significantly during the pandemic from 8.3% to 21.8% (p<0.001). Use of sleeping aids increased from 11.6% to 15.7% (p<0.001), with 7.7% of participants having difficulty falling asleep for more than two hours. Moreover 41.8% did not feel relaxed after getting up from sleep during the pandemic compared to 14.2% before (p<0.001)
Toprak Celenay et al., 2020	Turkey	375 individuals in the Stay at home group and 311 individuals in the Continued to work group were included in data analysis.	686	Cross-sectional study	Jenkins Sleep Scale	Sleep quality	JSS-T scores reveled sleep quality was similar in both groups (p > .05)
Torkian et al., 2021	Iran	3,446 people completed the questionnaire. most participants were female (66.7%), mean (± SD) age of the	3446	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	73.5% had poor sleep quality. Perceived income, hours spent outdoors, the number of people with COVID-19 that were acquainted with, and a history of depression were significantly related to sleep quality.

		participants was 34.2 (±11.60) years. 65% were married.					
Yalcin et al., 2022	Turkey	A sample of 8,276 volunteers, aged between 18 and 65, were recruited via an online platform. The mean age of the sample was 39.86 (± 13.13). Approximately half of the sample were females (47.33%). Majority of volunteers were married (67.85%).	8276	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	46.38% of the sample were poor sleepers as indexed by the PSQI The PHAM showed that the perceived vulnerability to diseases was significantly associated with poor sleep quality (β = 0.175, p < 0.001) Negative affectivity as indexed by DASS-21 was significantly tied to poor sleep quality (β = 0.188, p < 0.001)
Yilmaz et al., 2021	Turkey	A total of 1120 individuals, 412 (36·8 %) male and 708 (63·2 %) females, participated in the study. The mean age was determined as 33·04 ± 11·04.	1120	Cross-sectional study	Survey items developed by the study's author include questions on sleep patterns.	Sleep duration Sleep quality	During the pandemic period, 42·5 % of the individuals stated that they slept more and 40·2 % stated that there was no change in their sleep patterns. Daily physical activity durations were determined as 8·25 ± 1·77 h for sleep.
Younes et al., 2021	Lebanon	A total of 4397 respondents. Included participants from all Lebanese districts, of whom 2924 (66.5%) were females, and those who received university education were 3664 (83.3%). The recruited participants were young adults between 18–35 years old, among which 3439 (78.2%) aged between 18 and 25 years	4397	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	A considerable proportion of participants had symptoms of insomnia (941 [21.4%]). The median IQR scores on the the ISI for insomnia for all respondents was 10 (5–14). Higher perceived likelihood of contracting COVID-19 (aOR = 0.67, 95% CI: 0.56; 0.79) resulted in no clinical or subthreshold insomnia. Single marital status (aOR = 1.43, 95% CI: 1.05; 1.93), divorced marital status (aOR = 3.33, 95% CI: 1.50; 7.39), university education (aOR = 2.50, 95% CI: 1.51; 4.16), consumption of caffeinated beverages (aOR = 1.24, 95% CI: 1.03; 1.49) and energy drinks (aOR = 1.22, 95% CI: 1.02; 1.47) were significantly associated with moderate to severe insomnia.

							Age group of 25–35 years was significantly associated with less insomnia scores (aOR = 0.77, 95% CI: 0.62-0.96) as compared to lower age group of 18–25 years. However, cigarette smoking was significantly associated with higher insomnia (aOR = 1.53, 95% CI: 1.25; 1.88) scores. physical activity of more than 3 times per week during lockdown were significantly associated with less insomnia (aOR = 0.65, 95% CI: 0.52; 0.83) Being a non-Lebanese was significantly associated with insomnia (aOR = 1.42, 95% CI: 1.12; 1.81) Drinking 2L of water or more during lockdown was significantly associated with lower insomnia (aOR = 0.76, 95% CI: 0.65; 0.88) No change in body weight status during lockdown was significantly associated with lower insomnia (aOR = 0.71, 95% CI: 0.58; 0.86)
Yurumez Korkmaz et al., 2021	Turkey	Participants (n = 136; 82 females, 60.3%) had a mean age of 73.4 ± 5.9 years. (Geriatric sample)	136	Cross-sectional study	Survey items developed by the study's author including questions on sleep problems.	Sleep disorders	Sleep problems (P = 0.000) were more common in participants with depression and anxiety. Sleep problems were present in one third of our study population, and found to be statistically significantly higher among patients with depression and anxiety. Sleep problems, which may be a component of psychological distress, have been found to be common in elderly people due to social isolation.32 Also, restricted physical activities and concerns about COVID-19 may lead to sleep disorders.
Zach et al., 2021	Israel	Participants were 1202 people, 381 males and 821 females, aged 45–90.	1202	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration.	Sleep duration	During the time of lockdown sleeping hours increased. Among the younger participants, a positive relationship was found between physical activity and the number of sleeping hours, while in the older ones a positive relationship was found between inactivity and the duration of sleep.

Healthcare workers							
Reference	Location of Study	Population	Sample Size	Study Design	Sleep Health Measurement Tool	Sleep Health Domains	Main Findings
Aarafa et al., 2021	Egypt, Saudi Arabia	This study included 426 HCWs (275 from Egypt and 151 from Saudi Arabia) distributed as follows: 206 (48.4%) physicians, 103 (24.2%) nurses, and 117 (27.4%) other HCWs. Of them, 47.2% were aged ≤30 years, 50.2% were men, 65% were living with children, and 51.6% were living with older adults.	426	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration.	Sleep duration	37.3% had inadequate sleeping (<6 h/day). Female sex, age ≤30 years, working in Egypt, attending emergency and night shifts, watching/reading COVID-19 news ≥2 h/day, and not getting emotional support from family, society, and hospital were associated with a high likelihood of inadequate sleeping.
Abbas et al., 2021	Kuwait	217 HCWs at Kuwait MOH hospitals completed the survey with mean (±standard deviation) age of 35.8 (±7.3) years; 56.2% were male	217	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep Quality	64 experienced sleep difficulties before COVID-19 crisis and 21 (9.68%) had a history of consuming medication for sleep difficulties. Prevalence of poor SQ during the COVID-19 pandemic and its stresses increased to 171 (78.8%), with a global PSQI score mean (SD) of 9.36 ± 4.4; the worst components of SQ were sleep latency, duration, and efficacy. HCWs with poor sleep had higher weekly working hours compared with those with good sleep (67.25% versus 47.83, p =0.015). Among the 32 participants who did swabs for suspected COVID-19 patients during their duties, 30 (93.75%) of them (p =0.01) experienced poor sleep.
Abdelghani et al., 2021	Egypt	218 HCWs from Egypt.. The mean age of the participants was 39.5 ± 8.5 years. The majority were females (n=156,	218	Cross-sectional study	short health anxiety inventory (SHAI)	Sleep duration	Those who reported higher levels of health anxiety to COVID-19 virus infection were more likely to be identified as working more days weekly (5.7 ± 0.8 days) and having lower sleeping hours (6.8 ± 0.9 hours).

		72%), nurses (n=111, 51%), and married (n=192, 88%)					
Abdoli et al., 2021	Iran	A total of 321 full-time frontline hospital staff members in Farabi Hospital (mean age: 36.86; 58% females)	321	Cross-sectional study	Athens Insomnia Scale	Sleep problems (insomnia)	Of the 321 participants, 44 (13.7%) had an insomnia score of 0 to 5 points; 272 (86.3%) had a score of six points and higher. The odds to report insomnia was 3.14-fold higher (CI: 2.64–3.75) among participants compared to the general population.
Abu-Elenin et al., 2021	Egypt	237 physicians, their mean age was 38.2 ± 6.2 years and 58% of them were males.	237	Cross-sectional study	Electronic questionnaire on mental health including quesitons on sleep quality	Sleep quality	The mean rate for sleep quality were poor; at 6.5 ± 3.2 out of 10
Al Ammari et al., 2020	Saudi Arabia	720 complete responses. 194 (26.94%) Physicians, 262 (36.39%) Nurses, and 171 (23.75%) pharmacists completed the survey. The participants' female respondents (64.17%) were almost double the males (35.83%), with nearly 75% above 30 years of age	720	Cross-sectional study	Insomnia severity index	Sleep problems (insomnia)	The largest proportion of health care workers (85.83%) experienced absence to subthreshold insomnia (57.08 and 28.75%, respectively). The rest (14.16%) reported moderately severe to severe insomnia (10.41% and 3.75%, respectively)
Al Maqbali et al., 2021	Oman	Frontline nurses, majority were female (90.7%, n = 895), and were married (85%, n = 839). The largest age group was those aged 31–40 years (59.5%, n = 587), followed by 41–50 years (20.1%, n = 198)	987	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality Sleep duration Sleep problems (sleep latency)	580 (58.8%) experienced poor sleep quality Average sleep duration was 7.04 (SD = 1.59) hours per night with 61.3% (n = 605) of participants reporting sleep of less than 7 h. Mean of sleep latency was 38 min, with 71.4% (n = 705) of the participants reporting more than 15 min. 23.7% of the participants reported a sleep efficiency of less than 85% 30% rated their quality of sleep as "fairly bad" or "very bad". The two most common reasons for sleep

							disturbance were “could not get to sleep within 30 min”, and “waking up in the middle of the night or early morning” as reported by 56.03% and 54.31%.
Alghufli et al., 2021	United Arab Emirates	A total of 400 HCW completed the survey. Majority of them were females (84.5%, n = 338) and aged between 18 and 31 (53.5%, n = 214).	400	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	187 (46.8%) suffered from clinical insomnia HCWs in the fever clinic that had sub-threshold insomnia (26.4%, n = 14). While at the clean and mixed clinics, HCWs had subthreshold insomnia (38.2%, n = 47). Among the 3 HCWs working at telemedicine clinic, insomnia levels were between subthreshold and moderately severe (33.3%, n = 1 for each category).
Ali et al., 2021	Saudi Arabia	Out of 200 healthcare providers, 40% were males. 52% were aged 31–40 years old, 61% were married. The majority of the participants were Saudi nationals (84%), 74% were nurses, 11% were physicians and 15% were other healthcare providers.	200	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	Working as a physician was associated with insomnia (OR, 2.32; 95% CI, 0.89–6.07; P = < 0.05)
Aljuffali et al., 2022	Saudi Arabia	502 pharmacists were included in the present study. Their mean (±SD) age was 31 (±8) years. Most respondents were female (51.8%). Moreover, most respondents were Saudi pharmacists (88.9%)	502	Cross-sectional study	Survey items developed by the study’s author including questions on sleep duration and sleep quality.	Sleep quality Sleep duration	Sleeping disturbances were found to be related to high burnout levels
Almater et al., 2021	Saudi Arabia	One hundred and seven ophthalmologists successfully completed the survey with a response rate of 30.6%. Males constituted 56.1% (n = 60). Ophthalmology	107	simple random study	Insomnia Severity Index	Sleep problems (insomnia)	Overall prevalence of dinsomnia was 44.9%; 32 had subthreshold symptoms (29.9%), 14 had moderate symptoms (13.1%), and 2 had severe symptoms (1.9%). There was also a trend to experience symptoms of

		residents constituted the majority (n = 66, 61.7%)					insomnia in frontline health-care providers (P = 0.129)
Almhdawi et al., 2022	Jordan	326 physicians of all Jordanian medical sectors and specialties successfully completed all of the study survey sections with a mean age of 32.08 (±6.93) ranged between 24−70 years and 44.2% of them were males.	326	Cross-sectional study	Survey items developed by the study's author including questions on sleep quality.	Sleep quality	poor sleep quality (58.3%)
Alshekaili et al., 2020	Oman	1139 HCWs, 228 (20.0%) are males, and 911 (80.0%) are females. Their average age was 36.3±6.5 (mean±SD) ranging from 21 to 65 years. The majority were Omani (n=981, 86.1%) and were married (n=987, 86.9%).	1139	Cross-sectional study	Insomnia Severity Index.	Sleep disorder (insomnia)	211 (18.5%) respondents were reported to have insomnia. HCWs in the frontline group were 1.5 times more likely to report insomnia (OR=1.586, p=0.013) as compared with those in the non-frontline group.
Amra et al., 2021	Iran	Among the 372 HCW participants, 245 (66%) were women and mean age was 34.5 ± 7.1 years (age range 23 to 58).	372	Cross-sectional study	Pittsburgh Sleep Quality Index Insomnia Severity Index	Sleep quality Sleep duration Sleep disorder (Insomnia)	Those participants who were directly caring for the patients including physicians and nurses had significantly higher PSQI but lower ISI questionnaire scores relative to other participants. PSQI were significantly higher in the HCWs with positive coronovirus PCR ISI were significantly lower in the HCWs with positive Coronavirus RT-PCR than another group Positive association between COVID-like symptoms and sleep and mood disturbances was found in the group without a positive test result.
Araç et al., 2020	Turkey	210 volunteers, including 105 healthcare professionals in the emergency department (53.8% female) and 105 healthcare professionals	210	Cross-sectional study	Pittsburgh Sleep Quality Index (PSQI)	Sleep disorder	PSQI subscale scores of the participants in the primary group were significantly higher than those of participants in the secondary group.

		working in other departments (46.2% females) rendering services for COVID-19 patients.					
Aslan et al., 2022	Turkey	845 nurses completed the questionnaire. In total, 72.2% of the nurses were female, 78% were graduates, 57.2% were single, 53.8% had a medium-income level, 69.7% were working in a state hospital, and 7.6% had a chronic disease.	845	Cross-sectional study	Bergen Insomnia Scale	Sleep disorder (insomnia)	A positive correlation was found between COVID-19 Fear Scale and the Bergen Insomnia Scale (r = .392; p = .001). The relationship between COVID-19 Fear and Bergen Insomnia Scale score averages and nurses' educational status, income level, shift working status, the status of their relatives being diagnosed with COVID-19, the state of being satisfied with the management of the pandemic process by the Ministry of Health, the situation of having resources in the settings where they work, the status of being in quarantine was statistically significant (p < .05).
Aydin Sayilan et al., 2021	Turkey	267 nurses The mean age of the nurses in this study was 28.03 ± 5.99 y (min: 21; max: 51), 75.3% were female, 63.3% were single, and 72.7% held an undergraduate degree.	267	Cross-sectional study	The Pittsburgh Sleep Quality Index	Sleep quality	Nurses mostly experienced emotional exhaustion, and burnout levels increased in line with insomnia.
Åžahin et al., 2020	Turkey	Six hundred twenty (66.0%) of the 939 HCWs taking part in this study were female, 339 (36.1%) were aged 26–30, 617 (65.7%) were married, 580 (61.8%) were physicians, 820 (87.3%) were working in an urban area, and 529 (56.3%) had been working for less than 10 years.	939	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	473 (50.4%) experienced insomnia symptoms Female gender, having tested for COVID-19, and history of psychiatric illness emerged as risk factors for insomnia. Nurses and frontline workers had a significantly higher insomnia score than other groups.
Badahdah et	Oman	Examined sleep quality in	150	Cross-	Sleep Quality	Sleep quality	HCWs who scored 10 or higher on the 7-item

al., 2020		a sample of 150 physicians (39.3%) and nurses (60.7%) who cared for patients with COVID-19 in Oman. Females made up 77.3% of participants. The average age was 37.62 years (standard deviation [SD] = 7.79 years).		sectional study	Scale		Generalized Anxiety Disorder Scale scored lower on sleep quality (mean = 5.98, SD = 2.29) HCWs who scored less than 50 on the WHO-5 had a lower score on sleep quality (mean = 6.29, SD = 2.08) The mean SQS score of 7 indicates that 40.1% of participants had poor sleep quality
Barut et al., 2021	Turkey	There were 213 volunteers in of a healthcare team providing service for COVID-19 patients, females 60.9%. 163 healthcare team working without direct contact with COVID-19 patients, females 47.5%.	379	Cross-sectional study	Jenkins Sleep Scale	Sleep quality Sleep problems	Sleep problems and stress levels were significantly higher among healthcare professionals who had direct contact with COVID-19 (+) patients compared to those who did not (P<0.05).
Bilgiç et al., 2021	Turkey	The average age of the nurses in this study was 32.24±8.41 years (min: 19; max: 56) and the average years worked was 10.31±9.08 years. 84.9%of the nurses were female, 50.0%were married, and 74.9%had a bachelor's degree.	316	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	It was found that the average PSQI score of the nurses was 7.36±3.35 (min=1, max=20) a positively significant correlation was found between the average PSQI score of nurses and the PSS score. These findings suggest that nurses perceive high levels of stress and have poor sleep quality.
Bulut et al., 2021	Turkey	Of the 348 healthcare professionals, 176 (50.6%) were women and 172 (49.4%) men, while 190 (54.6%) were doctors and 158 (45.4%) nurses. And 350 participants in the control group, 163 women (46.9%) and 186	698	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	Healthcare professionals: 44 had insomnia (%12.6) Nonhealthcare professionals: 45 had insomnia (%12.9) Insomnia were found to be statistically significantly higher amongst those working in the "area of final diagnosis" (P = .002)

		men (53.1%)					
Chan et al., 2021	Oman	A total of 1132 participants returned their completed questionnaire. A two-step cluster analysis was used to split the sample into three clusters. Clusters A, B and C contained 416 (36.7%), 412 (36.4%) and 304 (26.9%) HCWs, respectively. Cluster A was characterized by HCWs who were older (Mean ± SD, 37.3 ± 7.0 years) with more working experience (13.6 ± 7.1 years) in the health-care setting. more than 84% (n = 353) had not handled any COVID-19 cases during the pandemic period. Cluster B was mostly around 36 years of age (SD = 6.3). The majority were physicians (43.4%, n = 179) or nurses (42.5%, n = 175) All were working in the frontline, and more than 60% (n = 257) had experienced COVID-19 cases in the pandemic. In Cluster C, most HCWs were nurses (44.1%, n = 134) and working in the tertiary care hospital (44.4%, n = 135). They were younger	1132	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	Cluster A: The majority did not report any symptoms of clinical insomnia (97.6%, n = 406) Cluster B: The majority did not report any symptoms of clinical insomnia (96.6%, n = 398) Cluster C: The majority reported clinical insomnia (60.2%, n = 183) during the pandemic.

		(34.8 ± 5.7 years) and with less working experience (11.9 ± 5.9 years) There were around 50% (n = 159) working in the frontline only.					
Dolev et al., 2021	Israel	Medical residents treating COVID-19: 20 internal medicine physicians, 7 physicians working in emergency departments. The non-COVID group: 31 internal medicine, 16 physicians working in emergency departments, 8 psychiatrists, 16 gynecologists, and 7 surgeons	105	Cohort study	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality	COVID-19 group had longer sleep duration (95% CI: COVID-19: 1.44–1.94 vs non-COVID-19: 0.15–0.37;U (27,64) = 313.00, P < 0.0001), longer sleep onset latency (95% CI: COVID-19: 1.75–2.01 vs non-COVID-19: 0.68–0.94; U (27,64) = 326.50, P < 0.0001), deteriorated daily function (95% CI: COVID-19: 2.54–2.91 vs non-COVID-19: 1.28–1.60;U(27,64) = 143.00, P < 0.0001), poorer sleep quality (95% CI: COVID-19: 2.75–3.01 vs non-COVID-19: 1.74–2.10; U(27,64) = 258.00, P < 0.0001), and worse global PSQI score (95% CI: COVID-19: 9.97–11.25 vs non-COVID-19: 4.57–5.27; t(89) = 9.751, P < 0.0001)
Durmaz Engin et al., 2021	Turkey	360 actively working ophthalmologists. While 64% of them worked in the pandemic hospitals, 44% were actively involved in COVID-related departments.	360	Cross-secitonal study	Insomnia Severity Index	Sleep disorder (insomnia)	Symptoms of insomnia were present in 46.9% of participants. Ophthalmologists working in a pandemic hospital were more likely to experience insomnia. Higher insomnia scores in female responders (p=0.002) and in those with a chronic disease (p=0.004). Higher levels of satisfaction with the hygiene conditions in COVID and the ophthalmology clinics lower ISI scores (p=0.004)
Elghazally et al., 2021	Egypt	Sample included 2331 physicians; 1177 of whom worked in front line hospitals (group II) and the remaining 1154 physicians (group I) in other health facilities (second line). The mean age of the participants is 34.3 ± 6.1	2331	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration.	Sleep duration	In group I and group II (45.1% and 40.1% respectively) were at risk of falling or staying asleep or sleeping excessively.

		years. The majority of participants in group I and group II were in age group between 30 and 40 years (70.6% and 55%, respectively). In both groups, the majority of participants were females, married, urban dwellers, and specialists					
Elgohary et al., 2021	Egypt	270 health care workers (HCWs). The studied group age ranged from 18 to 52 years with mean 34.98 ± 6.27 years. 57% of HCWs were female. More than 72% of them had post-graduate education. Most frequent occupations among the participants were physicians and nurses (70.7% and 16.3%, respectively).	270	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration.	Sleep duration	There was a statistical significant decrease in sleep hours among HCWs with severe and extremely severe depression.
Elkholy et al., 2021	Egypt	502 HCW dealing with COVID-19 in 20 hospitals in different parts of egypt; 60.0% were physicians, 16.1% were specialized nurses, and 23.9% were non-specialized nurses. About 35.3% worked in chest hospitals, 17.5% in fever hospitals, and 47.2% in quarantine hospitals.	502	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	According to the insomnia severity scale 320 (67.7%) showed positive results; 195 (41.2%) were sub-threshold, 101 (21.4%) were moderate and 24 (5.1%) were severe. Participants with age group (31–40) were at higher risk of severe insomnia compared to those with >40 years old participants (OR, 2.79; 95% CI, 1.02–7.66; p = .01)
Hawari et al., 2021	Jordan	937 practitioners (56.1% females). Approximately 68%, 14%, and 18% were nurses/technicians,	937	Cross-sectional study	Survey items developed by the study's author including	Sleep quality	Sleep disturbances were reported (in past seven days) by approximately 29% of subjects.

		physicians, and pharmacists (respectively).			questions on sleep-related issues.		
Jahrami et al., 2021	Bahrain	A total of 257 participants (129 FLHCW and 128 NFLHCW)	280	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	The FLHCW scored higher in the PSQI and PSS compared with the NFLHCW; however, the difference in the PSQI score was not statistically significant. For the FLHCW, 75% were poor sleepers, 85% had moderate-severe stress, and 61% had both poor sleep quality and moderate-severe stress. For the NFLHCW, 76% were poor sleepers, 84% had moderate-severe stress, and 62% had both poor sleep quality and moderate-severe stress. Female sex and professional background were the predictors of poor sleep quality and stress.
Kandemir et al., 2022	Turkey	The study was performed with 194 nurses working in the intensive care units of five hospitals in Istanbul.	194	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	39.7% of the nurses experienced moderate (21.6%) or severe insomnia (18.1%).
Karabulut et al., 2021	Turkey	210 health care professionals working in ICUs were included in the study. Of the participants, 159 (75.4%) were female, and 185 (88.1%) were nurses. The mean age of the participants was 27.04 ± 5.71 years.	210	Cross-sectional study	Vısual analog sleep scale	Sleep quality	a positive relationship was found between state anxiety and sleep (r = 0.158, p = 0.022) The mean perceived visual analog sleep score was moderate and found as 503.79 ± 134.24
Khamis et al., 2020	Oman	402 female doctors and nurses recruited from several health facilities in Oman. A total of 231 (57.5%) Omanis and 171 (42.5%) non-Omanis participated in this study. Of the total 402 participants, 28.4%	402	Cross-sectional study	Sleep Quality Scale	Sleep quality	39.3% had poor sleep quality; this was particularly prevalent among Omanis. A multiple regression analysis revealed that anxiety, stress, and well-being were significant predictors of poor sleep quality.

		were physicians and 71.6% were nurses. One in four (27.9%) participants reported caring for COVID-19 patients					
Meo et al., 2021	Saudi Arabia	HCWs: 859 (51.2%) females, and 819 (48.8%) males	1678	Observational-analytical study	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality	1376 (82.0%) of the HCWs had poor sleep quality (≥5 global PSQI score). The results show that 975 (58.10%) were frontline HCWs, and 407 (23.89%) were second-line HCWs who suffered from poor sleep quality. The highest poor sleep quality levels were identified among HCWs who work in frontline areas (emergency departments, intensive care units, and wards) (642 (84.6%)), in comparison with others who work in second-line areas (734 (79.9%). 585 (85.7%) HCWs directly involved were suffering from poor sleep quality in comparison with 791 (79.5%) non-directly involved healthcare workers.
Mosheva et al., 2020	Israel	1106 Israeli physicians (564 males and 542 females) during the COVID-19 outbreak.	1106	Cross-sectional study	Survey items developed by the study's author including questions on sleeping difficulties.		Found a positive association between sleep difficulties and higher levels of anxiety among physicians. Sleeping difficulties score (1.81/5) ± 0.88
Mousavi et al., 2021	Iran	321 HCWs from major tertiary hospitals in Isfahan which were dedicated to COVID-19 patients. The mean age of participants was 33.5 years (SD: 7.65, range: 23–65). The mean of working experience in our study sample was 6.7 years (SD: 6.20, range: 1–30). In the study sample, 236 (73.8%) participants were female	321	Cross-sectional study	Insomnia Severity Index	Sleep disorders (insomnia)	The mean score of ISI was 10.3 (SD: 5.95, range: 0–25), and just 123 (38.8%) participants had normal sleep. The Pearson correlation analysis revealed that there is a statistically significant correlation between GHQ-12 and age (r: −0.12, P: 0.02), working year (r: −0.12, P: 0.03), ISI score (r: 0.56, P: 0.000), and social support score (r: −0.27, P: 0.000)

		and 156 (48.6%) of them were a nurse.					
Nashwan et al., 2021	Qatar	A total of 200 nurses participated in the study (response rate 13.3%). About 74.5% of nurses were working in COVID-19 facilities. Around 19.0%, 65.5%, and 15.5% of nurses were aged 20–30, 31–40, and above 40 years, respectively. About 59.5% and 80.0% of nurses were males and married, respectively.	200	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	In this study, there were no significant differences in sleep quality, stress, anxiety, depression, and perceived social support between nurses working in COVID-19 and non-COVID-19 facilities in Qatar
Oteir et al., 2022	Jordan	A total of 122 HCWs participated in the study (response rate=64.2%). Among the participants, 44.3% were physicians, 32.8% were nurses and 17.2% were paramedics. The mean age of participants was 32.1 (±5.8) years, and the majority were males (80.3%)	122	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	insomnia (31.9%), with increased severity of insomnia among paramedics Mean score of ISI was 11.2 (±6.4)
Sis Çelik et al., 2021	Turkey	211 nurses using a web-based online survey in Turkey (including 104 nurses working in wards where patients with COVID-19/107 nurses working in wards where patients without COVID-19). It was determined that the average age	211	Cross-sectional study	Post-Sleep Inventory	Sleep disorders	it was found that 31.8% of the Nurses involved in the study had very serious sleep problem during the COVID-19 period, and 21.3% had a moderate problem When the sleep problems experienced were compared according to the Post-Sleep Inventory, it was determined that the difference between thegroups was not statistically significant (p>0.05). There was a moderately significant and positive correlation between the nurses' mean scores for the COVID-19 Fear Scale and Post-Sleep Inventory.

		of the nurses working in wards where patients with COVID-19 are hospitalized was 29.04± 6.42. It was determined that the average age of nurses working in wards where patients without COVID-19 are admitted was 26.22±4.89					
Taş et al., 2021	Turkey	448 Family Physicians participated in the study. The average age of the participants in the study was 39.10 ± 9.59 (min 24, max 65).	448	Cross-sectional study	Survey items developed by the study's author include questions on sleep quality.	Sleep quality	While the rate of family physicians who evaluated sleep quality as very poor before the onset of the pandemic was 1.3% (n = 6), this rate increased to 13.8% during the pandemic process (n = 62). While the rate of those who reported sleep quality as poor before the pandemic was 12.7% (n = 57), this rate increased to 48.2% (n = 216) after the pandemic. While 65.4% (n = 293) of the family physicians participating in the study defined sleep quality as good before the pandemic, this rate decreased to 35.7% (n = 160) after the pandemic. While the rate of those who stated that the quality of sleep before pandemic was very good was 20.5% (n = 92), this rate decreased to 2.2% (n = 10) after the pandemic ($p < 0.001$). Thinking that personal protective measures were insufficient ($p = 0.000$) and working as a practitioner as a professional title were the most important factors affecting the deterioration of sleep quality ($p = 0.004$). Age, gender, marital status, having a child, the institution of employment, the years spent in the profession, and having contact history with Covid-19 positive cases were not effective in impairing sleep quality ($p > 0.05$). Family physicians whose workload dimension

							increased were the family physicians whose sleep quality deteriorated during the pandemic (p = 0.000).
Tasdemir Yigitoglu et al., 2021	Turkey	435 healthcare staff members. Their mean age turned out to be 36.76 ± 7.58. Slightly more than half of the participants were women (56.1%, n = 244), whereas 67.8% (n = 295) were married and 66.9% (n = 291) were parents.	435	Cross-sectional study	Pittsburg Sleep Quality Index	Sleep quality	Their mean PSQI score was 8.42 ± 2.30, and poor sleep quality was identified in an overwhelming majority of the healthcare staff (92.9%, n = 404). As for the sleep quality scores derived from the PSQI data, strong evidence was found for the within-group differences in terms of gender (female healthcare staff suffer from poorer sleep quality), parenthood (poor sleep quality in the enrolled healthcare staff with children), years of experience in the current department, health-related problems, history of mental disorders, and job satisfaction (p < 0.05)
Yilmaz et al., 2021	Turkey	Four hundred thirty-four healthcare workers participated in the study, of whom 70.7% were under 35 years of age, 65.0% were female, 60.6% were married, 64.1% were physicians, 56.7% held a master's degree or above, 73.0% worked in a hospital, 50% worked on the frontline and 36.4% had 5-10 years' working experience	278	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	The total prevalence of poor sleep quality was 56.7% The prevalence of poor sleep quality was 67.3% in nurses, 55.4% in physicians and 42.3% in dentists. Poor sleep quality was more prevalent among women, nurses, hospital workers, frontline workers, individuals with <5 years of work experience, those with low social support and individuals with increased traumatic stress levels. High levels of social support and family social support were identified as protective factors against poor sleep quality. Multivariate regression analyses showed that poor sleep quality was significantly associated with working in hospitals and high traumatic stress levels during the COVID-19 pandemic.
Yilmaz et al., 2021	Turkey	600 Healthcare workers participated in this study. 364 were females and 236 were males with a mean age of 33.49 ± 7.29 years.	600	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	Mean ISI score was significantly higher among HCWs working in COVID-19 clinics and intensive care units (p=0.000; p=0.039). Mean ISI score was significantly higher in women than men (p=0.000; p=0.000; p=0.027; p=0.005). Mean ISI scores was significantly higher among nurses (p=0.008; p=0.004).
Youssef et al., 2020	Egypt	540 healthcare professionals	540	Cross-sectional	Insomnia Severity Index	Sleep disorder (insomnia)	Just over one half of respondents (51.9%, n=280) reported sub-threshold insomnia to

		participated; their ages ranged from 20 to 70 years, with a mean of 37.3 (SD=9.2). The majority were male (54.4%, n=294), highly educated (postgraduate) (78.3%, n=423), physicians (77%, n=416), married (74.1%, n=400), had experience of five years or more (77.8%, n=420)		study			severe insomnia. The quarantine group and the non-quarantine group had an insignificant difference in adverse psychological symptoms and insomnia. Insomnia was high among those who reported experiencing stress, depression and anxiety (P<0.001).
Zarzour et al., 2021	Lebanon	A total of 628 healthcare workers completed the survey; 409 (66.2%) were younger than 40 years, and 441 (71.4%) were women. Of all participants, 503 (81.4%) were nurses, 52 (8.4%) were physicians and 63 (10.2%) were residents.	628	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	The mean (SD) scores on the PSQI for sleep quality for all respondents was 6.0 (3.7). 48.4% were “poor sleepers” as they got PSQI scores higher than 5. Participants who were aged more than 50 had lower sleep quality scores than those aged between 41 and 50 and significantly lower scores than those younger than 40 (P = 0.005 (PSQI)) Residents had significantly higher sleep disturbances scores than practical nurses (P = 0.016). Registered nurses compared to physicians and practical nurses had significantly higher sleep quality scores (P < 0.001) Participants who reported having relatives or friends who got infected or quarantined had higher sleep disturbances scores than those who had not (P = 0.019 for PSQI). Participants who were exposed to COVID-19 related media for more than 2 hours per day, had poorer sleep quality (P = 0.011) than those who were exposed to media less than 2 hours per day and to those who were not exposed at all. Greater number of stress sources was positively correlated to higher sleep disturbances (r = 0.129, P

							= 0.001, respectively) Participants were asked whether they were still able to practice the strategies they normally use to deal with stress. Those who were still able to do it (60.4%) had lower anxiety and significantly lower sleep disturbances scores than those who were not (P = 0.096 for STAI and P = 0.011 for PSQI).

Students							
Reference	Location of Study	Population	Sample Size	Study Design	Sleep Health Measurement Tool	Sleep Health Domains	Main Findings
Al Mukhaini et al.,	Oman	376 Omani students who had returned to Oman from abroad due to the COVID19 pandemic. 255 male (67.8%) and 121 female (32.2%) participants. The mean age of the participants was 21.7 years old (SD = 3.8), ranging from 18 to 45 years old.	376	Cross-sectional study	Athens insomnia scale	Sleep problems (insomnia scale)	49.5% (n = 186) noted to be suffering from insomnia Female students were 2.4 times (OR = 2.43; CI: 1.50–3.93; P< .001) more likely to be insomniac compared to male students The risk of insomnia may be less in the subjects going for a walk (OR = 0.29; CI: 0.12–0.69; P = 0.008)
Ali et al., 2021	Lebanon	510 secondary level school students from grades 9–12 participated in this online survey. Among these, 382 (74.9%) were females, and there was no significant difference in age between male and female students.	510	Cross-sectional study	Insomnia Severity Index Bedtime Procrastination Scale	Sleep disorder (Insomnia, bedtime procrastination)	Screen time of more than seven hours per day was significantly associated with insomnia (82%), and bedtime procrastination.

Alrashed et al., 2021	Saudi Arabia	Total number of participants was 453 from 3rd to 5th medical year, and intern medical students.	453	Cross-sectional study	Insomnia Severity Index	Sleep problems (insomnia)	162 (34.9%) of the participants had insomnia symptoms, among them 57.4% of females and 42.6% of males have insomnia. Participants with an age group between 22 and 25 have more sleep issues (43.2%) as compared to other age groups. 3rd-year students have more insomnia 36.41% as compared to other years. The age group 30 and above have a high prevalence of insomnia (OR = 1.67; P = 0.26), followed by the age group 26–29 (OR = 1.40; P = 0.19) Those who have a severe level of stress have ~3 times higher prevalence of insomnia (OR = 2.81; P = 0.0008), followed by a moderate level of stress (OR = 1.50; P = 0.15) Those who were involved in religious practices have less sleep problems. Similarly, those who have mentally accepted the current COVID situation also have less sleep problems (P = 0.0001) as compared to those who did not accept the current situation.
Alshammari et al., 2021	Saudi Arabia	186 replies were received from professional pharmacy students . Female students accounted for 64.5 percent of the total, which is in line with their general ratio in the Pharm.D. Program. The second professional year had the most participants (25.8%), while the sixth professional year had the least (7.0%)	186	Cross-sectional study	Survey items developed by the study's author including questions on sleep quality.	Sleep quality	"Discovered that practically all students were plagued by symptoms of sadness, anxiety, tension, and poor sleep quality"
Alyoubi et al., 2021	Saudi Arabia	A total of 582 undergraduate students. 73% were female and 25% were male. The majority (78%) of undergraduate students	582	Cross-sectional study	Insomnia Severity Index	Sleep duration Sleep quality Sleep disorder (insomnia)	Over one-third of students reported that sleep had been impacted and worsened during the pandemic. 22% having trouble falling asleep, 17.9% waking up during the night, 8.8% waking up early in the morning, 25.9% have poor sleep quality, 22.7% feeling tired during the day, 9.3% have nightmares

		were enrolled at the King Abdulaziz University and 16% were studying at Jeddah University in Saudi Arabia.					and 5.2% have poor dreams This study showed that over half of students reported sleep disruption and 1.4% were taking melatonin supplements for the sleep problem. A small percentage (4.3%) had very mild sleep problem, while 16% reported a mild sleep problem, 21.8% moderate, 9.3% severe, and 1.2% very severe. There was no significant difference between older and younger students on the level of insomnia. Students reported a statistically high level of insomnia with a high level of depression, anxiety, perceived stress ($p < 0.001$). Undergraduate students reported statistically more insomnia symptoms with a lower level of psychological resilience ($r = -0.150$, $p < 0.001$). The level of insomnia was slightly higher for students who self-isolated Students who received support from mental health services but had it stopped and offered online and declined before COVID-19 reported a significantly higher level of insomnia $F (5, 555) = 2.768$, $p = 0.018$).
Bosi Bağcı et al., 2021	Turkey	340 interns accounting for 63·4 % of the target population completed the online questionnaire. Almost 60 % of the participants were composed of females and the mean age was 24·89	340	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	Sleep quality during the COVID-19 compared to the pre-COVID-19 period was assessed and it was found that only 27·8 % of the interns observed no change in sleep quality. However, 38.6 % of the interns experienced an improvement and 33.6 % had a reduction in sleep quality. Then, the sleep quality of interns was evaluated with PSQI and 53·4 % of the students were found to have poor sleep quality during the COVID-19 period. The effect of gender on sleep quality was also evaluated and even though female students had a predilection towards poor sleep quality, there was no significant difference between genders (P = 0·075)
Cakmak et al., 2022	Turkey	564 students The mean age of the participants was 28.13 ± 0.49 years (min: 18 / max: 90). While 71.1% of the participants were	564	Cross-sectional study	Bergen Insomnia Scale	Sleep disorder (insomnia)	The results revealed that 64.7% of the participants had insomnia. he findings suggest that there was no statistically significant difference between insomnia and age, educational attainment, smoking status, and who the participants lived during the quarantine ($p>0.05$).

		female, 66.5% were single. It was found that 66.3% of the individuals were university students, and 82.8% did not have any chronic diseases.					Those who used a phone or tablet before sleeping (p = 0.020) were found to have significantly higher levels of insomnia than others. The mean days of uninterrupted home quarantine was higher for participants experiencing insomnia.
Dalcalı et al., 2021	Turkey	mean age of students was 20.39 ± 2.05 years and 82% (n = 232) were female, and 33.6% (n = 95) were first-year students	283	Descriptive, correlational	Verran and Snyder–Halpern sleep scale (VAS)	sleep disturbance, effective sleep, daytime sleep	Before COVID-19, 21.20% reported that their night sleep was interrupted, while during the COVID-19 period, this rate increased to 28.26% and this increase was considered to be statistically significant. There was a high-level positive significant correlation between students' sleep quality and state anxiety (r: 0.305, p: 0.000**) and trait anxiety (r: 0.288; p: 0.000)
Elakany et al., 2022	Global	3793 (22.3%) of students. 61.7% females and the mean age was 31.0 years (SD = 8.9)	17,008	Cross-sectional study	Online survey	changes in sleep pattern (sleeping more, less, or no changes)	4,889 people (28.7%) reported change in sleep patterns. Compared to non-students, students had significantly higher odds of reporting changes in sleep (AOR = 1.52; 95% CI: 1.39, 1.67). Participants from LICs and LMICs had lower odds of reporting changes in sleep (AOR = 0.74; 95% CI: 0.58, 0.94 and AOR = 0.67; 95% CI: 0.61, 0.72). participants from UMICs, had significantly higher odds of reporting changes in sleep (AOR = 1.26; 95% 1.15, 1.39)
Elsalem et al., 2020	Jordan	1019 students from Jordan University of Science and Technology agreed to participate in the study and completed the survey. Approximately, half of the participants were from Faculty of Medicine (51.32%), while the other half in descending order were students from Faculties of Nursing, Dentistry, Pharmacy and Applied Medical Sciences. Almost two-	1019	Cross-sectional study	Survey items developed by the study's author include questions on sleep duration and sleep disorder.	Sleep duration. Sleep disorder (insomnia)	Student's experience of stress during exams was also found to be significantly associated with changes in sleeping hours. Among students who reported more stress with remote E-exams, 44.15% had reduction in their sleeping hours and 28.65% reported more consumption of medications to relief insomnia. Caffeine was mainly consumed to keep students more alert for exam preparation and was linked to loss of sleep during exams days

		thirds of the respondents (65.55%) were females.					
Göl et al., 2021	Turkey	2630 nursing students. The mean age of students participating in the study was 21.30 ± 1.95 SD. The majority of them (82.1%) were female students and 11.4% had a chronic disease.	2630	Cross-sectional study	GHQ-12	Sleep disorder (sleep pattern)	Change in sleep pattern 62.9% (= 0.629)
Goweda et al., 2020	Saudi Arabia	438 medical students were recruited from the second year to the sixth year among Umm Al-Qura University Faculty of Medicine. Half (50.5%) were female, nearly all (422, 96.3%) had a single marital status, and a minority (55,12.6%) had chronic disease.	438	Cross-sectional study	Sleep-50 questionnaire	Sleep disorders (narcolepsy, insomnia, CRD)	323 (73.7%) of the participants complained of at least one sleep disorder. The most prevalent sleep disorder was Narcolepsy (NL) with 226 (51.6%), followed by 138 (31.5%) with insomnia, and 98 (22.4%) indicating Circadian Rhythm sleep Disorder (CRD) 87 (19.9%) of respondents positive for at least two combined sleep disorders, and 63 (14.4%) demonstrating three combined sleep disorders. In the time students spent watching television and/or on smartphones, there was significant difference in students with sleep disorders (m=6.71 hours, SD=3.83) and those without (m=5.90 hours, SD=3.40) (p=0.004) Significant relationship between gender and sleep disorder, with females more affected at 178 (80.5%) than males at 145 (66.8%) (p=0.001)
Grande et al., 2021	Saudi Arabia	152 nursing intern students were involved in this study. Among them, 73% are in the age of 20 years and below, while 23.7% are between 31 and 40 years of age, and 3.3% fall within the age range of 21–30 years old. In terms of gender,	152	Cross-sectional study	Quality of Life Evaluation Scale	Sleep quality	Sleep satisfaction score 1.99/5.00

		53.9% are males, and 46.1% are females.					
Jalal et al., 2021	Saudi Arabia	628 students studying bachelor's degree programs, between 18 and 30 years of age. 70.9% were female	628	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	Approximately, 188 (29.9%) students felt that sleep quality was good before lockdown, and 126 (20.1%) students felt the same during the lockdown. Moreover, the total sleeping time increased from 6.6 ± 2.3 hours per day to 8.3 ± 2.7 hours per day, which was also proved statistically significant (p = 0.001).
Joseph et al., 2022	Israel	533 undergraduate students of education submitted an online questionnaire before the lockdown and at its end.	533	Prospective cohort	Mini Sleep Questionnaire	Sleep quality	Levels of sleep quality (mean 5.34 [SD 0.92] vs mean 5.12 [SD 0.46], P=.02) and well-being (mean 3.79 [SD 0.62] vs mean 3.67 [SD 0.59], P=.02) were higher during the COVID-19 lockdown. These findings indicate that undergraduate students seem to have taken advantage of the change in lifestyle due to the lockdown, directing the free time toward improving health by engaging in more physical activity, thus improving sleep quality and well-being.
Kheirallah et al., 2021	Jordan	1,404 students participated in the current study. About two-thirds (59.9%) of participants were females, 64.9% were enrolled at the two well-established medical schools at the University of Jordan (39.1%) and Jordan University of Science and Technology (JUST) (25.8%), and 59.6% were in the pre-clinical stage of their medical education.	1404	Cross-sectional study	Survey items developed by the study's author including questions on sleep disorders.	Sleep disorder (insomnia, nightmares)	About 13% of students self-reported experiencing increased insomnia, shallow sleep, nightmares, or insufficient sleep. In general, females self-reported experiencing significantly more sleeping problems than males. Likewise, students in the pre-clinical years experienced sleep problems (insomnia, shallow sleep, and insufficient sleep) significantly more frequently than those in their clinical years.
Meo et al., 2022	Saudia Arabia	The total number of medical and science students included was 782, out of whom 410 (52.4%) were medical	782	Cross-sectional Study	Pittsburgh Sleep Quality Index,	Sleep quality Sleep duration	Out of 782 participants, 669 (85.55%) had poor sleep quality (≥5 Global PSQI score), while only 113 students had good sleep quality (<5 Global PSQI score). Out of 410 medical students, 336 (81.95%) had poor sleep quality, and 74

		students, and 372 (47.6%) were science students, including Physics, Chemistry, Mathematics, Statistics, Botany, and Zoology. Among medical students, 143 (34.9%) were in pre-clinical years (1st and 2nd), while 266 (64.9%) of them were in clinical years 3rd, 4th, and 5th-year medical students. Female students were 65.3% of the sample.					(18.05%) had good sleep quality. While out of 372 science students, 333 (89.5%) had poor sleep quality, and 39 (10.5%) had good sleep quality. Overall, it was seen that the sleep quality of science students was poorer (Mean Global PSQI score= 8.78) than their medical counterparts (mean Global PSQI score= 7.93) Sleep quality, sleep duration, and daytime dysfunction were poorer among pre-clinical students than clinical students Out of the selected cases with poor sleep quality (≥5 PSQI score), 32.1% were males, and 67.9% were females. It was found that sleep disturbance and daytime dysfunction were poorer in students with higher BMI ranges
Nakhostin-Ansari et al., 2020	Iran	323 medical students have completed the questionnaire (response rate = 64.6%); 37.2% of them were clerks and 62.8% interns. The mean age of participants was 23.73 (SD = 1.62), and 47.7% of them were male and 52.3% female.	323	Cross-sectional study	Survey items developed by the study's author including questions on sleep patterns.	Sleep disorder (sleep pattern changes)	Changes in sleep pattern (74.3%)
Saadeh et al., 2021	Jordan	6,157 undergraduate students (mean age 19.79 ± 1.67 years, males 28.7%) from the University of Jordan	6157	Cross-sectional study	Pittsburgh Sleep Quality Index,	Sleep quality	The sleep quality of three-quarters of the participants was negatively affected by the extended quarantine. Nearly half of the participants reported poor sleep quality. The prevalence of poor sleep quality among participants was 76% (males: 71.5% and females: 77.8%).
Sarsak et al., 2022	Saudi Arabia	A total of 244 students completed the survey (60.7% were female). The mean age was 22.10±2.69	244	Cross-sectional study	Survey items developed by the study's author include questions on	Sleep quality	34.5% (n=84) reported sleeping late and waking up more frequently.

					sleep disturbances.		
Torun et al., 2020	Turkey	275 students. About 60.7% of the participants (n = 167) were female, 39.3% (n = 108) were male and the mean age was 22.10 ± 2.69.	275	Cross-sectional study	Survey items developed by the study's author include questions on sleep duration and sleep quality.	Sleep quality	After the COVID-19 pandemic, the sleep patterns of the participants changed as 29.5% (n = 81) asleep late, wake up frequently and can not fall asleep.

Children							
Reference	**Location of Study**	**Population**	**Sample Size**	**Study Design**	**Sleep Health Measurement Tool**	**Sleep Health Domains**	**Main Findings**
Alanazi et al., 2022	Saudi Arabia	A total of 1021 parents completed the survey, of which 78.8% were Saudis. Fifty-five per cent of respondents were mothers with an average age of 41 (±9.2) years. The mean age of the children was 8.5 (±1.85) years. Sixty per cent of the study sample were girls.	1021	Cross-sectional study	Survey items developed by the study's author including questions on sleeping duration and sleep quality.	Sleep duration Sleep quality	Slightly more than half the children met the sleep recommendations (95% CI 52.9, 60.9) Sleep quality was reasonably high (average of 5.4 [2.26] points out of 7.0) Weak negative correlation between parent education level and the quality of their child's sleep (r = −0.11, p < 0.0001)
Almhizai et al., 2021	Saudi Arabia	Questionnaire was completed by 1141 respondents. Of these, 454 were < 18 years old (360 were aged 16 - 18 years old, and 94 were < 15 years old). Thus, these respondents	1141	Cross-sectional study	Survey items developed by the study's author including questions on sleep quality and sleep duration.	Sleep quality Sleep duration	Higher age was associated with higher increase in the frequency of waking up (r = 0.076, P < 0.05), sleeping little (r = 0.058, P < 0.05) Having relatives who were infected with COVID-19 was associated with sleeping little (r = 0.074, P < 0.01) Children whose parents were divorced had higher scores on sleep disorders.

		completed the questionnaire on behalf of themselves. The remaining 688 respondents were adults and completed the questionnaire on behalf of their children. Male and female children represented 42.5% and 57.5% of the study sample.					
Almugti et al., 2021	Saudi Arabia	651 participants in total; slightly over half (58%) were female. The respondents answered questions related to their children. These items showed that the mean age of their children was 9±4 years, the majority of the children were living in apartments (63.9%), and that 89% of the children were living with both their father and mother.	651	Cross-sectional study	Survey items developed from a similar study on Arab Israeli children including questions on sleep quality and sleep duration.	Sleep duration Sleep quality	During the COVID-19 outbreak, one-third of children had asked to sleep in their parents' beds. Study reports reduced sleep time among children compared with the pre-pandemic period.
Al-Rahamneh et al., 2021	Jordan	Data collected from 1309 parents (mothers = 1219 (93.1%); fathers = 90 (6.9%) children (n = 1309 male = 716 (54.7%) and female = 593 (45.3%)), they were between 5–11 years of age (8.1 ± 2.02 years) and most of them were studying at private schools (92.7%).	1309	Cross-sectional study	Children's emotional and behavioral symptoms questionnaire	Sleep duration	42.5% of children had 8 h or less of sleep per night, which is considered as a short sleeping duration.
Bucak et	Adıyaman,	Group 1 (school age	372	Comparati	Children's Sleep	Child's sleep	Total CSHQ scores were 41.57 ± 7.57 (20–60) in

al.,2021	Turkey	children of health worker parents): 122 participants, 66 (54.1%) females and 56 (45.9%) males Group 2 (school age children of non-health worker parents): 250 participants, 129 (51.6%) females and 121 (48.4%) males		ve study	Habits Questionnaire (CSQH)	habits and sleep-related problems. 8 subscales included*: bedtime resistance, sleep onset delay, sleep duration, sleep anxiety, night wakings, parasomnias, sleep disordered breathing, and daytime somnolence.	Group 1 and 39.6 ± 8.47 (17–68) in Group 2 (p:0.03)
Cahal et al., 2021	Israel	Mean (±SD) age of patients was 6.2 years (4.7) with a range of 0–18 years. 276 (62%) males and 169 (38%) females 368 (82%) had a single respiratory disorder, the most common of which were asthma (n=291, 65%), recurrent pneumonia (n=96, 21.5%), bronchopulmonary dysplasia (BPD; n=32, 7.2%)	445	Cross-sectional study	Anonymous electronic questionnaire	Secondary outcomes related to patients' lifestyles	During the lockdown, Sleep duration increased in 59 patients (13.4%), decreased in 227 patients (51.1%) and remained unchanged in 155 patients (35.1%). Older patients experienced increased screen time, decreased physical activity, and shorter sleep duration (p = .008, <.001, and <.001, respectively) compared to their younger counterparts
El Refay et al., 2021	Egypt	765 responses were received from children and adolescents aged 4–16 years. 408 children (53.3%) were males and 357 participants (46.7%) were females. More than half of the participants	765	Cross-sectional study	Sleep Disturbance Scale for Children score.	Sleep quality Sleep disorder	The overall mean Sleep Disturbance Scale for Children score (SDSC) in participated groups was 44.6 ± 11.72 suggesting a widespread stressful impact of the lockdown Only 25 (3.2%) of participants had an (SDSC) over 70 which indicate acute severe sleep disorder 502 (65.6%) showed the symptoms suggestive of sleep disorder.

		407 (53.2%) were enrolled in primary schools.					Disorders of initiating and maintaining sleep were the most common among participants as 168 (33.4%) of them were suffering from it while 79 (15.7%) children were suffering from excessive somnolence. Significant positive correlations were found between SDSC and extra screen usage, understanding safety and quarantine measures, anxiety signs, and change in child lifestyle with (p = 0.029, 0.010, 0.001 and 0.001) sequentially Significant positive correlation was found between family income affection and sleep disorder score (p =0.04)
Ghanamah et al., 2021	Israel	382 parents answered a survery about their children. 51% of the children were males, the most representative grade was the first grade (21.2%), 11.8% of the children were detected in COVID-19 and 43.5% of the children were asked to be in isolation since they had been exposed to COVID-19 diagnosed person	382	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration and sleep quality.	Sleep duration Sleep quality	55.8% of the children, who before the pandemic outbreak used to sleep alone in their own bedroom, asked the parents to sleep in their parents' bed during the outbreak period. 41.4% showed sleep difficulties. (more in kindergarteners than in pre-kindergarteners) More hours spent in sleep through the outbreak compared to before the outbreak If the child was in isolation, those children asked their parents to sleep beside them more than the children who were not asked to be in isolation. In the families with diagnosed Coronavirus, the children asked to sleep beside the parents more than in families with no diagnosed member
Kaditis et al., 2021	Global	45.8% female; ages 3–17 years	845	Longitudinal study	Online survey	Change in bedtime, change in wake time, and change in sleep duration	As a result of the observed shift in bedtime and wake time, the median sleep duration score on weekdays increased significantly during the pandemic compared to before (p < .001), while there was no significant change during the weekend (p = .51). More children had an increase in sleep duration on weekdays than a decrease, whereas similar proportions of children had an increase or a decrease on weekends. Increase in sleep duration during the pandemic was most apparent in the 14–17 years age group during weekdays, while a

							decrease in sleep duration was most prominent in 3- to 5-year-old children during both weekdays and weekends. Sleep duration did not change in 43% of participants on weekdays and 46.2% on weekends. Children aged 14–17 years were the least likely to have unchanged sleep duration on weekdays (28.4%).
Kamaleddine et al., 2022	Lebanon	383 children whose parents agreed to use the responses for this study were finally included. The proportion of boys and girls was even.	383	Cross-sectional study	Children Sleep Habit Questionnaire	Sleep quality	Observed that children with screen time ≥2 h had sleep problems.
Mekkawy et al., 2022	Egypt	Participants in this study (n=672) were divided according to age into 4 main categories, 6–9 years (21.7%), 9–12 years (24.4%), 12–15 years (30.1%) and 15–18 years (23.8%). Males represented 48.2% and females 51.8%	672	Cross-sectional study	BEARS sleep screening tool	Sleep duration Sleep quality Sleep disorders	50% reported increase in their sleeping habit, 31.8% reported no change while 45.2% stated no sleeping problems, 19% had a difficulty to fall asleep, 16.1% had a problem waking up during sleep, 11.9% had a problem waking up feeling tired, & 7.7% had a problem sleeping too much . When comparing the sleep habits pre COVID-19 with the lockdown, results had shown significant decrease in the % of sleeping less than 7 hours from 41.4% to 5.4%, while there was significant increase in the % of sleeping more than 10 hours from 4.8% to 49.7% (p<0.001). On the other hand, the energy level status of being energized significantly decreased from 55.4% to 7.7%, and significantly increased in the lazy state from 3.6% to 54.8% (p<0.001)
Ranjbar et al., 2021	Iran	20697 filled questionnaires were received from the participants with an average age of 13.76 ± 2.50 which included 6139 (29.7%) male and 14558 (70.3%) females. Among the participants, 16672 (80.6%) were from urban areas	20697	Cross-sectional study	Survey items developed by the study's author include questions on sleep duration and sleep pattern.	Sleep duration Sleep disorder (sleep pattern changes)	2782 (13.4%) students had 5 or fewer hours of sleep, 2689 (13%) had 6 to 8 h, 2655 (12.8%) had 9 to 10 h, 1506 (7.3%) had 11 to 12 h, and 11065 (53.5%) had above 12 h of sleep throughout the day. The majority (8934: 43.2%) of students went to bed between 23 and 24 P.M. while the majority (11585: 56%) woke up at 8 A.M.

		and 4025 (19.4%) from rural areas.					
Ustuner Top et al., 2022	Turkey	Of the 1040 children, 528 (50.8%) males and 512 (49.2%) females were included in the analyses. The mean age of the children was 9.16 ± 2.05, and 80.3% were aged between 9 and 12 years.	1040	Cross-sectional study	The Children's Sleep Habits Questionnaire	Sleep quality Sleep duration Sleep disorder	The prevalence of sleep disturbances among 6–12-year-old children during the COVID-19 pandemic in Turkey was 55.5%. Sleep disturbances were found to be significantly associated with 6–8 years of age, and poor family relationships ($p < 0.05$). The most common sleep disturbances were bedtime resistance (51.9%), sleep onset delay (61.4%), and sleep duration (90.2%). The children's ages, family relationships, and eating habits were linked to their sleep disturbances. Moreover, their results indicated that sleep disturbances were more common in the children of parents who felt helpless, apprehensive, and frightened during the COVID-19 pandemic.
Zengin et al., 2021	Turkey	309 children. The average age of the children in the study was 10.3 ± 1.2; 52.1% of participants were male.	309	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration and sleep quality.	Sleep duration Sleep quality	Children stated that due to the pandemic they experienced changes in terms of sleep (61.5%; n = 190) Some of the children in the present study stated that their sleeping habits have become irregular, and the majority of them had reduced their time for social activity. These findings are similar to our results.
Zreik et al., 2021	Israel	Mothers of 264 children (120 boys), with a mean (SD, range) age of 31.27 (17.39, 6–72) months, participated in the study: 100 of the mothers were Arab and 141 were Jewish. Approximately 38% of the infants were firstborns, and families had a mean (SD) of 2.15 (0.95) children. The mean (SD) age of the mothers	264	Cross-sectional study	Insomnia Severity Index Brief Infant/Child Sleep Questionnaire	Sleep disorder (insomnia) Sleep quality Sleep duration	The majority of mothers reported no change in their child's sleep quality, duration, and sleeping arrangement. However, about 30% reported a negative change in child's sleep quality and a decrease in sleep duration, and there were also mothers who reported a positive change. 60% of the mothers reported a negative change in their sleep quality. In all, 23% of mothers scored above the clinical cut-off for insomnia (ISI score of >15) during the COVID-19 crisis, compared to only 11% who reported (retrospectively) having clinical insomnia before the COVID-19 crisis ($\chi 2$ (1) = 5.36,

		was 33.97 (4.20) years.					p = .02). The current maternal ISI score was positively correlated with child's sleep latency, number of night awakenings, and wake after sleep onset, and was negatively correlated with sleep duration. Maternal acute COVID-19 anxiety was positively correlated with the child's number of night awakenings, and negatively correlated with the child's sleep duration. When examining the correlations between the current maternal ISI score and child's sleep variables with maternal acute COVID-19 anxiety as a covariate, the correlations with child's sleep variables, number of night awakenings and WASO, remained significant (r = .26, p = .001 and r = .31, p < .001, respectively), while the correlations with child's sleep latency and sleep duration were no longer significant. The correlation between maternal acute COVID-19 anxiety and the current maternal ISI score was significant (r = .38, p < .001) and remained significant after controlling for the child's sleep duration, number of night awakenings, and WASO (r = .40, p < .001) The change in child's sleep quality was associated with the change in ISI score of the mother (r s = −.33, p < .001), so that mothers who reported that their child's sleep improved during the COVID-19 crisis, were more likely to report a decrease in their own insomnia symptoms during the crisis. Mothers who reported that their child's sleep had negatively changed had higher levels of anxiety traits, compared to mothers who reported no change in their child's sleep.
Patients With Chronic Illnesses							

Reference	Location of Study	Population	Sample Size	Study Design	Sleep Health Measurement Tool	Sleep Health Domains	Main Findings
Alkhotani et al., 2020	Saudi Arabia	A total of 156 patients with epilepsy completed the questionnaire. Sixty-two percent of our responders were female patients, 99% were living with family, 38% had generalized seizures, 47% were on single medications, and 48.1% had been seizure-free for the past three months prior to the start of the pandemic	156	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration and sleep quality.	Sleep duration Sleep quality	(71.2%) experienced a significant change in their sleep. Most frequent change in sleep was a reversal of the sleep pattern in 58% of the respondents (sleep after sunrise), followed by more sleep than usual in 9.6%, less sleep in 2.6%, and intermittent sleep in 0.6%.
Athamneh et al., 2021	Jordan	506 (90.03%) neurology patients responded to the questionnaire. Patients under 40 years of age constituted over half the sample. Men constituted 45.45% of the sample.	506	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration.	Sleep quality Sleep disorder (Sleep pattern changes)	Sleep disturbances were reported by nearly one in three patients who had epilepsy or headache, and the majority ascribed these disturbances to the impact of the pandemic Changes in sleep patterns were reported by 37.50% of patients with tension/migraine headaches, and 50.00% blamed these changes to the impact of the pandemic.
Çolak et al., 2021	Turkey	Pregnant women mean age 30.17 ± 5.47 years	149	Cross-sectional study	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality	The depression, anxiety, and defective sleep quality levels of the participants who were previously in the home quarantine were statistically significantly higher ($p < 0.001$, $p < 0.001$, $p < 0.001$, respectively).
Güç et al., 2022	Turkey	Of the 761 cancer patients, 480 (63.1%) are female and 281 (36.9%) are male. At the time of the study, their median age was 57.65 years (range, 20–90).	761	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	Mean scores of the 761 participants PSQI, 5.67 ± 4.24 (range, 0–19). Quality of sleep was found bad in 447 (58.7%) (global score ≥5). Multivariate analyses showed active treatment (OR: 21.4; 95% CI: 9.08–50.4; $p < 0.001$) as the major independent variable that affected sleep quality
Karatel et al., 2022	Turkey	The study includes 1,778 responses of 1,131	1778	Cross-sectional	Pittsburgh Sleep Quality Index	Sleep quality	The PSQI-total had shown a weak correlation with pain levels in all body parts.

		(63.6%) women and 647 (36.4%) men. Mean age was 28.3 ± 10.7 years with musculoskeletal pain		study			The highest correlation for sleep quality and pain levels was between the PSQI-5 and lower back pain. There was a weak correlation between PSQI-2 and the BDI score, and a moderate correlation between the PSQI-1, PSQI-5, PSQI-7, PSQI-total, and BDI score.
Keskin et al., 2022	Turkey	356 pregnant women were enrolled and completed the survey	356	Cross-sectional study	The Epworth sleepiness scale	Sleep disorder (sleepiness)	Mild sleepiness was found in 88.2% and severe sleepiness in 11.8% of the pregnant women
San et al., 2021	Turkey	145 patients who underwent a spine intervention within the past year were included in this study, there were 96 women (66%) and 49 men (34%), with a mean age of 54.78 ± 1.08 years.	145	Cross-sectional study	Survey items developed by the study's author include questions on sleep habits.	Sleep quality	24 patients always had sleep disturbance, 30 patients often had sleep disturbance, 37 patients sometimes had sleep disturbance, 9 patients rarely had sleep disturbance, and 45 patients had no sleep disturbance
Seyahi et al., 2020	Turkey	Studied in total 771 (245 M/ 526 F) patients with Rheumatic disease (Group 1), 535 (181 M/ 354 F) hospital workers (Group 2) and 917 (258 M/ 659 F) teachers/academic staff (Group 3)	2223	Cross-sectional study	Survey items developed by the study's author include questions on sleep problems.	Sleep disorder	The frequency of sleep problems in patients with RD was significantly higher than that of the teachers/academic staff, but then again, significantly lower than that reported in the hospital workers.
Yeni et al., 2022	Turkey	89 PwMS (people with multiple sclerosis) and 262 healthy controls. Mean age of PwMS was 41.08 (±10.2) years; 62% were female. Mean age of the control group was 38.08 (±11.4) and 51.5% were female	351	Cross-sectional	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality	Healthy controls (HC): Compared to pre-pandemic period, the mean PSQI score was determined to increase indicating impaired sleep quality ($p<0.001$) Sleep quality of the patients was seen to be impaired during the pandemic ($p<0.05$) Multiple regression analysis demonstrated that the anxiety, depression, and the sleep problems were predictors of both the physical health ($p<0.001$) and mental health ($p<0.001$)

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The Effects of the COVID-19 Pandemic on Sleep Health Among Middle Eastern and North African (MENA) Populations: A Systematic Review of the Literature

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Abstract

Objectives: This study sought to conduct a systematic review of the literature on the impact of the COVID-19 pandemic on sleep health among Middle Eastern and North African (MENA) populations, understudied geographic regions including with regards to sleep health.

Setting: A systematic literature search of studies published from inception to March 27th 2022 was conducted on multiple databases using developed keywords

Participants: Studies were included if they (1) investigated one or more aspects/dimensions of sleep health as an outcome (e.g., sleep duration, sleep quality, sleep problems); (2) measured the impact of a COVID-19 pandemic-related domain (e.g., impact of quarantine, work from home, lifestyle changes, etc.); (3) focused on at least one MENA region population; (4) were peer reviewed; (5) included >=100 participants; (6) were written in English; (7) had full-text article publicly available.

Primary and secondary outcomes measured: Primary outcomes were sleep duration, sleep quality and sleep problems

Results: In line with PRISMA guidelines, 164 studies were included for data extraction. The Newcastle-Ottawa (NOS) scale for cross-sectional studies was used to assess the quality of the studies. Overall, the COVID-19 pandemic significantly impacted sleep duration, sleep quality, and presence and severity of sleep disorders in MENA populations, including adults, children, students, healthcare workers, and people with chronic illnesses. The directionality and strength of associations, as well as the determinants of sleep health, varied by sub-populations.

Conclusions: Longitudinal studies are needed to understand the longer-term impact of the COVID pandemic on the sleep health of MENA populations. Sleep health interventions and policy measures should be tailored to the need of each sub-population.

Trial registration number: PROSPERO registration number: CRD42022321128.

Keywords: COVID-19, Sleep Health, Middle East, Health behaviors, Pandemic

Introduction

The COVID-19 pandemic, which was announced as a Public Health Emergency of International Concern on 30 January 2020, and a pandemic on 11 March 2020, continues to affect people's lives around the globe. Given the nature of transmission of the SARS-CoV-2 virus, in addition to lack of medication or vaccines in the early response of the pandemic, many of the public health interventions to prevent the transmission focused on physical distancing. Such measures included quarantine and lock-down orders. In turn, this affected people's ability to do many social and physical activities, hence significantly impacting people's 24-h behavioral patterns. Further, pandemic-related stress also contributed to abrupt changes in lifestyle behaviors.[1, 2] For instance, Park et al., reported that COVID-19 has had a negative impact on healthy and active lifestyles, as well as mental health and quality of life, among a sample of adults in South Korea.[3]

Research in the literature is demonstrating that among the many health outcomes and health behaviors that may be affected by the pandemic is sleep health.[4-8] Prior studies among various populations have shown that the pandemic affected a variety of sleep health domains, including sleep quality,[9-11] sleep duration,[12, 13] and sleep disorders.[14, 15] For instance, in a longitudinal study in Spain, Martínez-de-Quel reported that perceived sleep problems significantly increased following the onset of the pandemic.[16] Similarly, among 400 students and university administration staff workers in Italy, the prevalence of insomnia increased from 24% prior to the pandemic to 40% during the pandemic. Similarly, difficulties in sleep initiation among the same sample increased from 15% to 42% from before to during the pandemic.[17] A systematic review conducted in July 2020 showed that the prevalence of sleep problems during the COVID-19 pandemic is high and affects approximately 40% of people from the general and health care populations.[18] In addition to the observed trend in sleep health outcomes, the pandemic may have exacerbated a number of stressors that can directly increase poor sleep health. For instance, research among several global populations has shown an increase in intimate partner violence (IPV) due to lockdown measures, as well as economic and psychological stress brough about by the pandemic.[19-21] In turn, IPV has been linked with poor sleep quality and sleep disturbances among different populations.[22, 23]

Among Middle Eastern and North African (MENA) populations, the burden of non-communicable diseases has drastically increased from 1990 to 2010.[24] The epidemiological profile of Middle Eastern countries closely resembles that of countries in western Europe, the USA, and Canada, with health loss from most non-communicable diseases, such as CVD and cancer, increasing over the past 20 years.[24] However, Middle Eastern populations are faced with multiple challenges when attempting to deal with such an epidemiological profile. Indeed, political turmoil, conflict, and corruption within states have led to challenges in implementing policies and laws, as well as adhering to them on a population-level.[25] Additionally, while Middle Eastern populations are facing an epidemiological challenge similar to that of the developed world, they continue to be understudied in public health research including sleep health research. In part, this is due to Arab countries having weak health information systems,[26, 27] which limits data availability and produces major challenges for sound research and evidence-based policy making.

In addition, MENA countries epidemiological profile is characterized by high burden of psychosocial problems, including depression and anxiety.[24] Noncommunicable diseases and psychosocial problems, among other health outcomes, are consistently associated with sleep health.[28-32] Consequently, this exacerbation in poor sleep health that may be brought about by the pandemic can increase the risk of other undesirable health outcomes among populations. This issue is of increased urgency in areas with underdeveloped health research infrastructure where there continues to be lack of full understanding of the health of the population, as is the case in the MENA region.

Given the evident impact the pandemic had on sleep health worldwide, as well as the well-documented association between sleep health and the leading causes of morbidity and mortality, it is important to understand this association among Middle Eastern populations. This systematic review sought to investigate the association between COVID-19 induced national lockdowns and different domains of sleep health among MENA populations. To the best of our knowledge, this is the first systematic review investigating sleep health among Middle Eastern populations in the context of COVID-19. Additionally, and while there are several reviews examining sleep health domains in developed countries,[33, 34] there continues to be a lack of reviews studying sleep health in MENA countries, which collectively represent ~600 million of the word population. In fact, this systematic review would be the first to summarize the literature on the sleep health of MENA populations, filling an important gap in the literature.

Methods

A systematic literature search was performed in accordance with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines.[35] On March 27th, 2022, we conducted a systematic literature review on five different databases, namely PubMed, MEDLINE, Embase, CINAHL, and Web of Science. A set of specific keywords and MeSH terms was developed and is shown in supplementary table S1. The protocol of this systematic review is registered with PROSPERO (international prospective register of systematic reviews) with the ID CRD42022321128.

Search Strategy and Selection Criteria

The authors developed a set of keywords relevant to the research question and the population investigated. Boolean operators were used to ensure full inclusion of words within the keywords used Using Endnote referencing software, retrieved articles were entered and duplicates were identified and removed. Following that, articles were entered into Rayyan, a free web-tool for screening articles for systematic reviews. As shown in figure 1, title and abstract screening was conducted by two investigators (OT and YAA) independently. Next, full-text articles were accessed and screened in more depth. Conflicts were solved by discussion upon the conclusion of the screening process. The articles included were deemed eligible against the following criteria: (1) investigated an aspect sleep health as an outcome of interest (e.g., sleep duration, quality and presence of a sleep problem or disorder); (2) investigated a domain related to the COVID-19 pandemic induced lifestyle changes (e.g., lockdown, online schooling, etc.); (3) focused on at least one MENA population (supplementary table S2 includes a list of all MENA countries included); (4) were peer reviewed; (5) sample size >= 100 participants (6) were written in English; (7) had full-text article publicly available. Similarly, articles were excluded if they met at least one of the following: (1) were not written in English; (2) were not peer-reviewed' (3) did not have full-text available; (4) were systematic or narrative review in design. Where multiple articles reported data from the same dataset, we selected the article with the largest numbers of variables included and excluded the other articles as duplicates. Finally, there were no restrictions on the nature of data reported and both qualitative and quantitative studies were included in this review. Of note, prior to conducting our systematic search, an initial literature search was conducted by the authors to identify systematic reviews of sleep in relation to COVID-19 pandemic.

Data Extraction

Data extraction was done in accordance with a tabulated form. Two reviewers (OT and YAA) collectively performed the data extraction into a template table. Conflicts were resolved through a discussion and where necessary, a third reviewer. Data was categorized based on sub-populations identified, including adults, children, healthcare workers, students, and people with chronic illnesses. Other dimensions collected for each study included: (1) the first author and year of publication (e.g., reference); (2) location of the study (city and/or country); (3) study population of interest; (4) study sample size; (5) study design; (6) sleep health measurement tool; (7) sleep health domains; (8) main findings summarized.

Data Presentation

All data extracted from identified studies were presented in a tabulated form organized according to the different sub-populations identified among MENA populations. This included: 1) adults; 2) children; 3) healthcare workers; 4) students; 5) people with chronic illnesses. Main summary findings were presented in the tables, in addition to identifying specific factors that were associated with poor sleep health outcomes.

Quality Appraisal

Given that the majority of the studies identified were cross-sectional in design, The Newcastle-Ottawa scale (NOS) was used to assess the quality of the studies. Two reviewers (YAA and OT) independently assessed the risk of bias in all cross-sectional studies. Where necessary, conflicts in scoring were resolved by discussion. Only cross-sectional studies were scored against the NOS, yielding a total of 157 studies for risk assessment. The NOS was developed to assess the quality of nonrandomized studies according to different domains of the studies, including the study's design, content, and ease of use directed to the task of incorporating the quality assessments in the interpretation of meta-analytic results. In accordance with the NOS, the studies were scored against 7 different categories, including (1) selection (4 sub-categories, 4 stars maximum); (2) comparability (1 sub-category; 2 stars maximum); (3) outcome (2 sub-categories; 3 stars maximum). The full list of adapted questions from the NOS is attached as a supplementary file. Additionally, the results of the NOS assessment for our included cross-sectional studies are shown in supplementary table S3.

Ethical Approval

Ethical approval for this specific systematic review is not applicable since data utilized was collected from previously published research in the literature. All studies included in this review received ethical approval prior to data collection by their primary investigator.

Patient and Public Involvement

Patients and public were not involved in the design and conduct of this research

Results

3.1. Search results

As illustrated in figure 1, the systematic literature search yielded 683 studies from PubMed, 152 studies from MEDLINE, 285 studies from Embase, 63 studies from CINAHL, and 110 studies from Web of Science, resulting in a total of 1,293 studies. After removing duplicates (n = 338), 955 articles were screened independently by two investigators for title and abstract to determine relevance to our research question. This step excluded an additional 721 articles either because they did not investigate sleep health as one of the outcomes (n = 535), did not include people from the Middle East, (n = 153), or were not peer reviewed (n = 33). After this step, two independent investigators performed full-text screening on 234 potentially relevant articles. A total of 70 studies were excluded at this stage, mainly due to studies with unavailable full-text article (n=14), studies not reporting sleep health as an outcome (n=24), studies conducted explicitly outside the Middle East (n=24) or had a sample size of less than 100 participants (n = 8). As a result, a total of 164 articles were included in this review.

3.2. Study characteristics

The sample size of all included studies (n=164) ranged from 103 to 20,697 participants. Table S4 in the supplementary file presents a full list of all included studies and their extracted data. Furthermore, studies included were conducted across 17 Middle Eastern countries, including Turkey (n=44), Saudi Arabia (n=33), Iran (n=16), Israel (n=12), Jordan (n=12), Egypt (n=10), Oman, (n=6), United Arab Emirates (n=6), Lebanon (n=6), Kuwait (n=4), and Qatar (n=2). Only one study was conducted in each of the following countries: Bahrain, Palestine, Cyprus, and Iraq. Additionally, 11 studies included samples from multiple countries at once, including Syria, Yemen, Iraq, and others.

3.3. Quality appraisal

Most studies in this review were cross-sectional in design (n=156). All other study designs were longitudinal (n=8). Table S3 in the supplementary file presents the full NOS results for all studies assessed for bias, determined using the NOS protocol outlined in the Methods section. Most studies were moderate in quality.

3.4. Sleep health outcomes by sub-population

Data from all eligible studies was organized according to population type, with a total of five sub-populations. These included studies focusing on adults in the general population (n=74), healthcare workers (n=47), students (n=21), children (n=15), and people with chronic illnesses (n=7). For all populations, qualitative data synthesis was conducted with a focus on three main domains: sleep duration, sleep quality, and sleep disorders.

3.4.1. Adults

Across the studies conducted among adults (n=74), the sample size ranged from 103 to 14,171 participants.

Sleep Duration

Studies consistently reported that the pandemic negatively impacted the sleep duration of Middle Eastern adults[36-44]. In a global study including 5896 adults from 11 MENA countries, 49.6% of participants reporting that they were sleeping less than 7 hours and 53.2% reporting 10 or more hours of sleep.[36] In Egypt, 23.1% of adults younger than 30 years old reported inadequate sleeping (< 6h/day).[45] In terms of determinants of sleep duration among adults, data from Jordan revealed an increased burden of short sleep duration among males compared to females. Similarly, participants with higher education levels reported decreased daytime sleeping hours. [46] In terms of relationship status, individuals who reported being single had significantly increased amount of sleep compared to married individuals.[46]

Sleep Quality

Sleep quality (SQ) was altered for both COVID-19 patients and healthy individuals.[47] The Pittsburgh Sleep Quality Index (PSQI) score during lockdown was predominantly influenced by sleep-onset latency, sleep efficiency, and total sleep time.[48] Factors associated with reduced SQ included changes in sleeping habits, anxiety, fear driven by COVID-19 news and lack of treatment knowledge, female gender, monthly income, isolation,[49] perceived income, hours spent outdoors, the number of familiar people with COVID-19, and history of depression.[50]

Sleep Problems

Most families reported disrupted sleep patterns.[51] When quarantine period started in Saudi Arabia, 1/5 experienced new-onset nightmares, more significant among females.[52] In a global cross-sectional study including a number of Middle Eastern countries, around 33.3% of respondents reported feeling lazy and less energized during the pandemic, as opposed to 4.7% before the pandemic.[53] The prevalence of insomnia, anxiety, depression, and obesity increased with increasing phone screen time among university students. Of all countries, Iran reported the highest prevalence of insomnia among adults (55.2%).[47, 54] Finally, in a Turkey-based study among pregnant women, mild sleepiness was found in 88.2% of participants (n = 356), while severe sleepiness was reported in 11.8% of the same sample.[55]

3.4.2. Children

A total of 15 studies assessed sleep health among children. The sample size of studies ranged from 309 to 20,697 participants.

Sleep Duration

Most studies in the literature reported a change in the sleeping duration among children, with varying directions of change (e.g., increased, or decreased duration). In Saudi Arabia and Jordan, decreased sleep was reported among children's populations.[56, 57] Moreover, sleep duration in

Israel increased for 13.4% of participants, decreased for 51.1%, and remained unchanged for 35.1%. Sleeping less than seven hours decreased from 41.4% to 5.4%, while sleeping more than 10 hours significantly increased from 4.8% to 49.7%.[58] In Iran 13.4% of children, mostly from urban areas, reported that they had 5 or fewer hours of sleep.[59]

Sleep Quality

In Tukey, 61.5% of children experienced sleeping changes due to the pandemic.[60] Almhizai et al., demonstrated that older participants woke up more frequently during their sleep compared to children.[61] In Israel, 41.4% of children developed sleeping difficulties.[62] Similarly, in another Israeli study, 60% of mothers reported that their child's sleeping patterns had changed drastically and reported higher levels of anxiety traits associated with sleep changes.

Sleep Problems

Sleep disorders were reported in all studies among children. In Turkey, the prevalence of sleep disturbances among children was 55.5% and significantly associated with 6–8 years of age and poor family relationships. The most common sleep disturbances were bedtime resistance (51.9%) and sleep onset delay (61.4%).[63] Sleep disturbances were more common in children of parents who felt helpless, apprehensive, and frightened during the pandemic,[63] and children whose parents were divorced.[61] The direct effect of trauma scores on sleep problems, the direct effect of sleep problems on chronotype scores and on oppositional defiant disorder (ODD) symptom scores were significant.[64]

3.4.3. Healthcare workers

A total of 47 studies assessed sleep health among healthcare workers in all Middle Eastern countries listed in the study characteristics, except Palestine, Cyprus, and Iraq. The sample size of studies ranged from 105 to 2,331 participants.

Sleep Duration

Sleep duration significantly decreased for HCWs in most countries, except Israel, where medical residents treating COVID-19 reported longer sleep duration.[65] In Egypt, both physicians on the front line and others were at risk of falling asleep, staying asleep, or sleeping excessively.[66] Furthermore, there was a statistically significant decrease in sleeping hours among HCWs with severe and extremely severe depression.[67] Those with higher levels of health anxiety related to COVID-19 were working more days weekly and had lower sleeping hours.[68] Female sex, age ≤30 years, attending emergency and night shifts, watching/reading COVID-19 news ≥2 h/day, and not getting emotional support from family, society, and hospitals were associated with a high likelihood of inadequate sleeping HCW in Egypt.[69]

Sleep Quality

Most studies reported poor and reduced SQ, as measured by the PSQI, with poor sleep quality prevalence ranging from 48.4%[70] to 96.1%.[71] Both, front line HCWs and non-front line HCW

reported poor SQ and/or had moderate-severe stress.[72] In Saudi Arabia poor SQ levels were highest among front line HCWs (emergency departments, intensive care units, and wards).[73] The most negatively scored components of SQ included sleep latency, duration, and efficacy. Poor SQ was more prevalent among females, nurses, hospital workers, frontline workers, individuals with <5 years of work experience, those with low social support, and individuals with increased traumatic stress levels.[74]

Sleep Problems

HCWs between 31-40 years-old treating COVID-19 were at higher risk of severe insomnia, compared to those above 40 years-old.[75] In Turkey, insomnia incidence was 1.5 times higher for HCWs in the frontline and significantly higher amongst those working in the "area of final diagnosis".[76] In a tertiary care hospital in Oman, the majority of HCWs (60.2%) aged 34.8 ± 5.7 years and with less working experience (11.9 ± 5.9 years) reported clinical insomnia during the pandemic.[77] Mean Insomnia Severity Index score in Turkey was significantly higher among HCWs working in COVID-19 clinics and intensive care units and among nurses.[74]

3.4.4. Students

A total of 21 studies with sample sizes ranging from 152 to 17,008 participants assessed sleep health among students.

Sleep Duration

Among a large cohort of medical and science university students in Jordan, 44.2% of participants (n = 1019) reported reduction in their sleeping hours.[78] Another study reported a statistical increase of total sleeping time from 6.6 ± 2.3 h/day to 8.3 ± 2.7 h/day.[79] In Israel, a significant reduction in sleep duration from lockdown to post-lockdown period for workdays and weekends was reported.[80]

Sleep Quality

Furthermore, 85.55% of students reported poor SQ and 67.9% were females. It was found that sleep disturbance and daytime dysfunction were poorer in students with higher BMI ranges.[81] In Saudi Arabia, 25.9% of a sample of students reported poor SQ, 22.7% felt tired during the day, 9.3% had nightmares and 5.2% had poor dreams.[82] Furthermore, extended quarantine negatively affected SQ of three-quarters of the undergraduate students in Jordan, with poor sleep quality reported in nearly half of the same sample.[83] Additionally, about a third of the same sample reported sleeping late and waking up more frequently.[83]

Sleep Problems

In Saudi Arabia, 22% of students had trouble falling asleep, 17.9% waking up during the night, and 8.8% waking up early in the morning.[82] Students reported a statistically high level of insomnia with a high level of depression, anxiety, and perceived stress. Undergraduate students reported statistically more insomnia symptoms with a lower level of psychological resilience.[82]

Furthermore, lockdown in Turkey led to sleeping later, waking up frequently and failing to fall asleep.[84] In Saudi Arabia, medical students reported Narcolepsy (51.6%), insomnia (31.5%), and Circadian Rhythm Sleep Disorder (22.4%) as the most prevalent sleep disorders.[85] Furthermore, a statistically significant increase of night sleep interruptions was reported during COVID-19. In Jordan, students experienced increased insomnia, shallow sleep, nightmares, or insufficient sleep, and these disorders were reported in significantly more females than males.[86]

3.4.5. People with chronic illnesses

A total of 7 cross-sectional design studies assessed sleep health among the population with special conditions. The sample size of studies ranged from 145 to 2,223 participants. Those studies focused on a variety of chronic illnesses, including epilepsy (n=1), neurological conditions (n=1), cancer (n=1), musculoskeletal diseases (n=1), spine illnesses (n=1), rhematic disease (RD) (n=1), and multiple sclerosis (MS) (n=1).

Sleep Duration

In Saudi Arabia, 71.2% of patients with epilepsy experienced significant changes in their sleep.[87, 88] Almost half of them had been seizure-free in the three months prior to the pandemic. Furthermore, 9.6% of patients surveyed reported more sleep than usual, 2.6% reported less sleep, and 0.6% reported intermittent sleep.[87, 88]

Sleep Quality

Quality of sleep among different patient groups, as measured by PSQI, was affected during the pandemic. In Turkey, for patients with musculoskeletal pain, PSQI revealed a weak correlation with pain levels in all body parts.[89] Quality of sleep was found to be bad for 58.7% cancer patients.[90] Depression, anxiety, and defective SQ levels for pregnant women (mean age was 30.17 ± 5.47 years) who were previously in quarantine was significantly higher.[91] SQ among patients with MS patients was significantly impaired during the pandemic too.[92]

Sleep Problems

Although patients reported different experiences, a certain degree of sleep disorders was reported among almost all patients. In Jordan, Athamneh et al., reported that 37.5% of patients with chronic headaches reported changes in sleeping patterns during the COVID-19 pandemic.[93] Finally, the frequency of sleep problems in patients with RD was significantly higher than that of non-patients, but significantly lower than that reported in hospital workers.[94]

Discussion

This systematic review of the literature explored the impact of the COVID-19 pandemic on sleep health among populations in the Middle East. To the best of our knowledge, this is the very first systematic review on sleep health among any Middle Eastern population, and one of the first reviews to pool evidence on sleep health during the ongoing COVID-19 pandemic. The findings of our systematic review suggest that across all sub-populations (e.g., adults, children, students, healthcare workers, and people with chronic illnesses), the COVID-19 pandemic had a drastic negative Impact on sleep duration, sleep quality, and prevalence of sleep disorders.

Sleep duration was negatively impacted in all populations investigated, whereby the prevalence of short or long sleep seems to have increased. Similarly, sleep quality in all populations decreased drastically. Studies reported a consistent association between sociodemographic variables (e.g., being single,[44, 95-97] low education levels,[95, 97-101] unemployment during the pandemic,[102] female gender,[49, 96] low social support[74, 103]) and poorer sleep quality. Furthermore, with regards to sleep problems, insomnia was the most reported sleeping problem across studies. Higher prevalence of insomnia and other sleep disorders were observed among younger participants, those with a diagnosed mental disorder, unmarried participants, and undergraduate students.[104] Such findings suggest that psychological stressors, which may have been exacerbated by the pandemic,[105, 106] are associated with sleep problems and contributed to its high prevalence during the pandemic. Moreover, women reported higher rates of insomnia compared to men. Interestingly, there was an observed positive association between lockdown duration and the prevalence of insomnia. Finally, among people with chronic illnesses, reversal of sleeping pattern (e.g., initiating sleep after sunrise) was the most frequent change in sleep habits.[87]

When comparing different sub-populations in this study, HCWs' sleep health was the most impaired during the pandemic compared with other sub-populations. While in other populations sleep duration was affected with no specific trend, healthcare workers demonstrated predominantly decreased sleep duration. Furthermore, in addition to reduced sleep duration, front line HCWs reported the lowest SQ. Among HCWs, being on the front-line, being younger, and having less experience working were all associated with increased insomnia prevalence. Nurses experienced emotional exhaustion, and burnout levels increased in line with insomnia.[107] Long shifts, busy working conditions, and less sleep disturbed their sleeping patterns and made HCWs feel tired.

Our findings are consistent with prior research in other populations.[7, 18, 108, 109] For instance, Jahrami et al., reported an increased burden of sleep problem during the COVID-19 pandemic in early 2021, with approximately 40% of the general population reporting sleep problems.[18] Similarly, and consistent with our findings among Middle Eastern front-line workers, a meta-analysis conducted by Salari et al., showed that healthcare workers are more vulnerable to sleep disturbances during the pandemic.[109] This finding was associated with increased workplace stress and was shown in both nurses and physicians.[109]

The findings of this systematic review are important for public health policy and for directing intervention measures. Given that sleep is a risk factor for the leading causes of death including CVD, hypertension, diabetes, obesity, etc., interventions that promote sleep health are of high public health relevance, particularly in the current pandemic era. Such interventions can include social and administrative support, workplace interventions,[110] providing education that emphasizes the importance of sleep behavior, encouraging promoting behaviors and relaxation strategies. The differences in impact and severity of sleep health problems among different sub-populations, as identified in this study, suggest that policies and interventions should be tailored to each population. Some authors have already suggested emergency management measures that should be taken to improve the quality of sleep in FLHCWs during a pandemic: strengthen exercise intervention, psychological counseling, drug intervention treatment strategies if necessary, and other.[111] Similarly, sleep problems in childhood are linked with impaired motor and cognitive skills, as well as with difficulties in academic activities, emotional regulation, quality of life, growth, body composition, and immune function.[112] A daily routine is a fundamental aspect of children's development of healthy behaviors and adequate energy levels. Interventions that focus on health promotion and advocating for healthy sleeping patterns among children, especially as it relates to other health behaviors development, should be implemented.

In addition to intervention efforts to address poor sleep among MENA populations, there is a strong need to understand barriers to adequate sleep among each sub-population. The current literature provides evidence regarding barriers to adequate sleep focuses primarily on western populations. This includes environmental factors (e.g., decreased green space),[113, 114] social factors (e.g., decreased social cohesion,[115] decreased safety),[116-118] and ambient factors (e.g., increased air pollution,[119-123] increased noise).[124] However, there continues to be a lack of data on this topic in the MENA region despite high prevalence of poverty, gender inequality, political turmoil, violence, and other factors that are strongly linked with PTSD and other psychological factors, which are known to affect sleep.[125, 126] The unique social, structural, and environmental context of the MENA region, in addition to the demonstrated exacerbation of poor sleep health by the pandemic, highlights why increased efforts to understand and address sleep health, particularly post-pandemic, is relevant for MENA populations.

Strengths, limitations, and future research

This review is the first systematic review of the literature regarding the effects of COVID-19 pandemic on the sleep health of Middle Eastern populations. Additionally, this paper provides a robust qualitative synthesis of data to include a wide scope of research on the topic published to date. This review covers a wide range of outcomes (e.g., any study that reported a sleep health related domain), includes only peer-reviewed articles as the source of information of high quality, and incorporates a wider scope of studies and populations. Despite those strengths, this study is not without noteworthy limitations that must be considered when interpreting our results. Firstly, most included studies are cross-sectional in design, which poses an intrinsic limitation given the design. For instance, it is not possible to establish causation with such studies. Additionally, most of the studies utilize self-reported surveys. Given the rapidly evolving situation with the pandemic (e.g., lockdown measures, changes in epidemiology of COVID-19, etc.), this approach seemed

the most suitable to collect data rapidly. However, this introduces several limitations including self-selection bias, recall bias, and social desirability bias.[127-129] Another limitation specific to the design of this review is that it excludes studies conducted in languages other than English. Moreover, quarantine requirements differed across different countries within the MENA region, which could have had varying effects on the health of the population. This variation was challenging to capture and control for within our review and must be a consideration when interpreting our results.

Furthermore, studies included in this review utilized different methods for assessing sleep health, which varied across populations. Mainly, this included subjective measures, including a variety of tools to measure sleep health (e.g., Pittsburgh Sleep Quality Index, Insomnia Severity Index). In turn, this makes it challenging to compare results between different studies and different populations. Additionally, it is important to note that no study included in this review utilized objective tools to measure sleep health (e.g., actigraphy), and many studies utilized tools that do not have demonstrated validity or reliability in the context of sleep health measurement (e.g., surveys developed by authors of the study). Consequently, future research should focus on utilizing objective tools to measure sleep health. If not feasible, subjective tools with demonstrated reliability and validity are preferred. Finally, future research should continue to understand the long-term impacts of the abrupt change in lifestyle brought about by the COVID-19 pandemic on Middle Eastern populations.

Conclusions

This review sought to review and investigate the evidence between COVID-19 induced lockdowns on sleep health among different populations in the MENA region. Given high burden of poor sleep that has been exacerbated by the COVID pandemic, there is a strong need for tailored interventions to improve sleep health. Finally, and considering that Middle Eastern populations continue to be severely understudied in public health, future research should continue to investigate and explore the impact of the COVID-19 pandemic on public health in The Middle East, including longitudinal studies utilizing objective measures to assess the impact of sleep on the health of MENA populations across their lives.

Declarations

Ethics approval and consent to participate

Not Applicable

Consent for publication

Not Applicable

Availability of data and materials

All data generated or analyzed during this study are included in this published article and its supplementary information files

Competing interests

The authors declare that they have no competing interests

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Authors' contributions

All authors contributed to revise work for important intellectual content, gave the final approval of the version to be published, and agreed on all aspects of the work, especially concerning its accuracy and integrity. Further specific activities have been distributed as follows: Y.A.A conceived the hypothesis. Y.A.A and O.T designed the studies. Y.A.A, O.T. and R.M performed the article screening and data extraction. Y.A.A, O.T and G.S performed the quality assessment. All authors (Y.A.A., O.T.., G.S., R.M., N.M., D.T.,) had access to data and verified it, and contributed feedback to drafts of the manuscript. Y.A.A and O.T shaped the manuscript with input from the entire team.

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Figure Legends

Fig. 1. *Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) study selection flow diagram outlining the literature review process when searching for articles on PubMed and Web of Science*

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Fig. 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) study selection flow diagram outlining the literature review process when searching for articles on PubMed and Web of Science.

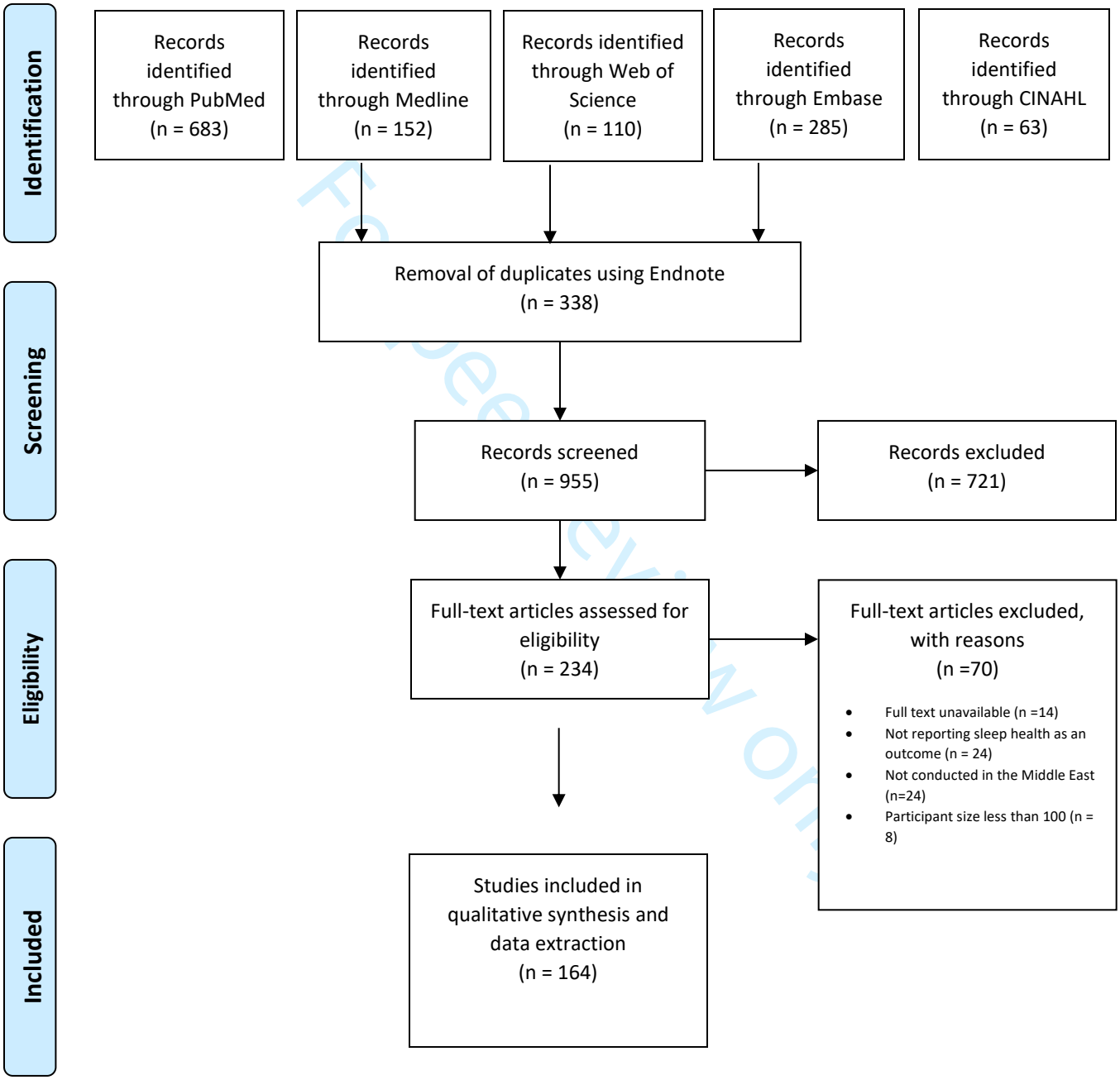

Table S1. Search keywords and MeSH terms developed for the literature search

Journal Databases Keyword Strategy
Search Keywords

1) Generic Exposure of Interest – COVID-19

('coronavirus disease 2019' OR '2019 novel coronavirus disease' OR '2019 novel coronavirus epidemic' OR '2019 novel coronavirus infection' OR '2019-ncov disease' OR '2019-ncov infection' OR 'covid' OR 'covid 19' OR 'covid 19 induced pneumonia' OR 'covid 2019' OR 'covid-10' OR 'covid-19' OR 'covid-19 induced pneumonia' OR 'covid-19 pneumonia' OR 'covid19' OR 'sars coronavirus 2 infection' OR 'sars coronavirus 2 pneumonia' OR 'sars-cov-2 disease' OR 'sars-cov-2 infection' OR 'sars-cov-2 pneumonia' OR 'sars-cov2 disease' OR 'sars-cov2 infection' OR 'sarscov2 disease' OR 'sarscov2 infection' OR 'wuhan coronavirus disease' OR 'wuhan coronavirus infection' OR 'coronavirus disease 2' OR 'coronavirus disease 2010' OR 'coronavirus disease 2019' OR 'coronavirus disease 2019 pneumonia' OR 'coronavirus disease-19' OR 'coronavirus infection 2019' OR 'ncov 2019 disease' OR 'ncov 2019 infection' OR 'new coronavirus pneumonia' OR 'novel coronavirus 2019 disease' OR 'novel coronavirus 2019 infection' OR 'novel coronavirus disease 2019' OR 'novel coronavirus infected pneumonia' OR 'novel coronavirus infection 2019' OR 'novel coronavirus pneumonia' OR 'paucisymptomatic coronavirus disease 2019' OR 'severe acute respiratory syndrome 2' OR 'severe acute respiratory syndrome 2 pneumonia' OR 'severe acute respiratory syndrome cov-2 infection' OR 'severe acute respiratory syndrome coronavirus 2 infection' OR 'severe acute respiratory syndrome coronavirus 2019 infection')

AND

2) Outcome of Interest - sleep health

('sleep' OR 'sleep' OR 'sleeping' OR 'sleep disorder' OR 'chronobiology disorders' OR 'disturbances of sleep' OR 'dyssomnia' OR 'dyssomnias' OR 'intrinsic sleep disorders' OR 'sleep disorder' OR 'sleep disorders' OR 'sleep disorders, intrinsic' OR 'sleep disturbance' OR 'sleep perturbation' OR 'sleep wake disorder' OR 'sleep wake disorders' OR 'sleep disordered breathing' OR 'apnea, sleep' OR 'apnoea, sleep' OR 'nocturnal apnea' OR 'nocturnal apnoea' OR 'obstructive sleep apnea' OR 'obstructive sleep apnea hypopnea syndrome' OR 'obstructive sleep apnea syndrome' OR 'obstructive sleep apnoea' OR 'obstructive sleep apnoea hypopnoea syndrome' OR 'obstructive sleep apnoea syndrome' OR 'obstructive sleep-disordered breathing' OR 'sleep apnea' OR 'sleep apnea syndrome' OR 'sleep apnea syndromes' OR 'sleep apnea, obstructive' OR 'sleep apnoea' OR 'sleep apnoea syndrome' OR 'sleep apnoea syndromes' OR 'sleep apnoea, obstructive' OR 'sleep disordered breathing')

AND

3) Population of Interest - Middle Eastern populations

('middle east' OR 'middle east' OR 'bahrain' OR 'cyprus' OR 'iraq' OR 'kuwait' OR 'saudi' OR 'saudi arabia' OR 'oman' OR 'omani' OR 'jordan' OR 'jordanian' OR 'bahraini' OR 'cypriot' OR 'lebanese' OR 'lebanon' OR 'kuwaiti' OR 'iran' OR 'iranian (citizen)' OR 'israel' OR 'israeli' OR 'gaza strip palestine' OR 'gaza strip' OR 'palestine' OR 'syrian' OR 'syrian arab republic' OR 'egypt' OR 'egyptian' OR 'yemen' OR 'yemeni' OR 'united arab emirates' OR 'emirati' OR 'turkey (republic)' OR 'turkish' OR 'eastern mediterranean region' OR ‘qatar’ OR ‘qatari’ OR ‘algeria’ OR ‘algerian’ OR ‘tunisia’ OR ‘tunisian’ OR ‘morroco’ OR ‘morrocon’ OR ‘libya’ OR ‘libyan’)

Table S2. List of countries considered in MENA definition in this study.

Country
Algeria
Bahrain
Egypt
Iran
Iraq
Israel
Jordan
Kuwait
Lebanon
Libya
Morocco
Oman
Qatar
Saudi Arabia
Syria
Tunisia
United Arab Emirates
Yemen

Table S3. Newcastle-Ottawa Scale for Bias Assessment

Study	Total Score	Selection				Comparability	Outcome	
		Representativeness of the sample	Sample size	Non-respondents	Ascertainments of exposure	Based on design and analysis	Assessment of Outcome	Statistical Test
Özenoğlu et al., 2021	6	*	*		*	*	*	*
Çolak et al., 2021	8	*	*		**	*	**	*
Abbas et al., 2021	6	*	*		*	*	*	*
Abdelghani et al., 2021	7	*	*		**	*	*	*
Abdoli et al., 2021	9	*	*	*	**	**	*	*
Alah et al., 2022	8	*	*	*	**	*	*	*
Abouzid et al., 2021	8	*	*	*	**	*	*	*
Abu-Elnenin et al., 2021	9	*	*	*	**	**	*	*
Ahorsu et al., 2020	8	*	*	*	*	*	**	*
Akbari et al., 2021	7	*	*		**	*	*	*
Akbarpour et al., 2022	6	*	*		*	*	*	*
Al Ammari et al., 2021	9	*	*	*	**	**	*	*
Al Maqbali et al., 2021	10	*	*	*	**	**	**	*
Al Miskry et al., 2021	9	*	*	*	**	**	*	*

Al Mukhaini et al., 2021	7	*	*		**	*	*	*
Al Ajlouni et al., 2022	8	*	*	*	**	*	*	*
Al Ajlouni et al., 2020	8	*	*	*	**	*	*	*
Al Musharaf et al., 2020	9	*	*	*	**	**	*	*
Al Mutawa et al., 2021	9	*	*	*	**	**	*	*
Al Rahamneh et al., 2021	6	*	*		*	*	*	*
Al Saleh et al., 2021	7	*	*	*	*	*	*	*
Al Anazi et al., 2022	6	*	*		*	*	*	*
Alboghdadly et al., 2022	6	*			**	*	*	*
Alfawaz et al., 2021	6	*	*		*	*	*	*
Alghamdi et al., 2022	6	*			**	*	*	*
AlGhufli et al., 2021	6	*			**	*	*	*
AlHadi et al., 2021	8	*	*	*	**	*	*	*
Alharbi et al., 2021	8	*	*	*	**	*	*	*
Alkhotani et al., 2020	8		*		**	**	**	*
Alhurishi et al., 2021	5				**	*	*	*
Ali et al., 2022	6	*		*	*	*	*	*

Ali et al., 2021	6	*			**	*	*	*
Aljemaiah et al., 2021	6	*			**	*	*	*
Aljuffali et al., 2022	9	*	*	*	**	**	*	*
Almhdawi et al., 2022	7	*	*		**	*	*	*
Almhizai et al., 2021	5	*			*	*	*	*
Almugti et al., 2021	7	*	*		**	*	*	*
Alnofaiey et al., 2020	7	*	*		**	*	*	*
Alomari et al., 2021	6	*	*		*	*	*	*
Alothman et al., 2021	9	*	*	*	**	**	*	*
Alqahtani et al., 2021	8	*	*	*	**	*	*	*
Alrashed et al., 2021	5				**	*	*	*
AlRasheed et al., 2022	8	*	*	*	**	*	*	*
Alshammari et al., 2021	4			*	*	*	*	
Alshekaili et al., 2020	7	*	*		**	*	*	*
Alshumrani et al., 2022	8	*	*		**	*	**	*
Alsulimani et al., 2021	6	*	*		*	*	*	*
Araç et al., 2020	7	*			**	**	*	*

Arafa et al., 2020	7	*	*		**	*	*	*
Arafa et al., 2021	7	*			**	**	*	*
Aslan et al., 2021	7	*	*		**	*	*	*
Athamneh et al., 2021	6	*			*	*	**	*
Aydin Sayilan et al., 2021	7	*	*		**	*	*	*
Şentürk et al., 2021	6	*			**	*	*	*
Büber et al., 2022	6	*			**	*	*	*
Badahdah et al., 2020	5	*			**	*	*	
Badri et al., 2021	7	*	*	*	*	*	*	*
Bar-zeev et al., 2022	6	*		*	*	*	*	*
Barbato et al., 2021	6	*			**	*	*	*
Bilgiç et al., 2021	6	*			**	*	*	*
Bağcı et al., 2021	8	*	*	*	**	*	*	*
Bucak et al., 2021	6	*			**	*	*	*
Bulut et al., 2021	7	*		*	**	*	*	*
Cahal et al., 2021	5	*			*	*	*	*
Cakmak et al., 2022	6		*		**	*	*	*

Chan et al., 2021	8	*	*	*	**	*	*	*
Cheikh Ismail et al., 2021	6	*			**	*	*	*
Cheikh Ismail et al., 2020	6	*			**	*	*	*
Cigiloglu et al., 2020	6	*			**	*	*	*
Coiro et al., 2021	6	*			**	*	*	*
Duran et al., 2021	7	*	*		**	*	*	*
Durmaz Engin et al., 2021	7	*	*		**	*	*	*
El Refay et al., 2021	6	*			**	*	*	*
Elghazally et al., 2021	6	*			**	*	*	*
Elgohary et al., 2021	6		*		**	*	*	*
Elkholy et al., 2021	7	*	*		**	*	*	*
Ellakani et al., 2022	5	*			*	*	*	*
Elsalem et al., 2020	5		*		*	*	*	*
Eren et al., 2021	7	*	*		**	*	*	*
Gol et al., 2021	7	*	*		**	*	*	*
Guc et al., 2022	8	*		*	**	*	**	*
Galali et al., 2021	5	*			*	*	*	*

Ghanamah et al., 2021	5	*			*	*	*	*
Gokseven et al., 2021	6	*			**	*	*	*
Goweda et al., 2021	5				**	*	*	*
Grande et al., 2021	7		*		**	**	*	*
Hadar-Shoval et al., 2021	7	*		*	**	*	*	*
Hammoudi et al., 2021	6	*			**	*	*	*
Hammouri et al., 2022	5	*			*	*	*	*
Hawari et al., 2021	6	*			**	*	*	*
Husain et al., 2021	6	*	*		*	*	*	*
Hussien et al., 2020	7	*	*		**	*	*	*
Iqbal et al., 2021	7	*	*		**	*	*	*
Jahrami et al., 2021	7	*			**	**	*	*
Jalal et al., 2021	8	*	*		**	**	*	*
Kamaleddine et al., 2022	5				**	*	*	*
Kandemir et al., 2021	6	*			**	*	*	*
Karabulut et al., 2021	5				**	*	*	*
Karahan Yilmaz et al., 2021	5	*			*	*	*	*

Karatel et al., 2022	6	*			**	*	*	*
Keskin et al., 2022	5				**	*	*	*
Khamis et al., 2020	6	*			**	*	*	*
Kheirallah et al., 2021	6	*	*		*	*	*	*
Kilani et al., 2020	6	*			**	*	*	*
Kolokotorni et al., 2021	6	*			**	*	*	*
Korkmaz et al., 2020	5				**	*	*	*
Lin et al., 2022	7	*	*		**	*	*	*
Lin et al., 2020	5	*			*	*	*	*
Maatouk et al., 2022	6	*			**	*	*	*
Mahamid et al., 2021	6	*			**	*	*	*
Masoumi et al., 2021	5				**	*	*	*
Mekkawy et al., 2022	6	*			**	*	*	*
Meo et al., 2022	7	*		*	**	*	*	*
Mosheva et al., 2020	6	*			**	*	*	*
Mousavi et al., 2021	7	*	*		**	*	*	*
Najafipour et al., 2021	6	*			**	*	*	*

Nakhostin-Ansaeri et al., 2021	6	*			**	*	*	*
Nakhostin-Ansari et al., 2020	5	*			*	*	*	*
Nashwan et al., 2021	5				**	*	*	*
Okudan et al., 2021	6	*			**	*	*	*
Oteir et al., 2022	8	*	*	*	**	*	*	*
Radwan et al., 2021	6	*		*	*	*	*	*
Ranjbar et al., 2021	6	*	*		*	*	*	*
Romdhani et al., 2021	7	*	*		**	*	*	*
Saadeh et al., 2021	7	*			**	**	*	*
Sadeghniiat-Haghighi et al., 2021	6	*			**	*	*	*
Salehinejad et al., 2020	6	*			**	*	*	*
Salman et al., 2021	6	*			**	*	*	*
Salman et al., 2021	6	*			**	*	*	*
San et al., 2021	5				**	*	*	*
Sarsak 2022	6	*			**	*	*	*
Seyahi et al., 2020	7	*		*	**	*	*	*
Sis Celik et al., 2021	5	*			*	*	*	*

Sultan et al., 2021	6	*	*		*	*	*	*
Tas et al., 2021	5		*		*	*	*	*
Tasdemir Yigitoglu et al., 2021	7	*	*		**	*	*	*
Toprak Celenay et al., 2020	6	*			**	*	*	*
Torkian et al., 2021	6	*			**	*	*	*
Torun et al., 2021	6			*	**	*	*	*
Ustuner Top et al., 2022	6	*			**	*	*	*
Yilmaz et al., 2021	6	*			**	*	*	*
Yalcin et al., 2022	8	*	*	*	**	*	*	*
Yeni et al., 2022	6				**	*	**	*
Yilmaz et al., 2021	8	*	*	*	**	*	*	*
Yilmaz et al., 2021	6	*			**	*	*	*
Younes et al., 2021	7	*	*		**	*	*	*
Youssef et al., 2020	7	*			**	**	*	*
Yurumez Korkmaz et al., 2021	6				**	**	*	*
Zach et al., 2021	7	*	*		**	*	*	*
Zarzour et al., 2021	6	*			**	*	*	*

Zengin et al., 2021	7	*	*	**	*	*	*
Zreik et al., 2021	6	*		**	*	*	*

Table S4. Results of full literature review, tabulated by sub-population

Adults							
Reference	**Location of Study**	**Population**	**Sample Size**	**Study Design**	**Sleep Health Measurement Tool**	**Sleep Health Domains**	**Main Findings**
Abouzid et al., 2021	Egypt, Jordan, United Arab Emirates, Kuwait, Bahrain, Saudi Arabia, Oman, Qatar, Yemen, Syria, Palestine. Iraq	5896 respondents were included. The participants were aged between 8–23 years (45%; 24–30, 20.5%; 31–40, 18.6%; 41–60, 13.6%;>40, 2.3%) and 62.8% were females	5896	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration.	Sleep duration	49.6% reported they were sleeping less than 7 h and the sleeping hours increased to 7–10 h. for 53.2%
Ahorsu et al., 2020	Qazvin, Iran	older adults (50 or older) with a mean age of 57.72 (SD = 7.31) 62% male	413	Cross-sectional study	Insomnia Severity Index (ISI)	Sleep disorder (insomnia)	fear of COVID-19 was a significant mediator (unstandardized coefficient = 0.360; LLCI = 0.112; ULCI = 0.664) in the association between perceived health status and insomnia, significant direct effects of perceived health status on fear of COVID-19 and insomnia (unstandardized coefficient of 1.621; SE = 0.378; p < .001) as well as a significant total effect on insomnia (unstandardized coefficient of 1.981; SE = 0.392; p < .001)
Akbari et al., 2021	Iran	adults (mean age 30±11 years, 54.3% female)	3,323	Cross-sectional	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality	Inactive participants (IPs) scored significantly lower (p < 0.001) on the global score of sleep-quality than active participants (APs) (mean ± SD, 6.04±2.95, 5.59±2.94, respectively). No significant differences in inactive subgroups. Significant differences in active subgroups (p=0.003) APs that maintained

							their activity levels had better sleep quality. Sleep quality after COVID-19: Sleep habits of 49.3% of individuals (APs= 49.5% and IPs= 49.1%) had changed, so that 39.8% of them slept later; sleep time of 44.6% of individuals (APs= 43.7% and IPs= 45.5%) had changed, so that 28.7% of them slept more; and a significant portion of them (APs= 36.7% and IPs= 42.2%) were dissatisfied with their sleep habit changes
Akbarpour et al., 2022	Iran	1223 individuals with a mean age of 39.82 ± 10.75 years participated in the study.	1223	Cross-sectional study	Insomnia Severity Index	Sleep problems (insomnia)	Prevalence of insomnia 55.2% Being married was associated with less risk for insomnia (OR= 0.69, CI-95%= 0.52-0.91).
Al Miskry et al., 2021	United Arab Emirates	737 participants: 60.7% (n = 447) university students, 27.4% (n = 202) faculty members, and 11.9% (n = 88) staff selected through the convenience sampling method. 72.6% (n = 535) of the participants were females, whereas 27.4% (n = 202) were males.	737	Cross-sectional study	Survey items developed by the study's author including questions on sleeping difficulties.	Sleep problems (sleep pattern disturbances)	19.5% experienced changes in sleep patterns
Al-Ajlouni et al., 2020	Jordan	mean age 37.35 (SD=11.01), with over 60% aged <40 years 52.9% male	1,240	Cross-sectional study	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality	over 60% of participants reported having experienced at least one sleep problem in the last week, and nearly half reported having had short sleep duration. Participants reporting mild anxiety were more likely to experience poor sleep quality (aPR = 3.01; 95% CI=2.07 to 4.35), short sleep duration (aPR = 1.35; 95% CI=1.17 to 1.56) and at least one sleep problem (aPR=1.41; 95% CI=1.27 to 1.56). Those reporting moderate anxiety were more likely to experience poor sleep quality (aPR=5.78; 95% CI=3.97 to 8.43), short sleep duration (aPR=1.73; 95% CI=1.47 to 2.04) and at least one sleep problem (aPR=1.56; 95% CI=1.39 to 1.75)

							compared with those reporting minimal anxiety. Corresponding to the dose–response relationship between anxiety and sleep health outcomes, those reporting severe anxiety were the most likely to experience poor sleep quality (aPR = 8.954; 95% CI = 6.12 to 13.08), short sleep duration (aPR = 2.23; 95% CI=1.91 to 2.61) and at least one sleep problem (aPR =1.73; 95% CI=1.54 to 1.95) P-trend <0.001 for all sleep outcomes
Al-Ajlouni et al., 2022	Jordan	60% less than 40 years old, mean age of 37.4 (SD = 11.0) 52.9% male	1,240	Cross-sectional study	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality	Participants who did not meet the guidelines for moderate-to-vigorous physical activity (MVPA) had higher prevalence of poor sleep quality (aPR = 1.68; 95% CI = 1.24–2.26), short sleep duration (aPR = 1.15; 95% CI = 1.00–1.31), and sleep problems (aPR = 1.22; 95% CI = 1.10–1.35)
Al-Musharaf et al., 2020	Saudi Arabia	A total of 638 young women, with a mean age of 22.0 years ± 1.9 years, were studied. More than half of the women (413; 60%) were undergraduates, and the majority of the sample was unemployed (579; 91%)	638	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep Quality Sleep duration	PHQ-9 score was positively correlated with the global PSQI score ($r = 0.25$, $p < 0.001$) and negatively correlated with the duration of sleep (h/day) ($r = -0.18$, $p < 0.001$) GAD-7 anxiety score was positively correlated with a higher global PSQI score (worse sleep) ($r = 0.178$, $p < 0.001$) and negatively correlated with duration of sleep (hours/day) ($r = -0.21$, $p < 0.001$) The stress score was positively correlated a higher global PSQI (worse sleep) ($r = 0.159$, $p < 0.001$) and negatively correlated with duration of sleep (h/day) ($r = -0.196$, $p < 0.001$).
Al-Mutawa et al., 2021	Kuwait, Qatar, Saudi Arabia, Bahrain, United Arab Emirates, and Oman	14,171 participants, 67.3% females and 60.4% younger than 35 years old. 64.2% from Kuwait	14171	Cross-sectional study	Insomnia Severity Index	Sleep problems (insomnia)	Insomnia among Omani participants was 48.4% UAE participants 66.7% Participants in UAE (AOR = 1.455; 1.209–1.750) and Kuwait (AOR = 1.412; 1.244–1.602) were 40% more likely to show insomnia symptoms than participants in Oman. Females were also shown to be more susceptible to insomnia during the pandemic since they were 55% more likely to report sleeping problems compared to males

							All age groups younger than 35 years old were about 3 times more likely to show insomnia symptoms than age group >65. The most susceptible age group was shown to be 18 to 24 years old with an adjusted odds ratio of 3.286. Divorced individuals were 31.5% more likely to have sleeping problems than married individuals. Students (AOR = 1.422; 1.227–1.647) were 42%, and unemployed individuals (AOR = 1.305; 1.171–1.454) were 30% more likely to experience sleeping problems. Non-smokers were also 36.5% less likely to report any sign of insomnia than smokers (AOR = 0.635; 0.578–0.698) participants with underlying psychological disorders were 2.1 times (AOR = 2.098; 1.831–2.404) and individuals with underlying medical conditions 34% more likely to experience any symptom of insomnia (AOR = 1.340; 1.218–1.474). Regarding the duration of lockdown, participants who were in no lockdown or experienced the lockdown for <7 days were 18.2% less likely to show insomnia symptoms (AOR = 0.818; 0.746–0.897) compared to those who were in lockdown for more than 30 days. Finally, participants who were never infected with COVID-19 were 18.1% less likely to experience sleep problems than those who contracted COVID-19 at least once (AOR = 0.819; 0.672–0.998)
Al-Saleh et al., 2021	Saudi Arabia	1641 respondents were included in the current survey. Male participants were 733 (44.7%) and 61.1% of the participants aged 35 years or more.	1641	Cross-sectional study	Survey items developed by the study's author including questions on sleeping duration.	Sleep duration	Daily sleep hours for less than 8 hours were recorded for 662 (40.3%) participants and family troubles was reported by 44% of the respondents. Poor sleep hygiene was significantly higher among males than females.
Alah et al., 2022	Qatar	1061 participants. Majority were men (757; 71.3%), 35 to 54 years	1061	Cross-sectional study	Survey items developed by the study's author	Sleep duration Sleep quality	488 (46%) reported an increase in sleep duration, 149 (14%) reported a decrease. The mean sleep duration increased significantly

		old (585; 55.1%), married (850; 80.1%), and have completed college or a higher degree of education (832; 78.4%). Over 50 nationalities were reported by participants with the most common being Indian nationality (56.6%). Only 37 (3.5%) Qatari nationals participated. 565 (53.3%) shifted to work from home.			including questions on sleep duration and sleep quality		from 6.90 h/d before to 7.78 h/d during home confinement (0.89 hour mean difference, 95% CI: 0.74 to 1.04, P<0.001). 165 (29.2%) of those working from home and 131 (26.4%) of those who continued working regularly reported poorer sleep quality during home confinement as compared with before.
Alfawaz et al., 2021	Saudi Arabia	Students, staff and faculty of King Saud University 47% (726) of the study participants were males and 53% (816) were females. A large proportion of participants were from the age-group of 20–45 years (1229, 79.7%) and most were educated either up to graduate or higher level (1434, 93%).	1542	Cross-sectional study	Survey items developed by the study's author including questions on sleep problems (insomnia).	Sleep problems (insomnia)	496 (32.2%) of the participants reported suffering from insomnia constantly (233, 15.1%) or sometimes (263, 17.1%) during lockdown.
Alghamdi et al., 2022	Saudi Arabia	Females (n = 236, 64.13%), single (n = 356, 96.74%), and in their senior year (n = 256, 69.57%). The mean age of the participants was 20.4 ± 1.6 years (range: 18–26 years)	382	Cross-sectional study	Generalized Sleep Disturbance Scale	Sleep duration Sleep quality Sleep problems (sleep disturbance, nightmares)	Most participants did not suffer from the presence of nightmares during the quarantine period (n = 251, 68.21%); however, (n = 52, 20.72%) experienced new-onset nightmares when the quarantine started. The presence of nightmares was more significant among females (n = 86; 73.8%) than males (n = 31; 26.5%, $\chi 2(1) = 6.5$; p = 0.010).) Male participants with statistically significant nightmares reported frequent early waking from sleep (n = 24, 58.54%) and frequent daytime sleepiness (n = 20, 48.78%). On the other hand, female participants with statistically significant nightmares reported frequent difficulty falling asleep

							(n = 92, 71.87%), frequent waking up during sleep (n = 84, 65.62%), and frequent daytime sleepiness (n = 72, 56.25%). The mean GSDS was 45.0 ± 14.9 (range: 12–130). There was no difference in the mean GSDS between males and females. The mean subjective reported sleep duration (total daily sleep time) was 7.98 ± 1.8 h; (range 4–15 h). There was a statistically significant difference in the mean sleep duration between males (mean = 7.7 ± 1.6 h) and females (mean = 8.1 ± 1.8 h; t(366) = −2.2; p = 0.029). Approximately 33.4% (n = 123) of the participants reported taking naps during the day (mean = 1.7 ± 0.96 h/d; range: 0–5 h/d). Most participants reported poor sleep quality (n = 226, 61.41%).
Alharbi et al., 2021	Saudi Arabia	3032 responses The majority of respondents (64.4%) were females.	3032	Cross-sectional study	The Insomnia Severity Index	Sleep disorder (insomnia)	Respondents who are younger, reported having a diagnosed mental illness, have never been married, and students had significantly higher ISI scores than others. The results of the regression model indicate that the most important factors associated with insomnia severity during the COVID-19 pandemic were the level of depression and anxiety, along with the respondent's intolerance of uncertainty, history of a sleep disorder, younger age, and whether they used emotion-based coping strategies.
Alharbi et al., 2021	Saudi Arabia	790 responses were included. The majority of participants were the Saudi population (n=735; 92.9%). Two-thirds of the participants were employed. A total of 27.5% were healthcare workers, 45.1% were enterprise or institution workers, and 27.5% were teachers or students.	790	Cross-sectional study	Pittsburgh sleep quality index score Athens sleep questionnaire	Sleep quality Sleep duration Sleep disorder (insomnia)	The overall Global PSQI was 6.67±3.82 for all participants The prevalence of insomnia and poor sleep quality were 54.4% and 55.5%, respectively. Saudi citizenship was associated with longer sleep duration (p=0.031). Female gender and being married were associated with worse global PSQI, sleep quality, sleep distribution, sleep latency, and daytime dysfunction. In terms of sleep duration, the male gender was worse than the female gender (p<0.001) The prevalence of insomnia was 430 (54.4%). Compared to non-Saudi participants, Saudi

							participants were linked to a greater prevalence of insomnia (45.5% versus 55%) the prevalence of insomnia was 61.3% in the single participants and 50.4% in the married participants.
Aljemaiah et al., 2020	Saudi Arabia	347 participants from Taif, Saudi Arabia n = 213 (61.4%) males and n = 134 (38.6%) females. The mean age was 35.5 years (s.d. = 10.3 years). The age range was 12 to 63 years.	347	Cross-sectional study	4DSQ scale	Sleep quality	Sleep disruption was reported during the initial phase of the lockdown as people's quality of sleep was severely reduced.
Allam et al., 2021	Egypt	A random sample of 336 staff members employed at Menoufia University age of the participants under the study ranged from 22 to 63 years (35.34±9.0), most of them were married and from urban residence (77.1% and 69%, respectively), and 51.2% were females.	336	Cross-sectional study	Survey items developed by the study's author including questions on sleep problems.	Sleep duration Sleep quality Sleep problems	Workaholics had higher risks than relaxed ones for sleep problems in terms of difficulty initiating sleep, difficulty maintaining sleep, and insufficient sleep (OR: 1.97, 3.39, and 2.23; respectively)
Alnofaiey et al., 2020	Saudi Arabia	340 (73.6%) had an age ranging from 23–30 years, 235 (50.9%) were females, 202 (43.7%) were from Taif city, 256 (55.4%) were residents, and 18.6% had an internal medicine specialty.	340	Cross-sectional study	Pittsburgh Sleep Quality Index (PSQI) scale.	Sleep duration Sleep quality Sleep disorders	Prevalence of sleep disorders was 43.9%, doctors in the age group of 31–40 years, associate consultants had a significant higher prevalence of sleep disorders. Medical interns and laboratory/pathology/microbiology doctors had a significant more difficulty in fall asleep during COVID-19, and internists and surgeons had a significant higher percent of those who used sleeping pills. Resident doctors had a significant higher percent of having trouble in staying awake, and residents and consultants had a significant higher percent of those who suffered decreased sleep duration. Sleep quality during COVID-19 was very good, fair good and very bad in 23.4%, 60% and 3.5% of HCW

							respectively. The study observed a negative impact of COVID-19 pandemic on HCW sleep quality.
Alomari et al., 2021	Jordan	1757 participants: The majority of the participants were women (69.4%), from a middle-income class (77.0%) while 51.6% held a bachelor's degree and 35.6% were unemployed.	1757	Cross-sectional study	Survey items developed by the study's author including questions on sleep quality, sleep duration, and sleep disorders.	Sleep duration Sleep quality	>50% (range: 53.1%–59.4%) of the participants reported an "increase" in sleep disturbance, nighttime sleeping, and total sleeping hours while 49.1% reported a "decrease" in daytime sleeping. Only age ($\chi 2 = 20.2$; $p = 0.0001$) was associated with changes in sleeping disturbances during COVID-19 confinement. Younger age ($\beta = -0.02$; OR = 0.98; $p = 0.05$) was associated with an "increase" in sleeping disturbance Only gender ($\chi 2 = 13.4$; $p = 0.001$) is an independent predictor of nighttime sleeping. Being a male is associated with a "decrease" ($\beta = 0.36$; OR = 1.4; $p = 0.006$) in nighttime sleeping hours. Being a male ($\beta = 0.34$; OR = 1.41; $p = 0.03$) and having a high school ($\beta = -0.70$ OR = 0.50; $p = 0.007$), two-year ($\beta = -0.67$; OR = 0.50; $p = 0.01$), and four-year ($\beta = -0.46$; OR = 0.63; $p = 0.05$) diplomas are associated with a "decrease" in daytime sleeping hours.
Alothman et al., 2021	Saudi Arabia	A total of 669 individuals attempted to complete the online survey, 554 participants completed at least 2 sections of the survey (82.8%), and 41.3% (n = 276) completed the whole online survey. The majority of the sample were female (83%)		Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality Sleep duration	Most had sufficient sleep duration (7.5 hrs ± 2.1), and also reported poor sleep quality (5.4 ± 2.4)
Alqahtani et al., 2021	Saudi Arabia	593 participants 7.7% were males, and 42.3% were females. The response from the age group of 20–30 years was 38.6%, 30.4% were between 31 and 40 years, 17% were in the	593	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality Sleep duration	The PSQI score (7.2) of the female respondents were higher than that of the males. The mean latency to fall asleep of the former was 42.51 (SD 31.6) min, which was longer than that of the latter. Although the mean PSQI score and the sleep latency of the age group 51 years were high, the mean sleep duration was the shortest.

		age group of 41–50 years, and 14% were 51 years. Most of the respondents were from Jazan (43.8%					The latency to fall asleep in the age groups of 41–50 years were higher, i.e., 45.13 (SD 34.3) min. The PSQI score and the latency to fall asleep of graduates and postgraduates were higher than those of the respondents with primary and high school education. The respondents with hypertension had the highest PSQI score of 8.09, followed by the subjects with asthma (7.74). However, the sleep duration of the subjects with hypertension was short. The subjects with asthma had the highest latency to fall asleep (55.61 SD 36.01 min) among the individuals with other comorbidities. Individuals with a family history of psychiatric disorders and sleeping pills had higher PSQI scores The presence of comorbidities was related to sleep duration (v2 = 12.13 [5], p = 0.03). Sleep duration affected males more than females (OR 1.92 [1.3–2.7], p = 0.001) and subjects aged 51 years (OR 2.49 [1.3–4.4], p = 0.002) Being worried/anxious of the infection significantly affected sleep latency (t = 2.3 [591], p = 0.018), sleep duration (t = 4.5 [591], p = 0.001), sleep efficiency (t = 2.7 [1.0], p = 0.005), and PSQI score (t = 2.84 [591], p = 0.005)
AlRasheed et al., 2021	Saudi Arabia	The study included 836 participants. The median age was 28 years, 624 (74.64%) were females, and 158 (18.90%) were healthcare workers.	836	Cross-sectional study	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality Sleep duration	Factors associated with poor sleep were recent changes in the sleep habits p = 0.004), anxiety or fear because of coronavirus news on social media p = 0.02), fear because there was no approved drug to treat COVID-19 p = 0.03), and unaware of the presence of chronic diseases p = 0.03). Female gender p = 0.02), fear or anxiety because of coronavirus news on social media p = 0.04), recent change in sleep habits (OR: 1.97 (1.15–3.39); p = 0.01), fear because there is no approved drug to treat COVID-19 p = 0.001), monthly income <1000 SR p = 0.01), and isolation p = 0.01) were

							associated with distress. PSQI and K10 scores were significantly correlated p < 0.001).
AlRasheed et al., 2021	Saudi Arabia	The study included a total of 353 participants; 88 were in isolation because they had current or suspected COVID-19 infection or because they had just arrived from abroad, with 265 non-isolated individuals serving as controls. The age of the isolated group was 28.6±9.8 (mean ± standard deviation) years versus 27.5±8.5 years for the non-isolated group, with males accounting for 37% in both groups	353	Cross-sectional study	Pittsburgh Sleep Quality Index (PSQI)	Sleep duration Sleep quality	The mean PSQI score was 8.5±3.6 and 8.4±3.5 for the isolated and non-isolated groups, respectively (P= 0.92). Poor sleep (PSQI ≥6) was reported in 235 (66.6%) Isolation was not associated with poor sleep (OR: 0.73 (95% CI: 0.41–1.3), P=0.29)
Alshumrani et al., 2022	Saudi Arabia	A total of 1091 participants were surveyed; 643 (58.9%) were COVID-19 patients. The mean age of the patients in the COVID-19 arm was 42.8 ± 15.2 years, with a male predominance of 61.1%.	1091	Cross-sectional study	Athens Insomnia Scale	Sleep quality Sleep disorder (insomnia)	The majority (58.1%) reported worsened sleep during the COVID-19 pandemic. Poor sleep quality was reported in 66.1% of the patients in the COVID-19 group (mean score of 6.9 ± 4.0) and 72.8% of participants in the control group (mean score 7.6 ± 4.3). Insomnia affected 50.5% of the patients with COVID-19 (mean score of 6.5 ± 5.5) and 58.5% of controls (mean score of 7.6 ± 5.5).
Arafa et al., 2021	Egypt	1629 participants, 48.1% were aged ≤ 30 years, 42.4% were men, and 20.0% were working in the health sector	1629	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration.	Sleep duration	inadequate sleeping (less than 6hrs/ day) (23.1%)
Badri et al., 2021	United Arab Emirates	574 older adults in Abu Dhabi About 60% were male and 40% were female. Most of them were	574	Cross-Sectonal study	Survey items developed by the study's author including questions on	Sleep disorders	The analysis took each of the ten psychological feelings as dependent variables, where time was treated as the only independent variable. and resulted in ten individual regression analyses. Sleeping disorders showed significance at the 0.05

		married (82.4%), while only (7.7%) were single. Around (3.1%) were separated, widowed, or divorced. About 40% were Emirati and 60% were non-Emiratis.			sleep duration.		level. The positive standardized coefficients and t-values note more negative development for sleeping for older adults, suggesting that time harms the development of the sleeping disorders.
Barbato et al., 2021	United Arab Emirates	international sample of foreign workers (n = 319) resident in the United Arab Emirates (UAE). The majority of participants were female (76%), European (69%) and highly educated (83% had a bachelor's or higher degree)	319	Cross-sectional study	Insomnia Severity Index	Sleep disorders(insomnia)	Insomnia symptoms were observed in 33% of participants, with 4% of participants showing severe symptoms. A higher reported prevalence of insomnia was observed among younger participants, females, and a more severe impact of COVID-19 in the home country.
Başkan et al., 2021	Turkey	Using the snowball sampling method for sample selection, 1.909 individuals aged 18-65 years living in Turkey. 69% of the respondents was female, 48.9% was married, 68.5% had moderate income, and 43.1% was civil servant. Of the participants, 78.6% was university graduate	1909	descriptive type research	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality	The PSQI score was 7.78±3.46, and 71.6% of the participants had poor sleep quality. A significant, positive and weak relationship was found between the total scores on PSQI and PSS ($p<0.05$)
Cheikh Ismail et al., 2020	United Arab Emirates	1012 participants, highest number of participants residing in Abu Dhabi (33.9%) and Dubai (32.5%) Females (75.9%), aged 26–35 years (29.1%), were married (56.4%), had no children (50%), completed a bachelor's	1012	Cross-sectional study	Copenhagen Psychosocial Questionnaire (COPSOQ-II) with modifications	Sleep quality Sleep duration Sleep disorder	Significant decrease in the percentage of participants who reported sleeping less than seven hours per night from 51.7% before the pandemic to 39% during the pandemic ($p < 0.001$) A higher percentage of participants reported poor sleep quality during the pandemic (28.1%) compared to before the pandemic (17.3) ($p < 0.001$), and sleep disturbances were also more common during the pandemic (60.8%) compared to before (52.9%).

		degree (54.1%), worked full-time (53.3%), and were working or studying from home during quarantine (61.6%).					30.9% of the surveyed participants reported feeling lazy and less energized during the pandemic, compared to only 4.7% before the pandemic ($p < 0.001$) Sleep disturbances increase was significantly higher in females ($p = 0.011$). Sleep duration and quality was most affected among participants aged 18–35 ($p < 0.001$).
Cheikh Ismail et al., 2021	Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Oman, Palestine, Qatar, Saudi Arabia, Syria, United Arab Emirates and Yemen.	2970 participants from 18 countries in the MENA region The largest proportion of respondents was from the United Arab Emirates (13·1 %), Jordan (11·9 %), Lebanon (11·5 %), Saudi Arabia (8·3 %) and Palestine (6·4 %). 28.4 % males, aged 18–25 years (29·6 %), were married (53·2 %), had no children (49·7 %), completed a university degree (48·5 %), worked full-time (44.8 %) and were working/studying from home during the lockdown (56.0 %)	2970	Cross-sectional study	Copenhagen Psychosocial Questionnaire	Sleep quality Sleep duration Sleep disorder	Although the percentage of participants who were sleeping <7 h per night decreased from 51·4 % before the pandemic to 36·6 % during the pandemic, the percentages of participants reporting poor sleep quality increased from 17·1 % before the pandemic to 29·2 % during the pandemic ($P < 0·001$). Moreover, a higher percentage of participants reported sleep disturbances during the pandemic (63·2 %) compared with before (53·1 %). As a result, 29·6 % of the participants reported feeling lazy and less energised during the pandemic, compared with only 4·7 % before the pandemic ($P < 0·001$)
Cigiloglu et al., 2020	Turkey	Of the 104 participants, 61 (58.7%) were men, and 75 (72.1%) were ages 65–74. With regard to health, 76.9% of respondents reported a history of at least one chronic disease	104	Cross-sectional study	Richards-Campbell Sleep Questionnaire	Sleep quality	None of the groups had a mean sleep score indicating very poor sleep quality (score: 0–25). As the monthly income and education level increased, scores for most of the sleep parameters also increased Found that depression and anxiety symptoms were associated with poorer quality of life and sleep quality.
Corio et al., 2021	Israel	2541 participants: Israel (N = 1969) and the U.S. (N = 572) Israeli sample: Age 40.4	2541	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	56% of the sample were poor sleepers A large majority of the sample (88.9%) reported that their sleeping habits had changed since the pandemic started in at least one of the 6 ways

		± 13.76, Female 55.1% (1085)					assessed. Almost 70% of the participants reported they were going to bed later, and almost 50% reported waking up later in the morning the strongest correlations were between use of sleeping medication and both depression (rs = .55, P < .001) and anxiety (rs = .57, P < .001), and between sleep disturbances and both depression (rs =.52, P < .001) and anxiety (rs=.49, P < .001). Participants who reported more COVID-related stress reported significantly poorer sleep quality, with moderate effect sizes
Duran et al., 2021	Turkey	405 participants, 70.9% of the participants were female, 29.1% were male. While 6.7% of the participants were single, 82.2% had undergraduate or higher degrees. 48.4% were continuing to work from their workplace, 15.1% were continuing to work from home, and 36.5% were not working at a job. 69.4% did not have children.	405	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	Mean sleep quality score was 6.39 ± 3.31. The prevalence of poor sleep quality was 55.1%. The sleep quality of the single participants and the participants with low education levels was poorer. The sleep quality of those who left work in the pandemic period was poorer than those who were working from home/office and those who were already not employed before the pandemic. The sleep quality of those not working in the field of health was better than healthcare professionals and those not working at all. The scores for psychological distress were negatively correlated with sleep quality levels.
Eren et al., 2021	Turkey	405 participants 67.9% (275) of the individuals participating in the study were women, and 34.6% (281) were under 20 years old. 68.4% (277) of the individuals are university graduates and high graduate, 67.2% (272) are single, 28.6% (116) have children.	405	Cross-sectional study	Pittsburg Sleep Quality Index	Sleep qualtiy	While 23% (93) of the participants had sleep problems before the COVID19 outbreak, 40% (162) had sleep problems after the COVID19 outbreak. It was determined that 183 (78.9%) participants with good sleep quality did not have sleep problems after the start of the COVID-19 outbreak, and 113 (65.3%) participants with poor sleep quality experienced sleep problems after the start of the COVID-19 outbreak. As a result of an increase in the state-trait anxiety scale score by 1 point, the risk of poor sleep quality increased 1.051 times (5.1%) A statistically significant relationship was found between PSQI classes and psychiatric diagnosis

							status (χ2=4.416, p=0.036). It was found that 226 people (97.4%) with good sleep level had no psychiatric diagnosis, and 12 people (6.9%) with bad sleep level had psychiatric diagnosis.
Galali, 2021	Iraqi Kurdistan	2137 participants included 74.9% (1,600) from Erbil, 22.3% (476) from Sulaimani, and 2.9% (61) from Duhok. Regarding gender, results showed that 43.4% (927) were male and 56.4% (1,210) were female.	2137	Cross-sectional study	Survey items developed by previous study "EBLC-COVID19 questionnaire" Including questions on sleeping behavior.	Sleep duration	During the pandemic, the percentage of people reporting sleeping between 7 and 9 hr per night increased from 44.8% to 53.6% and those reporting more than 9 hr sleep increased from 8.1% to 22.4%.
Gokseven et al., 2021	Israel	315 participants: 178 were female and 137 were male. The mean age was 71.5 ± 5.6 (min: 65, max: 94) years, and 26 participants were living alone.	315	Cross-sectional study	Survey items developed by the study's author including questions on sleep disorder.	Sleep disorder (Insomnia)	30.8% (n = 97) of the participants stated that they had difficulty falling asleep at night after the onset of COVID-19 infection
Hadar-Shoval et al., 2021	Israel	421 Participants. The sample comprised 295 women (70%), and participants had a mean age of 37.93 ± 16.47 years (range 18-90) and a mean education of 14.39±2.78 years. About 53.8% (n=226) lived in urban areas and 46.2% (n=194) in rural areas.	421	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	For the entire sample, sleep disorder (insomnia), as measured by PSQI, revealed poor sleep quality (6.82; above 5 is an indication of sleep disturbances).
Hammoudi et al., 2021	Lebanon	111 (18.8%) males, 480 (81.2%) females	591	Cross-sectional	Insomnia Severity Index	Insomnia levels	Regarding phone screen times among the university students, the prevalence of insomnia, anxiety,

				study	(ISI), Bedtime Procrastination Scale		depression, and overweight increased with increasing phone screen time. Female sex (adjusted odds ratio [aOR]=2.19, 95% confidence interval [CI]=1.27-3.77), overweight status (aOR=1.85, 95% CI=1.22-1.28), insomnia (aOR=1.06, 95% CI=1.02-1.10), and bedtime procrastination (aOR=1.03, 95% CI=1.00-1.07) were significant predictors of a phone screen time of ≥7 hours
Hammouri et al., 2022	Jordan	467 participants. 297 (64%) responses from females and 170 (36%) from males. The population age was between 18 and 103 years old and the mean was 33.9 years (SD 13.1).	467	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration.	Sleep duration	There is a significant difference in the increase in hours of sleep, where single people (59%) increased the amount of sleep more so than married people (43.4%). The respondents who increased their sleeping hours tended to have a younger mean of age for all significant pairwise comparisons.
Husain et al., 2020	Kuwait	415 adults participated in this descriptive cross-sectional study with a mean age of 38.47 ± 12.73 years; most of them were females, numbering 285 (68.7%).	415	Cross-sectional study	Survey items developed by the study's author including questions on sleeping habits.	Sleep quality	With regard to sleeping habits, results indicated significant statistical differences before and during the pandemic, there was a decrease in the percentage of participants who slept during the night and a marked increase in the percentage of participants who slept during the day (OR = 3.99 (95% CI 2.86–6.62), p < 0.001)
Hussien et al., 2020	Egypt, Jordan, and Saudi Arabia	General populations of Egypt (198 participants, 40% female), Jordan (148 participants, 36% female), and Saudi Arabia (358 participants, 42% female) were recruited.	704	Cross-sectional study	Survey items developed by the study's author including questions on sleep quality.	Sleep quality	53.7% of the sample reported sleep disturbances. A high DASS mean score was significantly associated with reporting disturbances in sleep
Iqbal et al., 2021	Saudi Arabia	397 questionnaires from the participants. The respondents were mostly of youth age (19-24 years), 66.5% of respondents were male, while there were 33.5%	397	Cross-sectional study	Pittsburgh sleep quality index	Sleep quality	While correlating the sleep patterns disturbance in individuals who had contact with COVID-19 patients, there was a significant sleep disturbance. The disturbance of sleep was in having problems falling sleep (p-value=0.024), having bad/horrible dreams (p-value=0.017), feeling cold at sleeping (p-

		females. Most of the participants did not contact any COVID-19 patients (75.1%, n=298)					value=0.038), and difficulty staying active during eating or driving (p-value=0.012). The sleep quality is poor due to the stay-at-home order, having a disorganized working schedule, and deprived lifestyle.
Karahan Yilmaz et al., 2021	Turkey	A total of 1120 individuals, 412 (36·8 %) male and 708 (63·2 %) females, participated in the study. The mean age was determined as 33·04 ± 11·04. Among those who participated in the research, 84·6 % of individuals were university/bachelor's/master's degree graduates.	1,120	Cross-sectional study	Survey items developed by the study's author including questions on sleep quality and sleep duration.	Sleep duration Sleep quality	During the pandemic period, 42·5 % of the individuals stated that they slept more and 40·2 % stated that there was no change in their sleep patterns. Daily physical activity durations were determined as 8·25 ± 1·77 h for sleep
Keng et al., 2022	86 countries	67% (n = 4959) of the participants were female	7,402	Longitudinal study	Survey	Question on sleep quality	COVID-related infection risk and perceived economic burden were both negatively associated with sleep quality during the previous week. (b = 0.67, SE = 0.01, p <.001) Those who reported high economic burden (top 10%) reported decreased sleep quality regardless of levels of perceived infection risk, b = -0.02, SE = 0.02, p =.325, whereas people perceiving low economic burden (bottom 10%) reported better sleep quality if their perceived infection risk was also low, b = -0.111, SE = 0.02, p <.001
Kilani et al., 2020	MENA region	917 males, 37.4 ±13.4 years old and 806 females 32.2 ± 11.5 years old	1,723	Cross-sectional study	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality	t-test analysis revealed a significant difference in mental wellbeing score based on sleep quality (t = -16.413, p < 0.001). A significant number of respondents (43%) reported poor sleep quality. Those with good sleep quality showed significantly better mental wellbeing (15.5 ± 3.4) in comparison with those with poor sleep quality (12.4 ± 4.2) (p <

							.001)
Kolokotroni et al., 2021	Cyprus	Out of 745 participants (sample of adults who resided in Cyprus during the Spring 2020 lockdown), 74% were female and median age was 39 years.	745	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	Overall participants reported significantly worse sleep quality score (4 v 5, p < 0.01) during lockdown. Regarding the individual PSQI score components (sleep latency, daytime dysfunction, sleep medication and sleep quality), all increased during lockdown (p < 0.01), demonstrating a worse sleep experience, except sleep efficiency, which marginally improved during lockdown (p < 0.01). a positive moderate correlation (r = 0.4064, p < 0.01) between differences in perceived stress and sleep quality index before and during lockdown, indicating that an increase in perceived stress was associated with worsening sleep quality. Overall support index score difference was negatively correlated with sleep quality index difference (r = − 0.2253, p < 0.01), showing that a decrease in the overall support index during lockdown was associated with worsening sleep quality.
Korkmaz et al., 2020	Turkey	61 (44%) females and 79 (56%) males participants The average age for female participants was 30.7 ± 6.2 and the average age for male participants was 35.6 ± 8.7	140	Cross-sectional study	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality	There was a positive correlation between the Beck Anxiety Inventory (BAI) scores and the PSQI and Problem Solving Inventory (PSI) scores of the participants and a negative correlation between the World Health Organization Quality of Life-BREF (WHOQOL-BREF) scores and the PSQI and PSI scores of the participants (p = 0.000, r = 0,508; p = 0.029, r = 0,184; p = 0.000, r = −0,360)
Lan et al., 2021	Israel	Studied the effects of lockdown in three cohorts: (1) 169 individuals from the general population; (2) 91 undergraduate students and (3) 39 women within fertility age.	299	Cohort study	Sleep logs Online questionnaire	Sleep duration Sleep quality Sleep disorders	In cohort (1) lockdown resulted in increased sleep duration (p<0.001), and delayed midsleep point during workdays (p=0.07) and weekends (p=0.02) largest change in sleep duration was shown in young people with late chronotype (p=0.04) and older subjects with early chronotype (p=0.04). In cohort (2), There were effects of lockdown

							(p=0.02) and chronotype (p=0.05) on sleep duration. Increased sleep during lockdown and in early chronotypes. Females slept more during lockdown (p=0.01) and students who work slept less (p=0.02). Midsleep point free days (MSF) was delayed during lockdown (p=0.001) with MSF of late chronotypes later than MSF of early chronotypes (p<0.001).
Lin et al., 2020	Iran	A sample of Iranian young adults (n = 1078 with 628 males; mean age = 26.24 years [SD ± 7.41])	1078	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	Insomnia was mutually and significantly correlated with psychological distress, problematic social media use, fear of COVID-19, COVID-19 misunderstanding. Problematic social media use was significantly associated with insomnia via both direct (B = 0.095; SE = 0.038) and indirect paths.
Lin et al., 2020	19 countries	N/A	N /A	Longitudinal study	Google trends	Sleep disorder (insomnia)	The countries with the greatest increases in searches for insomnia were Iran, Spain, the United States, and Italy; these countries exhibited a significant increase in insomnia searches on more than 10 of the 31 days observed. The number of COVID-19–related deaths was positively correlated to the number of days with an increase in searches for insomnia in the 19 countries (ρ=0.64, P=.003)
Lin et al., 2022	Iran	Sample of 10,843 participants (mean age = 35.54 years; SD = 12.00), 6751 were females (62.3%)	10843	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	Suicidal ideation was positively and significantly correlated with insomnia (r = 0.327; p < 0.001) Generalized trust was negatively and significantly correlated with insomnia (r = −0.100; p < 0.001) insomnia and fear of COVID-19 were positively and significantly correlated (r = 0.271; p < 0.001).
Maatouk et al., 2022	Lebanon	948 participants, divided into four groups: non-smokers not at risk (NSNR), non-smokers at risk (NSR), smokers not at risk (SNR), and smokers at risk (SR). A person at risk is	948	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration.	Sleep duration	NSNR significantly increased their sleep duration by 64.284 min per night (p < .001) SNR increased their sleep duration by 54.732 min per night (p < .001)

		an individual with a disease that could worsen the prognosis of a potential COVID-19 infection. Age mean: NSNR (26.52 years, standard deviation = 10.051), NSR (33.26 years, standard deviation = 15.672), SNR (29.55 years, standard deviation = 11.314), and SR (34.39 years, standard deviation = 12.193)					
Mahamid et al., 2021	West bank of Palestine	129 males and 237 females	366	Cross-sectional study	DSM-5 Level 2—Sleep Disturbance Scale	Sleep disorder(sleep disturbance)	Problematic internet use positively correlated with sleep disturbance ($r = .19$, $p < .01$), and negatively correlated with life satisfaction ($r = -.17$, $p < .01$). Moreover, life satisfaction negatively correlated to sleep disturbance ($r = -.25$, $p < .01$). Sleep disturbance explained statistically and significantly variance in problematic internet use ($B = .16$, $SE = .04$, $\beta = .20$)
Masoumi et al., 2021	Iran	Mean (SD) age was 28.8 (5.9) years. 119 females (60%)	200	Cross-sectional study	Mini-Sleep Questionnaire	Sleep duration and sleep quality	Sleep quality was 30%, worse in the pandemic period compared to the pre-pandemic states, The mean time to go to bed and wake-up time on weekdays in the pandemic were 35 and 24 min later than those in the pre-pandemic period respectively. The mean time to go to bed and wake-up time on weekends in the pandemic were 21 and 6 min later than those pre-pandemics. Before the pandemic, subjects went to bed on weekends 40 min later than on weekdays ($p < 0.0001$). In the pandemic, this difference decreased to 26 min ($p < 0.0001$). In both the pre-pandemic and pandemic periods, subjects woke up 96 min later on weekends compared to the weekdays ($p < 0.0001$). Before the pandemic, the

							mean sleep duration every night was 7 h and 22 min for the weekdays, which decreased to 6 h and 44 min during the pandemic. The difference signified a 38 min sleep debt every night. The night sleep duration on weekdays before the pandemic was 33 min shorter than the night sleep duration on weekends (p <0.0001). This difference decreased to 2 min during the pandemic.
Najafipour et al., 2021	Iran	Of 911 participants, 365 (40.1%) were men. Almost half of the participants (51.7%) aged over 55 years. Married people accounted for 80.4% of the samples, 72.7% were illiterate or have non-university education, and 67.6% were unemployed.	911	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration.	Sleep duration	42.8% and 58.8% experienced sleep time abnormality before and after the quarantine, respectively A high percentage of people experienced an increase in sleep hours (33.7%) The odds of an increase in sleep hours was higher in men and young people and lower in people with intense PA and higher levels of anxiety. The changes in the three variables were mostly related to the quarantine, although interaction between PA and sleep was also present. There was a negative relationship between anxiety and sleep hours and between PA and sleep hours both before and after quarantine.
Nakhostin-Ansari et al., 2021	Iran	675 people with a mean age of 40.28 years (SD=11.15) participated in the study. One-hundred and ninety-six (29%) were male, and 479 (71%) were female.	675	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	Three hundred and forty-two participants (50.7%) had subthreshold insomnia, 275 (40.7%) participants had moderate insomnia, and 58 participants (8.6%) had severe insomnia. Six-hundred and seventeen participants (91.4%) had DIS, 585 participants (86.7%) had DMS, and 520 participants (77%) suffered from EMA. The prevalence of these disorders was significantly different from each other (P<0.05), and DIS was the most common insomnia pattern. fear of COVID-19 was a risk factor for all patterns of insomnia (OR=1.19, 1.12, 1.02 for DMS, DIS, and EMA, respectively). Age was a risk factor for EMA (OR= 1.09), but it was a protective factor for DMS (OR=0.98). Self-employment was a risk factor for DMS (OR=1.61) and DIS (OR=1.59)

							Conclusion: Fear of COVID-19 is a major contributing factor to insomnia patterns. Investigation of COVID-19 fear in people with insomnia and the addition of attributed relieving or management strategies to conventional management of insomnia are reasonable approaches to improve the sleep condition of people in the pandemic.
Okudan et al., 2021	Turkey	37.88±12.44 years age, 346 (68.5%) females and 159 (1.5%) males	505	Cross-sectional study	Online survey	Quality of life (WHO Quality Of Life)-Bref version	27.5% (N.=142) informed that even they sleep enough time, wake up tired, while 22.1% (N.=114) cannot sleep enough time, and wake up tired.
Oved et al., 2021	Israel	Out of the 169 participants, 94 (55.62%) were women, and 75 (44.38%) were men. The age of the participants ranged between 20 and 80, with clear two main age groups: 20–40 and 60–80.	169	longitudinal study	Smartwatch data collection	Sleep duration Sleep quality	An increase was observed in sleep duration based on questionnaire responses (an average of 6.28 h versus 6.42 h, $p < 0.01$, Cohen's $d = 0.14$) and based on smartwatch records (an average of 7.03 h versus 7.12 h, $p = 0.05$, Cohen's $d = 0.14$), MSF (an average hour of 4.03 versus 4.12, $p = 0.02$, Cohen's $d = 0.13$) and MSW (an average hour of 3.43 versus 3.49, $p = 0.07$, Cohen's $d = 0.08$). No significant effects were found for stress, sleep quality and SJL.
Radwan et al., 2021	United Arab Emirates	2060 responses. Three-quarters (75.1%) were females, 31.7% were between 18 and 30 years old, 38.4% were between 31 and 40 years old, and 29.9% were older than 40 years. Over half of the study population (63.8%) were married and the majority had a university degree (76%).	2060	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration.	Sleep duration	Decreased sleep was reported by 20.8%. In terms of sleeping behavior, females were more likely to experience decreased sleep compared to males, whereas older adults (>40 years old vs. 18–30 years old) were less likely to experience decreased sleep during the lockdown.
Romdhani et al., 2021	49 countries	athletes (mean age: 25.1 (range 18-61) years, 1764 female (45%), 2427 team-sport (63%) and	3911	Cross-sectional study	Pittsburgh Sleep Quality Index (PSQI) and Insomnia	Sleep quality, Sleep disorder (insomnia)	PSQI (4.3 ± 2.4 to 5.8 ± 3.1) and ISI (4.8 ± 4.7 to 7.2 ± 6.4) scores increased from pre- to during lockdown ($p < 0.001$). PSQI was predominantly influenced by sleep-onset latency ($p < 0.001$; + 29.8%), sleep

		1442 elite (37%) athletes			Severity Index (ISI)		efficiency (p < 0.001; - 21.1%), and total sleep time (p < 0.001; - 20.1%), while ISI was affected by sleep-onset latency (p < 0.001; + 21.4%), bedtime (p < 0.001; + 9.4%), and eating after midnight (p < 0.001; + 9.1%) Athletes went to bed (+ 75 min; 5.4%; d = 1.14) and woke up (+ 150 min; 34.5%; d = 1.71) later during lockdown with an increased total sleep time (+ 48 min; 10.6%; d = 0.83). Lockdown-mediated circadian disruption had more deleterious effects on the sleep quality of individual-sport athletes compared with team-sport athletes (p < 0.001; d = 0.41), elite compared with non-elite athletes (p = 0.028; d = 0.44) and older compared with younger (p = 0.008; d = 0.46) athletes
Sadeghniiat-Haghighi et al., 2021	Iran	1,223 participants [827 (67.6%) female, mean age=39.82±10.75 years old]	1223	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	675 (55.2% [95%CI=52.40-57.98]) were categorized into the insomnia group. Insomnia was more prevalent in females (p=0.006), participants with 50 years old or higher (p=0.04), or high fear of COVID-19 (p<0.0001). Totally, 67.4%, 66.4%, and 55% of all participants had DIS, DMS, and EMA, respectively, in the current outbreak. Besides, 79% had impaired daily functioning, 51.6% had impaired quality of life, and 62% were worried about their sleep problem. Notably that a considerable percentage of individuals with normal ISI scores had at least one insomnia phenotype or impaired daily functioning and quality of life. Further analyses revealed a significant increasing trend in all four insomnia phenotypes prevalence with an increase in fear of COVID-19 (all p-values<0.0001).
Salehinejad et al., 2020	Iran	Healthy volunteers 137 females, mean age = 25.79 ± 7.31	160	Cross-sectional study	Pittsburgh Sleep Quality Index (PSQI), Quantitative sleep parameters, Morningness-Eveningness Questionnaire	PSQI: sleep quality, Quantitative Sleep parameters: about time to go to bed (clock), sleep onset latency time (in	PSQI: significant decrease of global sleep quality during quarantine (t = 6.95, p < 0.001. t-test showed that the time to fall asleep was prolonged during home quarantine as compared to the time before quarantine (t= 7.32, p < 0.001). The average sleep duration (in h) was significantly longer during quarantine, as compared to before quarantine as well (t = -3.65, p < 0.001). 85.6 % of the participants (137

						minutes), time to get up in the morning, and sleep duration Morningness-eveningness questionnaire: chronotype	of 160) reported at least 1 h delay to get up in the morning on average in home quarantine. The average delay to get up in the morning during home quarantine was 2.28 h. Results showed that participants' time to get up in the morning was significantly delayed during quarantine (t= 15.36, p < 0.001)
Salman et al., 2021	Kuwait	Data from 679 respondents (57.9% females and 42.1% males; 67.7% Kuwaiti nationals and 32.3% non-Kuwaiti nationals)	679	Cross-sectional study	Survey items developed by the study's author include questions on quality of sleep.	Sleep quality	Mental health was highly correlated with the quality of sleep Extremely severe depression was associated with having poor or very poor quality of sleep (1.75 times). Severe or extremely severe psychological distress was associated with having poor or very poor quality of sleep (2.20 times)
Salman et al., 2021	Kuwait	Among 679 respondents, 57.9% were female and 67.7% were Kuwaitis. Age group categories were represented relatively evenly, with 28.7% of respondents in their 20s, 29.3% in their 30s, 23.0% in their 40s, and 19.0% in the age range of 50 years or above. The average age was 37.7 (SD: 11.6).	679	Cross-sectional study	Survey items developed by the study's author include questions on quality of sleep.	Sleep quality	36.4% of respondents rated their quality of sleep as 'poor' or 'very poor'. Days of physical activity were positively correlated with 'quality of sleep' Sleep hours were positively correlated with good quality of sleep. Quality of sleep was negatively correlated with 'consumption of sugary drinks' and 'consumption of sweets and snacks', and positively correlated with 'the days of physical activity'.
Savci et al., 2021	Turkey	The final sample consisted of the remaining 103 older adults residing in a nursing home affiliated with the Istanbul Darulaceze Directorate of Hospice.	103	Correlational study	Survey items developed by the study's author include questions on sleep patterns.	Sleep quality	18.4% of the participants had change in sleep patterns during the pandemic.

		The inclusion criteria for the study were as follows: be over 65 years old, voluntarily agree to participate in the study, have a Standardized Mini Mental Test Score of 24 or higher, residence within the nursing home for at least one year, and speak and understand Turkish.					
Şentürk et al., 2021	Turkey	254 (55.3%) males and 205 (44.7%) females. The age of the participants ranged from 24 to 60 years (M=35.64, SD=6.84) and mean age was 35.64±6.84	459	Cross-sectional study	Jenkins Sleep Scale (JSS)	Subjective sleep quality	Poor sleep quality is a predictor of depression (β=0.378, p<0.001), of anxiety (β=0.373, p<0.001) and stress (β=0.324, p<0.001)
Sultan et al., 2021	Saudi Arabia	Three hundred thirty-eight individuals responded to the survey. Participants were 267 females (79%) and 71 males (21%) with a median age of 40 which ranged from 30 to 44 years.	338	Cross-sectional study	Survey items developed by the study's author include questions on sleep duration and sleep quality.	Sleep duration Sleep quality	The percentage of participants who used to sleep more than nine hours daily increased significantly during the pandemic from 8.3% to 21.8% (p<0.001). Use of sleeping aids increased from 11.6% to 15.7% (p<0.001), with 7.7% of participants having difficulty falling asleep for more than two hours. Moreover 41.8% did not feel relaxed after getting up from sleep during the pandemic compared to 14.2% before (p<0.001)
Toprak Celenay et al., 2020	Turkey	375 individuals in the Stay at home group and 311 individuals in the Continued to work group were included in data analysis.	686	Cross-sectional study	Jenkins Sleep Scale	Sleep quality	JSS-T scores reveled sleep quality was similar in both groups (p > .05)
Torkian et al., 2021	Iran	3,446 people completed the questionnaire. most participants were female (66.7%), mean (± SD) age of the	3446	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	73.5% had poor sleep quality. Perceived income, hours spent outdoors, the number of people with COVID-19 that were acquainted with, and a history of depression were significantly related to sleep quality.

		participants was 34.2 (±11.60) years. 65% were married.					
Yalcin et al., 2022	Turkey	A sample of 8,276 volunteers, aged between 18 and 65, were recruited via an online platform. The mean age of the sample was 39.86 (± 13.13). Approximately half of the sample were females (47.33%). Majority of volunteers were married (67.85%).	8276	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	46.38% of the sample were poor sleepers as indexed by the PSQI The PHAM showed that the perceived vulnerability to diseases was significantly associated with poor sleep quality (β = 0.175, p < 0.001) Negative affectivity as indexed by DASS-21 was significantly tied to poor sleep quality (β = 0.188, p < 0.001)
Yilmaz et al., 2021	Turkey	A total of 1120 individuals, 412 (36·8 %) male and 708 (63·2 %) females, participated in the study. The mean age was determined as 33·04 ± 11·04.	1120	Cross-sectional study	Survey items developed by the study's author include questions on sleep patterns.	Sleep duration Sleep quality	During the pandemic period, 42·5 % of the individuals stated that they slept more and 40·2 % stated that there was no change in their sleep patterns. Daily physical activity durations were determined as 8·25 ± 1·77 h for sleep.
Younes et al., 2021	Lebanon	A total of 4397 respondents. Included participants from all Lebanese districts, of whom 2924 (66.5%) were females, and those who received university education were 3664 (83.3%). The recruited participants were young adults between 18–35 years old, among which 3439 (78.2%) aged between 18 and 25 years	4397	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	A considerable proportion of participants had symptoms of insomnia (941 [21.4%]). The median IQR scores on the the ISI for insomnia for all respondents was 10 (5–14). Higher perceived likelihood of contracting COVID-19 (aOR = 0.67, 95% CI: 0.56; 0.79) resulted in no clinical or subthreshold insomnia. Single marital status (aOR = 1.43, 95% CI: 1.05; 1.93), divorced marital status (aOR = 3.33, 95% CI: 1.50; 7.39), university education (aOR = 2.50, 95% CI: 1.51; 4.16), consumption of caffeinated beverages (aOR = 1.24, 95% CI: 1.03; 1.49) and energy drinks (aOR = 1.22, 95% CI: 1.02; 1.47) were significantly associated with moderate to severe insomnia.

							Age group of 25–35 years was significantly associated with less insomnia scores (aOR = 0.77, 95% CI: 0.62-0.96) as compared to lower age group of 18–25 years. However, cigarette smoking was significantly associated with higher insomnia (aOR = 1.53, 95% CI: 1.25; 1.88) scores. physical activity of more than 3 times per week during lockdown were significantly associated with less insomnia (aOR = 0.65, 95% CI: 0.52; 0.83) Being a non-Lebanese was significantly associated with insomnia (aOR = 1.42, 95% CI: 1.12; 1.81) Drinking 2L of water or more during lockdown was significantly associated with lower insomnia (aOR = 0.76, 95% CI: 0.65; 0.88) No change in body weight status during lockdown was significantly associated with lower insomnia (aOR = 0.71, 95% CI: 0.58; 0.86)
Yurumez Korkmaz et al., 2021	Turkey	Participants (n = 136; 82 females, 60.3%) had a mean age of 73.4 ± 5.9 years. (Geriatric sample)	136	Cross-sectional study	Survey items developed by the study's author including questions on sleep problems.	Sleep disorders	Sleep problems (P = 0.000) were more common in participants with depression and anxiety. Sleep problems were present in one third of our study population, and found to be statistically significantly higher among patients with depression and anxiety. Sleep problems, which may be a component of psychological distress, have been found to be common in elderly people due to social isolation.32 Also, restricted physical activities and concerns about COVID-19 may lead to sleep disorders.
Zach et al., 2021	Israel	Participants were 1202 people, 381 males and 821 females, aged 45–90.	1202	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration.	Sleep duration	During the time of lockdown sleeping hours increased. Among the younger participants, a positive relationship was found between physical activity and the number of sleeping hours, while in the older ones a positive relationship was found between inactivity and the duration of sleep.

Healthcare workers							
Reference	Location of Study	Population	Sample Size	Study Design	Sleep Health Measurement Tool	Sleep Health Domains	Main Findings
Aarafa et al., 2021	Egypt, Saudi Arabia	This study included 426 HCWs (275 from Egypt and 151 from Saudi Arabia) distributed as follows: 206 (48.4%) physicians, 103 (24.2%) nurses, and 117 (27.4%) other HCWs. Of them, 47.2% were aged ≤30 years, 50.2% were men, 65% were living with children, and 51.6% were living with older adults.	426	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration.	Sleep duration	37.3% had inadequate sleeping (<6 h/day). Female sex, age ≤30 years, working in Egypt, attending emergency and night shifts, watching/reading COVID-19 news ≥2 h/day, and not getting emotional support from family, society, and hospital were associated with a high likelihood of inadequate sleeping.
Abbas et al., 2021	Kuwait	217 HCWs at Kuwait MOH hospitals completed the survey with mean (±standard deviation) age of 35.8 (±7.3) years; 56.2% were male	217	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep Quality	64 experienced sleep difficulties before COVID-19 crisis and 21 (9.68%) had a history of consuming medication for sleep difficulties. Prevalence of poor SQ during the COVID-19 pandemic and its stresses increased to 171 (78.8%), with a global PSQI score mean (SD) of 9.36 ± 4.4; the worst components of SQ were sleep latency, duration, and efficacy. HCWs with poor sleep had higher weekly working hours compared with those with good sleep (67.25% versus 47.83, p =0.015). Among the 32 participants who did swabs for suspected COVID-19 patients during their duties, 30 (93.75%) of them (p =0.01) experienced poor sleep.
Abdelghani et al., 2021	Egypt	218 HCWs from Egypt.. The mean age of the participants was 39.5 ± 8.5 years. The majority were females (n=156,	218	Cross-sectional study	short health anxiety inventory (SHAI)	Sleep duration	Those who reported higher levels of health anxiety to COVID-19 virus infection were more likely to be identified as working more days weekly (5.7 ± 0.8 days) and having lower sleeping hours (6.8 ± 0.9 hours).

		72%), nurses (n=111, 51%), and married (n=192, 88%)					
Abdoli et al., 2021	Iran	A total of 321 full-time frontline hospital staff members in Farabi Hospital (mean age: 36.86; 58% females)	321	Cross-sectional study	Athens Insomnia Scale	Sleep problems (insomnia)	Of the 321 participants, 44 (13.7%) had an insomnia score of 0 to 5 points; 272 (86.3%) had a score of six points and higher. The odds to report insomnia was 3.14-fold higher (CI: 2.64–3.75) among participants compared to the general population.
Abu-Elenin et al., 2021	Egypt	237 physicians, their mean age was 38.2 ± 6.2 years and 58% of them were males.	237	Cross-sectional study	Electronic questionnaire on mental health including quesitons on sleep quality	Sleep quality	The mean rate for sleep quality were poor; at 6.5 ± 3.2 out of 10
Al Ammari et al., 2020	Saudi Arabia	720 complete responses. 194 (26.94%) Physicians, 262 (36.39%) Nurses, and 171 (23.75%) pharmacists completed the survey. The participants' female respondents (64.17%) were almost double the males (35.83%), with nearly 75% above 30 years of age	720	Cross-sectional study	Insomnia severity index	Sleep problems (insomnia)	The largest proportion of health care workers (85.83%) experienced absence to subthreshold insomnia (57.08 and 28.75%, respectively). The rest (14.16%) reported moderately severe to severe insomnia (10.41% and 3.75%, respectively)
Al Maqbali et al., 2021	Oman	Frontline nurses, majority were female (90.7%, n = 895), and were married (85%, n = 839). The largest age group was those aged 31–40 years (59.5%, n = 587), followed by 41–50 years (20.1%, n = 198)	987	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality Sleep duration Sleep problems (sleep latency)	580 (58.8%) experienced poor sleep quality Average sleep duration was 7.04 (SD = 1.59) hours per night with 61.3% (n = 605) of participants reporting sleep of less than 7 h. Mean of sleep latency was 38 min, with 71.4% (n = 705) of the participants reporting more than 15 min. 23.7% of the participants reported a sleep efficiency of less than 85% 30% rated their quality of sleep as "fairly bad" or "very bad". The two most common reasons for sleep

							disturbance were “could not get to sleep within 30 min”, and “waking up in the middle of the night or early morning” as reported by 56.03% and 54.31%.
Alghufli et al., 2021	United Arab Emirates	A total of 400 HCW completed the survey. Majority of them were females (84.5%, n = 338) and aged between 18 and 31 (53.5%, n = 214).	400	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	187 (46.8%) suffered from clinical insomnia HCWs in the fever clinic that had sub-threshold insomnia (26.4%, n = 14). While at the clean and mixed clinics, HCWs had subthreshold insomnia (38.2%, n = 47). Among the 3 HCWs working at telemedicine clinic, insomnia levels were between subthreshold and moderately severe (33.3%, n = 1 for each category).
Ali et al., 2021	Saudi Arabia	Out of 200 healthcare providers, 40% were males. 52% were aged 31–40 years old, 61% were married. The majority of the participants were Saudi nationals (84%), 74% were nurses, 11% were physicians and 15% were other healthcare providers.	200	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	Working as a physician was associated with insomnia (OR, 2.32; 95% CI, 0.89–6.07; P = < 0.05)
Aljuffali et al., 2022	Saudi Arabia	502 pharmacists were included in the present study. Their mean (±SD) age was 31 (±8) years. Most respondents were female (51.8%). Moreover, most respondents were Saudi pharmacists (88.9%)	502	Cross-sectional study	Survey items developed by the study’s author including questions on sleep duration and sleep quality.	Sleep quality Sleep duration	Sleeping disturbances were found to be related to high burnout levels
Almater et al., 2021	Saudi Arabia	One hundred and seven ophthalmologists successfully completed the survey with a response rate of 30.6%. Males constituted 56.1% (n = 60). Ophthalmology	107	simple random study	Insomnia Severity Index	Sleep problems (insomnia)	Overall prevalence of dinsomnia was 44.9%; 32 had subthreshold symptoms (29.9%), 14 had moderate symptoms (13.1%), and 2 had severe symptoms (1.9%). There was also a trend to experience symptoms of

		residents constituted the majority (n = 66, 61.7%)					insomnia in frontline health-care providers (P = 0.129)
Almhdawi et al., 2022	Jordan	326 physicians of all Jordanian medical sectors and specialties successfully completed all of the study survey sections with a mean age of 32.08 (±6.93) ranged between 24−70 years and 44.2% of them were males.	326	Cross-sectional study	Survey items developed by the study's author including questions on sleep quality.	Sleep quality	poor sleep quality (58.3%)
Alshekaili et al., 2020	Oman	1139 HCWs, 228 (20.0%) are males, and 911 (80.0%) are females. Their average age was 36.3±6.5 (mean±SD) ranging from 21 to 65 years. The majority were Omani (n=981, 86.1%) and were married (n=987, 86.9%).	1139	Cross-sectional study	Insomnia Severity Index.	Sleep disorder (insomnia)	211 (18.5%) respondents were reported to have insomnia. HCWs in the frontline group were 1.5 times more likely to report insomnia (OR=1.586, p=0.013) as compared with those in the non-frontline group.
Amra et al., 2021	Iran	Among the 372 HCW participants, 245 (66%) were women and mean age was 34.5 ± 7.1 years (age range 23 to 58).	372	Cross-sectional study	Pittsburgh Sleep Quality Index Insomnia Severity Index	Sleep quality Sleep duration Sleep disorder (Insomnia)	Those participants who were directly caring for the patients including physicians and nurses had significantly higher PSQI but lower ISI questionnaire scores relative to other participants. PSQI were significantly higher in the HCWs with positive coronovirus PCR ISI were significantly lower in the HCWs with positive Coronavirus RT-PCR than another group Positive association between COVID-like symptoms and sleep and mood disturbances was found in the group without a positive test result.
Araç et al., 2020	Turkey	210 volunteers, including 105 healthcare professionals in the emergency department (53.8% female) and 105 healthcare professionals	210	Cross-sectional study	Pittsburgh Sleep Quality Index (PSQI)	Sleep disorder	PSQI subscale scores of the participants in the primary group were significantly higher than those of participants in the secondary group.

		working in other departments (46.2% females) rendering services for COVID-19 patients.					
Aslan et al., 2022	Turkey	845 nurses completed the questionnaire. In total, 72.2% of the nurses were female, 78% were graduates, 57.2% were single, 53.8% had a medium-income level, 69.7% were working in a state hospital, and 7.6% had a chronic disease.	845	Cross-sectional study	Bergen Insomnia Scale	Sleep disorder (insomnia)	A positive correlation was found between COVID-19 Fear Scale and the Bergen Insomnia Scale ($r = .392$; $p = .001$). The relationship between COVID-19 Fear and Bergen Insomnia Scale score averages and nurses' educational status, income level, shift working status, the status of their relatives being diagnosed with COVID-19, the state of being satisfied with the management of the pandemic process by the Ministry of Health, the situation of having resources in the settings where they work, the status of being in quarantine was statistically significant ($p < .05$).
Aydin Sayilan et al., 2021	Turkey	267 nurses The mean age of the nurses in this study was 28.03 ± 5.99 y (min: 21; max: 51), 75.3% were female, 63.3% were single, and 72.7% held an undergraduate degree.	267	Cross-sectional study	The Pittsburgh Sleep Quality Index	Sleep quality	Nurses mostly experienced emotional exhaustion, and burnout levels increased in line with insomnia.
Åžahin et al., 2020	Turkey	Six hundred twenty (66.0%) of the 939 HCWs taking part in this study were female, 339 (36.1%) were aged 26–30, 617 (65.7%) were married, 580 (61.8%) were physicians, 820 (87.3%) were working in an urban area, and 529 (56.3%) had been working for less than 10 years.	939	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	473 (50.4%) experienced insomnia symptoms Female gender, having tested for COVID-19, and history of psychiatric illness emerged as risk factors for insomnia. Nurses and frontline workers had a significantly higher insomnia score than other groups.
Badahdah et	Oman	Examined sleep quality in	150	Cross-	Sleep Quality	Sleep quality	HCWs who scored 10 or higher on the 7-item

al., 2020		a sample of 150 physicians (39.3%) and nurses (60.7%) who cared for patients with COVID-19 in Oman. Females made up 77.3% of participants. The average age was 37.62 years (standard deviation [SD] = 7.79 years).		sectional study	Scale		Generalized Anxiety Disorder Scale scored lower on sleep quality (mean = 5.98, SD = 2.29) HCWs who scored less than 50 on the WHO-5 had a lower score on sleep quality (mean = 6.29, SD = 2.08) The mean SQS score of 7 indicates that 40.1% of participants had poor sleep quality
Barut et al., 2021	Turkey	There were 213 volunteers in of a healthcare team providing service for COVID-19 patients, females 60.9%. 163 healthcare team working without direct contact with COVID-19 patients, females 47.5%.	379	Cross-sectional study	Jenkins Sleep Scale	Sleep quality Sleep problems	Sleep problems and stress levels were significantly higher among healthcare professionals who had direct contact with COVID-19 (+) patients compared to those who did not (P<0.05).
Bilgiç et al., 2021	Turkey	The average age of the nurses in this study was 32.24±8.41 years (min: 19; max: 56) and the average years worked was 10.31±9.08 years. 84.9%of the nurses were female, 50.0%were married, and 74.9%had a bachelor's degree.	316	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	It was found that the average PSQI score of the nurses was 7.36±3.35 (min=1, max=20) a positively significant correlation was found between the average PSQI score of nurses and the PSS score. These findings suggest that nurses perceive high levels of stress and have poor sleep quality.
Bulut et al., 2021	Turkey	Of the 348 healthcare professionals, 176 (50.6%) were women and 172 (49.4%) men, while 190 (54.6%) were doctors and 158 (45.4%) nurses. And 350 participants in the control group, 163 women (46.9%) and 186	698	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	Healthcare professionals: 44 had insomnia (%12.6) Nonhealthcare professionals: 45 had insomnia (%12.9) Insomnia were found to be statistically significantly higher amongst those working in the "area of final diagnosis" (P = .002)

		men (53.1%)					
Chan et al., 2021	Oman	A total of 1132 participants returned their completed questionnaire. A two-step cluster analysis was used to split the sample into three clusters. Clusters A, B and C contained 416 (36.7%), 412 (36.4%) and 304 (26.9%) HCWs, respectively. Cluster A was characterized by HCWs who were older (Mean ± SD, 37.3 ± 7.0 years) with more working experience (13.6 ± 7.1 years) in the health-care setting. more than 84% (n = 353) had not handled any COVID-19 cases during the pandemic period. Cluster B was mostly around 36 years of age (SD = 6.3). The majority were physicians (43.4%, n = 179) or nurses (42.5%, n = 175) All were working in the frontline, and more than 60% (n = 257) had experienced COVID-19 cases in the pandemic. In Cluster C, most HCWs were nurses (44.1%, n = 134) and working in the tertiary care hospital (44.4%, n = 135). They were younger	1132	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	Cluster A: The majority did not report any symptoms of clinical insomnia (97.6%, n = 406) Cluster B: The majority did not report any symptoms of clinical insomnia (96.6%, n = 398) Cluster C: The majority reported clinical insomnia (60.2%, n = 183) during the pandemic.

		(34.8 ± 5.7 years) and with less working experience (11.9 ± 5.9 years) There were around 50% (n = 159) working in the frontline only.					
Dolev et al., 2021	Israel	Medical residents treating COVID-19: 20 internal medicine physicians, 7 physicians working in emergency departments. The non-COVID group: 31 internal medicine, 16 physicians working in emergency departments, 8 psychiatrists, 16 gynecologists, and 7 surgeons	105	Cohort study	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality	COVID-19 group had longer sleep duration (95% CI: COVID-19: 1.44–1.94 vs non-COVID-19: 0.15–0.37;U (27,64) = 313.00, P < 0.0001), longer sleep onset latency (95% CI: COVID-19: 1.75–2.01 vs non-COVID-19: 0.68–0.94; U (27,64) = 326.50, P < 0.0001), deteriorated daily function (95% CI: COVID-19: 2.54–2.91 vs non-COVID-19: 1.28–1.60;U(27,64) = 143.00, P < 0.0001), poorer sleep quality (95% CI: COVID-19: 2.75–3.01 vs non-COVID-19: 1.74–2.10; U(27,64) = 258.00, P < 0.0001), and worse global PSQI score (95% CI: COVID-19: 9.97–11.25 vs non-COVID-19: 4.57–5.27; t(89) = 9.751, P < 0.0001)
Durmaz Engin et al., 2021	Turkey	360 actively working ophthalmologists. While 64% of them worked in the pandemic hospitals, 44% were actively involved in COVID-related departments.	360	Cross-secitonal study	Insomnia Severity Index	Sleep disorder (insomnia)	Symptoms of insomnia were present in 46.9% of participants. Ophthalmologists working in a pandemic hospital were more likely to experience insomnia. Higher insomnia scores in female responders (p=0.002) and in those with a chronic disease (p=0.004). Higher levels of satisfaction with the hygiene conditions in COVID and the ophthalmology clinics lower ISI scores (p=0.004)
Elghazally et al., 2021	Egypt	Sample included 2331 physicians; 1177 of whom worked in front line hospitals (group II) and the remaining 1154 physicians (group I) in other health facilities (second line). The mean age of the participants is 34.3 ± 6.1	2331	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration.	Sleep duration	In group I and group II (45.1% and 40.1% respectively) were at risk of falling or staying asleep or sleeping excessively.

		years. The majority of participants in group I and group II were in age group between 30 and 40 years (70.6% and 55%, respectively). In both groups, the majority of participants were females, married, urban dwellers, and specialists					
Elgohary et al., 2021	Egypt	270 health care workers (HCWs). The studied group age ranged from 18 to 52 years with mean 34.98 ± 6.27 years. 57% of HCWs were female. More than 72% of them had post-graduate education. Most frequent occupations among the participants were physicians and nurses (70.7% and 16.3%, respectively).	270	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration.	Sleep duration	There was a statistical significant decrease in sleep hours among HCWs with severe and extremely severe depression.
Elkholy et al., 2021	Egypt	502 HCW dealing with COVID-19 in 20 hospitals in different parts of egypt; 60.0% were physicians, 16.1% were specialized nurses, and 23.9% were non-specialized nurses. About 35.3% worked in chest hospitals, 17.5% in fever hospitals, and 47.2% in quarantine hospitals.	502	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	According to the insomnia severity scale 320 (67.7%) showed positive results; 195 (41.2%) were sub-threshold, 101 (21.4%) were moderate and 24 (5.1%) were severe. Participants with age group (31–40) were at higher risk of severe insomnia compared to those with >40 years old participants (OR, 2.79; 95% CI, 1.02–7.66; p = .01)
Hawari et al., 2021	Jordan	937 practitioners (56.1% females). Approximately 68%, 14%, and 18% were nurses/technicians,	937	Cross-sectional study	Survey items developed by the study's author including	Sleep quality	Sleep disturbances were reported (in past seven days) by approximately 29% of subjects.

		physicians, and pharmacists (respectively).			questions on sleep-related issues.		
Jahrami et al., 2021	Bahrain	A total of 257 participants (129 FLHCW and 128 NFLHCW)	280	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	The FLHCW scored higher in the PSQI and PSS compared with the NFLHCW; however, the difference in the PSQI score was not statistically significant. For the FLHCW, 75% were poor sleepers, 85% had moderate-severe stress, and 61% had both poor sleep quality and moderate-severe stress. For the NFLHCW, 76% were poor sleepers, 84% had moderate-severe stress, and 62% had both poor sleep quality and moderate-severe stress. Female sex and professional background were the predictors of poor sleep quality and stress.
Kandemir et al., 2022	Turkey	The study was performed with 194 nurses working in the intensive care units of five hospitals in Istanbul.	194	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	39.7% of the nurses experienced moderate (21.6%) or severe insomnia (18.1%).
Karabulut et al., 2021	Turkey	210 health care professionals working in ICUs were included in the study. Of the participants, 159 (75.4%) were female, and 185 (88.1%) were nurses. The mean age of the participants was 27.04 ± 5.71 years.	210	Cross-sectional study	Vısual analog sleep scale	Sleep quality	a positive relationship was found between state anxiety and sleep (r = 0.158, p = 0.022) The mean perceived visual analog sleep score was moderate and found as 503.79 ± 134.24
Khamis et al., 2020	Oman	402 female doctors and nurses recruited from several health facilities in Oman. A total of 231 (57.5%) Omanis and 171 (42.5%) non-Omanis participated in this study. Of the total 402 participants, 28.4%	402	Cross-sectional study	Sleep Quality Scale	Sleep quality	39.3% had poor sleep quality; this was particularly prevalent among Omanis. A multiple regression analysis revealed that anxiety, stress, and well-being were significant predictors of poor sleep quality.

		were physicians and 71.6% were nurses. One in four (27.9%) participants reported caring for COVID-19 patients					
Meo et al., 2021	Saudi Arabia	HCWs: 859 (51.2%) females, and 819 (48.8%) males	1678	Observational-analytical study	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality	1376 (82.0%) of the HCWs had poor sleep quality (≥5 global PSQI score). The results show that 975 (58.10%) were frontline HCWs, and 407 (23.89%) were second-line HCWs who suffered from poor sleep quality. The highest poor sleep quality levels were identified among HCWs who work in frontline areas (emergency departments, intensive care units, and wards) (642 (84.6%)), in comparison with others who work in second-line areas (734 (79.9%). 585 (85.7%) HCWs directly involved were suffering from poor sleep quality in comparison with 791 (79.5%) non-directly involved healthcare workers.
Mosheva et al., 2020	Israel	1106 Israeli physicians (564 males and 542 females) during the COVID-19 outbreak.	1106	Cross-sectional study	Survey items developed by the study's author including questions on sleeping difficulties.		Found a positive association between sleep difficulties and higher levels of anxiety among physicians. Sleeping difficulties score (1.81/5) ± 0.88
Mousavi et al., 2021	Iran	321 HCWs from major tertiary hospitals in Isfahan which were dedicated to COVID-19 patients. The mean age of participants was 33.5 years (SD: 7.65, range: 23–65). The mean of working experience in our study sample was 6.7 years (SD: 6.20, range: 1–30). In the study sample, 236 (73.8%) participants were female	321	Cross-sectional study	Insomnia Severity Index	Sleep disorders (insomnia)	The mean score of ISI was 10.3 (SD: 5.95, range: 0–25), and just 123 (38.8%) participants had normal sleep. The Pearson correlation analysis revealed that there is a statistically significant correlation between GHQ-12 and age (r: −0.12, P: 0.02), working year (r: −0.12, P: 0.03), ISI score (r: 0.56, P: 0.000), and social support score (r: −0.27, P: 0.000)

		and 156 (48.6%) of them were a nurse.					
Nashwan et al., 2021	Qatar	A total of 200 nurses participated in the study (response rate 13.3%). About 74.5% of nurses were working in COVID-19 facilities. Around 19.0%, 65.5%, and 15.5% of nurses were aged 20–30, 31–40, and above 40 years, respectively. About 59.5% and 80.0% of nurses were males and married, respectively.	200	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	In this study, there were no significant differences in sleep quality, stress, anxiety, depression, and perceived social support between nurses working in COVID-19 and non-COVID-19 facilities in Qatar
Oteir et al., 2022	Jordan	A total of 122 HCWs participated in the study (response rate=64.2%). Among the participants, 44.3% were physicians, 32.8% were nurses and 17.2% were paramedics. The mean age of participants was 32.1 (±5.8) years, and the majority were males (80.3%)	122	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	insomnia (31.9%), with increased severity of insomnia among paramedics Mean score of ISI was 11.2 (±6.4)
Sis Çelik et al., 2021	Turkey	211 nurses using a web-based online survey in Turkey (including 104 nurses working in wards where patients with COVID-19/107 nurses working in wards where patients without COVID-19). It was determined that the average age	211	Cross-sectional study	Post-Sleep Inventory	Sleep disorders	it was found that 31.8% of the Nurses involved in the study had very serious sleep problem during the COVID-19 period, and 21.3% had a moderate problem When the sleep problems experienced were compared according to the Post-Sleep Inventory, it was determined that the difference between thegroups was not statistically significant (p>0.05). There was a moderately significant and positive correlation between the nurses' mean scores for the COVID-19 Fear Scale and Post-Sleep Inventory.

		of the nurses working in wards where patients with COVID-19 are hospitalized was 29.04± 6.42. It was determined that the average age of nurses working in wards where patients without COVID-19 are admitted was 26.22±4.89					
Taş et al., 2021	Turkey	448 Family Physicians participated in the study. The average age of the participants in the study was 39.10 ± 9.59 (min 24, max 65).	448	Cross-sectional study	Survey items developed by the study's author include questions on sleep quality.	Sleep quality	While the rate of family physicians who evaluated sleep quality as very poor before the onset of the pandemic was 1.3% (n = 6), this rate increased to 13.8% during the pandemic process (n = 62). While the rate of those who reported sleep quality as poor before the pandemic was 12.7% (n = 57), this rate increased to 48.2% (n = 216) after the pandemic. While 65.4% (n = 293) of the family physicians participating in the study defined sleep quality as good before the pandemic, this rate decreased to 35.7% (n = 160) after the pandemic. While the rate of those who stated that the quality of sleep before pandemic was very good was 20.5% (n = 92), this rate decreased to 2.2% (n = 10) after the pandemic ($p < 0.001$). Thinking that personal protective measures were insufficient ($p = 0.000$) and working as a practitioner as a professional title were the most important factors affecting the deterioration of sleep quality ($p = 0.004$). Age, gender, marital status, having a child, the institution of employment, the years spent in the profession, and having contact history with Covid-19 positive cases were not effective in impairing sleep quality ($p > 0.05$). Family physicians whose workload dimension

							increased were the family physicians whose sleep quality deteriorated during the pandemic (p = 0.000).
Tasdemir Yigitoglu et al., 2021	Turkey	435 healthcare staff members. Their mean age turned out to be 36.76 ± 7.58. Slightly more than half of the participants were women (56.1%, n = 244), whereas 67.8% (n = 295) were married and 66.9% (n = 291) were parents.	435	Cross-sectional study	Pittsburg Sleep Quality Index	Sleep quality	Their mean PSQI score was 8.42 ± 2.30, and poor sleep quality was identified in an overwhelming majority of the healthcare staff (92.9%, n = 404). As for the sleep quality scores derived from the PSQI data, strong evidence was found for the within-group differences in terms of gender (female healthcare staff suffer from poorer sleep quality), parenthood (poor sleep quality in the enrolled healthcare staff with children), years of experience in the current department, health-related problems, history of mental disorders, and job satisfaction (p < 0.05)
Yilmaz et al., 2021	Turkey	Four hundred thirty-four healthcare workers participated in the study, of whom 70.7% were under 35 years of age, 65.0% were female, 60.6% were married, 64.1% were physicians, 56.7% held a master's degree or above, 73.0% worked in a hospital, 50% worked on the frontline and 36.4% had 5-10 years' working experience	278	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	The total prevalence of poor sleep quality was 56.7% The prevalence of poor sleep quality was 67.3% in nurses, 55.4% in physicians and 42.3% in dentists. Poor sleep quality was more prevalent among women, nurses, hospital workers, frontline workers, individuals with <5 years of work experience, those with low social support and individuals with increased traumatic stress levels. High levels of social support and family social support were identified as protective factors against poor sleep quality. Multivariate regression analyses showed that poor sleep quality was significantly associated with working in hospitals and high traumatic stress levels during the COVID-19 pandemic.
Yilmaz et al., 2021	Turkey	600 Healthcare workers participated in this study. 364 were females and 236 were males with a mean age of 33.49 ± 7.29 years.	600	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	Mean ISI score was significantly higher among HCWs working in COVID-19 clinics and intensive care units (p=0.000; p=0.039). Mean ISI score was significantly higher in women than men (p=0.000; p=0.000; p=0.027; p=0.005). Mean ISI scores was significantly higher among nurses (p=0.008; p=0.004).
Youssef et al., 2020	Egypt	540 healthcare professionals	540	Cross-sectional	Insomnia Severity Index	Sleep disorder (insomnia)	Just over one half of respondents (51.9%, n=280) reported sub-threshold insomnia to

		participated; their ages ranged from 20 to 70 years, with a mean of 37.3 (SD=9.2). The majority were male (54.4%, n=294), highly educated (postgraduate) (78.3%, n=423), physicians (77%, n=416), married (74.1%, n=400), had experience of five years or more (77.8%, n=420)		study			severe insomnia. The quarantine group and the non-quarantine group had an insignificant difference in adverse psychological symptoms and insomnia. Insomnia was high among those who reported experiencing stress, depression and anxiety (P<0.001).
Zarzour et al., 2021	Lebanon	A total of 628 healthcare workers completed the survey; 409 (66.2%) were younger than 40 years, and 441 (71.4%) were women. Of all participants, 503 (81.4%) were nurses, 52 (8.4%) were physicians and 63 (10.2%) were residents.	628	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	The mean (SD) scores on the PSQI for sleep quality for all respondents was 6.0 (3.7). 48.4% were “poor sleepers” as they got PSQI scores higher than 5. Participants who were aged more than 50 had lower sleep quality scores than those aged between 41 and 50 and significantly lower scores than those younger than 40 (P = 0.005 (PSQI)) Residents had significantly higher sleep disturbances scores than practical nurses (P = 0.016). Registered nurses compared to physicians and practical nurses had significantly higher sleep quality scores (P < 0.001) Participants who reported having relatives or friends who got infected or quarantined had higher sleep disturbances scores than those who had not (P = 0.019 for PSQI). Participants who were exposed to COVID-19 related media for more than 2 hours per day, had poorer sleep quality (P = 0.011) than those who were exposed to media less than 2 hours per day and to those who were not exposed at all. Greater number of stress sources was positively correlated to higher sleep disturbances (r = 0.129, P

							= 0.001, respectively) Participants were asked whether they were still able to practice the strategies they normally use to deal with stress. Those who were still able to do it (60.4%) had lower anxiety and significantly lower sleep disturbances scores than those who were not (P = 0.096 for STAI and P = 0.011 for PSQI).

Students							
Reference	Location of Study	Population	Sample Size	Study Design	Sleep Health Measurement Tool	Sleep Health Domains	Main Findings
Al Mukhaini et al.,	Oman	376 Omani students who had returned to Oman from abroad due to the COVID19 pandemic. 255 male (67.8%) and 121 female (32.2%) participants. The mean age of the participants was 21.7 years old (SD = 3.8), ranging from 18 to 45 years old.	376	Cross-sectional study	Athens insomnia scale	Sleep problems (insomnia scale)	49.5% (n = 186) noted to be suffering from insomnia Female students were 2.4 times (OR = 2.43; CI: 1.50–3.93; P< .001) more likely to be insomniac compared to male students The risk of insomnia may be less in the subjects going for a walk (OR = 0.29; CI: 0.12–0.69; P = 0.008)
Ali et al., 2021	Lebanon	510 secondary level school students from grades 9–12 participated in this online survey. Among these, 382 (74.9%) were females, and there was no significant difference in age between male and female students.	510	Cross-sectional study	Insomnia Severity Index Bedtime Procrastination Scale	Sleep disorder (Insomnia, bedtime procrastination)	Screen time of more than seven hours per day was significantly associated with insomnia (82%), and bedtime procrastination.

Alrashed et al., 2021	Saudi Arabia	Total number of participants was 453 from 3rd to 5th medical year, and intern medical students.	453	Cross-sectional study	Insomnia Severity Index	Sleep problems (insomnia)	162 (34.9%) of the participants had insomnia symptoms, among them 57.4% of females and 42.6% of males have insomnia. Participants with an age group between 22 and 25 have more sleep issues (43.2%) as compared to other age groups. 3rd-year students have more insomnia 36.41% as compared to other years. The age group 30 and above have a high prevalence of insomnia (OR = 1.67; P = 0.26), followed by the age group 26–29 (OR = 1.40; P = 0.19) Those who have a severe level of stress have ~3 times higher prevalence of insomnia (OR = 2.81; P = 0.0008), followed by a moderate level of stress (OR = 1.50; P = 0.15) Those who were involved in religious practices have less sleep problems. Similarly, those who have mentally accepted the current COVID situation also have less sleep problems (P = 0.0001) as compared to those who did not accept the current situation.
Alshammari et al., 2021	Saudi Arabia	186 replies were received from professional pharmacy students . Female students accounted for 64.5 percent of the total, which is in line with their general ratio in the Pharm.D. Program. The second professional year had the most participants (25.8%), while the sixth professional year had the least (7.0%)	186	Cross-sectional study	Survey items developed by the study's author including questions on sleep quality.	Sleep quality	"Discovered that practically all students were plagued by symptoms of sadness, anxiety, tension, and poor sleep quality"
Alyoubi et al., 2021	Saudi Arabia	A total of 582 undergraduate students. 73% were female and 25% were male. The majority (78%) of undergraduate students	582	Cross-sectional study	Insomnia Severity Index	Sleep duration Sleep quality Sleep disorder (insomnia)	Over one-third of students reported that sleep had been impacted and worsened during the pandemic. 22% having trouble falling asleep, 17.9% waking up during the night, 8.8% waking up early in the morning, 25.9% have poor sleep quality, 22.7% feeling tired during the day, 9.3% have nightmares

		were enrolled at the King Abdulaziz University and 16% were studying at Jeddah University in Saudi Arabia.					and 5.2% have poor dreams This study showed that over half of students reported sleep disruption and 1.4% were taking melatonin supplements for the sleep problem. A small percentage (4.3%) had very mild sleep problem, while 16% reported a mild sleep problem, 21.8% moderate, 9.3% severe, and 1.2% very severe. There was no significant difference between older and younger students on the level of insomnia. Students reported a statistically high level of insomnia with a high level of depression, anxiety, perceived stress ($p < 0.001$). Undergraduate students reported statistically more insomnia symptoms with a lower level of psychological resilience ($r = -0.150$, $p < 0.001$). The level of insomnia was slightly higher for students who self-isolated Students who received support from mental health services but had it stopped and offered online and declined before COVID-19 reported a significantly higher level of insomnia $F (5, 555) = 2.768$, $p = 0.018$).
Bosi Bağcı et al., 2021	Turkey	340 interns accounting for 63·4 % of the target population completed the online questionnaire. Almost 60 % of the participants were composed of females and the mean age was 24·89	340	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	Sleep quality during the COVID-19 compared to the pre-COVID-19 period was assessed and it was found that only 27·8 % of the interns observed no change in sleep quality. However, 38.6 % of the interns experienced an improvement and 33.6 % had a reduction in sleep quality. Then, the sleep quality of interns was evaluated with PSQI and 53·4 % of the students were found to have poor sleep quality during the COVID-19 period. The effect of gender on sleep quality was also evaluated and even though female students had a predilection towards poor sleep quality, there was no significant difference between genders (P = 0·075)
Cakmak et al., 2022	Turkey	564 students The mean age of the participants was 28.13 ± 0.49 years (min: 18 / max: 90). While 71.1% of the participants were	564	Cross-sectional study	Bergen Insomnia Scale	Sleep disorder (insomnia)	The results revealed that 64.7% of the participants had insomnia. he findings suggest that there was no statistically significant difference between insomnia and age, educational attainment, smoking status, and who the participants lived during the quarantine ($p>0.05$).

		female, 66.5% were single. It was found that 66.3% of the individuals were university students, and 82.8% did not have any chronic diseases.					Those who used a phone or tablet before sleeping (p = 0.020) were found to have significantly higher levels of insomnia than others. The mean days of uninterrupted home quarantine was higher for participants experiencing insomnia.
Dalcalı et al., 2021	Turkey	mean age of students was 20.39 ± 2.05 years and 82% (n = 232) were female, and 33.6% (n = 95) were first-year students	283	Descriptive, correlational	Verran and Snyder–Halpern sleep scale (VAS)	sleep disturbance, effective sleep, daytime sleep	Before COVID-19, 21.20% reported that their night sleep was interrupted, while during the COVID-19 period, this rate increased to 28.26% and this increase was considered to be statistically significant. There was a high-level positive significant correlation between students' sleep quality and state anxiety (r: 0.305, p: 0.000**) and trait anxiety (r: 0.288; p: 0.000)
Elakany et al., 2022	Global	3793 (22.3%) of students. 61.7% females and the mean age was 31.0 years (SD = 8.9)	17,008	Cross-sectional study	Online survey	changes in sleep pattern (sleeping more, less, or no changes)	4,889 people (28.7%) reported change in sleep patterns. Compared to non-students, students had significantly higher odds of reporting changes in sleep (AOR = 1.52; 95% CI: 1.39, 1.67). Participants from LICs and LMICs had lower odds of reporting changes in sleep (AOR = 0.74; 95% CI: 0.58, 0.94 and AOR = 0.67; 95% CI: 0.61, 0.72). participants from UMICs, had significantly higher odds of reporting changes in sleep (AOR = 1.26; 95% 1.15, 1.39)
Elsalem et al., 2020	Jordan	1019 students from Jordan University of Science and Technology agreed to participate in the study and completed the survey. Approximately, half of the participants were from Faculty of Medicine (51.32%), while the other half in descending order were students from Faculties of Nursing, Dentistry, Pharmacy and Applied Medical Sciences. Almost two-	1019	Cross-sectional study	Survey items developed by the study's author include questions on sleep duration and sleep disorder.	Sleep duration. Sleep disorder (insomnia)	Student's experience of stress during exams was also found to be significantly associated with changes in sleeping hours. Among students who reported more stress with remote E-exams, 44.15% had reduction in their sleeping hours and 28.65% reported more consumption of medications to relief insomnia. Caffeine was mainly consumed to keep students more alert for exam preparation and was linked to loss of sleep during exams days

		thirds of the respondents (65.55%) were females.					
Göl et al., 2021	Turkey	2630 nursing students. The mean age of students participating in the study was 21.30 ± 1.95 SD. The majority of them (82.1%) were female students and 11.4% had a chronic disease.	2630	Cross-sectional study	GHQ-12	Sleep disorder (sleep pattern)	Change in sleep pattern 62.9% (= 0.629)
Goweda et al., 2020	Saudi Arabia	438 medical students were recruited from the second year to the sixth year among Umm Al-Qura University Faculty of Medicine. Half (50.5%) were female, nearly all (422, 96.3%) had a single marital status, and a minority (55,12.6%) had chronic disease.	438	Cross-sectional study	Sleep-50 questionnaire	Sleep disorders (narcolepsy, insomnia, CRD)	323 (73.7%) of the participants complained of at least one sleep disorder. The most prevalent sleep disorder was Narcolepsy (NL) with 226 (51.6%), followed by 138 (31.5%) with insomnia, and 98 (22.4%) indicating Circadian Rhythm sleep Disorder (CRD) 87 (19.9%) of respondents positive for at least two combined sleep disorders, and 63 (14.4%) demonstrating three combined sleep disorders. In the time students spent watching television and/or on smartphones, there was significant difference in students with sleep disorders (m=6.71 hours, SD=3.83) and those without (m=5.90 hours, SD=3.40) (p=0.004) Significant relationship between gender and sleep disorder, with females more affected at 178 (80.5%) than males at 145 (66.8%) (p=0.001)
Grande et al., 2021	Saudi Arabia	152 nursing intern students were involved in this study. Among them, 73% are in the age of 20 years and below, while 23.7% are between 31 and 40 years of age, and 3.3% fall within the age range of 21–30 years old. In terms of gender,	152	Cross-sectional study	Quality of Life Evaluation Scale	Sleep quality	Sleep satisfaction score 1.99/5.00

		53.9% are males, and 46.1% are females.					
Jalal et al., 2021	Saudi Arabia	628 students studying bachelor's degree programs, between 18 and 30 years of age. 70.9% were female	628	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	Approximately, 188 (29.9%) students felt that sleep quality was good before lockdown, and 126 (20.1%) students felt the same during the lockdown. Moreover, the total sleeping time increased from 6.6 ± 2.3 hours per day to 8.3 ± 2.7 hours per day, which was also proved statistically significant (p = 0.001).
Joseph et al., 2022	Israel	533 undergraduate students of education submitted an online questionnaire before the lockdown and at its end.	533	Prospective cohort	Mini Sleep Questionnaire	Sleep quality	Levels of sleep quality (mean 5.34 [SD 0.92] vs mean 5.12 [SD 0.46], P=.02) and well-being (mean 3.79 [SD 0.62] vs mean 3.67 [SD 0.59], P=.02) were higher during the COVID-19 lockdown. These findings indicate that undergraduate students seem to have taken advantage of the change in lifestyle due to the lockdown, directing the free time toward improving health by engaging in more physical activity, thus improving sleep quality and well-being.
Kheirallah et al., 2021	Jordan	1,404 students participated in the current study. About two-thirds (59.9%) of participants were females, 64.9% were enrolled at the two well-established medical schools at the University of Jordan (39.1%) and Jordan University of Science and Technology (JUST) (25.8%), and 59.6% were in the pre-clinical stage of their medical education.	1404	Cross-sectional study	Survey items developed by the study's author including questions on sleep disorders.	Sleep disorder (insomnia, nightmares)	About 13% of students self-reported experiencing increased insomnia, shallow sleep, nightmares, or insufficient sleep. In general, females self-reported experiencing significantly more sleeping problems than males. Likewise, students in the pre-clinical years experienced sleep problems (insomnia, shallow sleep, and insufficient sleep) significantly more frequently than those in their clinical years.
Meo et al., 2022	Saudia Arabia	The total number of medical and science students included was 782, out of whom 410 (52.4%) were medical	782	Cross-sectional Study	Pittsburgh Sleep Quality Index,	Sleep quality Sleep duration	Out of 782 participants, 669 (85.55%) had poor sleep quality (≥5 Global PSQI score), while only 113 students had good sleep quality (<5 Global PSQI score). Out of 410 medical students, 336 (81.95%) had poor sleep quality, and 74

		students, and 372 (47.6%) were science students, including Physics, Chemistry, Mathematics, Statistics, Botany, and Zoology. Among medical students, 143 (34.9%) were in pre-clinical years (1st and 2nd), while 266 (64.9%) of them were in clinical years 3rd, 4th, and 5th-year medical students. Female students were 65.3% of the sample.					(18.05%) had good sleep quality. While out of 372 science students, 333 (89.5%) had poor sleep quality, and 39 (10.5%) had good sleep quality. Overall, it was seen that the sleep quality of science students was poorer (Mean Global PSQI score= 8.78) than their medical counterparts (mean Global PSQI score= 7.93) Sleep quality, sleep duration, and daytime dysfunction were poorer among pre-clinical students than clinical students Out of the selected cases with poor sleep quality (≥5 PSQI score), 32.1% were males, and 67.9% were females. It was found that sleep disturbance and daytime dysfunction were poorer in students with higher BMI ranges
Nakhostin-Ansari et al., 2020	Iran	323 medical students have completed the questionnaire (response rate = 64.6%); 37.2% of them were clerks and 62.8% interns. The mean age of participants was 23.73 (SD = 1.62), and 47.7% of them were male and 52.3% female.	323	Cross-sectional study	Survey items developed by the study's author including questions on sleep patterns.	Sleep disorder (sleep pattern changes)	Changes in sleep pattern (74.3%)
Saadeh et al., 2021	Jordan	6,157 undergraduate students (mean age 19.79 ± 1.67 years, males 28.7%) from the University of Jordan	6157	Cross-sectional study	Pittsburgh Sleep Quality Index,	Sleep quality	The sleep quality of three-quarters of the participants was negatively affected by the extended quarantine. Nearly half of the participants reported poor sleep quality. The prevalence of poor sleep quality among participants was 76% (males: 71.5% and females: 77.8%).
Sarsak et al., 2022	Saudi Arabia	A total of 244 students completed the survey (60.7% were female). The mean age was 22.10±2.69	244	Cross-sectional study	Survey items developed by the study's author include questions on	Sleep quality	34.5% (n=84) reported sleeping late and waking up more frequently.

					sleep disturbances.		
Torun et al., 2020	Turkey	275 students. About 60.7% of the participants (n = 167) were female, 39.3% (n = 108) were male and the mean age was 22.10 ± 2.69.	275	Cross-sectional study	Survey items developed by the study's author include questions on sleep duration and sleep quality.	Sleep quality	After the COVID-19 pandemic, the sleep patterns of the participants changed as 29.5% (n = 81) asleep late, wake up frequently and can not fall asleep.

Children							
Reference	**Location of Study**	**Population**	**Sample Size**	**Study Design**	**Sleep Health Measurement Tool**	**Sleep Health Domains**	**Main Findings**
Alanazi et al., 2022	Saudi Arabia	A total of 1021 parents completed the survey, of which 78.8% were Saudis. Fifty-five per cent of respondents were mothers with an average age of 41 (±9.2) years. The mean age of the children was 8.5 (±1.85) years. Sixty per cent of the study sample were girls.	1021	Cross-sectional study	Survey items developed by the study's author including questions on sleeping duration and sleep quality.	Sleep duration Sleep quality	Slightly more than half the children met the sleep recommendations (95% CI 52.9, 60.9) Sleep quality was reasonably high (average of 5.4 [2.26] points out of 7.0) Weak negative correlation between parent education level and the quality of their child's sleep (r = −0.11, p < 0.0001)
Almhizai et al., 2021	Saudi Arabia	Questionnaire was completed by 1141 respondents. Of these, 454 were < 18 years old (360 were aged 16 - 18 years old, and 94 were < 15 years old). Thus, these respondents	1141	Cross-sectional study	Survey items developed by the study's author including questions on sleep quality and sleep duration.	Sleep quality Sleep duration	Higher age was associated with higher increase in the frequency of waking up (r = 0.076, P < 0.05), sleeping little (r = 0.058, P < 0.05) Having relatives who were infected with COVID-19 was associated with sleeping little (r = 0.074, P < 0.01) Children whose parents were divorced had higher scores on sleep disorders.

		completed the questionnaire on behalf of themselves. The remaining 688 respondents were adults and completed the questionnaire on behalf of their children. Male and female children represented 42.5% and 57.5% of the study sample.					
Almugti et al., 2021	Saudi Arabia	651 participants in total; slightly over half (58%) were female. The respondents answered questions related to their children. These items showed that the mean age of their children was 9±4 years, the majority of the children were living in apartments (63.9%), and that 89% of the children were living with both their father and mother.	651	Cross-sectional study	Survey items developed from a similar study on Arab Israeli children including questions on sleep quality and sleep duration.	Sleep duration Sleep quality	During the COVID-19 outbreak, one-third of children had asked to sleep in their parents' beds. Study reports reduced sleep time among children compared with the pre-pandemic period.
Al-Rahamneh et al., 2021	Jordan	Data collected from 1309 parents (mothers = 1219 (93.1%); fathers = 90 (6.9%) children (n = 1309 male = 716 (54.7%) and female = 593 (45.3%)), they were between 5–11 years of age (8.1 ± 2.02 years) and most of them were studying at private schools (92.7%).	1309	Cross-sectional study	Children's emotional and behavioral symptoms questionnaire	Sleep duration	42.5% of children had 8 h or less of sleep per night, which is considered as a short sleeping duration.
Bucak et	Adıyaman,	Group 1 (school age	372	Comparati	Children's Sleep	Child's sleep	Total CSHQ scores were 41.57 ± 7.57 (20–60) in

al.,2021	Turkey	children of health worker parents): 122 participants, 66 (54.1%) females and 56 (45.9%) males Group 2 (school age children of non-health worker parents): 250 participants, 129 (51.6%) females and 121 (48.4%) males		ve study	Habits Questionnaire (CSQH)	habits and sleep-related problems. 8 subscales included*: bedtime resistance, sleep onset delay, sleep duration, sleep anxiety, night wakings, parasomnias, sleep disordered breathing, and daytime somnolence.	Group 1 and 39.6 ± 8.47 (17–68) in Group 2 (p:0.03)
Cahal et al., 2021	Israel	Mean (±SD) age of patients was 6.2 years (4.7) with a range of 0–18 years. 276 (62%) males and 169 (38%) females 368 (82%) had a single respiratory disorder, the most common of which were asthma (n=291, 65%), recurrent pneumonia (n=96, 21.5%), bronchopulmonary dysplasia (BPD; n=32, 7.2%)	445	Cross-sectional study	Anonymous electronic questionnaire	Secondary outcomes related to patients' lifestyles	During the lockdown, Sleep duration increased in 59 patients (13.4%), decreased in 227 patients (51.1%) and remained unchanged in 155 patients (35.1%). Older patients experienced increased screen time, decreased physical activity, and shorter sleep duration (p = .008, <.001, and <.001, respectively) compared to their younger counterparts
El Refay et al., 2021	Egypt	765 responses were received from children and adolescents aged 4–16 years. 408 children (53.3%) were males and 357 participants (46.7%) were females. More than half of the participants	765	Cross-sectional study	Sleep Disturbance Scale for Children score.	Sleep quality Sleep disorder	The overall mean Sleep Disturbance Scale for Children score (SDSC) in participated groups was 44.6 ± 11.72 suggesting a widespread stressful impact of the lockdown Only 25 (3.2%) of participants had an (SDSC) over 70 which indicate acute severe sleep disorder 502 (65.6%) showed the symptoms suggestive of sleep disorder.

		407 (53.2%) were enrolled in primary schools.					Disorders of initiating and maintaining sleep were the most common among participants as 168 (33.4%) of them were suffering from it while 79 (15.7%) children were suffering from excessive somnolence. Significant positive correlations were found between SDSC and extra screen usage, understanding safety and quarantine measures, anxiety signs, and change in child lifestyle with (p = 0.029, 0.010, 0.001 and 0.001) sequentially Significant positive correlation was found between family income affection and sleep disorder score (p =0.04)
Ghanamah et al., 2021	Israel	382 parents answered a survery about their children. 51% of the children were males, the most representative grade was the first grade (21.2%), 11.8% of the children were detected in COVID-19 and 43.5% of the children were asked to be in isolation since they had been exposed to COVID-19 diagnosed person	382	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration and sleep quality.	Sleep duration Sleep quality	55.8% of the children, who before the pandemic outbreak used to sleep alone in their own bedroom, asked the parents to sleep in their parents' bed during the outbreak period. 41.4% showed sleep difficulties. (more in kindergarteners than in pre-kindergarteners) More hours spent in sleep through the outbreak compared to before the outbreak If the child was in isolation, those children asked their parents to sleep beside them more than the children who were not asked to be in isolation. In the families with diagnosed Coronavirus, the children asked to sleep beside the parents more than in families with no diagnosed member
Kaditis et al., 2021	Global	45.8% female; ages 3–17 years	845	Longitudinal study	Online survey	Change in bedtime, change in wake time, and change in sleep duration	As a result of the observed shift in bedtime and wake time, the median sleep duration score on weekdays increased significantly during the pandemic compared to before (p < .001), while there was no significant change during the weekend (p = .51). More children had an increase in sleep duration on weekdays than a decrease, whereas similar proportions of children had an increase or a decrease on weekends. Increase in sleep duration during the pandemic was most apparent in the 14–17 years age group during weekdays, while a

							decrease in sleep duration was most prominent in 3- to 5-year-old children during both weekdays and weekends. Sleep duration did not change in 43% of participants on weekdays and 46.2% on weekends. Children aged 14–17 years were the least likely to have unchanged sleep duration on weekdays (28.4%).
Kamaleddine et al., 2022	Lebanon	383 children whose parents agreed to use the responses for this study were finally included. The proportion of boys and girls was even.	383	Cross-sectional study	Children Sleep Habit Questionnaire	Sleep quality	Observed that children with screen time ≥2 h had sleep problems.
Mekkawy et al., 2022	Egypt	Participants in this study (n=672) were divided according to age into 4 main categories, 6–9 years (21.7%), 9–12 years (24.4%), 12–15 years (30.1%) and 15–18 years (23.8%). Males represented 48.2% and females 51.8%	672	Cross-sectional study	BEARS sleep screening tool	Sleep duration Sleep quality Sleep disorders	50% reported increase in their sleeping habit, 31.8% reported no change while 45.2% stated no sleeping problems, 19% had a difficulty to fall asleep, 16.1% had a problem waking up during sleep, 11.9% had a problem waking up feeling tired, & 7.7% had a problem sleeping too much . When comparing the sleep habits pre COVID-19 with the lockdown, results had shown significant decrease in the % of sleeping less than 7 hours from 41.4% to 5.4%, while there was significant increase in the % of sleeping more than 10 hours from 4.8% to 49.7% (p<0.001). On the other hand, the energy level status of being energized significantly decreased from 55.4% to 7.7%, and significantly increased in the lazy state from 3.6% to 54.8% (p<0.001)
Ranjbar et al., 2021	Iran	20697 filled questionnaires were received from the participants with an average age of 13.76 ± 2.50 which included 6139 (29.7%) male and 14558 (70.3%) females. Among the participants, 16672 (80.6%) were from urban areas	20697	Cross-sectional study	Survey items developed by the study's author include questions on sleep duration and sleep pattern.	Sleep duration Sleep disorder (sleep pattern changes)	2782 (13.4%) students had 5 or fewer hours of sleep, 2689 (13%) had 6 to 8 h, 2655 (12.8%) had 9 to 10 h, 1506 (7.3%) had 11 to 12 h, and 11065 (53.5%) had above 12 h of sleep throughout the day. The majority (8934: 43.2%) of students went to bed between 23 and 24 P.M. while the majority (11585: 56%) woke up at 8 A.M.

		and 4025 (19.4%) from rural areas.					
Ustuner Top et al., 2022	Turkey	Of the 1040 children, 528 (50.8%) males and 512 (49.2%) females were included in the analyses. The mean age of the children was 9.16 ± 2.05, and 80.3% were aged between 9 and 12 years.	1040	Cross-sectional study	The Children's Sleep Habits Questionnaire	Sleep quality Sleep duration Sleep disorder	The prevalence of sleep disturbances among 6–12-year-old children during the COVID-19 pandemic in Turkey was 55.5%. Sleep disturbances were found to be significantly associated with 6–8 years of age, and poor family relationships ($p < 0.05$). The most common sleep disturbances were bedtime resistance (51.9%), sleep onset delay (61.4%), and sleep duration (90.2%). The children's ages, family relationships, and eating habits were linked to their sleep disturbances. Moreover, their results indicated that sleep disturbances were more common in the children of parents who felt helpless, apprehensive, and frightened during the COVID-19 pandemic.
Zengin et al., 2021	Turkey	309 children. The average age of the children in the study was 10.3 ± 1.2; 52.1% of participants were male.	309	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration and sleep quality.	Sleep duration Sleep quality	Children stated that due to the pandemic they experienced changes in terms of sleep (61.5%; n = 190) Some of the children in the present study stated that their sleeping habits have become irregular, and the majority of them had reduced their time for social activity. These findings are similar to our results.
Zreik et al., 2021	Israel	Mothers of 264 children (120 boys), with a mean (SD, range) age of 31.27 (17.39, 6–72) months, participated in the study: 100 of the mothers were Arab and 141 were Jewish. Approximately 38% of the infants were firstborns, and families had a mean (SD) of 2.15 (0.95) children. The mean (SD) age of the mothers	264	Cross-sectional study	Insomnia Severity Index Brief Infant/Child Sleep Questionnaire	Sleep disorder (insomnia) Sleep quality Sleep duration	The majority of mothers reported no change in their child's sleep quality, duration, and sleeping arrangement. However, about 30% reported a negative change in child's sleep quality and a decrease in sleep duration, and there were also mothers who reported a positive change. 60% of the mothers reported a negative change in their sleep quality. In all, 23% of mothers scored above the clinical cut-off for insomnia (ISI score of >15) during the COVID-19 crisis, compared to only 11% who reported (retrospectively) having clinical insomnia before the COVID-19 crisis ($\chi 2$ (1) = 5.36,

		was 33.97 (4.20) years.					p = .02). The current maternal ISI score was positively correlated with child's sleep latency, number of night awakenings, and wake after sleep onset, and was negatively correlated with sleep duration. Maternal acute COVID-19 anxiety was positively correlated with the child's number of night awakenings, and negatively correlated with the child's sleep duration. When examining the correlations between the current maternal ISI score and child's sleep variables with maternal acute COVID-19 anxiety as a covariate, the correlations with child's sleep variables, number of night awakenings and WASO, remained significant (r = .26, p = .001 and r = .31, p < .001, respectively), while the correlations with child's sleep latency and sleep duration were no longer significant. The correlation between maternal acute COVID-19 anxiety and the current maternal ISI score was significant (r = .38, p < .001) and remained significant after controlling for the child's sleep duration, number of night awakenings, and WASO (r = .40, p < .001) The change in child's sleep quality was associated with the change in ISI score of the mother (r s = −.33, p < .001), so that mothers who reported that their child's sleep improved during the COVID-19 crisis, were more likely to report a decrease in their own insomnia symptoms during the crisis. Mothers who reported that their child's sleep had negatively changed had higher levels of anxiety traits, compared to mothers who reported no change in their child's sleep.

Patients With Chronic Illnesses

Reference	Location of Study	Population	Sample Size	Study Design	Sleep Health Measurement Tool	Sleep Health Domains	Main Findings
Alkhotani et al., 2020	Saudi Arabia	A total of 156 patients with epilepsy completed the questionnaire. Sixty-two percent of our responders were female patients, 99% were living with family, 38% had generalized seizures, 47% were on single medications, and 48.1% had been seizure-free for the past three months prior to the start of the pandemic	156	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration and sleep quality.	Sleep duration Sleep quality	(71.2%) experienced a significant change in their sleep. Most frequent change in sleep was a reversal of the sleep pattern in 58% of the respondents (sleep after sunrise), followed by more sleep than usual in 9.6%, less sleep in 2.6%, and intermittent sleep in 0.6%.
Athamneh et al., 2021	Jordan	506 (90.03%) neurology patients responded to the questionnaire. Patients under 40 years of age constituted over half the sample. Men constituted 45.45% of the sample.	506	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration.	Sleep quality Sleep disorder (Sleep pattern changes)	Sleep disturbances were reported by nearly one in three patients who had epilepsy or headache, and the majority ascribed these disturbances to the impact of the pandemic Changes in sleep patterns were reported by 37.50% of patients with tension/migraine headaches, and 50.00% blamed these changes to the impact of the pandemic.
Çolak et al., 2021	Turkey	Pregnant women mean age 30.17 ± 5.47 years	149	Cross-sectional study	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality	The depression, anxiety, and defective sleep quality levels of the participants who were previously in the home quarantine were statistically significantly higher ($p < 0.001$, $p < 0.001$, $p < 0.001$, respectively).
Güç et al., 2022	Turkey	Of the 761 cancer patients, 480 (63.1%) are female and 281 (36.9%) are male. At the time of the study, their median age was 57.65 years (range, 20–90).	761	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	Mean scores of the 761 participants PSQI, 5.67 ± 4.24 (range, 0–19). Quality of sleep was found bad in 447 (58.7%) (global score ≥5). Multivariate analyses showed active treatment (OR: 21.4; 95% CI: 9.08–50.4; $p < 0.001$) as the major independent variable that affected sleep quality
Karatel et al., 2022	Turkey	The study includes 1,778 responses of 1,131	1778	Cross-sectional	Pittsburgh Sleep Quality Index	Sleep quality	The PSQI-total had shown a weak correlation with pain levels in all body parts.

		(63.6%) women and 647 (36.4%) men. Mean age was 28.3 ± 10.7 years with musculoskeletal pain		study			The highest correlation for sleep quality and pain levels was between the PSQI-5 and lower back pain. There was a weak correlation between PSQI-2 and the BDI score, and a moderate correlation between the PSQI-1, PSQI-5, PSQI-7, PSQI-total, and BDI score.
Keskin et al., 2022	Turkey	356 pregnant women were enrolled and completed the survey	356	Cross-sectional study	The Epworth sleepiness scale	Sleep disorder (sleepiness)	Mild sleepiness was found in 88.2% and severe sleepiness in 11.8% of the pregnant women
San et al., 2021	Turkey	145 patients who underwent a spine intervention within the past year were included in this study, there were 96 women (66%) and 49 men (34%), with a mean age of 54.78 ± 1.08 years.	145	Cross-sectional study	Survey items developed by the study's author include questions on sleep habits.	Sleep quality	24 patients always had sleep disturbance, 30 patients often had sleep disturbance, 37 patients sometimes had sleep disturbance, 9 patients rarely had sleep disturbance, and 45 patients had no sleep disturbance
Seyahi et al., 2020	Turkey	Studied in total 771 (245 M/ 526 F) patients with Rheumatic disease (Group 1), 535 (181 M/ 354 F) hospital workers (Group 2) and 917 (258 M/ 659 F) teachers/academic staff (Group 3)	2223	Cross-sectional study	Survey items developed by the study's author include questions on sleep problems.	Sleep disorder	The frequency of sleep problems in patients with RD was significantly higher than that of the teachers/academic staff, but then again, significantly lower than that reported in the hospital workers.
Yeni et al., 2022	Turkey	89 PwMS (people with multiple sclerosis) and 262 healthy controls. Mean age of PwMS was 41.08 (±10.2) years; 62% were female. Mean age of the control group was 38.08 (±11.4) and 51.5% were female	351	Cross-sectional	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality	Healthy controls (HC): Compared to pre-pandemic period, the mean PSQI score was determined to increase indicating impaired sleep quality ($p<0.001$) Sleep quality of the patients was seen to be impaired during the pandemic ($p<0.05$) Multiple regression analysis demonstrated that the anxiety, depression, and the sleep problems were predictors of both the physical health ($p<0.001$) and mental health ($p<0.001$)

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The Effects of the COVID-19 Pandemic on Sleep Health Among Middle Eastern and North African (MENA) Populations: A Systematic Review of the Literature

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Abstract

Objectives: This study sought to conduct a systematic review of the literature on the impact of the COVID-19 pandemic on sleep health among Middle Eastern and North African (MENA) populations, understudied geographic regions including with regards to sleep health.

Setting: A systematic literature search of studies published from inception to March 27th 2022 was conducted on multiple databases using developed keywords

Participants: Studies were included if they (1) investigated one or more aspects/dimensions of sleep health as an outcome (e.g., sleep duration, sleep quality, sleep problems); (2) measured the impact of a COVID-19 pandemic-related domain (e.g., impact of quarantine, work from home, lifestyle changes, etc.); (3) focused on at least one MENA region population; (4) were peer reviewed; (5) included >=100 participants; (6) were written in English; (7) had full-text article publicly available.

Primary and secondary outcomes measured: Primary outcomes were sleep duration, sleep quality and sleep problems

Results: In line with PRISMA guidelines, 164 studies were included for data extraction. The Newcastle-Ottawa (NOS) scale for cross-sectional studies was used to assess the quality of the studies. Overall, the COVID-19 pandemic significantly impacted sleep duration, sleep quality, and presence and severity of sleep disorders in MENA populations, including adults, children, students, healthcare workers, and people with chronic illnesses. The directionality and strength of associations, as well as the determinants of sleep health, varied by sub-populations.

Conclusions: Longitudinal studies are needed to understand the longer-term impact of the COVID pandemic on the sleep health of MENA populations. Sleep health interventions and policy measures should be tailored to the need of each sub-population.

Trial registration number: PROSPERO registration number: CRD42022321128.

Strengths and limitations of this study

- Study design that enabled the capturing of a wide scope of evidence, including both quantitative and qualitative studies among a severely understudied population.
- Comprehensive literature search of five major electronic databases and reporting as per Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines.
- Studies included in this review utilized different methods for assessing sleep health, making it challenging to compare results between different studies and populations.
- Most included studies are cross-sectional in design, posing an intrinsic limitation to this review and making it difficult to establish causation.
  Inability to measure for national variations in quarantine policies between countries, which could have had varying effects on the health of the population.

Keywords: COVID-19, Sleep Health, Middle East, Health behaviors, Pandemic

Introduction

The COVID-19 pandemic, which was announced as a Public Health Emergency of International Concern on 30 January 2020, and a pandemic on 11 March 2020, continues to affect people's lives around the globe. Given the nature of transmission of the SARS-CoV-2 virus, in addition to lack of medication or vaccines in the early response of the pandemic, many of the public health interventions to prevent the transmission focused on physical distancing. Such measures included quarantine and lock-down orders. In turn, this affected people's ability to do many social and physical activities, hence significantly impacting people's 24-h behavioral patterns. Further, pandemic-related stress also contributed to abrupt changes in lifestyle behaviors.[1, 2] For instance, Park et al., reported that COVID-19 has had a negative impact on healthy and active lifestyles, as well as mental health and quality of life, among a sample of adults in South Korea.[3]

Research in the literature is demonstrating that among the many health outcomes and health behaviors that may be affected by the pandemic is sleep health.[4-8] Prior studies among various populations have shown that the pandemic affected a variety of sleep health domains, including sleep quality,[9-11] sleep duration,[12, 13] and sleep disorders.[14, 15] For instance, in a longitudinal study in Spain, Martínez-de-Quel reported that perceived sleep problems significantly increased following the onset of the pandemic.[16] Similarly, among 400 students and university administration staff workers in Italy, the prevalence of insomnia increased from 24% prior to the pandemic to 40% during the pandemic. Similarly, difficulties in sleep initiation among the same sample increased from 15% to 42% from before to during the pandemic.[17] A systematic review conducted in July 2020 showed that the prevalence of sleep problems during the COVID-19 pandemic is high and affects approximately 40% of people from the general and health care populations.[18] In addition to the observed trend in sleep health outcomes, the pandemic may have exacerbated a number of stressors that can directly increase poor sleep health. For instance, research among several global populations has shown an increase in intimate partner violence (IPV) due to lockdown measures, as well as economic and psychological stress brough about by the pandemic.[19-21] In turn, IPV has been linked with poor sleep quality and sleep disturbances among different populations.[22, 23]

Among Middle Eastern and North African (MENA) populations, the burden of non-communicable diseases has drastically increased from 1990 to 2010.[24] The epidemiological profile of Middle Eastern countries closely resembles that of countries in western Europe, the USA, and Canada, with health loss from most non-communicable diseases, such as CVD and cancer, increasing over the past 20 years.[24] However, Middle Eastern populations are faced with multiple challenges when attempting to deal with such an epidemiological profile. Indeed, political turmoil, conflict, and corruption within states have led to challenges in implementing policies and laws, as well as adhering to them on a population-level.[25] Additionally, while Middle Eastern populations are facing an epidemiological challenge similar to that of the developed world, they continue to be understudied in public health research including sleep health research. In part, this is due to Arab countries having weak health information systems,[26, 27] which limits data availability and produces major challenges for sound research and evidence-based policy making.

In addition, MENA countries epidemiological profile is characterized by high burden of psychosocial problems, including depression and anxiety.[24] Noncommunicable diseases and psychosocial problems, among other health outcomes, are consistently associated with sleep health.[28-32] Consequently, this exacerbation in poor sleep health that may be brought about by the pandemic can increase the risk of other undesirable health outcomes among populations. This issue is of increased urgency in areas with underdeveloped health research infrastructure where there continues to be lack of full understanding of the health of the population, as is the case in the MENA region.

Given the evident impact the pandemic had on sleep health worldwide, as well as the well-documented association between sleep health and the leading causes of morbidity and mortality, it is important to understand this association among Middle Eastern populations. This systematic review sought to investigate the association between COVID-19 induced national lockdowns and different domains of sleep health among MENA populations. To the best of our knowledge, this is the first systematic review investigating sleep health among Middle Eastern populations in the context of COVID-19. Additionally, and while there are several reviews examining sleep health domains in developed countries,[33, 34] there continues to be a lack of reviews studying sleep health in MENA countries, which collectively represent ~600 million of the word population. In fact, this systematic review would be the first to summarize the literature on the sleep health of MENA populations, filling an important gap in the literature.

Methods

A systematic literature search was performed in accordance with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines.[35] On March 27th, 2022, we conducted a systematic literature review on five different databases, namely PubMed, MEDLINE, Embase, CINAHL, and Web of Science. A set of specific keywords and MeSH terms was developed and is shown in supplementary table S1. The protocol of this systematic review is registered with PROSPERO (international prospective register of systematic reviews) with the ID CRD42022321128. The protocol for this review can be publicly accessed on PROSPERO webpage.

Search Strategy and Selection Criteria

The authors developed a set of keywords relevant to the research question and the population investigated. Boolean operators were used to ensure full inclusion of words within the keywords used Using Endnote referencing software, retrieved articles were entered and duplicates were identified and removed. Following that, articles were entered into Rayyan, a free web-tool for screening articles for systematic reviews. As shown in figure 1, title and abstract screening was conducted by two investigators (OT and YAA) independently. Next, full-text articles were accessed and screened in more depth. Conflicts were solved by discussion upon the conclusion of the screening process. The articles included were deemed eligible against the following criteria: (1) investigated an aspect sleep health as an outcome of interest (e.g., sleep duration, quality and presence of a sleep problem or disorder); (2) investigated a domain related to the COVID-19 pandemic induced lifestyle changes (e.g., lockdown, online schooling, etc.); (3) focused on at least one MENA population (supplementary table S2 includes a list of all MENA countries included); (4) were peer reviewed; (5) sample size >= 100 participants (6) were written in English; (7) had full-text article publicly available. Similarly, articles were excluded if they met at least one of the following: (1) were not written in English; (2) were not peer-reviewed' (3) did not have full-text available; (4) were systematic or narrative review in design. Where multiple articles reported data from the same dataset, we selected the article with the largest numbers of variables included and excluded the other articles as duplicates. Finally, there were no restrictions on the nature of data reported and both qualitative and quantitative studies were included in this review. Of note, prior to conducting our systematic search, an initial literature search was conducted by the authors to identify systematic reviews of sleep in relation to COVID-19 pandemic.

Data Extraction

Data extraction was done in accordance with a tabulated form. Two reviewers (OT and YAA) collectively performed the data extraction into a template table. Conflicts were resolved through a discussion and where necessary, a third reviewer. Data was categorized based on sub-populations identified, including adults, children, healthcare workers, students, and people with chronic illnesses. Other dimensions collected for each study included: (1) the first author and year of publication (e.g., reference); (2) location of the study (city and/or country); (3) study population of interest; (4) study sample size; (5) study design; (6) sleep health measurement tool; (7) sleep health domains; (8) main findings summarized.

Data Presentation

All data extracted from identified studies were presented in a tabulated form organized according to the different sub-populations identified among MENA populations. This included: 1) adults; 2) children; 3) healthcare workers; 4) students; 5) people with chronic illnesses. Main summary findings were presented in the tables, in addition to identifying specific factors that were associated with poor sleep health outcomes.

Quality Appraisal

Given that the majority of the studies identified were cross-sectional in design, The Newcastle-Ottawa scale (NOS) was used to assess the quality of the studies. Two reviewers (YAA and OT) independently assessed the risk of bias in all cross-sectional studies. Where necessary, conflicts in scoring were resolved by discussion. Only cross-sectional studies were scored against the NOS, yielding a total of 157 studies for risk assessment. The NOS was developed to assess the quality of nonrandomized studies according to different domains of the studies, including the study's design, content, and ease of use directed to the task of incorporating the quality assessments in the interpretation of meta-analytic results. In accordance with the NOS, the studies were scored against 7 different categories, including (1) selection (4 sub-categories, 4 stars maximum); (2) comparability (1 sub-category; 2 stars maximum); (3) outcome (2 sub-categories; 3 stars maximum). The full list of adapted questions from the NOS is attached as a supplementary file. Additionally, the results of the NOS assessment for our included cross-sectional studies are shown in supplementary table S3.

Ethical Approval

Ethical approval for this specific systematic review is not applicable since data utilized was collected from previously published research in the literature. All studies included in this review received ethical approval prior to data collection by their primary investigator.

Patient and Public Involvement

Patients and public were not involved in the design and conduct of this research

Results

3.1. Search results

As illustrated in figure 1, the systematic literature search yielded 683 studies from PubMed, 152 studies from MEDLINE, 285 studies from Embase, 63 studies from CINAHL, and 110 studies from Web of Science, resulting in a total of 1,293 studies. After removing duplicates (n = 338), 955 articles were screened independently by two investigators for title and abstract to determine relevance to our research question. This step excluded an additional 721 articles either because they did not investigate sleep health as one of the outcomes (n = 535), did not include people from the Middle East, (n = 153), or were not peer reviewed (n = 33). After this step, two independent investigators performed full-text screening on 234 potentially relevant articles. A total of 70 studies were excluded at this stage, mainly due to studies with unavailable full-text article (n=14), studies not reporting sleep health as an outcome (n=24), studies conducted explicitly outside the Middle East (n=24) or had a sample size of less than 100 participants (n = 8). As a result, a total of 164 articles were included in this review.

3.2. Study characteristics

The sample size of all included studies (n=164) ranged from 103 to 20,697 participants. Table S4 in the supplementary file presents a full list of all included studies and their extracted data. Furthermore, studies included were conducted across 17 Middle Eastern countries, including Turkey (n=44), Saudi Arabia (n=33), Iran (n=16), Israel (n=12), Jordan (n=12), Egypt (n=10), Oman, (n=6), United Arab Emirates (n=6), Lebanon (n=6), Kuwait (n=4), and Qatar (n=2). Only one study was conducted in each of the following countries: Bahrain, Palestine, Cyprus, and Iraq. Additionally, 11 studies included samples from multiple countries at once, including Syria, Yemen, Iraq, and others.

3.3. Quality appraisal

Most studies in this review were cross-sectional in design (n=156). All other study designs were longitudinal (n=8). Table S3 in the supplementary file presents the full NOS results for all studies assessed for bias, determined using the NOS protocol outlined in the Methods section. Most studies were moderate in quality.

3.4. Sleep health outcomes by sub-population

Data from all eligible studies was organized according to population type, with a total of five sub-populations. These included studies focusing on adults in the general population (n=74), healthcare workers (n=47), students (n=21), children (n=15), and people with chronic illnesses (n=7). For all populations, qualitative data synthesis was conducted with a focus on three main domains: sleep duration, sleep quality, and sleep disorders.

3.4.1. Adults

Across the studies conducted among adults (n=74), the sample size ranged from 103 to 14,171 participants.

Sleep Duration

Studies consistently reported that the pandemic negatively impacted the sleep duration of Middle Eastern adults[36-44]. In a global study including 5896 adults from 11 MENA countries, 49.6% of participants reporting that they were sleeping less than 7 hours and 53.2% reporting 10 or more hours of sleep.[36] In Egypt, 23.1% of adults younger than 30 years old reported inadequate sleeping (< 6h/day).[45] In terms of determinants of sleep duration among adults, data from Jordan revealed an increased burden of short sleep duration among males compared to females. Similarly, participants with higher education levels reported decreased daytime sleeping hours. [46] In terms of relationship status, individuals who reported being single had significantly increased amount of sleep compared to married individuals.[46]

Sleep Quality

Sleep quality (SQ) was altered for both COVID-19 patients and healthy individuals.[47] The Pittsburgh Sleep Quality Index (PSQI) score during lockdown was predominantly influenced by sleep-onset latency, sleep efficiency, and total sleep time.[48] Factors associated with reduced SQ included changes in sleeping habits, anxiety, fear driven by COVID-19 news and lack of treatment knowledge, female gender, monthly income, isolation,[49] perceived income, hours spent outdoors, the number of familiar people with COVID-19, and history of depression.[50]

Sleep Problems

Most families reported disrupted sleep patterns.[51] When quarantine period started in Saudi Arabia, 1/5 experienced new-onset nightmares, more significant among females.[52] In a global cross-sectional study including a number of Middle Eastern countries, around 33.3% of respondents reported feeling lazy and less energized during the pandemic, as opposed to 4.7% before the pandemic.[53] The prevalence of insomnia, anxiety, depression, and obesity increased with increasing phone screen time among university students. Of all countries, Iran reported the highest prevalence of insomnia among adults (55.2%).[47, 54] Finally, in a Turkey-based study among pregnant women, mild sleepiness was found in 88.2% of participants (n = 356), while severe sleepiness was reported in 11.8% of the same sample.[55]

3.4.2. Children

A total of 15 studies assessed sleep health among children. The sample size of studies ranged from 309 to 20,697 participants.

Sleep Duration

Most studies in the literature reported a change in the sleeping duration among children, with varying directions of change (e.g., increased, or decreased duration). In Saudi Arabia and Jordan, decreased sleep was reported among children's populations.[56, 57] Moreover, sleep duration in

Israel increased for 13.4% of participants, decreased for 51.1%, and remained unchanged for 35.1%. Sleeping less than seven hours decreased from 41.4% to 5.4%, while sleeping more than 10 hours significantly increased from 4.8% to 49.7%.[58] In Iran 13.4% of children, mostly from urban areas, reported that they had 5 or fewer hours of sleep.[59]

Sleep Quality

In Tukey, 61.5% of children experienced sleeping changes due to the pandemic.[60] Almhizai et al., demonstrated that older participants woke up more frequently during their sleep compared to children.[61] In Israel, 41.4% of children developed sleeping difficulties.[62] Similarly, in another Israeli study, 60% of mothers reported that their child's sleeping patterns had changed drastically and reported higher levels of anxiety traits associated with sleep changes.

Sleep Problems

Sleep disorders were reported in all studies among children. In Turkey, the prevalence of sleep disturbances among children was 55.5% and significantly associated with 6–8 years of age and poor family relationships. The most common sleep disturbances were bedtime resistance (51.9%) and sleep onset delay (61.4%).[63] Sleep disturbances were more common in children of parents who felt helpless, apprehensive, and frightened during the pandemic,[63] and children whose parents were divorced.[61] The direct effect of trauma scores on sleep problems, the direct effect of sleep problems on chronotype scores and on oppositional defiant disorder (ODD) symptom scores were significant.[64]

3.4.3. Healthcare workers

A total of 47 studies assessed sleep health among healthcare workers in all Middle Eastern countries listed in the study characteristics, except Palestine, Cyprus, and Iraq. The sample size of studies ranged from 105 to 2,331 participants.

Sleep Duration

Sleep duration significantly decreased for HCWs in most countries, except Israel, where medical residents treating COVID-19 reported longer sleep duration.[65] In Egypt, both physicians on the front line and others were at risk of falling asleep, staying asleep, or sleeping excessively.[66] Furthermore, there was a statistically significant decrease in sleeping hours among HCWs with severe and extremely severe depression.[67] Those with higher levels of health anxiety related to COVID-19 were working more days weekly and had lower sleeping hours.[68] Female sex, age ≤30 years, attending emergency and night shifts, watching/reading COVID-19 news ≥2 h/day, and not getting emotional support from family, society, and hospitals were associated with a high likelihood of inadequate sleeping HCW in Egypt.[69]

Sleep Quality

Most studies reported poor and reduced SQ, as measured by the PSQI, with poor sleep quality prevalence ranging from 48.4%[70] to 96.1%.[71] Both, front line HCWs and non-front line HCW

reported poor SQ and/or had moderate-severe stress.[72] In Saudi Arabia poor SQ levels were highest among front line HCWs (emergency departments, intensive care units, and wards).[73] The most negatively scored components of SQ included sleep latency, duration, and efficacy. Poor SQ was more prevalent among females, nurses, hospital workers, frontline workers, individuals with <5 years of work experience, those with low social support, and individuals with increased traumatic stress levels.[74]

Sleep Problems

HCWs between 31-40 years-old treating COVID-19 were at higher risk of severe insomnia, compared to those above 40 years-old.[75] In Turkey, insomnia incidence was 1.5 times higher for HCWs in the frontline and significantly higher amongst those working in the "area of final diagnosis".[76] In a tertiary care hospital in Oman, the majority of HCWs (60.2%) aged 34.8 ± 5.7 years and with less working experience (11.9 ± 5.9 years) reported clinical insomnia during the pandemic.[77] Mean Insomnia Severity Index score in Turkey was significantly higher among HCWs working in COVID-19 clinics and intensive care units and among nurses.[74]

3.4.4. Students

A total of 21 studies with sample sizes ranging from 152 to 17,008 participants assessed sleep health among students.

Sleep Duration

Among a large cohort of medical and science university students in Jordan, 44.2% of participants (n = 1019) reported reduction in their sleeping hours.[78] Another study reported a statistical increase of total sleeping time from 6.6 ± 2.3 h/day to 8.3 ± 2.7 h/day.[79] In Israel, a significant reduction in sleep duration from lockdown to post-lockdown period for workdays and weekends was reported.[80]

Sleep Quality

Furthermore, 85.55% of students reported poor SQ and 67.9% were females. It was found that sleep disturbance and daytime dysfunction were poorer in students with higher BMI ranges.[81] In Saudi Arabia, 25.9% of a sample of students reported poor SQ, 22.7% felt tired during the day, 9.3% had nightmares and 5.2% had poor dreams.[82] Furthermore, extended quarantine negatively affected SQ of three-quarters of the undergraduate students in Jordan, with poor sleep quality reported in nearly half of the same sample.[83] Additionally, about a third of the same sample reported sleeping late and waking up more frequently.[83]

Sleep Problems

In Saudi Arabia, 22% of students had trouble falling asleep, 17.9% waking up during the night, and 8.8% waking up early in the morning.[82] Students reported a statistically high level of insomnia with a high level of depression, anxiety, and perceived stress. Undergraduate students reported statistically more insomnia symptoms with a lower level of psychological resilience.[82]

Furthermore, lockdown in Turkey led to sleeping later, waking up frequently and failing to fall asleep.[84] In Saudi Arabia, medical students reported Narcolepsy (51.6%), insomnia (31.5%), and Circadian Rhythm Sleep Disorder (22.4%) as the most prevalent sleep disorders.[85] Furthermore, a statistically significant increase of night sleep interruptions was reported during COVID-19. In Jordan, students experienced increased insomnia, shallow sleep, nightmares, or insufficient sleep, and these disorders were reported in significantly more females than males.[86]

3.4.5. People with chronic illnesses

A total of 7 cross-sectional design studies assessed sleep health among the population with special conditions. The sample size of studies ranged from 145 to 2,223 participants. Those studies focused on a variety of chronic illnesses, including epilepsy (n=1), neurological conditions (n=1), cancer (n=1), musculoskeletal diseases (n=1), spine illnesses (n=1), rhematic disease (RD) (n=1), and multiple sclerosis (MS) (n=1).

Sleep Duration

In Saudi Arabia, 71.2% of patients with epilepsy experienced significant changes in their sleep.[87, 88] Almost half of them had been seizure-free in the three months prior to the pandemic. Furthermore, 9.6% of patients surveyed reported more sleep than usual, 2.6% reported less sleep, and 0.6% reported intermittent sleep.[87, 88]

Sleep Quality

Quality of sleep among different patient groups, as measured by PSQI, was affected during the pandemic. In Turkey, for patients with musculoskeletal pain, PSQI revealed a weak correlation with pain levels in all body parts.[89] Quality of sleep was found to be bad for 58.7% cancer patients.[90] Depression, anxiety, and defective SQ levels for pregnant women (mean age was 30.17 ± 5.47 years) who were previously in quarantine was significantly higher.[91] SQ among patients with MS patients was significantly impaired during the pandemic too.[92]

Sleep Problems

Although patients reported different experiences, a certain degree of sleep disorders was reported among almost all patients. In Jordan, Athamneh et al., reported that 37.5% of patients with chronic headaches reported changes in sleeping patterns during the COVID-19 pandemic.[93] Finally, the frequency of sleep problems in patients with RD was significantly higher than that of non-patients, but significantly lower than that reported in hospital workers.[94]

Discussion

This systematic review of the literature explored the impact of the COVID-19 pandemic on sleep health among populations in the Middle East. To the best of our knowledge, this is the very first systematic review on sleep health among any Middle Eastern population, and one of the first reviews to pool evidence on sleep health during the ongoing COVID-19 pandemic. The findings of our systematic review suggest that across all sub-populations (e.g., adults, children, students, healthcare workers, and people with chronic illnesses), the COVID-19 pandemic had a drastic negative Impact on sleep duration, sleep quality, and prevalence of sleep disorders.

Sleep duration was negatively impacted in all populations investigated, whereby the prevalence of short or long sleep seems to have increased. Similarly, sleep quality in all populations decreased drastically. Studies reported a consistent association between sociodemographic variables (e.g., being single,[44, 95-97] low education levels,[95, 97-101] unemployment during the pandemic,[102] female gender,[49, 96] low social support[74, 103]) and poorer sleep quality. Furthermore, with regards to sleep problems, insomnia was the most reported sleeping problem across studies. Higher prevalence of insomnia and other sleep disorders were observed among younger participants, those with a diagnosed mental disorder, unmarried participants, and undergraduate students.[104] Such findings suggest that psychological stressors, which may have been exacerbated by the pandemic,[105, 106] are associated with sleep problems and contributed to its high prevalence during the pandemic. Moreover, women reported higher rates of insomnia compared to men. Interestingly, there was an observed positive association between lockdown duration and the prevalence of insomnia. Finally, among people with chronic illnesses, reversal of sleeping pattern (e.g., initiating sleep after sunrise) was the most frequent change in sleep habits.[87]

When comparing different sub-populations in this study, HCWs' sleep health was the most impaired during the pandemic compared with other sub-populations. While in other populations sleep duration was affected with no specific trend, healthcare workers demonstrated predominantly decreased sleep duration. Furthermore, in addition to reduced sleep duration, front line HCWs reported the lowest SQ. Among HCWs, being on the front-line, being younger, and having less experience working were all associated with increased insomnia prevalence. Nurses experienced emotional exhaustion, and burnout levels increased in line with insomnia.[107] Long shifts, busy working conditions, and less sleep disturbed their sleeping patterns and made HCWs feel tired.

Our findings are consistent with prior research in other populations.[7, 18, 108, 109] For instance, Jahrami et al., reported an increased burden of sleep problem during the COVID-19 pandemic in early 2021, with approximately 40% of the general population reporting sleep problems.[18] Similarly, and consistent with our findings among Middle Eastern front-line workers, a meta-analysis conducted by Salari et al., showed that healthcare workers are more vulnerable to sleep disturbances during the pandemic.[109] This finding was associated with increased workplace stress and was shown in both nurses and physicians.[109]

The findings of this systematic review are important for public health policy and for directing intervention measures. Given that sleep is a risk factor for the leading causes of death including CVD, hypertension, diabetes, obesity, etc., interventions that promote sleep health are of high public health relevance, particularly in the current pandemic era. Such interventions can include social and administrative support, workplace interventions,[110] providing education that emphasizes the importance of sleep behavior, encouraging promoting behaviors and relaxation strategies. The differences in impact and severity of sleep health problems among different sub-populations, as identified in this study, suggest that policies and interventions should be tailored to each population. Some authors have already suggested emergency management measures that should be taken to improve the quality of sleep in FLHCWs during a pandemic: strengthen exercise intervention, psychological counseling, drug intervention treatment strategies if necessary, and other.[111] Similarly, sleep problems in childhood are linked with impaired motor and cognitive skills, as well as with difficulties in academic activities, emotional regulation, quality of life, growth, body composition, and immune function.[112] A daily routine is a fundamental aspect of children's development of healthy behaviors and adequate energy levels. Interventions that focus on health promotion and advocating for healthy sleeping patterns among children, especially as it relates to other health behaviors development, should be implemented.

In addition to intervention efforts to address poor sleep among MENA populations, there is a strong need to understand barriers to adequate sleep among each sub-population. The current literature provides evidence regarding barriers to adequate sleep focuses primarily on western populations. This includes environmental factors (e.g., decreased green space),[113, 114] social factors (e.g., decreased social cohesion,[115] decreased safety),[116-118] and ambient factors (e.g., increased air pollution,[119-123] increased noise).[124] However, there continues to be a lack of data on this topic in the MENA region despite high prevalence of poverty, gender inequality, political turmoil, violence, and other factors that are strongly linked with PTSD and other psychological factors, which are known to affect sleep.[125, 126] The unique social, structural, and environmental context of the MENA region, in addition to the demonstrated exacerbation of poor sleep health by the pandemic, highlights why increased efforts to understand and address sleep health, particularly post-pandemic, is relevant for MENA populations.

Strengths, limitations, and future research

This review is the first systematic review of the literature regarding the effects of COVID-19 pandemic on the sleep health of Middle Eastern populations. Additionally, this paper provides a robust qualitative synthesis of data to include a wide scope of research on the topic published to date. This review covers a wide range of outcomes (e.g., any study that reported a sleep health related domain), includes only peer-reviewed articles as the source of information of high quality, and incorporates a wider scope of studies and populations. Despite those strengths, this study is not without noteworthy limitations that must be considered when interpreting our results. Firstly, most included studies are cross-sectional in design, which poses an intrinsic limitation given the design. For instance, it is not possible to establish causation with such studies. Additionally, most of the studies utilize self-reported surveys. Given the rapidly evolving situation with the pandemic (e.g., lockdown measures, changes in epidemiology of COVID-19, etc.), this approach seemed

the most suitable to collect data rapidly. However, this introduces several limitations including self-selection bias, recall bias, and social desirability bias.[127-129] Another limitation specific to the design of this review is that it excludes studies conducted in languages other than English. Moreover, quarantine requirements differed across different countries within the MENA region, which could have had varying effects on the health of the population. This variation was challenging to capture and control for within our review and must be a consideration when interpreting our results.

Furthermore, studies included in this review utilized different methods for assessing sleep health, which varied across populations. Mainly, this included subjective measures, including a variety of tools to measure sleep health (e.g., Pittsburgh Sleep Quality Index, Insomnia Severity Index). In turn, this makes it challenging to compare results between different studies and different populations. Additionally, it is important to note that no study included in this review utilized objective tools to measure sleep health (e.g., actigraphy), and many studies utilized tools that do not have demonstrated validity or reliability in the context of sleep health measurement (e.g., surveys developed by authors of the study). Consequently, future research should focus on utilizing objective tools to measure sleep health. If not feasible, subjective tools with demonstrated reliability and validity are preferred. Finally, future research should continue to understand the long-term impacts of the abrupt change in lifestyle brought about by the COVID-19 pandemic on Middle Eastern populations.

Conclusions

This review sought to review and investigate the evidence between COVID-19 induced lockdowns on sleep health among different populations in the MENA region. Given high burden of poor sleep that has been exacerbated by the COVID pandemic, there is a strong need for tailored interventions to improve sleep health. Finally, and considering that Middle Eastern populations continue to be severely understudied in public health, future research should continue to investigate and explore the impact of the COVID-19 pandemic on public health in The Middle East, including longitudinal studies utilizing objective measures to assess the impact of sleep on the health of MENA populations across their lives.

Declarations

Ethics approval and consent to participate

Not Applicable

Consent for publication

Not Applicable

Availability of data and materials

All data generated or analyzed during this study are included in this published article and its supplementary information files

Competing interests

The authors declare that they have no competing interests

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Authors' contributions

Y.A.A and O.T conceived the hypothesis. Y.A.A and O.T designed the study. Y.A.A, O.T, D.D. drafted the protocol. Y.A.A designed the search strategy and performed the literature search. Y.A.A, O.T., and R.M performed the article screening and data extraction. Y.A.A., O.T, and G.S performed the quality assessment. All authors (Y.A.A., O.T.., G.S., R.M., N.M., D.D.,) had access to data and verified it, and contributed feedback to drafts of the manuscript. Y.A.A and O.T shaped the manuscript with input from the entire team. All authors (Y.A.A., O.T.., G.S., R.M., N.M., D.D.,) contributed to revise work for important intellectual content, gave the final approval of the version to be published, and agreed on all aspects of the work, especially concerning its design, accuracy and integrity. The corresponding author confirms that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

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Figure Legends

Fig. 1. *Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) study selection flow diagram outlining the literature review process when searching for articles on PubMed and Web of Science*

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Fig. 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) study selection flow diagram outlining the literature review process when searching for articles on PubMed and Web of Science.

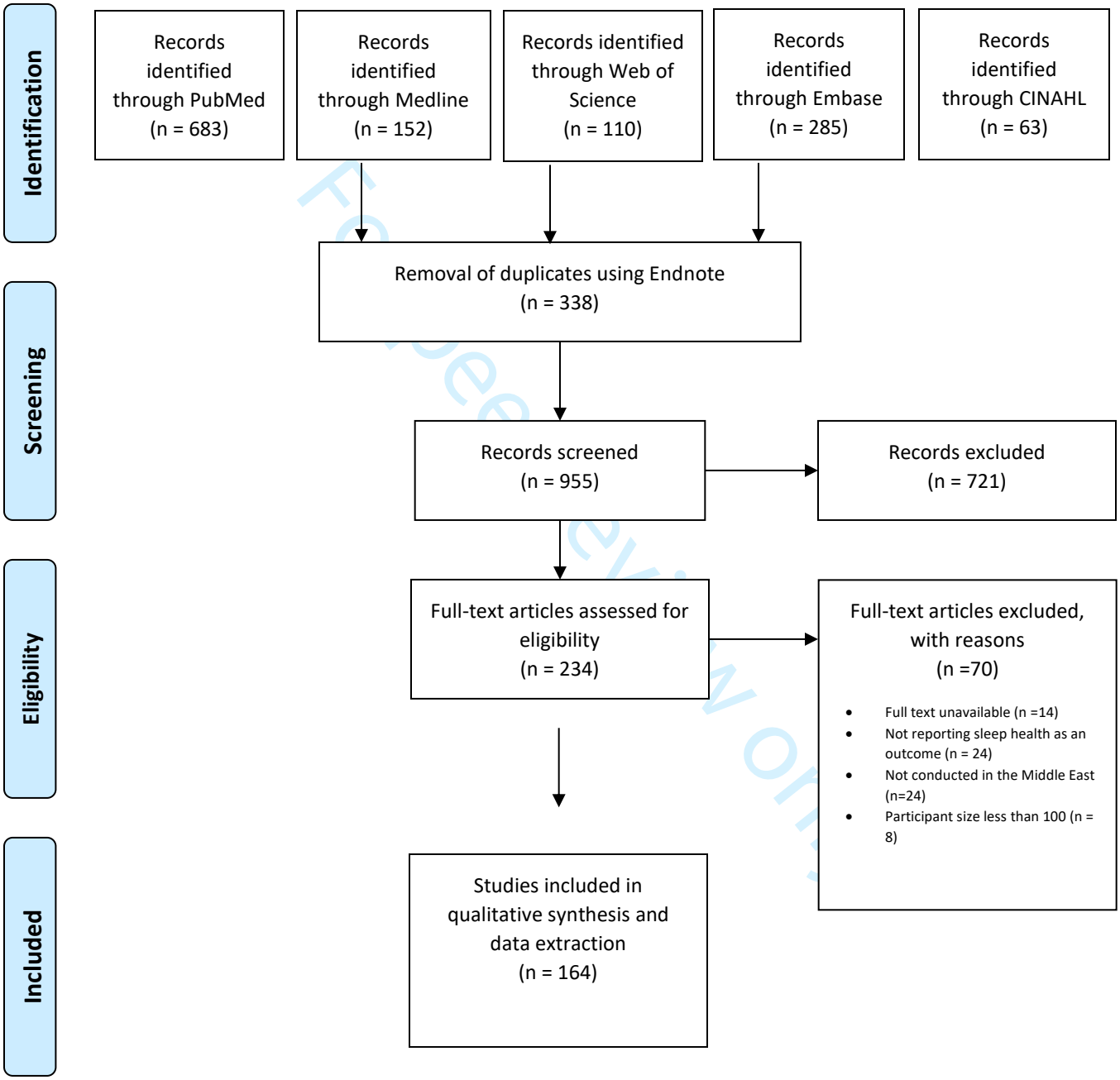

Table S1. Search keywords and MeSH terms developed for the literature search

Journal Databases Keyword Strategy
Search Keywords

1) Generic Exposure of Interest – COVID-19

('coronavirus disease 2019' OR '2019 novel coronavirus disease' OR '2019 novel coronavirus epidemic' OR '2019 novel coronavirus infection' OR '2019-ncov disease' OR '2019-ncov infection' OR 'covid' OR 'covid 19' OR 'covid 19 induced pneumonia' OR 'covid 2019' OR 'covid-10' OR 'covid-19' OR 'covid-19 induced pneumonia' OR 'covid-19 pneumonia' OR 'covid19' OR 'sars coronavirus 2 infection' OR 'sars coronavirus 2 pneumonia' OR 'sars-cov-2 disease' OR 'sars-cov-2 infection' OR 'sars-cov-2 pneumonia' OR 'sars-cov2 disease' OR 'sars-cov2 infection' OR 'sarscov2 disease' OR 'sarscov2 infection' OR 'wuhan coronavirus disease' OR 'wuhan coronavirus infection' OR 'coronavirus disease 2' OR 'coronavirus disease 2010' OR 'coronavirus disease 2019' OR 'coronavirus disease 2019 pneumonia' OR 'coronavirus disease-19' OR 'coronavirus infection 2019' OR 'ncov 2019 disease' OR 'ncov 2019 infection' OR 'new coronavirus pneumonia' OR 'novel coronavirus 2019 disease' OR 'novel coronavirus 2019 infection' OR 'novel coronavirus disease 2019' OR 'novel coronavirus infected pneumonia' OR 'novel coronavirus infection 2019' OR 'novel coronavirus pneumonia' OR 'paucisymptomatic coronavirus disease 2019' OR 'severe acute respiratory syndrome 2' OR 'severe acute respiratory syndrome 2 pneumonia' OR 'severe acute respiratory syndrome cov-2 infection' OR 'severe acute respiratory syndrome coronavirus 2 infection' OR 'severe acute respiratory syndrome coronavirus 2019 infection')

AND

2) Outcome of Interest - sleep health

('sleep' OR 'sleep' OR 'sleeping' OR 'sleep disorder' OR 'chronobiology disorders' OR 'disturbances of sleep' OR 'dyssomnia' OR 'dyssomnias' OR 'intrinsic sleep disorders' OR 'sleep disorder' OR 'sleep disorders' OR 'sleep disorders, intrinsic' OR 'sleep disturbance' OR 'sleep perturbation' OR 'sleep wake disorder' OR 'sleep wake disorders' OR 'sleep disordered breathing' OR 'apnea, sleep' OR 'apnoea, sleep' OR 'nocturnal apnea' OR 'nocturnal apnoea' OR 'obstructive sleep apnea' OR 'obstructive sleep apnea hypopnea syndrome' OR 'obstructive sleep apnea syndrome' OR 'obstructive sleep apnoea' OR 'obstructive sleep apnoea hypopnoea syndrome' OR 'obstructive sleep apnoea syndrome' OR 'obstructive sleep-disordered breathing' OR 'sleep apnea' OR 'sleep apnea syndrome' OR 'sleep apnea syndromes' OR 'sleep apnea, obstructive' OR 'sleep apnoea' OR 'sleep apnoea syndrome' OR 'sleep apnoea syndromes' OR 'sleep apnoea, obstructive' OR 'sleep disordered breathing')

AND

3) Population of Interest - Middle Eastern populations

('middle east' OR 'middle east' OR 'bahrain' OR 'cyprus' OR 'iraq' OR 'kuwait' OR 'saudi' OR 'saudi arabia' OR 'oman' OR 'omani' OR 'jordan' OR 'jordanian' OR 'bahraini' OR 'cypriot' OR 'lebanese' OR 'lebanon' OR 'kuwaiti' OR 'iran' OR 'iranian (citizen)' OR 'israel' OR 'israeli' OR 'gaza strip palestine' OR 'gaza strip' OR 'palestine' OR 'syrian' OR 'syrian arab republic' OR 'egypt' OR 'egyptian' OR 'yemen' OR 'yemeni' OR 'united arab emirates' OR 'emirati' OR 'turkey (republic)' OR 'turkish' OR 'eastern mediterranean region' OR ‘qatar’ OR ‘qatari’ OR ‘algeria’ OR ‘algerian’ OR ‘tunisia’ OR ‘tunisian’ OR ‘morroco’ OR ‘morrocon’ OR ‘libya’ OR ‘libyan’)

Table S2. List of countries considered in MENA definition in this study.

Country
Algeria
Bahrain
Egypt
Iran
Iraq
Israel
Jordan
Kuwait
Lebanon
Libya
Morocco
Oman
Qatar
Saudi Arabia
Syria
Tunisia
United Arab Emirates
Yemen

Table S3. Newcastle-Ottawa Scale for Bias Assessment

Study	Total Score	Selection				Comparability	Outcome	
		Representativeness of the sample	Sample size	Non-respondents	Ascertainments of exposure	Based on design and analysis	Assessment of Outcome	Statistical Test
Özenoğlu et al., 2021	6	*	*		*	*	*	*
Çolak et al., 2021	8	*	*		**	*	**	*
Abbas et al., 2021	6	*	*		*	*	*	*
Abdelghani et al., 2021	7	*	*		**	*	*	*
Abdoli et al., 2021	9	*	*	*	**	**	*	*
Alah et al., 2022	8	*	*	*	**	*	*	*
Abouzid et al., 2021	8	*	*	*	**	*	*	*
Abu-Elnenin et al., 2021	9	*	*	*	**	**	*	*
Ahorsu et al., 2020	8	*	*	*	*	*	**	*
Akbari et al., 2021	7	*	*		**	*	*	*
Akbarpour et al., 2022	6	*	*		*	*	*	*
Al Ammari et al., 2021	9	*	*	*	**	**	*	*
Al Maqbali et al., 2021	10	*	*	*	**	**	**	*
Al Miskry et al., 2021	9	*	*	*	**	**	*	*

Al Mukhaini et al., 2021	7	*	*		**	*	*	*
Al Ajlouni et al., 2022	8	*	*	*	**	*	*	*
Al Ajlouni et al., 2020	8	*	*	*	**	*	*	*
Al Musharaf et al., 2020	9	*	*	*	**	**	*	*
Al Mutawa et al., 2021	9	*	*	*	**	**	*	*
Al Rahamneh et al., 2021	6	*	*		*	*	*	*
Al Saleh et al., 2021	7	*	*	*	*	*	*	*
Al Anazi et al., 2022	6	*	*		*	*	*	*
Alboghdadly et al., 2022	6	*			**	*	*	*
Alfawaz et al., 2021	6	*	*		*	*	*	*
Alghamdi et al., 2022	6	*			**	*	*	*
AlGhufli et al., 2021	6	*			**	*	*	*
AlHadi et al., 2021	8	*	*	*	**	*	*	*
Alharbi et al., 2021	8	*	*	*	**	*	*	*
Alkhotani et al., 2020	8		*		**	**	**	*
Alhurishi et al., 2021	5				**	*	*	*
Ali et al., 2022	6	*		*	*	*	*	*

Ali et al., 2021	6	*			**	*	*	*
Aljemaiah et al., 2021	6	*			**	*	*	*
Aljuffali et al., 2022	9	*	*	*	**	**	*	*
Almhdawi et al., 2022	7	*	*		**	*	*	*
Almhizai et al., 2021	5	*			*	*	*	*
Almugti et al., 2021	7	*	*		**	*	*	*
Alnofaiey et al., 2020	7	*	*		**	*	*	*
Alomari et al., 2021	6	*	*		*	*	*	*
Alothman et al., 2021	9	*	*	*	**	**	*	*
Alqahtani et al., 2021	8	*	*	*	**	*	*	*
Alrashed et al., 2021	5				**	*	*	*
AlRasheed et al., 2022	8	*	*	*	**	*	*	*
Alshammari et al., 2021	4			*	*	*	*	
Alshekaili et al., 2020	7	*	*		**	*	*	*
Alshumrani et al., 2022	8	*	*		**	*	**	*
Alsulimani et al., 2021	6	*	*		*	*	*	*
Araç et al., 2020	7	*			**	**	*	*

Arafa et al., 2020	7	*	*		**	*	*	*
Arafa et al., 2021	7	*			**	**	*	*
Aslan et al., 2021	7	*	*		**	*	*	*
Athamneh et al., 2021	6	*			*	*	**	*
Aydin Sayilan et al., 2021	7	*	*		**	*	*	*
Şentürk et al., 2021	6	*			**	*	*	*
Büber et al., 2022	6	*			**	*	*	*
Badahdah et al., 2020	5	*			**	*	*	
Badri et al., 2021	7	*	*	*	*	*	*	*
Bar-zeev et al., 2022	6	*		*	*	*	*	*
Barbato et al., 2021	6	*			**	*	*	*
Bilgiç et al., 2021	6	*			**	*	*	*
Bağcı et al., 2021	8	*	*	*	**	*	*	*
Bucak et al., 2021	6	*			**	*	*	*
Bulut et al., 2021	7	*		*	**	*	*	*
Cahal et al., 2021	5	*			*	*	*	*
Cakmak et al., 2022	6		*		**	*	*	*

Chan et al., 2021	8	*	*	*	**	*	*	*
Cheikh Ismail et al., 2021	6	*			**	*	*	*
Cheikh Ismail et al., 2020	6	*			**	*	*	*
Cigiloglu et al., 2020	6	*			**	*	*	*
Coiro et al., 2021	6	*			**	*	*	*
Duran et al., 2021	7	*	*		**	*	*	*
Durmaz Engin et al., 2021	7	*	*		**	*	*	*
El Refay et al., 2021	6	*			**	*	*	*
Elghazally et al., 2021	6	*			**	*	*	*
Elgohary et al., 2021	6		*		**	*	*	*
Elkholy et al., 2021	7	*	*		**	*	*	*
Ellakani et al., 2022	5	*			*	*	*	*
Elsalem et al., 2020	5		*		*	*	*	*
Eren et al., 2021	7	*	*		**	*	*	*
Gol et al., 2021	7	*	*		**	*	*	*
Guc et al., 2022	8	*		*	**	*	**	*
Galali et al., 2021	5	*			*	*	*	*

Ghanamah et al., 2021	5	*			*	*	*	*
Gokseven et al., 2021	6	*			**	*	*	*
Goweda et al., 2021	5				**	*	*	*
Grande et al., 2021	7		*		**	**	*	*
Hadar-Shoval et al., 2021	7	*		*	**	*	*	*
Hammoudi et al., 2021	6	*			**	*	*	*
Hammouri et al., 2022	5	*			*	*	*	*
Hawari et al., 2021	6	*			**	*	*	*
Husain et al., 2021	6	*	*		*	*	*	*
Hussien et al., 2020	7	*	*		**	*	*	*
Iqbal et al., 2021	7	*	*		**	*	*	*
Jahrami et al., 2021	7	*			**	**	*	*
Jalal et al., 2021	8	*	*		**	**	*	*
Kamaleddine et al., 2022	5				**	*	*	*
Kandemir et al., 2021	6	*			**	*	*	*
Karabulut et al., 2021	5				**	*	*	*
Karahan Yilmaz et al., 2021	5	*			*	*	*	*

Karatel et al., 2022	6	*			**	*	*	*
Keskin et al., 2022	5				**	*	*	*
Khamis et al., 2020	6	*			**	*	*	*
Kheirallah et al., 2021	6	*	*		*	*	*	*
Kilani et al., 2020	6	*			**	*	*	*
Kolokotorni et al., 2021	6	*			**	*	*	*
Korkmaz et al., 2020	5				**	*	*	*
Lin et al., 2022	7	*	*		**	*	*	*
Lin et al., 2020	5	*			*	*	*	*
Maatouk et al., 2022	6	*			**	*	*	*
Mahamid et al., 2021	6	*			**	*	*	*
Masoumi et al., 2021	5				**	*	*	*
Mekkawy et al., 2022	6	*			**	*	*	*
Meo et al., 2022	7	*		*	**	*	*	*
Mosheva et al., 2020	6	*			**	*	*	*
Mousavi et al., 2021	7	*	*		**	*	*	*
Najafipour et al., 2021	6	*			**	*	*	*

Nakhostin-Ansaeri et al., 2021	6	*			**	*	*	*
Nakhostin-Ansari et al., 2020	5	*			*	*	*	*
Nashwan et al., 2021	5				**	*	*	*
Okudan et al., 2021	6	*			**	*	*	*
Oteir et al., 2022	8	*	*	*	**	*	*	*
Radwan et al., 2021	6	*		*	*	*	*	*
Ranjbar et al., 2021	6	*	*		*	*	*	*
Romdhani et al., 2021	7	*	*		**	*	*	*
Saadeh et al., 2021	7	*			**	**	*	*
Sadeghniiat-Haghighi et al., 2021	6	*			**	*	*	*
Salehinejad et al., 2020	6	*			**	*	*	*
Salman et al., 2021	6	*			**	*	*	*
Salman et al., 2021	6	*			**	*	*	*
San et al., 2021	5				**	*	*	*
Sarsak 2022	6	*			**	*	*	*
Seyahi et al., 2020	7	*		*	**	*	*	*
Sis Celik et al., 2021	5	*			*	*	*	*

Sultan et al., 2021	6	*	*		*	*	*	*
Tas et al., 2021	5		*		*	*	*	*
Tasdemir Yigitoglu et al., 2021	7	*	*		**	*	*	*
Toprak Celenay et al., 2020	6	*			**	*	*	*
Torkian et al., 2021	6	*			**	*	*	*
Torun et al., 2021	6			*	**	*	*	*
Ustuner Top et al., 2022	6	*			**	*	*	*
Yilmaz et al., 2021	6	*			**	*	*	*
Yalcin et al., 2022	8	*	*	*	**	*	*	*
Yeni et al., 2022	6				**	*	**	*
Yilmaz et al., 2021	8	*	*	*	**	*	*	*
Yilmaz et al., 2021	6	*			**	*	*	*
Younes et al., 2021	7	*	*		**	*	*	*
Youssef et al., 2020	7	*			**	**	*	*
Yurumez Korkmaz et al., 2021	6				**	**	*	*
Zach et al., 2021	7	*	*		**	*	*	*
Zarzour et al., 2021	6	*			**	*	*	*

Zengin et al., 2021	7	*	*	**	*	*	*
Zreik et al., 2021	6	*		**	*	*	*

Table S4. Results of full literature review, tabulated by sub-population

Adults							
Reference	**Location of Study**	**Population**	**Sample Size**	**Study Design**	**Sleep Health Measurement Tool**	**Sleep Health Domains**	**Main Findings**
Abouzid et al., 2021	Egypt, Jordan, United Arab Emirates, Kuwait, Bahrain, Saudi Arabia, Oman, Qatar, Yemen, Syria, Palestine. Iraq	5896 respondents were included. The participants were aged between 8–23 years (45%; 24–30, 20.5%; 31–40, 18.6%; 41–60, 13.6%;>40, 2.3%) and 62.8% were females	5896	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration.	Sleep duration	49.6% reported they were sleeping less than 7 h and the sleeping hours increased to 7–10 h. for 53.2%
Ahorsu et al., 2020	Qazvin, Iran	older adults (50 or older) with a mean age of 57.72 (SD = 7.31) 62% male	413	Cross-sectional study	Insomnia Severity Index (ISI)	Sleep disorder (insomnia)	fear of COVID-19 was a significant mediator (unstandardized coefficient = 0.360; LLCI = 0.112; ULCI = 0.664) in the association between perceived health status and insomnia, significant direct effects of perceived health status on fear of COVID-19 and insomnia (unstandardized coefficient of 1.621; SE = 0.378; p < .001) as well as a significant total effect on insomnia (unstandardized coefficient of 1.981; SE = 0.392; p < .001)
Akbari et al., 2021	Iran	adults (mean age 30±11 years, 54.3% female)	3,323	Cross-sectional	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality	Inactive participants (IPs) scored significantly lower (p < 0.001) on the global score of sleep-quality than active participants (APs) (mean ± SD, 6.04±2.95, 5.59±2.94, respectively). No significant differences in inactive subgroups. Significant differences in active subgroups (p=0.003) APs that maintained

							their activity levels had better sleep quality. Sleep quality after COVID-19: Sleep habits of 49.3% of individuals (APs= 49.5% and IPs= 49.1%) had changed, so that 39.8% of them slept later; sleep time of 44.6% of individuals (APs= 43.7% and IPs= 45.5%) had changed, so that 28.7% of them slept more; and a significant portion of them (APs= 36.7% and IPs= 42.2%) were dissatisfied with their sleep habit changes
Akbarpour et al., 2022	Iran	1223 individuals with a mean age of 39.82 ± 10.75 years participated in the study.	1223	Cross-sectional study	Insomnia Severity Index	Sleep problems (insomnia)	Prevalence of insomnia 55.2% Being married was associated with less risk for insomnia (OR= 0.69, CI-95%= 0.52-0.91).
Al Miskry et al., 2021	United Arab Emirates	737 participants: 60.7% (n = 447) university students, 27.4% (n = 202) faculty members, and 11.9% (n = 88) staff selected through the convenience sampling method. 72.6% (n = 535) of the participants were females, whereas 27.4% (n = 202) were males.	737	Cross-sectional study	Survey items developed by the study's author including questions on sleeping difficulties.	Sleep problems (sleep pattern disturbances)	19.5% experienced changes in sleep patterns
Al-Ajlouni et al., 2020	Jordan	mean age 37.35 (SD=11.01), with over 60% aged <40 years 52.9% male	1,240	Cross-sectional study	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality	over 60% of participants reported having experienced at least one sleep problem in the last week, and nearly half reported having had short sleep duration. Participants reporting mild anxiety were more likely to experience poor sleep quality (aPR = 3.01; 95% CI=2.07 to 4.35), short sleep duration (aPR = 1.35; 95% CI=1.17 to 1.56) and at least one sleep problem (aPR=1.41; 95% CI=1.27 to 1.56). Those reporting moderate anxiety were more likely to experience poor sleep quality (aPR=5.78; 95% CI=3.97 to 8.43), short sleep duration (aPR=1.73; 95% CI=1.47 to 2.04) and at least one sleep problem (aPR=1.56; 95% CI=1.39 to 1.75)

							compared with those reporting minimal anxiety. Corresponding to the dose–response relationship between anxiety and sleep health outcomes, those reporting severe anxiety were the most likely to experience poor sleep quality (aPR = 8.954; 95% CI = 6.12 to 13.08), short sleep duration (aPR = 2.23; 95% CI=1.91 to 2.61) and at least one sleep problem (aPR =1.73; 95% CI=1.54 to 1.95) P-trend <0.001 for all sleep outcomes
Al-Ajlouni et al., 2022	Jordan	60% less than 40 years old, mean age of 37.4 (SD = 11.0) 52.9% male	1,240	Cross-sectional study	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality	Participants who did not meet the guidelines for moderate-to-vigorous physical activity (MVPA) had higher prevalence of poor sleep quality (aPR = 1.68; 95% CI = 1.24–2.26), short sleep duration (aPR = 1.15; 95% CI = 1.00–1.31), and sleep problems (aPR = 1.22; 95% CI = 1.10–1.35)
Al-Musharaf et al., 2020	Saudi Arabia	A total of 638 young women, with a mean age of 22.0 years ± 1.9 years, were studied. More than half of the women (413; 60%) were undergraduates, and the majority of the sample was unemployed (579; 91%)	638	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep Quality Sleep duration	PHQ-9 score was positively correlated with the global PSQI score ($r = 0.25$, $p < 0.001$) and negatively correlated with the duration of sleep (h/day) ($r = -0.18$, $p < 0.001$) GAD-7 anxiety score was positively correlated with a higher global PSQI score (worse sleep) ($r = 0.178$, $p < 0.001$) and negatively correlated with duration of sleep (hours/day) ($r = -0.21$, $p < 0.001$) The stress score was positively correlated a higher global PSQI (worse sleep) ($r = 0.159$, $p < 0.001$) and negatively correlated with duration of sleep (h/day) ($r = -0.196$, $p < 0.001$).
Al-Mutawa et al., 2021	Kuwait, Qatar, Saudi Arabia, Bahrain, United Arab Emirates, and Oman	14,171 participants, 67.3% females and 60.4% younger than 35 years old. 64.2% from Kuwait	14171	Cross-sectional study	Insomnia Severity Index	Sleep problems (insomnia)	Insomnia among Omani participants was 48.4% UAE participants 66.7% Participants in UAE (AOR = 1.455; 1.209–1.750) and Kuwait (AOR = 1.412; 1.244–1.602) were 40% more likely to show insomnia symptoms than participants in Oman. Females were also shown to be more susceptible to insomnia during the pandemic since they were 55% more likely to report sleeping problems compared to males

							All age groups younger than 35 years old were about 3 times more likely to show insomnia symptoms than age group >65. The most susceptible age group was shown to be 18 to 24 years old with an adjusted odds ratio of 3.286. Divorced individuals were 31.5% more likely to have sleeping problems than married individuals. Students (AOR = 1.422; 1.227–1.647) were 42%, and unemployed individuals (AOR = 1.305; 1.171–1.454) were 30% more likely to experience sleeping problems. Non-smokers were also 36.5% less likely to report any sign of insomnia than smokers (AOR = 0.635; 0.578–0.698) participants with underlying psychological disorders were 2.1 times (AOR = 2.098; 1.831–2.404) and individuals with underlying medical conditions 34% more likely to experience any symptom of insomnia (AOR = 1.340; 1.218–1.474). Regarding the duration of lockdown, participants who were in no lockdown or experienced the lockdown for <7 days were 18.2% less likely to show insomnia symptoms (AOR = 0.818; 0.746–0.897) compared to those who were in lockdown for more than 30 days. Finally, participants who were never infected with COVID-19 were 18.1% less likely to experience sleep problems than those who contracted COVID-19 at least once (AOR = 0.819; 0.672–0.998)
Al-Saleh et al., 2021	Saudi Arabia	1641 respondents were included in the current survey. Male participants were 733 (44.7%) and 61.1% of the participants aged 35 years or more.	1641	Cross-sectional study	Survey items developed by the study's author including questions on sleeping duration.	Sleep duration	Daily sleep hours for less than 8 hours were recorded for 662 (40.3%) participants and family troubles was reported by 44% of the respondents. Poor sleep hygiene was significantly higher among males than females.
Alah et al., 2022	Qatar	1061 participants. Majority were men (757; 71.3%), 35 to 54 years	1061	Cross-sectional study	Survey items developed by the study's author	Sleep duration Sleep quality	488 (46%) reported an increase in sleep duration, 149 (14%) reported a decrease. The mean sleep duration increased significantly

		old (585; 55.1%), married (850; 80.1%), and have completed college or a higher degree of education (832; 78.4%). Over 50 nationalities were reported by participants with the most common being Indian nationality (56.6%). Only 37 (3.5%) Qatari nationals participated. 565 (53.3%) shifted to work from home.			including questions on sleep duration and sleep quality		from 6.90 h/d before to 7.78 h/d during home confinement (0.89 hour mean difference, 95% CI: 0.74 to 1.04, P<0.001). 165 (29.2%) of those working from home and 131 (26.4%) of those who continued working regularly reported poorer sleep quality during home confinement as compared with before.
Alfawaz et al., 2021	Saudi Arabia	Students, staff and faculty of King Saud University 47% (726) of the study participants were males and 53% (816) were females. A large proportion of participants were from the age-group of 20–45 years (1229, 79.7%) and most were educated either up to graduate or higher level (1434, 93%).	1542	Cross-sectional study	Survey items developed by the study's author including questions on sleep problems (insomnia).	Sleep problems (insomnia)	496 (32.2%) of the participants reported suffering from insomnia constantly (233, 15.1%) or sometimes (263, 17.1%) during lockdown.
Alghamdi et al., 2022	Saudi Arabia	Females (n = 236, 64.13%), single (n = 356, 96.74%), and in their senior year (n = 256, 69.57%). The mean age of the participants was 20.4 ± 1.6 years (range: 18–26 years)	382	Cross-sectional study	Generalized Sleep Disturbance Scale	Sleep duration Sleep quality Sleep problems (sleep disturbance, nightmares)	Most participants did not suffer from the presence of nightmares during the quarantine period (n = 251, 68.21%); however, (n = 52, 20.72%) experienced new-onset nightmares when the quarantine started. The presence of nightmares was more significant among females (n = 86; 73.8%) than males (n = 31; 26.5%, $\chi 2(1) = 6.5$; p = 0.010).) Male participants with statistically significant nightmares reported frequent early waking from sleep (n = 24, 58.54%) and frequent daytime sleepiness (n = 20, 48.78%). On the other hand, female participants with statistically significant nightmares reported frequent difficulty falling asleep

							(n = 92, 71.87%), frequent waking up during sleep (n = 84, 65.62%), and frequent daytime sleepiness (n = 72, 56.25%). The mean GSDS was 45.0 ± 14.9 (range: 12–130). There was no difference in the mean GSDS between males and females. The mean subjective reported sleep duration (total daily sleep time) was 7.98 ± 1.8 h; (range 4–15 h). There was a statistically significant difference in the mean sleep duration between males (mean = 7.7 ± 1.6 h) and females (mean = 8.1 ± 1.8 h; t(366) = −2.2; p = 0.029). Approximately 33.4% (n = 123) of the participants reported taking naps during the day (mean = 1.7 ± 0.96 h/d; range: 0–5 h/d). Most participants reported poor sleep quality (n = 226, 61.41%).
Alharbi et al., 2021	Saudi Arabia	3032 responses The majority of respondents (64.4%) were females.	3032	Cross-sectional study	The Insomnia Severity Index	Sleep disorder (insomnia)	Respondents who are younger, reported having a diagnosed mental illness, have never been married, and students had significantly higher ISI scores than others. The results of the regression model indicate that the most important factors associated with insomnia severity during the COVID-19 pandemic were the level of depression and anxiety, along with the respondent's intolerance of uncertainty, history of a sleep disorder, younger age, and whether they used emotion-based coping strategies.
Alharbi et al., 2021	Saudi Arabia	790 responses were included. The majority of participants were the Saudi population (n=735; 92.9%). Two-thirds of the participants were employed. A total of 27.5% were healthcare workers, 45.1% were enterprise or institution workers, and 27.5% were teachers or students.	790	Cross-sectional study	Pittsburgh sleep quality index score Athens sleep questionnaire	Sleep quality Sleep duration Sleep disorder (insomnia)	The overall Global PSQI was 6.67±3.82 for all participants The prevalence of insomnia and poor sleep quality were 54.4% and 55.5%, respectively. Saudi citizenship was associated with longer sleep duration (p=0.031). Female gender and being married were associated with worse global PSQI, sleep quality, sleep distribution, sleep latency, and daytime dysfunction. In terms of sleep duration, the male gender was worse than the female gender (p<0.001) The prevalence of insomnia was 430 (54.4%). Compared to non-Saudi participants, Saudi

							participants were linked to a greater prevalence of insomnia (45.5% versus 55%) the prevalence of insomnia was 61.3% in the single participants and 50.4% in the married participants.
Aljemaiah et al., 2020	Saudi Arabia	347 participants from Taif, Saudi Arabia n = 213 (61.4%) males and n = 134 (38.6%) females. The mean age was 35.5 years (s.d. = 10.3 years). The age range was 12 to 63 years.	347	Cross-sectional study	4DSQ scale	Sleep quality	Sleep disruption was reported during the initial phase of the lockdown as people's quality of sleep was severely reduced.
Allam et al., 2021	Egypt	A random sample of 336 staff members employed at Menoufia University age of the participants under the study ranged from 22 to 63 years (35.34±9.0), most of them were married and from urban residence (77.1% and 69%, respectively), and 51.2% were females.	336	Cross-sectional study	Survey items developed by the study's author including questions on sleep problems.	Sleep duration Sleep quality Sleep problems	Workaholics had higher risks than relaxed ones for sleep problems in terms of difficulty initiating sleep, difficulty maintaining sleep, and insufficient sleep (OR: 1.97, 3.39, and 2.23; respectively)
Alnofaiey et al., 2020	Saudi Arabia	340 (73.6%) had an age ranging from 23–30 years, 235 (50.9%) were females, 202 (43.7%) were from Taif city, 256 (55.4%) were residents, and 18.6% had an internal medicine specialty.	340	Cross-sectional study	Pittsburgh Sleep Quality Index (PSQI) scale.	Sleep duration Sleep quality Sleep disorders	Prevalence of sleep disorders was 43.9%, doctors in the age group of 31–40 years, associate consultants had a significant higher prevalence of sleep disorders. Medical interns and laboratory/pathology/microbiology doctors had a significant more difficulty in fall asleep during COVID-19, and internists and surgeons had a significant higher percent of those who used sleeping pills. Resident doctors had a significant higher percent of having trouble in staying awake, and residents and consultants had a significant higher percent of those who suffered decreased sleep duration. Sleep quality during COVID-19 was very good, fair good and very bad in 23.4%, 60% and 3.5% of HCW

							respectively. The study observed a negative impact of COVID-19 pandemic on HCW sleep quality.
Alomari et al., 2021	Jordan	1757 participants: The majority of the participants were women (69.4%), from a middle-income class (77.0%) while 51.6% held a bachelor's degree and 35.6% were unemployed.	1757	Cross-sectional study	Survey items developed by the study's author including questions on sleep quality, sleep duration, and sleep disorders.	Sleep duration Sleep quality	>50% (range: 53.1%–59.4%) of the participants reported an "increase" in sleep disturbance, nighttime sleeping, and total sleeping hours while 49.1% reported a "decrease" in daytime sleeping. Only age ($\chi 2 = 20.2$; $p = 0.0001$) was associated with changes in sleeping disturbances during COVID-19 confinement. Younger age ($\beta = -0.02$; OR = 0.98; $p = 0.05$) was associated with an "increase" in sleeping disturbance Only gender ($\chi 2 = 13.4$; $p = 0.001$) is an independent predictor of nighttime sleeping. Being a male is associated with a "decrease" ($\beta = 0.36$; OR = 1.4; $p = 0.006$) in nighttime sleeping hours. Being a male ($\beta = 0.34$; OR = 1.41; $p = 0.03$) and having a high school ($\beta = -0.70$ OR = 0.50; $p = 0.007$), two-year ($\beta = -0.67$; OR = 0.50; $p = 0.01$), and four-year ($\beta = -0.46$; OR = 0.63; $p = 0.05$) diplomas are associated with a "decrease" in daytime sleeping hours.
Alothman et al., 2021	Saudi Arabia	A total of 669 individuals attempted to complete the online survey, 554 participants completed at least 2 sections of the survey (82.8%), and 41.3% (n = 276) completed the whole online survey. The majority of the sample were female (83%)		Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality Sleep duration	Most had sufficient sleep duration (7.5 hrs ± 2.1), and also reported poor sleep quality (5.4 ± 2.4)
Alqahtani et al., 2021	Saudi Arabia	593 participants 7.7% were males, and 42.3% were females. The response from the age group of 20–30 years was 38.6%, 30.4% were between 31 and 40 years, 17% were in the	593	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality Sleep duration	The PSQI score (7.2) of the female respondents were higher than that of the males. The mean latency to fall asleep of the former was 42.51 (SD 31.6) min, which was longer than that of the latter. Although the mean PSQI score and the sleep latency of the age group 51 years were high, the mean sleep duration was the shortest.

		age group of 41–50 years, and 14% were 51 years. Most of the respondents were from Jazan (43.8%					The latency to fall asleep in the age groups of 41–50 years were higher, i.e., 45.13 (SD 34.3) min. The PSQI score and the latency to fall asleep of graduates and postgraduates were higher than those of the respondents with primary and high school education. The respondents with hypertension had the highest PSQI score of 8.09, followed by the subjects with asthma (7.74). However, the sleep duration of the subjects with hypertension was short. The subjects with asthma had the highest latency to fall asleep (55.61 SD 36.01 min) among the individuals with other comorbidities. Individuals with a family history of psychiatric disorders and sleeping pills had higher PSQI scores The presence of comorbidities was related to sleep duration (v2 = 12.13 [5], p = 0.03). Sleep duration affected males more than females (OR 1.92 [1.3–2.7], p = 0.001) and subjects aged 51 years (OR 2.49 [1.3–4.4], p = 0.002) Being worried/anxious of the infection significantly affected sleep latency (t = 2.3 [591], p = 0.018), sleep duration (t = 4.5 [591], p = 0.001), sleep efficiency (t = 2.7 [1.0], p = 0.005), and PSQI score (t = 2.84 [591], p = 0.005)
AlRasheed et al., 2021	Saudi Arabia	The study included 836 participants. The median age was 28 years, 624 (74.64%) were females, and 158 (18.90%) were healthcare workers.	836	Cross-sectional study	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality Sleep duration	Factors associated with poor sleep were recent changes in the sleep habits p = 0.004), anxiety or fear because of coronavirus news on social media p = 0.02), fear because there was no approved drug to treat COVID-19 p = 0.03), and unaware of the presence of chronic diseases p = 0.03). Female gender p = 0.02), fear or anxiety because of coronavirus news on social media p = 0.04), recent change in sleep habits (OR: 1.97 (1.15–3.39); p = 0.01), fear because there is no approved drug to treat COVID-19 p = 0.001), monthly income <1000 SR p = 0.01), and isolation p = 0.01) were

							associated with distress. PSQI and K10 scores were significantly correlated p < 0.001).
AlRasheed et al., 2021	Saudi Arabia	The study included a total of 353 participants; 88 were in isolation because they had current or suspected COVID-19 infection or because they had just arrived from abroad, with 265 non-isolated individuals serving as controls. The age of the isolated group was 28.6±9.8 (mean ± standard deviation) years versus 27.5±8.5 years for the non-isolated group, with males accounting for 37% in both groups	353	Cross-sectional study	Pittsburgh Sleep Quality Index (PSQI)	Sleep duration Sleep quality	The mean PSQI score was 8.5±3.6 and 8.4±3.5 for the isolated and non-isolated groups, respectively (P= 0.92). Poor sleep (PSQI ≥6) was reported in 235 (66.6%) Isolation was not associated with poor sleep (OR: 0.73 (95% CI: 0.41–1.3), P=0.29)
Alshumrani et al., 2022	Saudi Arabia	A total of 1091 participants were surveyed; 643 (58.9%) were COVID-19 patients. The mean age of the patients in the COVID-19 arm was 42.8 ± 15.2 years, with a male predominance of 61.1%.	1091	Cross-sectional study	Athens Insomnia Scale	Sleep quality Sleep disorder (insomnia)	The majority (58.1%) reported worsened sleep during the COVID-19 pandemic. Poor sleep quality was reported in 66.1% of the patients in the COVID-19 group (mean score of 6.9 ± 4.0) and 72.8% of participants in the control group (mean score 7.6 ± 4.3). Insomnia affected 50.5% of the patients with COVID-19 (mean score of 6.5 ± 5.5) and 58.5% of controls (mean score of 7.6 ± 5.5).
Arafa et al., 2021	Egypt	1629 participants, 48.1% were aged ≤ 30 years, 42.4% were men, and 20.0% were working in the health sector	1629	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration.	Sleep duration	inadequate sleeping (less than 6hrs/ day) (23.1%)
Badri et al., 2021	United Arab Emirates	574 older adults in Abu Dhabi About 60% were male and 40% were female. Most of them were	574	Cross-Sectonal study	Survey items developed by the study's author including questions on	Sleep disorders	The analysis took each of the ten psychological feelings as dependent variables, where time was treated as the only independent variable. and resulted in ten individual regression analyses. Sleeping disorders showed significance at the 0.05

		married (82.4%), while only (7.7%) were single. Around (3.1%) were separated, widowed, or divorced. About 40% were Emirati and 60% were non-Emiratis.			sleep duration.		level. The positive standardized coefficients and t-values note more negative development for sleeping for older adults, suggesting that time harms the development of the sleeping disorders.
Barbato et al., 2021	United Arab Emirates	international sample of foreign workers (n = 319) resident in the United Arab Emirates (UAE). The majority of participants were female (76%), European (69%) and highly educated (83% had a bachelor's or higher degree)	319	Cross-sectional study	Insomnia Severity Index	Sleep disorders(insomnia)	Insomnia symptoms were observed in 33% of participants, with 4% of participants showing severe symptoms. A higher reported prevalence of insomnia was observed among younger participants, females, and a more severe impact of COVID-19 in the home country.
Başkan et al., 2021	Turkey	Using the snowball sampling method for sample selection, 1.909 individuals aged 18-65 years living in Turkey. 69% of the respondents was female, 48.9% was married, 68.5% had moderate income, and 43.1% was civil servant. Of the participants, 78.6% was university graduate	1909	descriptive type research	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality	The PSQI score was 7.78±3.46, and 71.6% of the participants had poor sleep quality. A significant, positive and weak relationship was found between the total scores on PSQI and PSS ($p<0.05$)
Cheikh Ismail et al., 2020	United Arab Emirates	1012 participants, highest number of participants residing in Abu Dhabi (33.9%) and Dubai (32.5%) Females (75.9%), aged 26–35 years (29.1%), were married (56.4%), had no children (50%), completed a bachelor's	1012	Cross-sectional study	Copenhagen Psychosocial Questionnaire (COPSOQ-II) with modifications	Sleep quality Sleep duration Sleep disorder	Significant decrease in the percentage of participants who reported sleeping less than seven hours per night from 51.7% before the pandemic to 39% during the pandemic ($p < 0.001$) A higher percentage of participants reported poor sleep quality during the pandemic (28.1%) compared to before the pandemic (17.3) ($p < 0.001$), and sleep disturbances were also more common during the pandemic (60.8%) compared to before (52.9%).

		degree (54.1%), worked full-time (53.3%), and were working or studying from home during quarantine (61.6%).					30.9% of the surveyed participants reported feeling lazy and less energized during the pandemic, compared to only 4.7% before the pandemic ($p < 0.001$) Sleep disturbances increase was significantly higher in females ($p = 0.011$). Sleep duration and quality was most affected among participants aged 18–35 ($p < 0.001$).
Cheikh Ismail et al., 2021	Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Oman, Palestine, Qatar, Saudi Arabia, Syria, United Arab Emirates and Yemen.	2970 participants from 18 countries in the MENA region The largest proportion of respondents was from the United Arab Emirates (13·1 %), Jordan (11·9 %), Lebanon (11·5 %), Saudi Arabia (8·3 %) and Palestine (6·4 %). 28.4 % males, aged 18–25 years (29·6 %), were married (53·2 %), had no children (49·7 %), completed a university degree (48·5 %), worked full-time (44.8 %) and were working/studying from home during the lockdown (56.0 %)	2970	Cross-sectional study	Copenhagen Psychosocial Questionnaire	Sleep quality Sleep duration Sleep disorder	Although the percentage of participants who were sleeping <7 h per night decreased from 51·4 % before the pandemic to 36·6 % during the pandemic, the percentages of participants reporting poor sleep quality increased from 17·1 % before the pandemic to 29·2 % during the pandemic ($P < 0·001$). Moreover, a higher percentage of participants reported sleep disturbances during the pandemic (63·2 %) compared with before (53·1 %). As a result, 29·6 % of the participants reported feeling lazy and less energised during the pandemic, compared with only 4·7 % before the pandemic ($P < 0·001$)
Cigiloglu et al., 2020	Turkey	Of the 104 participants, 61 (58.7%) were men, and 75 (72.1%) were ages 65–74. With regard to health, 76.9% of respondents reported a history of at least one chronic disease	104	Cross-sectional study	Richards-Campbell Sleep Questionnaire	Sleep quality	None of the groups had a mean sleep score indicating very poor sleep quality (score: 0–25). As the monthly income and education level increased, scores for most of the sleep parameters also increased Found that depression and anxiety symptoms were associated with poorer quality of life and sleep quality.
Corio et al., 2021	Israel	2541 participants: Israel (N = 1969) and the U.S. (N = 572) Israeli sample: Age 40.4	2541	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	56% of the sample were poor sleepers A large majority of the sample (88.9%) reported that their sleeping habits had changed since the pandemic started in at least one of the 6 ways

		± 13.76, Female 55.1% (1085)					assessed. Almost 70% of the participants reported they were going to bed later, and almost 50% reported waking up later in the morning the strongest correlations were between use of sleeping medication and both depression (rs = .55, P < .001) and anxiety (rs = .57, P < .001), and between sleep disturbances and both depression (rs =.52, P < .001) and anxiety (rs=.49, P < .001). Participants who reported more COVID-related stress reported significantly poorer sleep quality, with moderate effect sizes
Duran et al., 2021	Turkey	405 participants, 70.9% of the participants were female, 29.1% were male. While 6.7% of the participants were single, 82.2% had undergraduate or higher degrees. 48.4% were continuing to work from their workplace, 15.1% were continuing to work from home, and 36.5% were not working at a job. 69.4% did not have children.	405	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	Mean sleep quality score was 6.39 ± 3.31. The prevalence of poor sleep quality was 55.1%. The sleep quality of the single participants and the participants with low education levels was poorer. The sleep quality of those who left work in the pandemic period was poorer than those who were working from home/office and those who were already not employed before the pandemic. The sleep quality of those not working in the field of health was better than healthcare professionals and those not working at all. The scores for psychological distress were negatively correlated with sleep quality levels.
Eren et al., 2021	Turkey	405 participants 67.9% (275) of the individuals participating in the study were women, and 34.6% (281) were under 20 years old. 68.4% (277) of the individuals are university graduates and high graduate, 67.2% (272) are single, 28.6% (116) have children.	405	Cross-sectional study	Pittsburg Sleep Quality Index	Sleep qualtiy	While 23% (93) of the participants had sleep problems before the COVID19 outbreak, 40% (162) had sleep problems after the COVID19 outbreak. It was determined that 183 (78.9%) participants with good sleep quality did not have sleep problems after the start of the COVID-19 outbreak, and 113 (65.3%) participants with poor sleep quality experienced sleep problems after the start of the COVID-19 outbreak. As a result of an increase in the state-trait anxiety scale score by 1 point, the risk of poor sleep quality increased 1.051 times (5.1%) A statistically significant relationship was found between PSQI classes and psychiatric diagnosis

							status (χ2=4.416, p=0.036). It was found that 226 people (97.4%) with good sleep level had no psychiatric diagnosis, and 12 people (6.9%) with bad sleep level had psychiatric diagnosis.
Galali, 2021	Iraqi Kurdistan	2137 participants included 74.9% (1,600) from Erbil, 22.3% (476) from Sulaimani, and 2.9% (61) from Duhok. Regarding gender, results showed that 43.4% (927) were male and 56.4% (1,210) were female.	2137	Cross-sectional study	Survey items developed by previous study "EBLC-COVID19 questionnaire" Including questions on sleeping behavior.	Sleep duration	During the pandemic, the percentage of people reporting sleeping between 7 and 9 hr per night increased from 44.8% to 53.6% and those reporting more than 9 hr sleep increased from 8.1% to 22.4%.
Gokseven et al., 2021	Israel	315 participants: 178 were female and 137 were male. The mean age was 71.5 ± 5.6 (min: 65, max: 94) years, and 26 participants were living alone.	315	Cross-sectional study	Survey items developed by the study's author including questions on sleep disorder.	Sleep disorder (Insomnia)	30.8% (n = 97) of the participants stated that they had difficulty falling asleep at night after the onset of COVID-19 infection
Hadar-Shoval et al., 2021	Israel	421 Participants. The sample comprised 295 women (70%), and participants had a mean age of 37.93 ± 16.47 years (range 18-90) and a mean education of 14.39±2.78 years. About 53.8% (n=226) lived in urban areas and 46.2% (n=194) in rural areas.	421	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	For the entire sample, sleep disorder (insomnia), as measured by PSQI, revealed poor sleep quality (6.82; above 5 is an indication of sleep disturbances).
Hammoudi et al., 2021	Lebanon	111 (18.8%) males, 480 (81.2%) females	591	Cross-sectional	Insomnia Severity Index	Insomnia levels	Regarding phone screen times among the university students, the prevalence of insomnia, anxiety,

				study	(ISI), Bedtime Procrastination Scale		depression, and overweight increased with increasing phone screen time. Female sex (adjusted odds ratio [aOR]=2.19, 95% confidence interval [CI]=1.27-3.77), overweight status (aOR=1.85, 95% CI=1.22-1.28), insomnia (aOR=1.06, 95% CI=1.02-1.10), and bedtime procrastination (aOR=1.03, 95% CI=1.00-1.07) were significant predictors of a phone screen time of ≥7 hours
Hammouri et al., 2022	Jordan	467 participants. 297 (64%) responses from females and 170 (36%) from males. The population age was between 18 and 103 years old and the mean was 33.9 years (SD 13.1).	467	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration.	Sleep duration	There is a significant difference in the increase in hours of sleep, where single people (59%) increased the amount of sleep more so than married people (43.4%). The respondents who increased their sleeping hours tended to have a younger mean of age for all significant pairwise comparisons.
Husain et al., 2020	Kuwait	415 adults participated in this descriptive cross-sectional study with a mean age of 38.47 ± 12.73 years; most of them were females, numbering 285 (68.7%).	415	Cross-sectional study	Survey items developed by the study's author including questions on sleeping habits.	Sleep quality	With regard to sleeping habits, results indicated significant statistical differences before and during the pandemic, there was a decrease in the percentage of participants who slept during the night and a marked increase in the percentage of participants who slept during the day (OR = 3.99 (95% CI 2.86–6.62), p < 0.001)
Hussien et al., 2020	Egypt, Jordan, and Saudi Arabia	General populations of Egypt (198 participants, 40% female), Jordan (148 participants, 36% female), and Saudi Arabia (358 participants, 42% female) were recruited.	704	Cross-sectional study	Survey items developed by the study's author including questions on sleep quality.	Sleep quality	53.7% of the sample reported sleep disturbances. A high DASS mean score was significantly associated with reporting disturbances in sleep
Iqbal et al., 2021	Saudi Arabia	397 questionnaires from the participants. The respondents were mostly of youth age (19-24 years), 66.5% of respondents were male, while there were 33.5%	397	Cross-sectional study	Pittsburgh sleep quality index	Sleep quality	While correlating the sleep patterns disturbance in individuals who had contact with COVID-19 patients, there was a significant sleep disturbance. The disturbance of sleep was in having problems falling sleep (p-value=0.024), having bad/horrible dreams (p-value=0.017), feeling cold at sleeping (p-

		females. Most of the participants did not contact any COVID-19 patients (75.1%, n=298)					value=0.038), and difficulty staying active during eating or driving (p-value=0.012). The sleep quality is poor due to the stay-at-home order, having a disorganized working schedule, and deprived lifestyle.
Karahan Yilmaz et al., 2021	Turkey	A total of 1120 individuals, 412 (36·8 %) male and 708 (63·2 %) females, participated in the study. The mean age was determined as 33·04 ± 11·04. Among those who participated in the research, 84·6 % of individuals were university/bachelor's/master's degree graduates.	1,120	Cross-sectional study	Survey items developed by the study's author including questions on sleep quality and sleep duration.	Sleep duration Sleep quality	During the pandemic period, 42·5 % of the individuals stated that they slept more and 40·2 % stated that there was no change in their sleep patterns. Daily physical activity durations were determined as 8·25 ± 1·77 h for sleep
Keng et al., 2022	86 countries	67% (n = 4959) of the participants were female	7,402	Longitudinal study	Survey	Question on sleep quality	COVID-related infection risk and perceived economic burden were both negatively associated with sleep quality during the previous week. (b = 0.67, SE = 0.01, p <.001) Those who reported high economic burden (top 10%) reported decreased sleep quality regardless of levels of perceived infection risk, b = -0.02, SE = 0.02, p =.325, whereas people perceiving low economic burden (bottom 10%) reported better sleep quality if their perceived infection risk was also low, b = -0.111, SE = 0.02, p <.001
Kilani et al., 2020	MENA region	917 males, 37.4 ±13.4 years old and 806 females 32.2 ± 11.5 years old	1,723	Cross-sectional study	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality	t-test analysis revealed a significant difference in mental wellbeing score based on sleep quality (t = -16.413, p < 0.001). A significant number of respondents (43%) reported poor sleep quality. Those with good sleep quality showed significantly better mental wellbeing (15.5 ± 3.4) in comparison with those with poor sleep quality (12.4 ± 4.2) (p <

							.001)
Kolokotroni et al., 2021	Cyprus	Out of 745 participants (sample of adults who resided in Cyprus during the Spring 2020 lockdown), 74% were female and median age was 39 years.	745	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	Overall participants reported significantly worse sleep quality score (4 v 5, p < 0.01) during lockdown. Regarding the individual PSQI score components (sleep latency, daytime dysfunction, sleep medication and sleep quality), all increased during lockdown (p < 0.01), demonstrating a worse sleep experience, except sleep efficiency, which marginally improved during lockdown (p < 0.01). a positive moderate correlation (r = 0.4064, p < 0.01) between differences in perceived stress and sleep quality index before and during lockdown, indicating that an increase in perceived stress was associated with worsening sleep quality. Overall support index score difference was negatively correlated with sleep quality index difference (r = − 0.2253, p < 0.01), showing that a decrease in the overall support index during lockdown was associated with worsening sleep quality.
Korkmaz et al., 2020	Turkey	61 (44%) females and 79 (56%) males participants The average age for female participants was 30.7 ± 6.2 and the average age for male participants was 35.6 ± 8.7	140	Cross-sectional study	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality	There was a positive correlation between the Beck Anxiety Inventory (BAI) scores and the PSQI and Problem Solving Inventory (PSI) scores of the participants and a negative correlation between the World Health Organization Quality of Life-BREF (WHOQOL-BREF) scores and the PSQI and PSI scores of the participants (p = 0.000, r = 0,508; p = 0.029, r = 0,184; p = 0.000, r = −0,360)
Lan et al., 2021	Israel	Studied the effects of lockdown in three cohorts: (1) 169 individuals from the general population; (2) 91 undergraduate students and (3) 39 women within fertility age.	299	Cohort study	Sleep logs Online questionnaire	Sleep duration Sleep quality Sleep disorders	In cohort (1) lockdown resulted in increased sleep duration (p<0.001), and delayed midsleep point during workdays (p=0.07) and weekends (p=0.02) largest change in sleep duration was shown in young people with late chronotype (p=0.04) and older subjects with early chronotype (p=0.04). In cohort (2), There were effects of lockdown

							(p=0.02) and chronotype (p=0.05) on sleep duration. Increased sleep during lockdown and in early chronotypes. Females slept more during lockdown (p=0.01) and students who work slept less (p=0.02). Midsleep point free days (MSF) was delayed during lockdown (p=0.001) with MSF of late chronotypes later than MSF of early chronotypes (p<0.001).
Lin et al., 2020	Iran	A sample of Iranian young adults (n = 1078 with 628 males; mean age = 26.24 years [SD ± 7.41])	1078	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	Insomnia was mutually and significantly correlated with psychological distress, problematic social media use, fear of COVID-19, COVID-19 misunderstanding. Problematic social media use was significantly associated with insomnia via both direct (B = 0.095; SE = 0.038) and indirect paths.
Lin et al., 2020	19 countries	N/A	N /A	Longitudinal study	Google trends	Sleep disorder (insomnia)	The countries with the greatest increases in searches for insomnia were Iran, Spain, the United States, and Italy; these countries exhibited a significant increase in insomnia searches on more than 10 of the 31 days observed. The number of COVID-19–related deaths was positively correlated to the number of days with an increase in searches for insomnia in the 19 countries (ρ=0.64, P=.003)
Lin et al., 2022	Iran	Sample of 10,843 participants (mean age = 35.54 years; SD = 12.00), 6751 were females (62.3%)	10843	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	Suicidal ideation was positively and significantly correlated with insomnia (r = 0.327; p < 0.001) Generalized trust was negatively and significantly correlated with insomnia (r = −0.100; p < 0.001) insomnia and fear of COVID-19 were positively and significantly correlated (r = 0.271; p < 0.001).
Maatouk et al., 2022	Lebanon	948 participants, divided into four groups: non-smokers not at risk (NSNR), non-smokers at risk (NSR), smokers not at risk (SNR), and smokers at risk (SR). A person at risk is	948	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration.	Sleep duration	NSNR significantly increased their sleep duration by 64.284 min per night (p < .001) SNR increased their sleep duration by 54.732 min per night (p < .001)

		an individual with a disease that could worsen the prognosis of a potential COVID-19 infection. Age mean: NSNR (26.52 years, standard deviation = 10.051), NSR (33.26 years, standard deviation = 15.672), SNR (29.55 years, standard deviation = 11.314), and SR (34.39 years, standard deviation = 12.193)					
Mahamid et al., 2021	West bank of Palestine	129 males and 237 females	366	Cross-sectional study	DSM-5 Level 2—Sleep Disturbance Scale	Sleep disorder(sleep disturbance)	Problematic internet use positively correlated with sleep disturbance ($r = .19$, $p < .01$), and negatively correlated with life satisfaction ($r = -.17$, $p < .01$). Moreover, life satisfaction negatively correlated to sleep disturbance ($r = -.25$, $p < .01$). Sleep disturbance explained statistically and significantly variance in problematic internet use ($B = .16$, $SE = .04$, $\beta = .20$)
Masoumi et al., 2021	Iran	Mean (SD) age was 28.8 (5.9) years. 119 females (60%)	200	Cross-sectional study	Mini-Sleep Questionnaire	Sleep duration and sleep quality	Sleep quality was 30%, worse in the pandemic period compared to the pre-pandemic states, The mean time to go to bed and wake-up time on weekdays in the pandemic were 35 and 24 min later than those in the pre-pandemic period respectively. The mean time to go to bed and wake-up time on weekends in the pandemic were 21 and 6 min later than those pre-pandemics. Before the pandemic, subjects went to bed on weekends 40 min later than on weekdays ($p < 0.0001$). In the pandemic, this difference decreased to 26 min ($p < 0.0001$). In both the pre-pandemic and pandemic periods, subjects woke up 96 min later on weekends compared to the weekdays ($p < 0.0001$). Before the pandemic, the

							mean sleep duration every night was 7 h and 22 min for the weekdays, which decreased to 6 h and 44 min during the pandemic. The difference signified a 38 min sleep debt every night. The night sleep duration on weekdays before the pandemic was 33 min shorter than the night sleep duration on weekends (p <0.0001). This difference decreased to 2 min during the pandemic.
Najafipour et al., 2021	Iran	Of 911 participants, 365 (40.1%) were men. Almost half of the participants (51.7%) aged over 55 years. Married people accounted for 80.4% of the samples, 72.7% were illiterate or have non-university education, and 67.6% were unemployed.	911	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration.	Sleep duration	42.8% and 58.8% experienced sleep time abnormality before and after the quarantine, respectively A high percentage of people experienced an increase in sleep hours (33.7%) The odds of an increase in sleep hours was higher in men and young people and lower in people with intense PA and higher levels of anxiety. The changes in the three variables were mostly related to the quarantine, although interaction between PA and sleep was also present. There was a negative relationship between anxiety and sleep hours and between PA and sleep hours both before and after quarantine.
Nakhostin-Ansari et al., 2021	Iran	675 people with a mean age of 40.28 years (SD=11.15) participated in the study. One-hundred and ninety-six (29%) were male, and 479 (71%) were female.	675	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	Three hundred and forty-two participants (50.7%) had subthreshold insomnia, 275 (40.7%) participants had moderate insomnia, and 58 participants (8.6%) had severe insomnia. Six-hundred and seventeen participants (91.4%) had DIS, 585 participants (86.7%) had DMS, and 520 participants (77%) suffered from EMA. The prevalence of these disorders was significantly different from each other (P<0.05), and DIS was the most common insomnia pattern. fear of COVID-19 was a risk factor for all patterns of insomnia (OR=1.19, 1.12, 1.02 for DMS, DIS, and EMA, respectively). Age was a risk factor for EMA (OR= 1.09), but it was a protective factor for DMS (OR=0.98). Self-employment was a risk factor for DMS (OR=1.61) and DIS (OR=1.59)

							Conclusion: Fear of COVID-19 is a major contributing factor to insomnia patterns. Investigation of COVID-19 fear in people with insomnia and the addition of attributed relieving or management strategies to conventional management of insomnia are reasonable approaches to improve the sleep condition of people in the pandemic.
Okudan et al., 2021	Turkey	37.88±12.44 years age, 346 (68.5%) females and 159 (1.5%) males	505	Cross-sectional study	Online survey	Quality of life (WHO Quality Of Life)-Bref version	27.5% (N.=142) informed that even they sleep enough time, wake up tired, while 22.1% (N.=114) cannot sleep enough time, and wake up tired.
Oved et al., 2021	Israel	Out of the 169 participants, 94 (55.62%) were women, and 75 (44.38%) were men. The age of the participants ranged between 20 and 80, with clear two main age groups: 20–40 and 60–80.	169	longitudinal study	Smartwatch data collection	Sleep duration Sleep quality	An increase was observed in sleep duration based on questionnaire responses (an average of 6.28 h versus 6.42 h, $p < 0.01$, Cohen's $d = 0.14$) and based on smartwatch records (an average of 7.03 h versus 7.12 h, $p = 0.05$, Cohen's $d = 0.14$), MSF (an average hour of 4.03 versus 4.12, $p = 0.02$, Cohen's $d = 0.13$) and MSW (an average hour of 3.43 versus 3.49, $p = 0.07$, Cohen's $d = 0.08$). No significant effects were found for stress, sleep quality and SJL.
Radwan et al., 2021	United Arab Emirates	2060 responses. Three-quarters (75.1%) were females, 31.7% were between 18 and 30 years old, 38.4% were between 31 and 40 years old, and 29.9% were older than 40 years. Over half of the study population (63.8%) were married and the majority had a university degree (76%).	2060	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration.	Sleep duration	Decreased sleep was reported by 20.8%. In terms of sleeping behavior, females were more likely to experience decreased sleep compared to males, whereas older adults (>40 years old vs. 18–30 years old) were less likely to experience decreased sleep during the lockdown.
Romdhani et al., 2021	49 countries	athletes (mean age: 25.1 (range 18-61) years, 1764 female (45%), 2427 team-sport (63%) and	3911	Cross-sectional study	Pittsburgh Sleep Quality Index (PSQI) and Insomnia	Sleep quality, Sleep disorder (insomnia)	PSQI (4.3 ± 2.4 to 5.8 ± 3.1) and ISI (4.8 ± 4.7 to 7.2 ± 6.4) scores increased from pre- to during lockdown ($p < 0.001$). PSQI was predominantly influenced by sleep-onset latency ($p < 0.001$; + 29.8%), sleep

		1442 elite (37%) athletes			Severity Index (ISI)		efficiency (p < 0.001; - 21.1%), and total sleep time (p < 0.001; - 20.1%), while ISI was affected by sleep-onset latency (p < 0.001; + 21.4%), bedtime (p < 0.001; + 9.4%), and eating after midnight (p < 0.001; + 9.1%) Athletes went to bed (+ 75 min; 5.4%; d = 1.14) and woke up (+ 150 min; 34.5%; d = 1.71) later during lockdown with an increased total sleep time (+ 48 min; 10.6%; d = 0.83). Lockdown-mediated circadian disruption had more deleterious effects on the sleep quality of individual-sport athletes compared with team-sport athletes (p < 0.001; d = 0.41), elite compared with non-elite athletes (p = 0.028; d = 0.44) and older compared with younger (p = 0.008; d = 0.46) athletes
Sadeghniiat-Haghighi et al., 2021	Iran	1,223 participants [827 (67.6%) female, mean age=39.82±10.75 years old]	1223	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	675 (55.2% [95%CI=52.40-57.98]) were categorized into the insomnia group. Insomnia was more prevalent in females (p=0.006), participants with 50 years old or higher (p=0.04), or high fear of COVID-19 (p<0.0001). Totally, 67.4%, 66.4%, and 55% of all participants had DIS, DMS, and EMA, respectively, in the current outbreak. Besides, 79% had impaired daily functioning, 51.6% had impaired quality of life, and 62% were worried about their sleep problem. Notably that a considerable percentage of individuals with normal ISI scores had at least one insomnia phenotype or impaired daily functioning and quality of life. Further analyses revealed a significant increasing trend in all four insomnia phenotypes prevalence with an increase in fear of COVID-19 (all p-values<0.0001).
Salehinejad et al., 2020	Iran	Healthy volunteers 137 females, mean age = 25.79 ± 7.31	160	Cross-sectional study	Pittsburgh Sleep Quality Index (PSQI), Quantitative sleep parameters, Morningness-Eveningness Questionnaire	PSQI: sleep quality, Quantitative Sleep parameters: about time to go to bed (clock), sleep onset latency time (in	PSQI: significant decrease of global sleep quality during quarantine (t = 6.95, p < 0.001. t-test showed that the time to fall asleep was prolonged during home quarantine as compared to the time before quarantine (t= 7.32, p < 0.001). The average sleep duration (in h) was significantly longer during quarantine, as compared to before quarantine as well (t = -3.65, p < 0.001). 85.6 % of the participants (137

						minutes), time to get up in the morning, and sleep duration Morningness-eveningness questionnaire: chronotype	of 160) reported at least 1 h delay to get up in the morning on average in home quarantine. The average delay to get up in the morning during home quarantine was 2.28 h. Results showed that participants' time to get up in the morning was significantly delayed during quarantine (t= 15.36, p < 0.001)
Salman et al., 2021	Kuwait	Data from 679 respondents (57.9% females and 42.1% males; 67.7% Kuwaiti nationals and 32.3% non-Kuwaiti nationals)	679	Cross-sectional study	Survey items developed by the study's author include questions on quality of sleep.	Sleep quality	Mental health was highly correlated with the quality of sleep Extremely severe depression was associated with having poor or very poor quality of sleep (1.75 times). Severe or extremely severe psychological distress was associated with having poor or very poor quality of sleep (2.20 times)
Salman et al., 2021	Kuwait	Among 679 respondents, 57.9% were female and 67.7% were Kuwaitis. Age group categories were represented relatively evenly, with 28.7% of respondents in their 20s, 29.3% in their 30s, 23.0% in their 40s, and 19.0% in the age range of 50 years or above. The average age was 37.7 (SD: 11.6).	679	Cross-sectional study	Survey items developed by the study's author include questions on quality of sleep.	Sleep quality	36.4% of respondents rated their quality of sleep as 'poor' or 'very poor'. Days of physical activity were positively correlated with 'quality of sleep' Sleep hours were positively correlated with good quality of sleep. Quality of sleep was negatively correlated with 'consumption of sugary drinks' and 'consumption of sweets and snacks', and positively correlated with 'the days of physical activity'.
Savci et al., 2021	Turkey	The final sample consisted of the remaining 103 older adults residing in a nursing home affiliated with the Istanbul Darulaceze Directorate of Hospice.	103	Correlational study	Survey items developed by the study's author include questions on sleep patterns.	Sleep quality	18.4% of the participants had change in sleep patterns during the pandemic.

		The inclusion criteria for the study were as follows: be over 65 years old, voluntarily agree to participate in the study, have a Standardized Mini Mental Test Score of 24 or higher, residence within the nursing home for at least one year, and speak and understand Turkish.					
Şentürk et al., 2021	Turkey	254 (55.3%) males and 205 (44.7%) females. The age of the participants ranged from 24 to 60 years (M=35.64, SD=6.84) and mean age was 35.64±6.84	459	Cross-sectional study	Jenkins Sleep Scale (JSS)	Subjective sleep quality	Poor sleep quality is a predictor of depression (β=0.378, p<0.001), of anxiety (β=0.373, p<0.001) and stress (β=0.324, p<0.001)
Sultan et al., 2021	Saudi Arabia	Three hundred thirty-eight individuals responded to the survey. Participants were 267 females (79%) and 71 males (21%) with a median age of 40 which ranged from 30 to 44 years.	338	Cross-sectional study	Survey items developed by the study's author include questions on sleep duration and sleep quality.	Sleep duration Sleep quality	The percentage of participants who used to sleep more than nine hours daily increased significantly during the pandemic from 8.3% to 21.8% (p<0.001). Use of sleeping aids increased from 11.6% to 15.7% (p<0.001), with 7.7% of participants having difficulty falling asleep for more than two hours. Moreover 41.8% did not feel relaxed after getting up from sleep during the pandemic compared to 14.2% before (p<0.001)
Toprak Celenay et al., 2020	Turkey	375 individuals in the Stay at home group and 311 individuals in the Continued to work group were included in data analysis.	686	Cross-sectional study	Jenkins Sleep Scale	Sleep quality	JSS-T scores reveled sleep quality was similar in both groups (p > .05)
Torkian et al., 2021	Iran	3,446 people completed the questionnaire. most participants were female (66.7%), mean (± SD) age of the	3446	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	73.5% had poor sleep quality. Perceived income, hours spent outdoors, the number of people with COVID-19 that were acquainted with, and a history of depression were significantly related to sleep quality.

		participants was 34.2 (±11.60) years. 65% were married.					
Yalcin et al., 2022	Turkey	A sample of 8,276 volunteers, aged between 18 and 65, were recruited via an online platform. The mean age of the sample was 39.86 (± 13.13). Approximately half of the sample were females (47.33%). Majority of volunteers were married (67.85%).	8276	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	46.38% of the sample were poor sleepers as indexed by the PSQI The PHAM showed that the perceived vulnerability to diseases was significantly associated with poor sleep quality (β = 0.175, p < 0.001) Negative affectivity as indexed by DASS-21 was significantly tied to poor sleep quality (β = 0.188, p < 0.001)
Yilmaz et al., 2021	Turkey	A total of 1120 individuals, 412 (36·8 %) male and 708 (63·2 %) females, participated in the study. The mean age was determined as 33·04 ± 11·04.	1120	Cross-sectional study	Survey items developed by the study's author include questions on sleep patterns.	Sleep duration Sleep quality	During the pandemic period, 42·5 % of the individuals stated that they slept more and 40·2 % stated that there was no change in their sleep patterns. Daily physical activity durations were determined as 8·25 ± 1·77 h for sleep.
Younes et al., 2021	Lebanon	A total of 4397 respondents. Included participants from all Lebanese districts, of whom 2924 (66.5%) were females, and those who received university education were 3664 (83.3%). The recruited participants were young adults between 18–35 years old, among which 3439 (78.2%) aged between 18 and 25 years	4397	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	A considerable proportion of participants had symptoms of insomnia (941 [21.4%]). The median IQR scores on the the ISI for insomnia for all respondents was 10 (5–14). Higher perceived likelihood of contracting COVID-19 (aOR = 0.67, 95% CI: 0.56; 0.79) resulted in no clinical or subthreshold insomnia. Single marital status (aOR = 1.43, 95% CI: 1.05; 1.93), divorced marital status (aOR = 3.33, 95% CI: 1.50; 7.39), university education (aOR = 2.50, 95% CI: 1.51; 4.16), consumption of caffeinated beverages (aOR = 1.24, 95% CI: 1.03; 1.49) and energy drinks (aOR = 1.22, 95% CI: 1.02; 1.47) were significantly associated with moderate to severe insomnia.

							Age group of 25–35 years was significantly associated with less insomnia scores (aOR = 0.77, 95% CI: 0.62-0.96) as compared to lower age group of 18–25 years. However, cigarette smoking was significantly associated with higher insomnia (aOR = 1.53, 95% CI: 1.25; 1.88) scores. physical activity of more than 3 times per week during lockdown were significantly associated with less insomnia (aOR = 0.65, 95% CI: 0.52; 0.83) Being a non-Lebanese was significantly associated with insomnia (aOR = 1.42, 95% CI: 1.12; 1.81) Drinking 2L of water or more during lockdown was significantly associated with lower insomnia (aOR = 0.76, 95% CI: 0.65; 0.88) No change in body weight status during lockdown was significantly associated with lower insomnia (aOR = 0.71, 95% CI: 0.58; 0.86)
Yurumez Korkmaz et al., 2021	Turkey	Participants (n = 136; 82 females, 60.3%) had a mean age of 73.4 ± 5.9 years. (Geriatric sample)	136	Cross-sectional study	Survey items developed by the study's author including questions on sleep problems.	Sleep disorders	Sleep problems (P = 0.000) were more common in participants with depression and anxiety. Sleep problems were present in one third of our study population, and found to be statistically significantly higher among patients with depression and anxiety. Sleep problems, which may be a component of psychological distress, have been found to be common in elderly people due to social isolation.32 Also, restricted physical activities and concerns about COVID-19 may lead to sleep disorders.
Zach et al., 2021	Israel	Participants were 1202 people, 381 males and 821 females, aged 45–90.	1202	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration.	Sleep duration	During the time of lockdown sleeping hours increased. Among the younger participants, a positive relationship was found between physical activity and the number of sleeping hours, while in the older ones a positive relationship was found between inactivity and the duration of sleep.

Healthcare workers							
Reference	Location of Study	Population	Sample Size	Study Design	Sleep Health Measurement Tool	Sleep Health Domains	Main Findings
Aarafa et al., 2021	Egypt, Saudi Arabia	This study included 426 HCWs (275 from Egypt and 151 from Saudi Arabia) distributed as follows: 206 (48.4%) physicians, 103 (24.2%) nurses, and 117 (27.4%) other HCWs. Of them, 47.2% were aged ≤30 years, 50.2% were men, 65% were living with children, and 51.6% were living with older adults.	426	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration.	Sleep duration	37.3% had inadequate sleeping (<6 h/day). Female sex, age ≤30 years, working in Egypt, attending emergency and night shifts, watching/reading COVID-19 news ≥2 h/day, and not getting emotional support from family, society, and hospital were associated with a high likelihood of inadequate sleeping.
Abbas et al., 2021	Kuwait	217 HCWs at Kuwait MOH hospitals completed the survey with mean (±standard deviation) age of 35.8 (±7.3) years; 56.2% were male	217	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep Quality	64 experienced sleep difficulties before COVID-19 crisis and 21 (9.68%) had a history of consuming medication for sleep difficulties. Prevalence of poor SQ during the COVID-19 pandemic and its stresses increased to 171 (78.8%), with a global PSQI score mean (SD) of 9.36 ± 4.4; the worst components of SQ were sleep latency, duration, and efficacy. HCWs with poor sleep had higher weekly working hours compared with those with good sleep (67.25% versus 47.83, p =0.015). Among the 32 participants who did swabs for suspected COVID-19 patients during their duties, 30 (93.75%) of them (p =0.01) experienced poor sleep.
Abdelghani et al., 2021	Egypt	218 HCWs from Egypt.. The mean age of the participants was 39.5 ± 8.5 years. The majority were females (n=156,	218	Cross-sectional study	short health anxiety inventory (SHAI)	Sleep duration	Those who reported higher levels of health anxiety to COVID-19 virus infection were more likely to be identified as working more days weekly (5.7 ± 0.8 days) and having lower sleeping hours (6.8 ± 0.9 hours).

		72%), nurses (n=111, 51%), and married (n=192, 88%)					
Abdoli et al., 2021	Iran	A total of 321 full-time frontline hospital staff members in Farabi Hospital (mean age: 36.86; 58% females)	321	Cross-sectional study	Athens Insomnia Scale	Sleep problems (insomnia)	Of the 321 participants, 44 (13.7%) had an insomnia score of 0 to 5 points; 272 (86.3%) had a score of six points and higher. The odds to report insomnia was 3.14-fold higher (CI: 2.64–3.75) among participants compared to the general population.
Abu-Elenin et al., 2021	Egypt	237 physicians, their mean age was 38.2 ± 6.2 years and 58% of them were males.	237	Cross-sectional study	Electronic questionnaire on mental health including quesitons on sleep quality	Sleep quality	The mean rate for sleep quality were poor; at 6.5 ± 3.2 out of 10
Al Ammari et al., 2020	Saudi Arabia	720 complete responses. 194 (26.94%) Physicians, 262 (36.39%) Nurses, and 171 (23.75%) pharmacists completed the survey. The participants' female respondents (64.17%) were almost double the males (35.83%), with nearly 75% above 30 years of age	720	Cross-sectional study	Insomnia severity index	Sleep problems (insomnia)	The largest proportion of health care workers (85.83%) experienced absence to subthreshold insomnia (57.08 and 28.75%, respectively). The rest (14.16%) reported moderately severe to severe insomnia (10.41% and 3.75%, respectively)
Al Maqbali et al., 2021	Oman	Frontline nurses, majority were female (90.7%, n = 895), and were married (85%, n = 839). The largest age group was those aged 31–40 years (59.5%, n = 587), followed by 41–50 years (20.1%, n = 198)	987	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality Sleep duration Sleep problems (sleep latency)	580 (58.8%) experienced poor sleep quality Average sleep duration was 7.04 (SD = 1.59) hours per night with 61.3% (n = 605) of participants reporting sleep of less than 7 h. Mean of sleep latency was 38 min, with 71.4% (n = 705) of the participants reporting more than 15 min. 23.7% of the participants reported a sleep efficiency of less than 85% 30% rated their quality of sleep as "fairly bad" or "very bad". The two most common reasons for sleep

							disturbance were “could not get to sleep within 30 min”, and “waking up in the middle of the night or early morning” as reported by 56.03% and 54.31%.
Alghufli et al., 2021	United Arab Emirates	A total of 400 HCW completed the survey. Majority of them were females (84.5%, n = 338) and aged between 18 and 31 (53.5%, n = 214).	400	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	187 (46.8%) suffered from clinical insomnia HCWs in the fever clinic that had sub-threshold insomnia (26.4%, n = 14). While at the clean and mixed clinics, HCWs had subthreshold insomnia (38.2%, n = 47). Among the 3 HCWs working at telemedicine clinic, insomnia levels were between subthreshold and moderately severe (33.3%, n = 1 for each category).
Ali et al., 2021	Saudi Arabia	Out of 200 healthcare providers, 40% were males. 52% were aged 31–40 years old, 61% were married. The majority of the participants were Saudi nationals (84%), 74% were nurses, 11% were physicians and 15% were other healthcare providers.	200	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	Working as a physician was associated with insomnia (OR, 2.32; 95% CI, 0.89–6.07; P = < 0.05)
Aljuffali et al., 2022	Saudi Arabia	502 pharmacists were included in the present study. Their mean (±SD) age was 31 (±8) years. Most respondents were female (51.8%). Moreover, most respondents were Saudi pharmacists (88.9%)	502	Cross-sectional study	Survey items developed by the study’s author including questions on sleep duration and sleep quality.	Sleep quality Sleep duration	Sleeping disturbances were found to be related to high burnout levels
Almater et al., 2021	Saudi Arabia	One hundred and seven ophthalmologists successfully completed the survey with a response rate of 30.6%. Males constituted 56.1% (n = 60). Ophthalmology	107	simple random study	Insomnia Severity Index	Sleep problems (insomnia)	Overall prevalence of dinsomnia was 44.9%; 32 had subthreshold symptoms (29.9%), 14 had moderate symptoms (13.1%), and 2 had severe symptoms (1.9%). There was also a trend to experience symptoms of

		residents constituted the majority (n = 66, 61.7%)					insomnia in frontline health-care providers (P = 0.129)
Almhdawi et al., 2022	Jordan	326 physicians of all Jordanian medical sectors and specialties successfully completed all of the study survey sections with a mean age of 32.08 (±6.93) ranged between 24−70 years and 44.2% of them were males.	326	Cross-sectional study	Survey items developed by the study's author including questions on sleep quality.	Sleep quality	poor sleep quality (58.3%)
Alshekaili et al., 2020	Oman	1139 HCWs, 228 (20.0%) are males, and 911 (80.0%) are females. Their average age was 36.3±6.5 (mean±SD) ranging from 21 to 65 years. The majority were Omani (n=981, 86.1%) and were married (n=987, 86.9%).	1139	Cross-sectional study	Insomnia Severity Index.	Sleep disorder (insomnia)	211 (18.5%) respondents were reported to have insomnia. HCWs in the frontline group were 1.5 times more likely to report insomnia (OR=1.586, p=0.013) as compared with those in the non-frontline group.
Amra et al., 2021	Iran	Among the 372 HCW participants, 245 (66%) were women and mean age was 34.5 ± 7.1 years (age range 23 to 58).	372	Cross-sectional study	Pittsburgh Sleep Quality Index Insomnia Severity Index	Sleep quality Sleep duration Sleep disorder (Insomnia)	Those participants who were directly caring for the patients including physicians and nurses had significantly higher PSQI but lower ISI questionnaire scores relative to other participants. PSQI were significantly higher in the HCWs with positive coronovirus PCR ISI were significantly lower in the HCWs with positive Coronavirus RT-PCR than another group Positive association between COVID-like symptoms and sleep and mood disturbances was found in the group without a positive test result.
Araç et al., 2020	Turkey	210 volunteers, including 105 healthcare professionals in the emergency department (53.8% female) and 105 healthcare professionals	210	Cross-sectional study	Pittsburgh Sleep Quality Index (PSQI)	Sleep disorder	PSQI subscale scores of the participants in the primary group were significantly higher than those of participants in the secondary group.

		working in other departments (46.2% females) rendering services for COVID-19 patients.					
Aslan et al., 2022	Turkey	845 nurses completed the questionnaire. In total, 72.2% of the nurses were female, 78% were graduates, 57.2% were single, 53.8% had a medium-income level, 69.7% were working in a state hospital, and 7.6% had a chronic disease.	845	Cross-sectional study	Bergen Insomnia Scale	Sleep disorder (insomnia)	A positive correlation was found between COVID-19 Fear Scale and the Bergen Insomnia Scale (r = .392; p = .001). The relationship between COVID-19 Fear and Bergen Insomnia Scale score averages and nurses' educational status, income level, shift working status, the status of their relatives being diagnosed with COVID-19, the state of being satisfied with the management of the pandemic process by the Ministry of Health, the situation of having resources in the settings where they work, the status of being in quarantine was statistically significant (p < .05).
Aydin Sayilan et al., 2021	Turkey	267 nurses The mean age of the nurses in this study was 28.03 ± 5.99 y (min: 21; max: 51), 75.3% were female, 63.3% were single, and 72.7% held an undergraduate degree.	267	Cross-sectional study	The Pittsburgh Sleep Quality Index	Sleep quality	Nurses mostly experienced emotional exhaustion, and burnout levels increased in line with insomnia.
Åžahin et al., 2020	Turkey	Six hundred twenty (66.0%) of the 939 HCWs taking part in this study were female, 339 (36.1%) were aged 26–30, 617 (65.7%) were married, 580 (61.8%) were physicians, 820 (87.3%) were working in an urban area, and 529 (56.3%) had been working for less than 10 years.	939	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	473 (50.4%) experienced insomnia symptoms Female gender, having tested for COVID-19, and history of psychiatric illness emerged as risk factors for insomnia. Nurses and frontline workers had a significantly higher insomnia score than other groups.
Badahdah et	Oman	Examined sleep quality in	150	Cross-	Sleep Quality	Sleep quality	HCWs who scored 10 or higher on the 7-item

al., 2020		a sample of 150 physicians (39.3%) and nurses (60.7%) who cared for patients with COVID-19 in Oman. Females made up 77.3% of participants. The average age was 37.62 years (standard deviation [SD] = 7.79 years).		sectional study	Scale		Generalized Anxiety Disorder Scale scored lower on sleep quality (mean = 5.98, SD = 2.29) HCWs who scored less than 50 on the WHO-5 had a lower score on sleep quality (mean = 6.29, SD = 2.08) The mean SQS score of 7 indicates that 40.1% of participants had poor sleep quality
Barut et al., 2021	Turkey	There were 213 volunteers in of a healthcare team providing service for COVID-19 patients, females 60.9%. 163 healthcare team working without direct contact with COVID-19 patients, females 47.5%.	379	Cross-sectional study	Jenkins Sleep Scale	Sleep quality Sleep problems	Sleep problems and stress levels were significantly higher among healthcare professionals who had direct contact with COVID-19 (+) patients compared to those who did not (P<0.05).
Bilgiç et al., 2021	Turkey	The average age of the nurses in this study was 32.24±8.41 years (min: 19; max: 56) and the average years worked was 10.31±9.08 years. 84.9%of the nurses were female, 50.0%were married, and 74.9%had a bachelor's degree.	316	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	It was found that the average PSQI score of the nurses was 7.36±3.35 (min=1, max=20) a positively significant correlation was found between the average PSQI score of nurses and the PSS score. These findings suggest that nurses perceive high levels of stress and have poor sleep quality.
Bulut et al., 2021	Turkey	Of the 348 healthcare professionals, 176 (50.6%) were women and 172 (49.4%) men, while 190 (54.6%) were doctors and 158 (45.4%) nurses. And 350 participants in the control group, 163 women (46.9%) and 186	698	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	Healthcare professionals: 44 had insomnia (%12.6) Nonhealthcare professionals: 45 had insomnia (%12.9) Insomnia were found to be statistically significantly higher amongst those working in the "area of final diagnosis" (P = .002)

		men (53.1%)					
Chan et al., 2021	Oman	A total of 1132 participants returned their completed questionnaire. A two-step cluster analysis was used to split the sample into three clusters. Clusters A, B and C contained 416 (36.7%), 412 (36.4%) and 304 (26.9%) HCWs, respectively. Cluster A was characterized by HCWs who were older (Mean ± SD, 37.3 ± 7.0 years) with more working experience (13.6 ± 7.1 years) in the health-care setting. more than 84% (n = 353) had not handled any COVID-19 cases during the pandemic period. Cluster B was mostly around 36 years of age (SD = 6.3). The majority were physicians (43.4%, n = 179) or nurses (42.5%, n = 175) All were working in the frontline, and more than 60% (n = 257) had experienced COVID-19 cases in the pandemic. In Cluster C, most HCWs were nurses (44.1%, n = 134) and working in the tertiary care hospital (44.4%, n = 135). They were younger	1132	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	Cluster A: The majority did not report any symptoms of clinical insomnia (97.6%, n = 406) Cluster B: The majority did not report any symptoms of clinical insomnia (96.6%, n = 398) Cluster C: The majority reported clinical insomnia (60.2%, n = 183) during the pandemic.

		(34.8 ± 5.7 years) and with less working experience (11.9 ± 5.9 years) There were around 50% (n = 159) working in the frontline only.					
Dolev et al., 2021	Israel	Medical residents treating COVID-19: 20 internal medicine physicians, 7 physicians working in emergency departments. The non-COVID group: 31 internal medicine, 16 physicians working in emergency departments, 8 psychiatrists, 16 gynecologists, and 7 surgeons	105	Cohort study	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality	COVID-19 group had longer sleep duration (95% CI: COVID-19: 1.44–1.94 vs non-COVID-19: 0.15–0.37;U (27,64) = 313.00, P < 0.0001), longer sleep onset latency (95% CI: COVID-19: 1.75–2.01 vs non-COVID-19: 0.68–0.94; U (27,64) = 326.50, P < 0.0001), deteriorated daily function (95% CI: COVID-19: 2.54–2.91 vs non-COVID-19: 1.28–1.60;U(27,64) = 143.00, P < 0.0001), poorer sleep quality (95% CI: COVID-19: 2.75–3.01 vs non-COVID-19: 1.74–2.10; U(27,64) = 258.00, P < 0.0001), and worse global PSQI score (95% CI: COVID-19: 9.97–11.25 vs non-COVID-19: 4.57–5.27; t(89) = 9.751, P < 0.0001)
Durmaz Engin et al., 2021	Turkey	360 actively working ophthalmologists. While 64% of them worked in the pandemic hospitals, 44% were actively involved in COVID-related departments.	360	Cross-secitonal study	Insomnia Severity Index	Sleep disorder (insomnia)	Symptoms of insomnia were present in 46.9% of participants. Ophthalmologists working in a pandemic hospital were more likely to experience insomnia. Higher insomnia scores in female responders (p=0.002) and in those with a chronic disease (p=0.004). Higher levels of satisfaction with the hygiene conditions in COVID and the ophthalmology clinics lower ISI scores (p=0.004)
Elghazally et al., 2021	Egypt	Sample included 2331 physicians; 1177 of whom worked in front line hospitals (group II) and the remaining 1154 physicians (group I) in other health facilities (second line). The mean age of the participants is 34.3 ± 6.1	2331	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration.	Sleep duration	In group I and group II (45.1% and 40.1% respectively) were at risk of falling or staying asleep or sleeping excessively.

		years. The majority of participants in group I and group II were in age group between 30 and 40 years (70.6% and 55%, respectively). In both groups, the majority of participants were females, married, urban dwellers, and specialists					
Elgohary et al., 2021	Egypt	270 health care workers (HCWs). The studied group age ranged from 18 to 52 years with mean 34.98 ± 6.27 years. 57% of HCWs were female. More than 72% of them had post-graduate education. Most frequent occupations among the participants were physicians and nurses (70.7% and 16.3%, respectively).	270	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration.	Sleep duration	There was a statistical significant decrease in sleep hours among HCWs with severe and extremely severe depression.
Elkholy et al., 2021	Egypt	502 HCW dealing with COVID-19 in 20 hospitals in different parts of egypt; 60.0% were physicians, 16.1% were specialized nurses, and 23.9% were non-specialized nurses. About 35.3% worked in chest hospitals, 17.5% in fever hospitals, and 47.2% in quarantine hospitals.	502	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	According to the insomnia severity scale 320 (67.7%) showed positive results; 195 (41.2%) were sub-threshold, 101 (21.4%) were moderate and 24 (5.1%) were severe. Participants with age group (31–40) were at higher risk of severe insomnia compared to those with >40 years old participants (OR, 2.79; 95% CI, 1.02–7.66; p = .01)
Hawari et al., 2021	Jordan	937 practitioners (56.1% females). Approximately 68%, 14%, and 18% were nurses/technicians,	937	Cross-sectional study	Survey items developed by the study's author including	Sleep quality	Sleep disturbances were reported (in past seven days) by approximately 29% of subjects.

		physicians, and pharmacists (respectively).			questions on sleep-related issues.		
Jahrami et al., 2021	Bahrain	A total of 257 participants (129 FLHCW and 128 NFLHCW)	280	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	The FLHCW scored higher in the PSQI and PSS compared with the NFLHCW; however, the difference in the PSQI score was not statistically significant. For the FLHCW, 75% were poor sleepers, 85% had moderate-severe stress, and 61% had both poor sleep quality and moderate-severe stress. For the NFLHCW, 76% were poor sleepers, 84% had moderate-severe stress, and 62% had both poor sleep quality and moderate-severe stress. Female sex and professional background were the predictors of poor sleep quality and stress.
Kandemir et al., 2022	Turkey	The study was performed with 194 nurses working in the intensive care units of five hospitals in Istanbul.	194	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	39.7% of the nurses experienced moderate (21.6%) or severe insomnia (18.1%).
Karabulut et al., 2021	Turkey	210 health care professionals working in ICUs were included in the study. Of the participants, 159 (75.4%) were female, and 185 (88.1%) were nurses. The mean age of the participants was 27.04 ± 5.71 years.	210	Cross-sectional study	Vısual analog sleep scale	Sleep quality	a positive relationship was found between state anxiety and sleep (r = 0.158, p = 0.022) The mean perceived visual analog sleep score was moderate and found as 503.79 ± 134.24
Khamis et al., 2020	Oman	402 female doctors and nurses recruited from several health facilities in Oman. A total of 231 (57.5%) Omanis and 171 (42.5%) non-Omanis participated in this study. Of the total 402 participants, 28.4%	402	Cross-sectional study	Sleep Quality Scale	Sleep quality	39.3% had poor sleep quality; this was particularly prevalent among Omanis. A multiple regression analysis revealed that anxiety, stress, and well-being were significant predictors of poor sleep quality.

		were physicians and 71.6% were nurses. One in four (27.9%) participants reported caring for COVID-19 patients					
Meo et al., 2021	Saudi Arabia	HCWs: 859 (51.2%) females, and 819 (48.8%) males	1678	Observational-analytical study	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality	1376 (82.0%) of the HCWs had poor sleep quality (≥5 global PSQI score). The results show that 975 (58.10%) were frontline HCWs, and 407 (23.89%) were second-line HCWs who suffered from poor sleep quality. The highest poor sleep quality levels were identified among HCWs who work in frontline areas (emergency departments, intensive care units, and wards) (642 (84.6%)), in comparison with others who work in second-line areas (734 (79.9%). 585 (85.7%) HCWs directly involved were suffering from poor sleep quality in comparison with 791 (79.5%) non-directly involved healthcare workers.
Mosheva et al., 2020	Israel	1106 Israeli physicians (564 males and 542 females) during the COVID-19 outbreak.	1106	Cross-sectional study	Survey items developed by the study's author including questions on sleeping difficulties.		Found a positive association between sleep difficulties and higher levels of anxiety among physicians. Sleeping difficulties score (1.81/5) ± 0.88
Mousavi et al., 2021	Iran	321 HCWs from major tertiary hospitals in Isfahan which were dedicated to COVID-19 patients. The mean age of participants was 33.5 years (SD: 7.65, range: 23–65). The mean of working experience in our study sample was 6.7 years (SD: 6.20, range: 1–30). In the study sample, 236 (73.8%) participants were female	321	Cross-sectional study	Insomnia Severity Index	Sleep disorders (insomnia)	The mean score of ISI was 10.3 (SD: 5.95, range: 0–25), and just 123 (38.8%) participants had normal sleep. The Pearson correlation analysis revealed that there is a statistically significant correlation between GHQ-12 and age (r: −0.12, P: 0.02), working year (r: −0.12, P: 0.03), ISI score (r: 0.56, P: 0.000), and social support score (r: −0.27, P: 0.000)

		and 156 (48.6%) of them were a nurse.					
Nashwan et al., 2021	Qatar	A total of 200 nurses participated in the study (response rate 13.3%). About 74.5% of nurses were working in COVID-19 facilities. Around 19.0%, 65.5%, and 15.5% of nurses were aged 20–30, 31–40, and above 40 years, respectively. About 59.5% and 80.0% of nurses were males and married, respectively.	200	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	In this study, there were no significant differences in sleep quality, stress, anxiety, depression, and perceived social support between nurses working in COVID-19 and non-COVID-19 facilities in Qatar
Oteir et al., 2022	Jordan	A total of 122 HCWs participated in the study (response rate=64.2%). Among the participants, 44.3% were physicians, 32.8% were nurses and 17.2% were paramedics. The mean age of participants was 32.1 (±5.8) years, and the majority were males (80.3%)	122	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	insomnia (31.9%), with increased severity of insomnia among paramedics Mean score of ISI was 11.2 (±6.4)
Sis Çelik et al., 2021	Turkey	211 nurses using a web-based online survey in Turkey (including 104 nurses working in wards where patients with COVID-19/107 nurses working in wards where patients without COVID-19). It was determined that the average age	211	Cross-sectional study	Post-Sleep Inventory	Sleep disorders	it was found that 31.8% of the Nurses involved in the study had very serious sleep problem during the COVID-19 period, and 21.3% had a moderate problem When the sleep problems experienced were compared according to the Post-Sleep Inventory, it was determined that the difference between thegroups was not statistically significant (p>0.05). There was a moderately significant and positive correlation between the nurses' mean scores for the COVID-19 Fear Scale and Post-Sleep Inventory.

		of the nurses working in wards where patients with COVID-19 are hospitalized was 29.04± 6.42. It was determined that the average age of nurses working in wards where patients without COVID-19 are admitted was 26.22±4.89					
Taş et al., 2021	Turkey	448 Family Physicians participated in the study. The average age of the participants in the study was 39.10 ± 9.59 (min 24, max 65).	448	Cross-sectional study	Survey items developed by the study's author include questions on sleep quality.	Sleep quality	While the rate of family physicians who evaluated sleep quality as very poor before the onset of the pandemic was 1.3% (n = 6), this rate increased to 13.8% during the pandemic process (n = 62). While the rate of those who reported sleep quality as poor before the pandemic was 12.7% (n = 57), this rate increased to 48.2% (n = 216) after the pandemic. While 65.4% (n = 293) of the family physicians participating in the study defined sleep quality as good before the pandemic, this rate decreased to 35.7% (n = 160) after the pandemic. While the rate of those who stated that the quality of sleep before pandemic was very good was 20.5% (n = 92), this rate decreased to 2.2% (n = 10) after the pandemic ($p < 0.001$). Thinking that personal protective measures were insufficient ($p = 0.000$) and working as a practitioner as a professional title were the most important factors affecting the deterioration of sleep quality ($p = 0.004$). Age, gender, marital status, having a child, the institution of employment, the years spent in the profession, and having contact history with Covid-19 positive cases were not effective in impairing sleep quality ($p > 0.05$). Family physicians whose workload dimension

							increased were the family physicians whose sleep quality deteriorated during the pandemic (p = 0.000).
Tasdemir Yigitoglu et al., 2021	Turkey	435 healthcare staff members. Their mean age turned out to be 36.76 ± 7.58. Slightly more than half of the participants were women (56.1%, n = 244), whereas 67.8% (n = 295) were married and 66.9% (n = 291) were parents.	435	Cross-sectional study	Pittsburg Sleep Quality Index	Sleep quality	Their mean PSQI score was 8.42 ± 2.30, and poor sleep quality was identified in an overwhelming majority of the healthcare staff (92.9%, n = 404). As for the sleep quality scores derived from the PSQI data, strong evidence was found for the within-group differences in terms of gender (female healthcare staff suffer from poorer sleep quality), parenthood (poor sleep quality in the enrolled healthcare staff with children), years of experience in the current department, health-related problems, history of mental disorders, and job satisfaction (p < 0.05)
Yilmaz et al., 2021	Turkey	Four hundred thirty-four healthcare workers participated in the study, of whom 70.7% were under 35 years of age, 65.0% were female, 60.6% were married, 64.1% were physicians, 56.7% held a master's degree or above, 73.0% worked in a hospital, 50% worked on the frontline and 36.4% had 5-10 years' working experience	278	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	The total prevalence of poor sleep quality was 56.7% The prevalence of poor sleep quality was 67.3% in nurses, 55.4% in physicians and 42.3% in dentists. Poor sleep quality was more prevalent among women, nurses, hospital workers, frontline workers, individuals with <5 years of work experience, those with low social support and individuals with increased traumatic stress levels. High levels of social support and family social support were identified as protective factors against poor sleep quality. Multivariate regression analyses showed that poor sleep quality was significantly associated with working in hospitals and high traumatic stress levels during the COVID-19 pandemic.
Yilmaz et al., 2021	Turkey	600 Healthcare workers participated in this study. 364 were females and 236 were males with a mean age of 33.49 ± 7.29 years.	600	Cross-sectional study	Insomnia Severity Index	Sleep disorder (insomnia)	Mean ISI score was significantly higher among HCWs working in COVID-19 clinics and intensive care units (p=0.000; p=0.039). Mean ISI score was significantly higher in women than men (p=0.000; p=0.000; p=0.027; p=0.005). Mean ISI scores was significantly higher among nurses (p=0.008; p=0.004).
Youssef et al., 2020	Egypt	540 healthcare professionals	540	Cross-sectional	Insomnia Severity Index	Sleep disorder (insomnia)	Just over one half of respondents (51.9%, n=280) reported sub-threshold insomnia to

		participated; their ages ranged from 20 to 70 years, with a mean of 37.3 (SD=9.2). The majority were male (54.4%, n=294), highly educated (postgraduate) (78.3%, n=423), physicians (77%, n=416), married (74.1%, n=400), had experience of five years or more (77.8%, n=420)		study			severe insomnia. The quarantine group and the non-quarantine group had an insignificant difference in adverse psychological symptoms and insomnia. Insomnia was high among those who reported experiencing stress, depression and anxiety (P<0.001).
Zarzour et al., 2021	Lebanon	A total of 628 healthcare workers completed the survey; 409 (66.2%) were younger than 40 years, and 441 (71.4%) were women. Of all participants, 503 (81.4%) were nurses, 52 (8.4%) were physicians and 63 (10.2%) were residents.	628	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	The mean (SD) scores on the PSQI for sleep quality for all respondents was 6.0 (3.7). 48.4% were “poor sleepers” as they got PSQI scores higher than 5. Participants who were aged more than 50 had lower sleep quality scores than those aged between 41 and 50 and significantly lower scores than those younger than 40 (P = 0.005 (PSQI)) Residents had significantly higher sleep disturbances scores than practical nurses (P = 0.016). Registered nurses compared to physicians and practical nurses had significantly higher sleep quality scores (P < 0.001) Participants who reported having relatives or friends who got infected or quarantined had higher sleep disturbances scores than those who had not (P = 0.019 for PSQI). Participants who were exposed to COVID-19 related media for more than 2 hours per day, had poorer sleep quality (P = 0.011) than those who were exposed to media less than 2 hours per day and to those who were not exposed at all. Greater number of stress sources was positively correlated to higher sleep disturbances (r = 0.129, P

							= 0.001, respectively) Participants were asked whether they were still able to practice the strategies they normally use to deal with stress. Those who were still able to do it (60.4%) had lower anxiety and significantly lower sleep disturbances scores than those who were not (P = 0.096 for STAI and P = 0.011 for PSQI).

Students							
Reference	Location of Study	Population	Sample Size	Study Design	Sleep Health Measurement Tool	Sleep Health Domains	Main Findings
Al Mukhaini et al.,	Oman	376 Omani students who had returned to Oman from abroad due to the COVID19 pandemic. 255 male (67.8%) and 121 female (32.2%) participants. The mean age of the participants was 21.7 years old (SD = 3.8), ranging from 18 to 45 years old.	376	Cross-sectional study	Athens insomnia scale	Sleep problems (insomnia scale)	49.5% (n = 186) noted to be suffering from insomnia Female students were 2.4 times (OR = 2.43; CI: 1.50–3.93; P< .001) more likely to be insomniac compared to male students The risk of insomnia may be less in the subjects going for a walk (OR = 0.29; CI: 0.12–0.69; P = 0.008)
Ali et al., 2021	Lebanon	510 secondary level school students from grades 9–12 participated in this online survey. Among these, 382 (74.9%) were females, and there was no significant difference in age between male and female students.	510	Cross-sectional study	Insomnia Severity Index Bedtime Procrastination Scale	Sleep disorder (Insomnia, bedtime procrastination)	Screen time of more than seven hours per day was significantly associated with insomnia (82%), and bedtime procrastination.

Alrashed et al., 2021	Saudi Arabia	Total number of participants was 453 from 3rd to 5th medical year, and intern medical students.	453	Cross-sectional study	Insomnia Severity Index	Sleep problems (insomnia)	162 (34.9%) of the participants had insomnia symptoms, among them 57.4% of females and 42.6% of males have insomnia. Participants with an age group between 22 and 25 have more sleep issues (43.2%) as compared to other age groups. 3rd-year students have more insomnia 36.41% as compared to other years. The age group 30 and above have a high prevalence of insomnia (OR = 1.67; P = 0.26), followed by the age group 26–29 (OR = 1.40; P = 0.19) Those who have a severe level of stress have ~3 times higher prevalence of insomnia (OR = 2.81; P = 0.0008), followed by a moderate level of stress (OR = 1.50; P = 0.15) Those who were involved in religious practices have less sleep problems. Similarly, those who have mentally accepted the current COVID situation also have less sleep problems (P = 0.0001) as compared to those who did not accept the current situation.
Alshammari et al., 2021	Saudi Arabia	186 replies were received from professional pharmacy students . Female students accounted for 64.5 percent of the total, which is in line with their general ratio in the Pharm.D. Program. The second professional year had the most participants (25.8%), while the sixth professional year had the least (7.0%)	186	Cross-sectional study	Survey items developed by the study's author including questions on sleep quality.	Sleep quality	"Discovered that practically all students were plagued by symptoms of sadness, anxiety, tension, and poor sleep quality"
Alyoubi et al., 2021	Saudi Arabia	A total of 582 undergraduate students. 73% were female and 25% were male. The majority (78%) of undergraduate students	582	Cross-sectional study	Insomnia Severity Index	Sleep duration Sleep quality Sleep disorder (insomnia)	Over one-third of students reported that sleep had been impacted and worsened during the pandemic. 22% having trouble falling asleep, 17.9% waking up during the night, 8.8% waking up early in the morning, 25.9% have poor sleep quality, 22.7% feeling tired during the day, 9.3% have nightmares

		were enrolled at the King Abdulaziz University and 16% were studying at Jeddah University in Saudi Arabia.					and 5.2% have poor dreams This study showed that over half of students reported sleep disruption and 1.4% were taking melatonin supplements for the sleep problem. A small percentage (4.3%) had very mild sleep problem, while 16% reported a mild sleep problem, 21.8% moderate, 9.3% severe, and 1.2% very severe. There was no significant difference between older and younger students on the level of insomnia. Students reported a statistically high level of insomnia with a high level of depression, anxiety, perceived stress ($p < 0.001$). Undergraduate students reported statistically more insomnia symptoms with a lower level of psychological resilience ($r = -0.150$, $p < 0.001$). The level of insomnia was slightly higher for students who self-isolated Students who received support from mental health services but had it stopped and offered online and declined before COVID-19 reported a significantly higher level of insomnia $F (5, 555) = 2.768$, $p = 0.018$).
Bosi Bağcı et al., 2021	Turkey	340 interns accounting for 63·4 % of the target population completed the online questionnaire. Almost 60 % of the participants were composed of females and the mean age was 24·89	340	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	Sleep quality during the COVID-19 compared to the pre-COVID-19 period was assessed and it was found that only 27·8 % of the interns observed no change in sleep quality. However, 38.6 % of the interns experienced an improvement and 33.6 % had a reduction in sleep quality. Then, the sleep quality of interns was evaluated with PSQI and 53·4 % of the students were found to have poor sleep quality during the COVID-19 period. The effect of gender on sleep quality was also evaluated and even though female students had a predilection towards poor sleep quality, there was no significant difference between genders (P = 0·075)
Cakmak et al., 2022	Turkey	564 students The mean age of the participants was 28.13 ± 0.49 years (min: 18 / max: 90). While 71.1% of the participants were	564	Cross-sectional study	Bergen Insomnia Scale	Sleep disorder (insomnia)	The results revealed that 64.7% of the participants had insomnia. he findings suggest that there was no statistically significant difference between insomnia and age, educational attainment, smoking status, and who the participants lived during the quarantine ($p>0.05$).

		female, 66.5% were single. It was found that 66.3% of the individuals were university students, and 82.8% did not have any chronic diseases.					Those who used a phone or tablet before sleeping (p = 0.020) were found to have significantly higher levels of insomnia than others. The mean days of uninterrupted home quarantine was higher for participants experiencing insomnia.
Dalcalı et al., 2021	Turkey	mean age of students was 20.39 ± 2.05 years and 82% (n = 232) were female, and 33.6% (n = 95) were first-year students	283	Descriptive, correlational	Verran and Snyder–Halpern sleep scale (VAS)	sleep disturbance, effective sleep, daytime sleep	Before COVID-19, 21.20% reported that their night sleep was interrupted, while during the COVID-19 period, this rate increased to 28.26% and this increase was considered to be statistically significant. There was a high-level positive significant correlation between students' sleep quality and state anxiety (r: 0.305, p: 0.000**) and trait anxiety (r: 0.288; p: 0.000)
Elakany et al., 2022	Global	3793 (22.3%) of students. 61.7% females and the mean age was 31.0 years (SD = 8.9)	17,008	Cross-sectional study	Online survey	changes in sleep pattern (sleeping more, less, or no changes)	4,889 people (28.7%) reported change in sleep patterns. Compared to non-students, students had significantly higher odds of reporting changes in sleep (AOR = 1.52; 95% CI: 1.39, 1.67). Participants from LICs and LMICs had lower odds of reporting changes in sleep (AOR = 0.74; 95% CI: 0.58, 0.94 and AOR = 0.67; 95% CI: 0.61, 0.72). participants from UMICs, had significantly higher odds of reporting changes in sleep (AOR = 1.26; 95% 1.15, 1.39)
Elsalem et al., 2020	Jordan	1019 students from Jordan University of Science and Technology agreed to participate in the study and completed the survey. Approximately, half of the participants were from Faculty of Medicine (51.32%), while the other half in descending order were students from Faculties of Nursing, Dentistry, Pharmacy and Applied Medical Sciences. Almost two-	1019	Cross-sectional study	Survey items developed by the study's author include questions on sleep duration and sleep disorder.	Sleep duration. Sleep disorder (insomnia)	Student's experience of stress during exams was also found to be significantly associated with changes in sleeping hours. Among students who reported more stress with remote E-exams, 44.15% had reduction in their sleeping hours and 28.65% reported more consumption of medications to relief insomnia. Caffeine was mainly consumed to keep students more alert for exam preparation and was linked to loss of sleep during exams days

		thirds of the respondents (65.55%) were females.					
Göl et al., 2021	Turkey	2630 nursing students. The mean age of students participating in the study was 21.30 ± 1.95 SD. The majority of them (82.1%) were female students and 11.4% had a chronic disease.	2630	Cross-sectional study	GHQ-12	Sleep disorder (sleep pattern)	Change in sleep pattern 62.9% (= 0.629)
Goweda et al., 2020	Saudi Arabia	438 medical students were recruited from the second year to the sixth year among Umm Al-Qura University Faculty of Medicine. Half (50.5%) were female, nearly all (422, 96.3%) had a single marital status, and a minority (55,12.6%) had chronic disease.	438	Cross-sectional study	Sleep-50 questionnaire	Sleep disorders (narcolepsy, insomnia, CRD)	323 (73.7%) of the participants complained of at least one sleep disorder. The most prevalent sleep disorder was Narcolepsy (NL) with 226 (51.6%), followed by 138 (31.5%) with insomnia, and 98 (22.4%) indicating Circadian Rhythm sleep Disorder (CRD) 87 (19.9%) of respondents positive for at least two combined sleep disorders, and 63 (14.4%) demonstrating three combined sleep disorders. In the time students spent watching television and/or on smartphones, there was significant difference in students with sleep disorders (m=6.71 hours, SD=3.83) and those without (m=5.90 hours, SD=3.40) (p=0.004) Significant relationship between gender and sleep disorder, with females more affected at 178 (80.5%) than males at 145 (66.8%) (p=0.001)
Grande et al., 2021	Saudi Arabia	152 nursing intern students were involved in this study. Among them, 73% are in the age of 20 years and below, while 23.7% are between 31 and 40 years of age, and 3.3% fall within the age range of 21–30 years old. In terms of gender,	152	Cross-sectional study	Quality of Life Evaluation Scale	Sleep quality	Sleep satisfaction score 1.99/5.00

		53.9% are males, and 46.1% are females.					
Jalal et al., 2021	Saudi Arabia	628 students studying bachelor's degree programs, between 18 and 30 years of age. 70.9% were female	628	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	Approximately, 188 (29.9%) students felt that sleep quality was good before lockdown, and 126 (20.1%) students felt the same during the lockdown. Moreover, the total sleeping time increased from 6.6 ± 2.3 hours per day to 8.3 ± 2.7 hours per day, which was also proved statistically significant (p = 0.001).
Joseph et al., 2022	Israel	533 undergraduate students of education submitted an online questionnaire before the lockdown and at its end.	533	Prospective cohort	Mini Sleep Questionnaire	Sleep quality	Levels of sleep quality (mean 5.34 [SD 0.92] vs mean 5.12 [SD 0.46], P=.02) and well-being (mean 3.79 [SD 0.62] vs mean 3.67 [SD 0.59], P=.02) were higher during the COVID-19 lockdown. These findings indicate that undergraduate students seem to have taken advantage of the change in lifestyle due to the lockdown, directing the free time toward improving health by engaging in more physical activity, thus improving sleep quality and well-being.
Kheirallah et al., 2021	Jordan	1,404 students participated in the current study. About two-thirds (59.9%) of participants were females, 64.9% were enrolled at the two well-established medical schools at the University of Jordan (39.1%) and Jordan University of Science and Technology (JUST) (25.8%), and 59.6% were in the pre-clinical stage of their medical education.	1404	Cross-sectional study	Survey items developed by the study's author including questions on sleep disorders.	Sleep disorder (insomnia, nightmares)	About 13% of students self-reported experiencing increased insomnia, shallow sleep, nightmares, or insufficient sleep. In general, females self-reported experiencing significantly more sleeping problems than males. Likewise, students in the pre-clinical years experienced sleep problems (insomnia, shallow sleep, and insufficient sleep) significantly more frequently than those in their clinical years.
Meo et al., 2022	Saudia Arabia	The total number of medical and science students included was 782, out of whom 410 (52.4%) were medical	782	Cross-sectional Study	Pittsburgh Sleep Quality Index,	Sleep quality Sleep duration	Out of 782 participants, 669 (85.55%) had poor sleep quality (≥5 Global PSQI score), while only 113 students had good sleep quality (<5 Global PSQI score). Out of 410 medical students, 336 (81.95%) had poor sleep quality, and 74

		students, and 372 (47.6%) were science students, including Physics, Chemistry, Mathematics, Statistics, Botany, and Zoology. Among medical students, 143 (34.9%) were in pre-clinical years (1st and 2nd), while 266 (64.9%) of them were in clinical years 3rd, 4th, and 5th-year medical students. Female students were 65.3% of the sample.					(18.05%) had good sleep quality. While out of 372 science students, 333 (89.5%) had poor sleep quality, and 39 (10.5%) had good sleep quality. Overall, it was seen that the sleep quality of science students was poorer (Mean Global PSQI score= 8.78) than their medical counterparts (mean Global PSQI score= 7.93) Sleep quality, sleep duration, and daytime dysfunction were poorer among pre-clinical students than clinical students Out of the selected cases with poor sleep quality (≥5 PSQI score), 32.1% were males, and 67.9% were females. It was found that sleep disturbance and daytime dysfunction were poorer in students with higher BMI ranges
Nakhostin-Ansari et al., 2020	Iran	323 medical students have completed the questionnaire (response rate = 64.6%); 37.2% of them were clerks and 62.8% interns. The mean age of participants was 23.73 (SD = 1.62), and 47.7% of them were male and 52.3% female.	323	Cross-sectional study	Survey items developed by the study's author including questions on sleep patterns.	Sleep disorder (sleep pattern changes)	Changes in sleep pattern (74.3%)
Saadeh et al., 2021	Jordan	6,157 undergraduate students (mean age 19.79 ± 1.67 years, males 28.7%) from the University of Jordan	6157	Cross-sectional study	Pittsburgh Sleep Quality Index,	Sleep quality	The sleep quality of three-quarters of the participants was negatively affected by the extended quarantine. Nearly half of the participants reported poor sleep quality. The prevalence of poor sleep quality among participants was 76% (males: 71.5% and females: 77.8%).
Sarsak et al., 2022	Saudi Arabia	A total of 244 students completed the survey (60.7% were female). The mean age was 22.10±2.69	244	Cross-sectional study	Survey items developed by the study's author include questions on	Sleep quality	34.5% (n=84) reported sleeping late and waking up more frequently.

					sleep disturbances.		
Torun et al., 2020	Turkey	275 students. About 60.7% of the participants (n = 167) were female, 39.3% (n = 108) were male and the mean age was 22.10 ± 2.69.	275	Cross-sectional study	Survey items developed by the study's author include questions on sleep duration and sleep quality.	Sleep quality	After the COVID-19 pandemic, the sleep patterns of the participants changed as 29.5% (n = 81) asleep late, wake up frequently and can not fall asleep.

Children							
Reference	**Location of Study**	**Population**	**Sample Size**	**Study Design**	**Sleep Health Measurement Tool**	**Sleep Health Domains**	**Main Findings**
Alanazi et al., 2022	Saudi Arabia	A total of 1021 parents completed the survey, of which 78.8% were Saudis. Fifty-five per cent of respondents were mothers with an average age of 41 (±9.2) years. The mean age of the children was 8.5 (±1.85) years. Sixty per cent of the study sample were girls.	1021	Cross-sectional study	Survey items developed by the study's author including questions on sleeping duration and sleep quality.	Sleep duration Sleep quality	Slightly more than half the children met the sleep recommendations (95% CI 52.9, 60.9) Sleep quality was reasonably high (average of 5.4 [2.26] points out of 7.0) Weak negative correlation between parent education level and the quality of their child's sleep (r = −0.11, p < 0.0001)
Almhizai et al., 2021	Saudi Arabia	Questionnaire was completed by 1141 respondents. Of these, 454 were < 18 years old (360 were aged 16 - 18 years old, and 94 were < 15 years old). Thus, these respondents	1141	Cross-sectional study	Survey items developed by the study's author including questions on sleep quality and sleep duration.	Sleep quality Sleep duration	Higher age was associated with higher increase in the frequency of waking up (r = 0.076, P < 0.05), sleeping little (r = 0.058, P < 0.05) Having relatives who were infected with COVID-19 was associated with sleeping little (r = 0.074, P < 0.01) Children whose parents were divorced had higher scores on sleep disorders.

		completed the questionnaire on behalf of themselves. The remaining 688 respondents were adults and completed the questionnaire on behalf of their children. Male and female children represented 42.5% and 57.5% of the study sample.					
Almugti et al., 2021	Saudi Arabia	651 participants in total; slightly over half (58%) were female. The respondents answered questions related to their children. These items showed that the mean age of their children was 9±4 years, the majority of the children were living in apartments (63.9%), and that 89% of the children were living with both their father and mother.	651	Cross-sectional study	Survey items developed from a similar study on Arab Israeli children including questions on sleep quality and sleep duration.	Sleep duration Sleep quality	During the COVID-19 outbreak, one-third of children had asked to sleep in their parents' beds. Study reports reduced sleep time among children compared with the pre-pandemic period.
Al-Rahamneh et al., 2021	Jordan	Data collected from 1309 parents (mothers = 1219 (93.1%); fathers = 90 (6.9%) children (n = 1309 male = 716 (54.7%) and female = 593 (45.3%)), they were between 5–11 years of age (8.1 ± 2.02 years) and most of them were studying at private schools (92.7%).	1309	Cross-sectional study	Children's emotional and behavioral symptoms questionnaire	Sleep duration	42.5% of children had 8 h or less of sleep per night, which is considered as a short sleeping duration.
Bucak et	Adıyaman,	Group 1 (school age	372	Comparati	Children's Sleep	Child's sleep	Total CSHQ scores were 41.57 ± 7.57 (20–60) in

al.,2021	Turkey	children of health worker parents): 122 participants, 66 (54.1%) females and 56 (45.9%) males Group 2 (school age children of non-health worker parents): 250 participants, 129 (51.6%) females and 121 (48.4%) males		ve study	Habits Questionnaire (CSQH)	habits and sleep-related problems. 8 subscales included*: bedtime resistance, sleep onset delay, sleep duration, sleep anxiety, night wakings, parasomnias, sleep disordered breathing, and daytime somnolence.	Group 1 and 39.6 ± 8.47 (17–68) in Group 2 (p:0.03)
Cahal et al., 2021	Israel	Mean (±SD) age of patients was 6.2 years (4.7) with a range of 0–18 years. 276 (62%) males and 169 (38%) females 368 (82%) had a single respiratory disorder, the most common of which were asthma (n=291, 65%), recurrent pneumonia (n=96, 21.5%), bronchopulmonary dysplasia (BPD; n=32, 7.2%)	445	Cross-sectional study	Anonymous electronic questionnaire	Secondary outcomes related to patients' lifestyles	During the lockdown, Sleep duration increased in 59 patients (13.4%), decreased in 227 patients (51.1%) and remained unchanged in 155 patients (35.1%). Older patients experienced increased screen time, decreased physical activity, and shorter sleep duration (p = .008, <.001, and <.001, respectively) compared to their younger counterparts
El Refay et al., 2021	Egypt	765 responses were received from children and adolescents aged 4–16 years. 408 children (53.3%) were males and 357 participants (46.7%) were females. More than half of the participants	765	Cross-sectional study	Sleep Disturbance Scale for Children score.	Sleep quality Sleep disorder	The overall mean Sleep Disturbance Scale for Children score (SDSC) in participated groups was 44.6 ± 11.72 suggesting a widespread stressful impact of the lockdown Only 25 (3.2%) of participants had an (SDSC) over 70 which indicate acute severe sleep disorder 502 (65.6%) showed the symptoms suggestive of sleep disorder.

		407 (53.2%) were enrolled in primary schools.					Disorders of initiating and maintaining sleep were the most common among participants as 168 (33.4%) of them were suffering from it while 79 (15.7%) children were suffering from excessive somnolence. Significant positive correlations were found between SDSC and extra screen usage, understanding safety and quarantine measures, anxiety signs, and change in child lifestyle with (p = 0.029, 0.010, 0.001 and 0.001) sequentially Significant positive correlation was found between family income affection and sleep disorder score (p =0.04)
Ghanamah et al., 2021	Israel	382 parents answered a survery about their children. 51% of the children were males, the most representative grade was the first grade (21.2%), 11.8% of the children were detected in COVID-19 and 43.5% of the children were asked to be in isolation since they had been exposed to COVID-19 diagnosed person	382	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration and sleep quality.	Sleep duration Sleep quality	55.8% of the children, who before the pandemic outbreak used to sleep alone in their own bedroom, asked the parents to sleep in their parents' bed during the outbreak period. 41.4% showed sleep difficulties. (more in kindergarteners than in pre-kindergarteners) More hours spent in sleep through the outbreak compared to before the outbreak If the child was in isolation, those children asked their parents to sleep beside them more than the children who were not asked to be in isolation. In the families with diagnosed Coronavirus, the children asked to sleep beside the parents more than in families with no diagnosed member
Kaditis et al., 2021	Global	45.8% female; ages 3–17 years	845	Longitudinal study	Online survey	Change in bedtime, change in wake time, and change in sleep duration	As a result of the observed shift in bedtime and wake time, the median sleep duration score on weekdays increased significantly during the pandemic compared to before (p < .001), while there was no significant change during the weekend (p = .51). More children had an increase in sleep duration on weekdays than a decrease, whereas similar proportions of children had an increase or a decrease on weekends. Increase in sleep duration during the pandemic was most apparent in the 14–17 years age group during weekdays, while a

							decrease in sleep duration was most prominent in 3- to 5-year-old children during both weekdays and weekends. Sleep duration did not change in 43% of participants on weekdays and 46.2% on weekends. Children aged 14–17 years were the least likely to have unchanged sleep duration on weekdays (28.4%).
Kamaleddine et al., 2022	Lebanon	383 children whose parents agreed to use the responses for this study were finally included. The proportion of boys and girls was even.	383	Cross-sectional study	Children Sleep Habit Questionnaire	Sleep quality	Observed that children with screen time ≥2 h had sleep problems.
Mekkawy et al., 2022	Egypt	Participants in this study (n=672) were divided according to age into 4 main categories, 6–9 years (21.7%), 9–12 years (24.4%), 12–15 years (30.1%) and 15–18 years (23.8%). Males represented 48.2% and females 51.8%	672	Cross-sectional study	BEARS sleep screening tool	Sleep duration Sleep quality Sleep disorders	50% reported increase in their sleeping habit, 31.8% reported no change while 45.2% stated no sleeping problems, 19% had a difficulty to fall asleep, 16.1% had a problem waking up during sleep, 11.9% had a problem waking up feeling tired, & 7.7% had a problem sleeping too much . When comparing the sleep habits pre COVID-19 with the lockdown, results had shown significant decrease in the % of sleeping less than 7 hours from 41.4% to 5.4%, while there was significant increase in the % of sleeping more than 10 hours from 4.8% to 49.7% (p<0.001). On the other hand, the energy level status of being energized significantly decreased from 55.4% to 7.7%, and significantly increased in the lazy state from 3.6% to 54.8% (p<0.001)
Ranjbar et al., 2021	Iran	20697 filled questionnaires were received from the participants with an average age of 13.76 ± 2.50 which included 6139 (29.7%) male and 14558 (70.3%) females. Among the participants, 16672 (80.6%) were from urban areas	20697	Cross-sectional study	Survey items developed by the study's author include questions on sleep duration and sleep pattern.	Sleep duration Sleep disorder (sleep pattern changes)	2782 (13.4%) students had 5 or fewer hours of sleep, 2689 (13%) had 6 to 8 h, 2655 (12.8%) had 9 to 10 h, 1506 (7.3%) had 11 to 12 h, and 11065 (53.5%) had above 12 h of sleep throughout the day. The majority (8934: 43.2%) of students went to bed between 23 and 24 P.M. while the majority (11585: 56%) woke up at 8 A.M.

		and 4025 (19.4%) from rural areas.					
Ustuner Top et al., 2022	Turkey	Of the 1040 children, 528 (50.8%) males and 512 (49.2%) females were included in the analyses. The mean age of the children was 9.16 ± 2.05, and 80.3% were aged between 9 and 12 years.	1040	Cross-sectional study	The Children's Sleep Habits Questionnaire	Sleep quality Sleep duration Sleep disorder	The prevalence of sleep disturbances among 6–12-year-old children during the COVID-19 pandemic in Turkey was 55.5%. Sleep disturbances were found to be significantly associated with 6–8 years of age, and poor family relationships ($p < 0.05$). The most common sleep disturbances were bedtime resistance (51.9%), sleep onset delay (61.4%), and sleep duration (90.2%). The children's ages, family relationships, and eating habits were linked to their sleep disturbances. Moreover, their results indicated that sleep disturbances were more common in the children of parents who felt helpless, apprehensive, and frightened during the COVID-19 pandemic.
Zengin et al., 2021	Turkey	309 children. The average age of the children in the study was 10.3 ± 1.2; 52.1% of participants were male.	309	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration and sleep quality.	Sleep duration Sleep quality	Children stated that due to the pandemic they experienced changes in terms of sleep (61.5%; n = 190) Some of the children in the present study stated that their sleeping habits have become irregular, and the majority of them had reduced their time for social activity. These findings are similar to our results.
Zreik et al., 2021	Israel	Mothers of 264 children (120 boys), with a mean (SD, range) age of 31.27 (17.39, 6–72) months, participated in the study: 100 of the mothers were Arab and 141 were Jewish. Approximately 38% of the infants were firstborns, and families had a mean (SD) of 2.15 (0.95) children. The mean (SD) age of the mothers	264	Cross-sectional study	Insomnia Severity Index Brief Infant/Child Sleep Questionnaire	Sleep disorder (insomnia) Sleep quality Sleep duration	The majority of mothers reported no change in their child's sleep quality, duration, and sleeping arrangement. However, about 30% reported a negative change in child's sleep quality and a decrease in sleep duration, and there were also mothers who reported a positive change. 60% of the mothers reported a negative change in their sleep quality. In all, 23% of mothers scored above the clinical cut-off for insomnia (ISI score of >15) during the COVID-19 crisis, compared to only 11% who reported (retrospectively) having clinical insomnia before the COVID-19 crisis ($\chi 2$ (1) = 5.36,

		was 33.97 (4.20) years.					p = .02). The current maternal ISI score was positively correlated with child's sleep latency, number of night awakenings, and wake after sleep onset, and was negatively correlated with sleep duration. Maternal acute COVID-19 anxiety was positively correlated with the child's number of night awakenings, and negatively correlated with the child's sleep duration. When examining the correlations between the current maternal ISI score and child's sleep variables with maternal acute COVID-19 anxiety as a covariate, the correlations with child's sleep variables, number of night awakenings and WASO, remained significant (r = .26, p = .001 and r = .31, p < .001, respectively), while the correlations with child's sleep latency and sleep duration were no longer significant. The correlation between maternal acute COVID-19 anxiety and the current maternal ISI score was significant (r = .38, p < .001) and remained significant after controlling for the child's sleep duration, number of night awakenings, and WASO (r = .40, p < .001) The change in child's sleep quality was associated with the change in ISI score of the mother (r s = −.33, p < .001), so that mothers who reported that their child's sleep improved during the COVID-19 crisis, were more likely to report a decrease in their own insomnia symptoms during the crisis. Mothers who reported that their child's sleep had negatively changed had higher levels of anxiety traits, compared to mothers who reported no change in their child's sleep.

Patients With Chronic Illnesses

Reference	Location of Study	Population	Sample Size	Study Design	Sleep Health Measurement Tool	Sleep Health Domains	Main Findings
Alkhotani et al., 2020	Saudi Arabia	A total of 156 patients with epilepsy completed the questionnaire. Sixty-two percent of our responders were female patients, 99% were living with family, 38% had generalized seizures, 47% were on single medications, and 48.1% had been seizure-free for the past three months prior to the start of the pandemic	156	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration and sleep quality.	Sleep duration Sleep quality	(71.2%) experienced a significant change in their sleep. Most frequent change in sleep was a reversal of the sleep pattern in 58% of the respondents (sleep after sunrise), followed by more sleep than usual in 9.6%, less sleep in 2.6%, and intermittent sleep in 0.6%.
Athamneh et al., 2021	Jordan	506 (90.03%) neurology patients responded to the questionnaire. Patients under 40 years of age constituted over half the sample. Men constituted 45.45% of the sample.	506	Cross-sectional study	Survey items developed by the study's author including questions on sleep duration.	Sleep quality Sleep disorder (Sleep pattern changes)	Sleep disturbances were reported by nearly one in three patients who had epilepsy or headache, and the majority ascribed these disturbances to the impact of the pandemic Changes in sleep patterns were reported by 37.50% of patients with tension/migraine headaches, and 50.00% blamed these changes to the impact of the pandemic.
Çolak et al., 2021	Turkey	Pregnant women mean age 30.17 ± 5.47 years	149	Cross-sectional study	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality	The depression, anxiety, and defective sleep quality levels of the participants who were previously in the home quarantine were statistically significantly higher ($p < 0.001$, $p < 0.001$, $p < 0.001$, respectively).
Güç et al., 2022	Turkey	Of the 761 cancer patients, 480 (63.1%) are female and 281 (36.9%) are male. At the time of the study, their median age was 57.65 years (range, 20–90).	761	Cross-sectional study	Pittsburgh Sleep Quality Index	Sleep quality	Mean scores of the 761 participants PSQI, 5.67 ± 4.24 (range, 0–19). Quality of sleep was found bad in 447 (58.7%) (global score ≥5). Multivariate analyses showed active treatment (OR: 21.4; 95% CI: 9.08–50.4; $p < 0.001$) as the major independent variable that affected sleep quality
Karatel et al., 2022	Turkey	The study includes 1,778 responses of 1,131	1778	Cross-sectional	Pittsburgh Sleep Quality Index	Sleep quality	The PSQI-total had shown a weak correlation with pain levels in all body parts.

		(63.6%) women and 647 (36.4%) men. Mean age was 28.3 ± 10.7 years with musculoskeletal pain		study			The highest correlation for sleep quality and pain levels was between the PSQI-5 and lower back pain. There was a weak correlation between PSQI-2 and the BDI score, and a moderate correlation between the PSQI-1, PSQI-5, PSQI-7, PSQI-total, and BDI score.
Keskin et al., 2022	Turkey	356 pregnant women were enrolled and completed the survey	356	Cross-sectional study	The Epworth sleepiness scale	Sleep disorder (sleepiness)	Mild sleepiness was found in 88.2% and severe sleepiness in 11.8% of the pregnant women
San et al., 2021	Turkey	145 patients who underwent a spine intervention within the past year were included in this study, there were 96 women (66%) and 49 men (34%), with a mean age of 54.78 ± 1.08 years.	145	Cross-sectional study	Survey items developed by the study's author include questions on sleep habits.	Sleep quality	24 patients always had sleep disturbance, 30 patients often had sleep disturbance, 37 patients sometimes had sleep disturbance, 9 patients rarely had sleep disturbance, and 45 patients had no sleep disturbance
Seyahi et al., 2020	Turkey	Studied in total 771 (245 M/ 526 F) patients with Rheumatic disease (Group 1), 535 (181 M/ 354 F) hospital workers (Group 2) and 917 (258 M/ 659 F) teachers/academic staff (Group 3)	2223	Cross-sectional study	Survey items developed by the study's author include questions on sleep problems.	Sleep disorder	The frequency of sleep problems in patients with RD was significantly higher than that of the teachers/academic staff, but then again, significantly lower than that reported in the hospital workers.
Yeni et al., 2022	Turkey	89 PwMS (people with multiple sclerosis) and 262 healthy controls. Mean age of PwMS was 41.08 (±10.2) years; 62% were female. Mean age of the control group was 38.08 (±11.4) and 51.5% were female	351	Cross-sectional	Pittsburgh Sleep Quality Index (PSQI)	Sleep quality	Healthy controls (HC): Compared to pre-pandemic period, the mean PSQI score was determined to increase indicating impaired sleep quality ($p<0.001$) Sleep quality of the patients was seen to be impaired during the pandemic ($p<0.05$) Multiple regression analysis demonstrated that the anxiety, depression, and the sleep problems were predictors of both the physical health ($p<0.001$) and mental health ($p<0.001$)

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	4
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	4
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	5
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	5
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Supplementary S1
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	5
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	5, 6
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	5, 6
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	5, 6
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	6
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	5
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	5
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	5, 6
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	5, 6
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	N/A
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	N/A
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	N/A
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	6

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	6
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	7, figure 1
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	7
Study characteristics	17	Cite each included study and present its characteristics.	7 – 11
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Supplementary S3
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	Supplementary S4
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Pages 7 – 11, Supplementary S4
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	N/A
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	N/A
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	N/A
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Supplementary S3
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	Supplementary S3
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	12, 13
	23b	Discuss any limitations of the evidence included in the review.	13, 14
	23c	Discuss any limitations of the review processes used.	13, 14
	23d	Discuss implications of the results for practice, policy, and future research.	12 – 13
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	2, 5
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	5
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	N/A
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	16
Competing interests	26	Declare any competing interests of review authors.	16
Availability of	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included	16

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
data, code and other materials		studies; data used for all analyses; analytic code; any other materials used in the review.	

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

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