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REVIEW ARTICLES

Socioeconomic status and sleep health: a narrative synthesis of 3 decades of empirical research

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Study Objectives: This review aims to assess the association between socioeconomic status (SES) and sleep health in the general population and the mediating effects of lifestyle and mental and physical health in this relationship.

Methods: Observational studies testing the independent association between objective or subjective SES indicators and behavioral/physiological or clinical sleep health variables in the general population were included. PubMed/MEDLINE was searched for reports published from January 1990 to December 2019. The direction of effect was used as the primary effect measure, testing the hypothesis that low SES is associated with poor sleep health outcomes. Results are presented in the form of direction effect plots and synthesized as binomial proportions.

Results: Overall, 336 studies were identified. A high proportion of effects at the expected direction was noted for measures of sleep continuity (100% for sleep latency, 50–100% for awakenings, 66.7–100% for sleep efficiency), symptoms of disturbed sleep (75–94.1% for insomnia, 66.7–100% for sleep-disordered breathing, 60–100% for hypersomnia), and general sleep satisfaction (62.5–100%), while the effect on sleep duration was inconsistent and depended on the specific SES variable (92.3% for subjective SES, 31.7% for employment status). Lifestyle habits, chronic illnesses, and psychological factors were identified as key mediators of the SES–sleep relationship.

Conclusions: Unhealthy behaviors, increased stress levels, and limited access to health care in low-SES individuals may explain the SES–sleep health gradient. However, the cross-sectional design of most studies and the high heterogeneity in employed measures of SES and sleep limit the quality of evidence. Further research is warranted due to important implications for health issues and policy changes.

Keywords: socioeconomic status, education, income, employment status, sleep health, sleep duration, insomnia, sleep quality

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BRIEF SUMMARY

Current Knowledge/Study Rationale: A social gradient in sleep health has been observed in individual studies but its magnitude and the factors that mediate it have never been synthesized before.

Study Impact: Low socioeconomic status is significantly associated with poor sleep continuity and quality and increased symptoms of disturbed sleep in the context of multiple environmental, physical, and psychological stressful factors. A pathway model is proposed with implications for health care providers and public health policy makers.

INTRODUCTION

Physiological mechanisms of sleep disturbances were extensively documented in the last two decades,[1,2] as well as their association with several other health outcomes, such as cardiovascular diseases and mental health.[3] Since sleep health is a well-known health determinant,[3] it is a matter of utmost importance to public health globally.[4,5] It is commonly recognized that good sleep is necessary for optimal health and a poor sleep health may affect hormone levels, mood, and weight.[5,6] Current clinical recommendations to improve sleep health include advice like establishing a regular sleep schedule, limiting or reducing stressors, limiting exposure to blue light in the hours before sleep, not using bed for any activities keeping the brain awake, and avoiding hormonal disruptors, such as alcohol, nicotine, caffeine, and other stimulants, in the hours before bedtime.[7,8] However, people often fall under these situations because of a recurrent exposure to stressors produced by their social environment and their socioeconomic status (SES).

SES is a marker of living conditions and habits that influence health by way of different processes, including stress-related mechanisms.[9] Even though measurement of SES has several methodological issues across research in health disparities,[9] there is no doubt that low SES and its related chronic stress accumulated over time has major implications in health behaviors, environmental exposures, and health care utilization, resulting in increased morbidity and mortality.[10–14] There is a vast amount of evidence across countries that health status is positively associated with socioeconomic indicators such as income, education, and other markers of socioeconomic position.[10,11,13,14] In some analyses, lower SES is associated with greater physician and hospital use, although it appears that these findings are primarily driven by higher rates of poor health status or medical need in socioeconomically disadvantaged populations.[10,11,13,14] Findings from a review in US child and adult populations with data on multiple health indicators revealed a clear gradient pattern in health disparities, in a way that even groups with intermediate SES levels were consistently less healthy than those of high SES.[15] Among health outcomes influenced by variations of SES, the empirical literature also revealed that the same socioeconomic markers are often associated with sleep disturbances.

While in recent years there has been an increase in the interest in SES in sleep-related studies,[5,16–21] there is a lack of reviews synthesizing the influence of SES on sleep health, leading to a general misunderstanding of the situation. There is no consensus on a positive or a negative association between SES and sleep health or sleep disturbances. Some studies reported different associations and trends between employment,[22] education,[23–26] or living conditions[14,18,27] and individual sleep health. Furthermore, there is not enough information to understand potential pathways linking SES and sleep in general.

By studying the SES–sleep relation across the age span and also by considering the influence of socioeconomic indicators, such as education, household income, and occupation, we will be able to better understand how SES and the sleep health gradient associated with it contribute to the emergence of social inequalities and health disparities in the general population. It is important to synthesize the current literature on the SES–sleep relation and to move knowledge forward. The aims of this review are (1) to assess the association between SES and sleep health in the general population and (2) to explore the mediating effect of lifestyle and physical/mental health factors on the relationship between SES and sleep in the general population.

METHODS

Literature search

We performed a search in the PubMed/MEDLINE database to identify relevant studies testing the association between SES and various sleep indices. The search strategy included the following terms: socioeconomic* OR socio-economic* OR "social status" OR "social position*" OR "social class*" OR "social rank*" OR education* OR income* OR occupation* OR employment OR *employed OR asset* AND sleep* OR insomnia* OR circadian OR parasomnia* OR "restless leg*" OR "periodic leg movement*". The search was restricted to published articles from January 1990 to December 2019 and excluded articles identified as reviews or meta-analyses.

Inclusion criteria

We considered observational studies of any design (cross-sectional, prospective, or retrospective cohort) that evaluated human participants of any age, gender, or race/ethnicity from the general population.

We considered multiple objective measures of SES, such as education, income, occupation, employment status, assets, and composite scores, as well as subjective SES, self-assessed by participants. In the composite category, we also included such variables as access to health insurance or recipiency of public benefits, since they are objective but may relate to more than one core SES measure (income, employment, or assets). In the subjective category, we included those variables that were measured based on participants' own judgement of their social class (usually relatively to others) or their economic situation (financial difficulties, food security, etc). Proxy measures of SES (neighborhood or residence area deprivation indexes) were included when individual data were not available. For studies examining children or adolescents, parental SES measures (parental education and occupation, household income/assets) were used instead.

We evaluated sleep health on both a behavioral/physiological and a clinical (absence of complaints) basis.[28,29] In the first instance, variables were grouped in the following categories: sleep duration, sleep latency, number of awakenings/wake after sleep onset, and sleep efficiency. Sleep timing was not evaluated due to difficulty in defining normal ranges. Variables should be presented numerically and derived either from objective tests, such as wrist actigraphy/accelerometry or polysomnography (PSG), or subjective reports in the form of questionnaires or sleep diaries. Clinical sleep variables were grouped as follows:

(1) insomnia/sleep difficulty, including complaints of difficulty in initiating sleep, difficulty in maintaining sleep, early morning awakening, or nonrestorative sleep, with or without daytime consequences, obtained from validated or nonvalidated questionnaires,
(2) sleep-disordered breathing, including complaints of snoring and sleep apnea symptoms (breathing stops, gasping, etc) from questionnaires or objective measurement of respiratory events during sleep (polygraphy or PSG),
(3) hypersomnia, including measurements of daytime sleepiness/hypersomnolence or long sleep duration, either by questionnaires or by objective tests (actigraphy, PSG, multiple sleep latency test),
(4) abnormal movements/behaviors during sleep, including complaints of restless legs, leg cramps, bruxism, rhythmic movements, parasomnias, nightmares, and enuresis, evaluated by questionnaires or PSG.

A final category was labeled as composite sleep disturbance, which included either composite measures of the above-mentioned physiological or clinical variables, usually in the form of validated scales, or variables that generally measure the overall satisfaction and quality of sleep, self-assessed in questionnaires. Sleep variables could be either continuous or categorical with cut-offs that were already defined in each article. Parental reports of children's sleep health and sleep problems were also eligible.

Exclusion criteria

Reports were excluded based on the following criteria: (1) they were interventional trials, reviews or meta-analyses, case series or case reports, and not presenting original research; (2) they were in a non-English language; (3) the full text was not accessible; (4) they recruited participants that already presented specific conditions at baseline (namely, pregnant women, shift workers, caregivers, sleep disorders, or other chronic diseases); (5) they did not provide full effects or statistical significance in cases where either SES or sleep were evaluated as covariates or mediators of other comparisons; or (6) they reported univariate associations and unadjusted estimates of the variables of interest. The latter criterion was implemented to avoid biases in the assessment of true relationships.

Data extraction and quality assessment

We extracted the following data from included studies:

(1) study design (based on the SES–sleep analyses and not necessarily on the whole study),
(2) setting, time period of recruitment, participation rate, and sample size justification,
(3) characteristics of participants (numbers, age range, derived population, attrition),
(4) timing of SES and sleep measurement and range of follow-up (for cohort studies),
(5) SES measures (variables, measurement details, levels/categories if grouped),
(6) sleep measures (variables, measurement details/instruments, cut-off thresholds if categorical, assessors),
(7) covariates included in the analyses that tested the SES–sleep association,
(8) main results (statistical significance and direction of the association between SES and sleep),
(9) significant interaction/mediation effects of the SES–sleep association by other variables.

We used the National Heart, Lung, and Blood Institute's Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies[30] to rate the quality of included studies. SES was considered the exposure and sleep measures the outcome variable, respectively. Rating of the exposure and outcome assessment in each article was influenced by objectivity; studies employing subjective or area SES measures, self-reported physiological sleep parameters, or nondiagnostic symptoms/signs of sleep disorders (according to the *International Classification of Sleep Disorders*, third edition or the *Diagnostic and Statistical Manual of Mental Disorders*, fifth edition diagnostic criteria) were downgraded. Blinding of outcome assessors was nonapplicable in self-reported outcomes. Age, gender, and race were considered essential confounders in statistical analyses, while body mass index or obesity were also required in studies assessing sleep-disordered breathing. Regarding overall quality rating, we calculated the proportion of positive rating on the sum of applicable criteria. Studies with < 50% positive rating were judged as poor quality, ≥ 65% as good quality, and the rest as fair quality.

Effect measures and synthesis of results

Due to the high heterogeneity in the measurement and categorization of SES and sleep indices between studies, a meta-analysis was deemed nonfeasible, and outcomes are presented narratively with emphasis on direction rather than magnitude of effects. For each comparison between a SES and a sleep indicator in each study, a vote counting method[31] was applied based on the direction of the effect of the SES predictor on the sleep outcome. The direction effect could be classified as expected, conflicting/unclear, or opposite, in respect to the expectance that lower SES predicts poorer sleep outcomes, which was guided by the widely acknowledged conceptual framework of the SES–health gradient.[32] When studies presented analyses with multiple levels of covariate adjustment, direction effect was extracted from the least adjusted model (including age, gender, and race) to minimize heterogeneity. When studies reported data for more than one sleep outcome in a specific outcome category and the direction of effects was not similar in at least 70% of them, the overall direction was categorized as conflicting/unclear. The same classification was used when the statistical tests for the SES–sleep association literally showed absence of an effect (eg, P values > 0.9). In studies where outcome data were only presented stratified according to participants' characteristics or recruiting sites, we summarized them, using fixed or random effects estimates, respectively, before deciding on the effect direction. When both continuous and categorical sleep outcome data were presented for the same outcome category, we preferred the categorical ones, while when outcome data were reported for more than two exposure SES levels without a clear trend in the effect direction we based the voting only on the association between the lowest and highest SES category.

Effect direction plots were drawn for each SES predictor to visualize the direction of the associations with each outcome category. In these plots, information presented for each study include its design, its quality rating, its sample size, and the direction effect vote for the applicable outcome categories.[33] A binomial test was used to synthesize the direction of effects for each SES–sleep association. Studies that have not tested the association of interest or showed conflicting/unclear effect direction were excluded from the calculation. For each comparison, we present proportion of studies with expected direction of effect, the corresponding 95% Jeffreys confidence interval (CI) of the proportion, and the two-sided P value at the alpha level of 0.05 from the binomial test. A sensitivity analysis was undertaken, eliminating studies of poor quality. We also sought to investigate if the proportion of expected effects was influenced by certain study characteristics, such as the outcome measurement (only for the behavioral/physiological sleep outcomes) or the number of covariates included in the respective models from where the effect directions were drawn. We did this by fitting binomial regression models with effect direction as the dependent variable (1 = expected effect, 0 = opposite effect) and outcome measurement (objective vs subjective) or covariate amount (on continuous scale) as independent variables. A two-sided P value of < 0.05 indicated the statistical significance of the association.

Significant mediators of the association between SES and sleep are discussed separately with the aim to propose a theoretical model explaining socioeconomic inequalities in sleep health, while interaction effects between SES and demographic characteristics (age, gender, and race) in predicting sleep measures were also recognized and put under consideration. Mediators were identified either by hierarchical regression analysis (entering in the last step and reducing the effect of the main predictors) or by mediation analysis (showing significant indirect effects accounting for the variance between dependent and independent variables). Due to the limited number of studies that have tested these effects, the results are only presented narratively and were not synthesized.

RESULTS

Study selection

We identified a total of 9,815 articles. After title and abstract screening, we were able to exclude 9,107 reports for clearly not meeting our inclusion criteria and evaluated 708 full texts for eligibility. At this step, we further excluded 372 articles for reporting univariate associations between variables of interest (n = 132), not evaluating either of the key variables (n = 66), including samples from specific populations (n = 65), not presenting any comparison between variables of interest (n = 62), assessing variables of interest as covariates (n = 38), and not presenting original research or including duplicate samples (n = 9), and ended up with 336 studies[13,16,18,19,23–27,34–360] for inclusion (**Figure 1**).

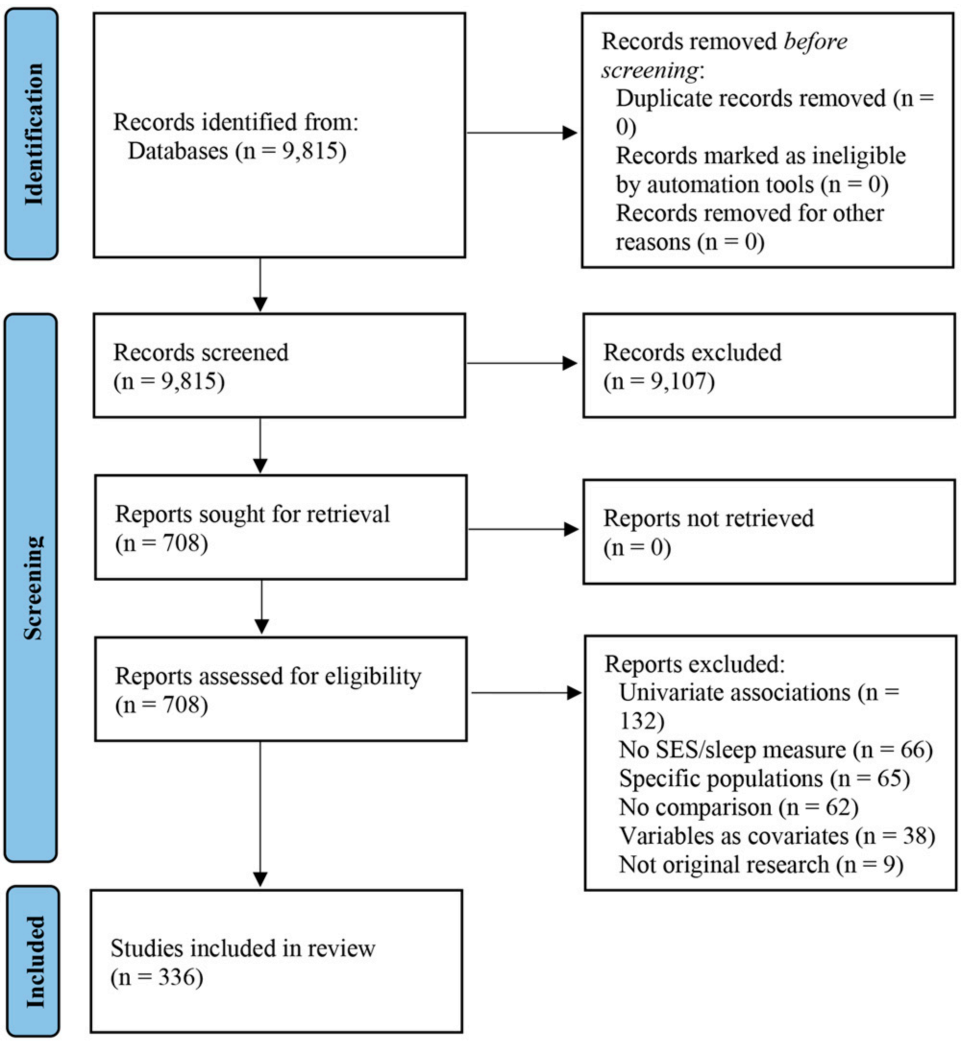
Characteristics of included studies

Most studies were published between the years 2010 and 2019 (n = 247). Considering specific SES–sleep analyses for assessment of study design, 28 studies had a prospective cohort design (median follow-up: 5 years, range: 1–34 years), 2 had a retrospective cohort design (median follow-up: 3 years, range: 1–5 years) and the rest were cross-sectional (n = 306). Study settings were mostly in Asian (n = 105) and North American (n = 103) countries, followed by Europe (n = 71), South America (n = 21), Oceania (n = 21), and Africa (n = 7), while 8 reports came from countries of different continents. Ninety studies evaluated children and adolescents. Twenty-eight studies focused only on women and 4 on men. Six studies enrolled only ethnic minorities, while participants were employees in 17 and students in 7 studies, respectively.

The most frequent SES indicator was educational attainment (n = 246), followed by income (n = 142), employment status (n = 110), occupational class (n = 40), assets (n = 32), composite or other objective measures (n = 36), and subjective ratings (n = 36).

The number of studies that evaluated each sleep outcome was 139 for sleep duration, 22 for sleep latency, 18 for awakenings/wake after sleep onset, 21 for sleep efficiency, 94 for insomnia, 27 for sleep-disordered breathing, 64 for hypersomnia, 19 for abnormal movements/behaviors, and 90 for the composite sleep disturbance category. For objective evaluation of sleep, studies employed wrist actigraphy/accelerometry (n = 25) or PSG (n = 9). The most frequently used validated questionnaires for subjective sleep reports were the Pittsburgh Sleep Quality Index (n = 41), the Epworth Sleepiness Scale (n = 14), the Children's Sleep Habits Questionnaire (n = 8), the Insomnia

Figure 1—Review flow diagram.



Severity Index (n = 7), the Athens Insomnia Scale (n = 4), and the Berlin Questionnaire (n = 4). All articles of this review are detailed in **Table S1** in the supplemental material.

Quality rating

Most articles were rated of fair overall quality (n = 234), followed by 54 of poor and 48 of good quality. All reports (n = 336) clearly stated their objectives and most of them (n = 330) recruited participants from the same population with uniform eligibility criteria. The population under assessment was clearly defined in 297 articles (88.4%) and the participation rate exceeded 50% in 229 studies (71.8% of applicable). Only 35 studies (10.4%) provided sample size justification, 18 studies (5.4%) measured the exposure prior to outcome, and 27 studies (8.0%) allowed sufficient time for the exposure to have an impact on outcome. Most reports assessed multiple levels of exposure (n = 238, 70.8%), with objective measures (n = 317, 94.3%); however only 13 articles (3.9%) mentioned repeated exposure measurements. Sixty-six studies (19.6%) used objective outcome measures and 54.5% of applicable reports (n = 18) referred to blinding of outcome assessors. From 28 prospective studies, only 7 (25.0%) were able to maintain a follow-up rate over 80%. Finally, 90.2% of reports (n = 303) adjusted for key confounding variables in their statistical analyses (**Table S2**).

Synthesis of results

Direction of effects

Proportion and 95% CIs of reports with expected SES–sleep associations are presented in **Figure 2** in the form of a heat map. In the heat map cells, green shading indicates a high proportion of expected directions of effects, yellow shading represents an equal proportion of expected and opposite directions of effects, and red shading corresponds to a high proportion of opposite directions of effects. The complete effect direction plots for all comparisons are presented in **Figure S1**, **Figure S2**, **Figure S3**, **Figure S4**, **Figure S5**, **Figure S6**, and **Figure S7**.

Regarding the behavioral/physiological sleep outcomes, the direction of effects on sleep duration was inconsistent for the different SES indicators. The estimated effects of education, income, occupation, and subjective SES were on the expected direction (range of proportions: 62.0–92.3%), while the estimated effects of employment status, assets, and composite SES were in the opposite direction or were unclear (range of proportions: 31.7–50.0%). The significance tests showed that short sleep duration was associated with low levels of education (P = .005), low subjective SES (P = .003), and being employed (P = .029). On the other hand, the direction of effects on measures of sleep continuity was consistently expected (proportions: 100.0% for sleep latency, 50.0–100.0% for awakenings/wake after sleep onset, and 66.7–100.0% for sleep efficiency). The significance tests revealed that increased sleep latency was associated with low levels of education (P < .001) or income (P = .016) and with unemployment (P = .031), while reduced sleep efficiency was related to low levels of education (P = .012) or income (P = .031).

Regarding the clinical sleep outcomes, estimated effects of SES on sleep were in the expected direction for insomnia (75.0–94.1%), hypersomnia (60.0–100.0%), abnormal movements/behaviors (50.0–100.0%), and composite sleep disturbances (62.5–100.0%). The same was true for sleep-disordered breathing (66.7–100.0%), except for its association with composite SES measures (0.0% of expected effects). Binomial probabilities were statistically

Figure 2—Heat map presentation for the synthesis of effects direction for the associations between each socioeconomic indicator and sleep outcome category.

Sleep outcome \ SES indicator	Education	Income	Employment	Occupation	Assets	Composite	Subjective
	Proportion of expected direction of effects in % (95% CI)						
↓ Sleep duration	**65.9 (55.4, 75.3)**	62.0 (48.2, 74.5)	**31.7 (19.1, 46.8)**	66.7 (34.8, 89.6)	45.5 (20.0, 73.0)	50.0 (27.2, 72.8)	**92.3 (69.3, 99.2)**
↑ Sleep latency	**100.0 (81.5, 100.0)**	**100.0 (70.8, 100.0)**	**100.0 (67.0, 100.0)**	—	—	100.0 (62.1, 100.0)	100.0 (62.1, 100.0)
↑ Awakening/WASO	77.8 (45.6, 95.1)	100.0 (55.5, 100.0)	50.0 (6.1, 93.9)	—	—	80.0 (37.1, 97.7)	100.0 (33.3, 100.0)
↓ Sleep efficiency	**90.9 (64.7, 99.0)**	**100.0 (67.0, 100.0)**	66.7 (17.7, 96.1)	100.0 (46.4, 100.0)	100.0 (14.7, 100.0)	66.7 (17.7, 96.1)	66.7 (17.7, 96.1)
Sleep difficulty/insomnia	**81.2 (70.4, 89.3)**	**83.9 (68.2, 93.6)**	**87.5 (73.0, 95.6)**	**92.9 (71.2, 99.2)**	87.5 (54.6, 98.6)	75.0 (40.8, 94.4)	**94.1 (75.6, 99.4)**
Sleep disordered breathing	**88.9 (68.9, 97.6)**	**100.0 (67.0, 100.0)**	66.7 (17.7, 96.1)	100.0 (33.3, 100.0)	100.0 (33.3, 100.0)	0.0 (0.0, 66.7)	100.0 (14.7, 100.0)
Hypersomnia	**95.7 (86.8, 99.1)**	**85.7 (69.5, 95.0)**	**91.7 (75.9, 98.2)**	85.7 (49.9, 98.4)	60.0 (20.9, 90.6)	62.5 (29.5, 88.1)	**100.0 (67.0, 100.0)**
Abnormal movements/behaviors	**90.0 (61.9, 98.9)**	**100.0 (73.8, 100.0)**	100.0 (55.5, 100.0)	50.0 (6.1, 93.9)	—	66.7 (17.7, 96.1)	—
Composite sleep disturbance	**81.8 (70.1, 90.3)**	**80.6 (65.6, 90.9)**	**77.3 (57.1, 90.8)**	87.5 (54.6, 98.6)	62.5 (29.5, 88.1)	**100.0 (70.8, 100.0)**	**100.0 (80.0, 100.0)**

Scale	100.0	75.0	50.0	25.0	0.0

Shades of green indicate a high proportion of expected direction of effects, shades of yellow an equal proportion of expected and opposite direction of effects, and shades of red a high proportion of opposite direction of effects. Values in bold indicate statistically significant proportions (P < .05) from the binomial test. CI = confidence interval, SES = socioeconomic status, WASO = wake after sleep onset.

significant for the effects of low educational attainment and low levels of income in all categories of sleep complaints and also for the effects of unemployment ($P < .001$), low occupational class ($P = .002$), and low subjective SES ($P < .001$) on insomnia, the effects of unemployment ($P < .001$) and low subjective SES ($P = .031$) on hypersomnia, and the effects of unemployment ($P = .017$), low composite SES ($P = .016$), and low subjective SES ($P = .001$) on composite sleep disturbance.

Eliminating the studies that were rated at poor quality did not change the summary direction of effects in any of the SES–sleep associations. However, the effect of employment status on sleep duration in favor of unemployment was no longer significant (binomial proportion of expected direction 34.2% [95% CI: 20.7%, 50.0%], $P = .074$). The method of outcome measurement had a significant impact only on the relationship between education and sleep duration. Studies that employed subjective sleep duration measures (binomial proportion of expected direction 70.3% [95% CI: 59.2%, 79.8%], $P = .001$) had 4 times higher probability (odds ratio 4.14 [95% CI: 1.10, 15.57], $P = .036$) of presenting effects on the expected direction compared to studies using objective ones (binomial proportion of expected direction 36.4% [95% CI: 13.7%, 65.2%], $P = .549$). The number of covariates tested in each study did not have a significant influence on the effect directions for any of the SES–sleep associations.

Interaction and mediation effects

Gender (n = 11) and race/ethnicity (n = 10) were the most common variables significantly moderating the association between SES and sleep outcomes. The interaction effect, however, was not in the same direction in all studies. Four studies showed nonsignificant results in one gender compared to the other (2[137,303] in men and 2[61,318] in women), 3 articles[45,128,307] reported worse outcome for men compared to women for each respective SES level, and 2 reports[77,138] showed an inverse SES/sleep association in women compared to men. Regarding race, 4 studies[92,124,125,176] found poorer and 2 studies[136,294] better sleep in low-SES ethnic minorities compared to Whites for each respective SES level, while 2 reports[212,215] showed opposite effects of SES on sleep measures in racial groups opposed to Caucasian populations. Advancing age predicted poorer sleep in low- as opposed to high-SES individuals in 3 studies,[13,84,307] while the opposite effect was also demonstrated in 1 study.[307] A 3-way interaction between race, gender, and SES was found in 1 study,[247] where African American men had less pronounced and nonsignificant impacts of SES on sleep. Finally, 1 study[84] reported a significant 4-way interaction between race, gender, age, and SES, with older minority women of low SES exerting significantly more negative effects on sleep.

Behavioral, environmental, and sleep hygiene factors (smoking, alcohol consumption, physical activity, home environment, family status, screen time) were the most frequently encountered mediators (n = 24), while psychological/mental (anxiety, depression, worries) and physical health factors (obesity, presence of chronic illnesses, perceived health) each accounted for attenuation effects in 22 studies. Work-related characteristics (working hours, job demands, support, reward, or commitment) and perceived levels of stress showed mediation effects in 8 and 6 studies, respectively. All the above associations worked in the same way: low SES was linked to adverse and unfavorable environmental, lifestyle, physical, and psychological outcomes, which in turn were associated with poorer sleep.

DISCUSSION

Summary of findings

We aimed to synthesize the evidence from the existing literature on the association between SES and sleep health. Our findings support the hypothesis that lower SES is linked to poorer outcomes for nearly all the domains of sleep health evaluated, both in adults and children/adolescents. The association between SES and sleep duration is the least clear and requires further research. With the exception of subjective SES, which showed a very high proportion of expected directions of effects on sleep duration, the other more objective SES indicators presented only modest proportions of expected effects, ranging from 31.7 to 66.7%. The proportion of expected effects was statistically significant for the education–sleep duration relation, but in the subset of studies using objective sleep duration measurements (actigraphy or PSG) the effect was in the opposite direction. The only statistically significant effect in the opposite direction than expected is the association between sleep duration and employment status, where employed individuals exhibited higher odds of having short sleep duration. A very logical explanation is that employment is usually linked to increased work commitments early in the morning, forcing employed individuals to curtail their sleep schedule. The fact that unemployed individuals usually have lower levels of education, income, or assets than employed ones, but appear to sleep longer than them, could also explain the nonsignificant effects of the other SES indicators on sleep duration. Another possible reason behind this opposite effect is that unemployed individuals may also represent economically inactive populations, such as housewives or students, whose SES could vary depending on the other members of the household. Subjective SES ratings may better reflect the social structure and class, especially in developing societies or minorities, where individual SES could differ from household SES or neighborhood/community SES. In pediatric populations, children from high-SES families may spend less time sleeping at the expense of screen-playing time, academic commitments, or extracurricular activities. Despite these inconsistencies, there was evidence for a SES gradient in measures of sleep continuity and efficiency, meaning that low-SES individuals spend more time in bed to obtain the same amount of sleep as high-SES individuals. Finally, the only SES predictor that failed to reach statistical significance in its direction effect on sleep outcomes was assets, possibly owing to the small number of studies that employed this measure.

Correlation with previous literature

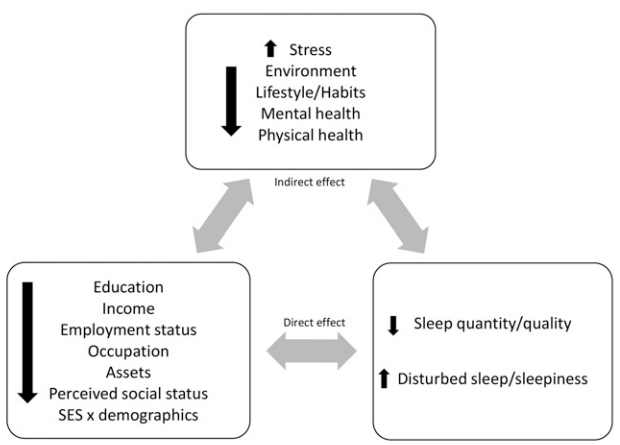
Our results are in accordance with previous reviews examining the impact of SES on a variety of health habits (diet,[361] physical activity,[362] smoking,[363] or alcohol use[364]), biomarkers (blood pressure,[365] obesity,[366] cortisol secretion and allostatic load[367]), and diseases (cardiovascular diseases,[368] diabetes mellitus,[369] mental health disorders[370]), while chronic exposure to low SES from childhood leads to higher risk for overall and cause-specific mortality.[371] This review adds to the growing body of literature about the detrimental effects of low social position on health and quality of life and is highly relevant for health care providers and policy makers alike; the former must acknowledge SES as an independent risk factor for poor sleep health and the latter need to implement targeted screening programs and accessible interventions tailored to these populations.

Sleep disparities in the context of socioeconomic disadvantage

We further tried to highlight the mechanisms responsible for the observed relations by identifying factors that mediate or attenuate the association between SES and sleep. **Figure 3** depicts the theoretical model for the observed complex interactions between SES and sleep. Environmental, physical, and psychological health factors are possibly located in the pathway that links low SES and poor sleep. Our findings are in agreement with the previously described social-ecological model of sleep health,[12] according to which sleep is influenced by individual-level factors (behavior, psychology, health), but these are embedded in the context of social factors (work, neighborhood), and the latter are also embedded within the context of societal factors (environment, technology). This model reveals the complexity of sleep, since it is conceptualized as the result of different processes acting on macrolevel (sociopolitical context) and microlevel (local living conditions). At the individual level, low-SES individuals are more prone to unhealthy behaviors, including those that relate to sleep health, due to being less educated, having higher stress levels in the context of financial or employment insecurity, and having limited access to health care resources and programs.[372] As a result, their physical and mental health is worse than that of individuals of higher SES strata, and that is also reflected in their sleep.[373] At the social and societal level, working long hours[374] and in unhealthy environments,[375] engaging in shift work,[376] and living in crowded houses[377] or in noisy, unpleasant, and dangerous neighborhoods[14,378] might adversely impact sleep, while the influence of cultural and ethnic/racial beliefs and attitudes about sleep and health in general could be stronger in socioeconomically deprived individuals.[379]

On the other hand, the effect of nonmodifiable characteristics, such as gender and race, seems conflicting between studies and warrants more attention in future research designs. Regarding ethnicity, several studies have shown that, particularly in developed countries, African American, Hispanic, and Latin American communities report more difficulty falling asleep, have poorer sleep quality, and sleep less than their Caucasian counterparts.[17,24,146,215,234,236,274,294] There appears to be an association between the "social stress" experienced by people from certain ethnic groups and the development of sleep disturbances among their members.

Figure 3—Proposed pathways linking socioeconomic status and sleep outcomes.



The bidirectional arrows imply a possible reciprocal relationship between the two variables.

Limitations

Limitations of this review also exist. The variety of SES measures and the different levels for each SES indicator in the included studies led to substantial heterogeneity and prevented the performance of a meta-analysis. Although vote counting is an acceptable synthesis method, it is limited by the fact that each study contributes equally in the synthesis, regardless of the size of its sample. Only the PubMed/MEDLINE database was searched, which could result in some low-impact manuscripts' being missed. Several studies assessed sleep outcomes using a single question, an approach that may not capture the multidimensionality and day-to-day variability of sleep. Use of validated composite SES scores, validated sleep questionnaires, sleep diaries, and objective sleep assessments (actigraphy or PSG) is strongly encouraged in future research. Moreover, the cross-sectional design most studies employed cannot be safely used to infer causality. The establishment of cohorts free of sleep disorders at baseline and their prospective follow-up for long time periods across multiple trajectories of SES will provide more reliable evidence.

CONCLUSIONS

There exists a social gradient in sleep health in individuals both in developed and developing societies and across all ages. Socioeconomic deprivation is associated with poorer sleep continuity/efficiency, higher frequency of sleep complaints and daytime sleepiness, and lower overall sleep satisfaction, while the effect of social position on sleep duration varies depending on the way SES is assessed. Individual- and social-level factors that influence this relationship are behavioral traits, physical and mental health problems, work-related issues, and environmental characteristics. Future research should identify the combined effect of psychological factors, stress, and lifestyle on the development and progression of sleep disturbances, so that behavioral and pharmacological interventions can be implemented to reduce the incidence of sleep disturbances.

ABBREVIATIONS

CI, confidence interval
PSG, polysomnography
SES, socioeconomic status

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