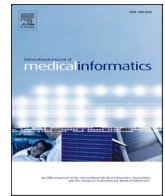




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Impact of COVID-19 on the psychological health of university students in Spain and their attitudes toward Mobile mental health solutions

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ABSTRACT

Background: The coronavirus disease 2019 (COVID-19) pandemic has had an impact on several aspects of life, including university students' mental health. Mobile mental care applications (apps) comprise a form of online mental care that enables the delivery of remote mental care.

Objectives: This study aimed to explore the impact of COVID-19 on the mental health of university students in Spain and to explore their attitudes toward the use of mobile mental care apps.

Method: Respondents answered a survey, which comprised two sections. The first included the 12-item General Health Questionnaire (GHQ-12) that was employed to assess the students' mental health. The second section included six questions developed by the authors to explore the students' attitudes toward mental care apps.

Results: The results showed that the students suffered from anxiety and depression as well as social dysfunction. Further, 91.3 % of the students had never used a mobile app for mental health, 36.3 % were unaware of such apps, and 79.2 % were willing to use them in the future.

Conclusions: The COVID-19 pandemic had a significant impact on the psychological health of university students. Mobile mental care apps may be an effective and efficient way to access mental care, particularly during a pandemic.

1. Introduction

Over 50 different epidemics and pandemics have had a considerable influence on the history of humankind [1] of which the most recent pandemic is the coronavirus disease 2019 (COVID-19) [2]. COVID-19 is caused by the novel 2019 coronavirus (2019-nCoV), which is associated with pneumonia [3]. The outbreak started in December 2019 in Wuhan, China [3]. By August 16, 2020, the disease had spread throughout the world, and more than 21,294,845 people had been infected; of these, 761,779 had died.

Individuals with limited protection from the disease [4] and with physical and mental illnesses are the most vulnerable [5]. Furthermore, the pandemic has had an adverse effect on the mental health of various social groups [6], including university students who were affected by the closure of universities.

Spain has been one of the most affected countries by the pandemic. On August 16, 2020, the country had the fastest rate of new cases in

Europe [7] and the highest number of cases in Western Europe [8], with over 342,813 confirmed cases and over 28,617 deaths [9]. Spain was declared by the Center of Disease Control and Prevention (CDC) as a high-risk area with limited medical resources [10]. In March 2020, Spain closed all its schools and universities to 9.5 million students in accordance with government regulations to contain the disease [11].

Anxiety, depression, and stress have been common psychological reactions to the pandemic, with possible long-term psychological effects [12]. Several stressors associated with the pandemic have affected those in quarantine as well as healthcare providers [12].

First, this study explored the psychological impact of the COVID-19 pandemic on university students in Spain. The 12-item General Health Questionnaire (GHQ-12) was employed to assess the psychological state of students from Valladolid University [13–15]. Second, this study examined university students' attitudes toward the use of mobile mental care applications (apps), such apps could help overcome mental health delivery obstacles including cost, stigmas, and a lack of mental

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healthcare professionals.

COVID-19 has exacerbated such barriers because traditional psychological care and monitoring have decreased substantially owing to the safety measures that have been implemented because of COVID-19 [16]. However, online care, such as mobile apps, has been adopted as an alternative [17–19]. Research has shown that mobile mental care apps are effective for several psychological difficulties, including anxiety, post-traumatic stress disorder, and depression [20–22].

2. Materials and methods

An online survey was employed in this study.

2.1. Methodology for sharing the questionnaire

Google Forms was employed to develop the online questionnaire. The Privacy Policy Service of the University of Valladolid evaluated the questionnaire to ensure the anonymity of the participants. Subsequently, an email with a link to the survey was sent to all students at the University of Valladolid. The survey was available online from July 7–20, 2020. It was estimated that it would take four minutes to complete; no incentives were offered to any respondents.

2.2. Survey structure

The survey comprised two sections, which are as follows. The first part includes the established GHQ-12 questionnaire to provide an assessment of the psychological state of the participants, while the second part aims to evaluate the participants' opinion and willingness to use mobile apps to support mental care. In total, the survey consists of 21 questions. Three questions collecting basic information on the characteristics of the students (gender, age and field of study). Twelve questions evaluating the physiological state of the participants. And six questions investigating their attitudes towards mobile applications for mental health.

2.2.1. GHQ-12

This study employed the GHQ-12 to evaluate the participants' psychological state. The GHQ-12 contains 12 questions, which are assessed on a four-point Likert scale, with 0 indicating that the indicator in question is not present and 3 indicating that it is more prevalent than usual (Appendix A). Higher scores indicate the probability of the respondents suffering from psychological difficulties. The scores can be classified into three severity categories: *normal*, *high*, and *severe*.

The GHQ-12 can be used to detect specific psychological factors; this study considered the following: anxiety and depression, social dysfunction, and loss of confidence. Each factor is associated with certain GHQ-12 items, and the evaluation thereof is calculated using the scores obtained from the specific items (Appendix B).

2.2.2. Assessment of mobile applications for mental health

The same approach as that of previous studies on similar topics was employed to design the questions [23–26], namely, to explore the respondents' awareness and prior experience of using mental care mobile apps, their willingness to use such apps, and their preferences and reasons thereof in comparison to consulting with a mental care professional (Appendix C). The participants' preferred features and functionalities of mobile mental care apps were also examined.

2.3. Analysis

The respondents' answers were only considered if they had answered all the questions. The data were analyzed via IBM SPSS v.26. The results were available in Google Sheet, which was downloaded as an Excel sheet.

The first part investigates the psychological state of the participants,

if an item is indicating a better/healthier than normal or same as usual, then the issue investigated by the item is not present more than usual for the participant, and the associated scores are 0 and 1 respectively. However, if it is answered with answers indicating worse/more than usual or much worse/more than usual, then it reflects an abnormal presence of the issue at that period, and the scores would be 2 and 3, respectively.

In the second section, multiple-choice answers were quantified, and the answers to open-ended questions were analyzed and classified to determine the respondents' attitudes.

3. Results

3.1. Participants' characteristics

Of the 21,769 students at Valladolid University during the 2019/2020 academic year, 608 (2.79 %) completed the survey. Most respondents were women (74 %), which might be because the majority (56.63 %) of the Valladolid University students were female. Additionally, females have been found to be more willing to complete surveys in similar studies [27]. Of the total participants, 67.5 % were between 18 and 23 years old. During the 2019/2020 academic year, 72.87 % of the students at the university were 23 years old or younger, explaining their prevalence in the sample. Furthermore, 31.3 % of the respondents were studying social and legal sciences (Table 1).

3.2. Results of the GHQ-12

The GHQ-12 results are displayed in Table 2. Most respondents reported a worse/more than usual prevalence of the particular psychological issues in eight items. However, a majority indicated that their ability to make decisions and face problems had not changed (items 4 and 8). Furthermore, most noted that they did not experience a loss of confidence or feelings of self-worthlessness (items 10 and 11). Description of each item (1–12) and its possible answers are provided in Appendix A.

The total GHQ-12 scores and the scores of the three investigated psychological factors were calculated and categorized into three scales according to the specifications presented in Appendix B.

The results in relation to the total number of respondents and their gender are presented in Appendix D. The results showed that 52.1 % of the respondents were classified as *high*, 30.1 % as *severe*, and 17.8 % as *normal*. Furthermore, the results revealed that female respondents had been critically affected. Regarding anxiety and depression, 44.7 %, 31.6 %, and 23.7 % of the respondents were classified as *high*, *severe*, and *normal*, respectively. Concerning social dysfunction, 53.6 % of the respondents were classified as *high*, 33.7 % as *severe*, and 12.7 % as *normal*. The most positive results concerned the loss of confidence scale: 57.4 % of the respondents were classified as *normal*.

Table 1
Respondents' demographic information.

		Total	%
Gender	Female	450	74
	Male	158	26
	< = 18–19	92	15.1%
Age	20–21	182	29.9%
	22–23	137	22.5%
	≥24	197	32.4%
	Naturals Science and Chemistry	17	2.8%
Field of Study	Mathematics and Physics	32	5.3%
	Health Sciences	80	13.2%
	Engineering and Architecture	126	20.7%
	Social and Legal Sciences	190	31.3 %
	Arts and Humanities	61	10.0%
	Others	102	16.8%

Table 2
GHQ-12 results.

Item Nr	0: Better/healthier than normal		1: Same as usual		2: Worse/more than usual		3: Much worse/more than usual	
	Count	%	Count	%	Count	%	Count	%
Item 1	55	9.0%	101	16.6%	270	44.4%	182	29.9%
Item 2	111	18.3%	157	25.8%	223	36.7%	117	19.2%
Item 3	64	10.5%	173	28.5%	208	34.2%	163	26.8%
Item 4	45	7.4%	258	42.4%	216	35.5%	89	14.6%
Item 5	75	12.3%	110	18.1%	253	41.6%	170	28.0%
Item 6	115	18.9%	182	29.9%	215	35.4%	96	15.8%
Item 7	31	5.1%	86	14.1%	227	37.3%	264	43.4%
Item 8	26	4.3%	274	45.1%	224	36.8%	84	13.8%
Item 9	78	12.8%	110	18.1%	234	38.5%	186	30.6%
Item 10	208	34.2%	153	25.2%	146	24.0%	101	16.6%
Item 11	264	43.4%	119	19.6%	139	22.9%	86	14.1%
Item 12	49	8.1%	219	36.0%	236	38.8%	104	17.1%

3.3. Results of the assessment of mental health mobile applications

In total, 36.3 % of the respondents had not heard of mobile mental care apps. Furthermore, 91.3 % (N = 555) had never used such a mobile app for mental health. Their willingness to use mobile apps for mental health was directly assessed in Question 3. The results further demonstrated 55.4 % of the respondents were willing to use this type of app. Only 9.5 % indicated that they were unwilling to use a mental care mobile app. The Q1–Q4 results are displayed in Table 3.

The association between the users’ previous usage of mental care mobile apps and their willingness to use such apps in the future is presented in Appendix E. In total, 79.2 % of the respondents who had used mobile apps for mental health were receptive to using them in the future. Moreover, 53.2 % who did not have previous experiences with such apps were willing to use them in the future. However, 36.8 % were doubtful, and 10.1 % stated they would not use them. Finally, only two of the respondents who had used such apps did not want to use them in the future. It can be concluded that most of the individuals who have used mobile apps for mental health are open to using them again.

The willingness of the respondents who were classified as *severe* in relation to the GHQ-12 is presented in Appendix F. Of these, 62.3 % had no previous knowledge of mental care mobile apps, and 55.19 % had no intention of using them. This is noteworthy because these individuals may be regarded as those in need of such resources. Moreover, 159 individuals never have used a mobile application for mental health. In total, 54.64 % (N = 100) of the participants are receptive to the use of this kind of mobile applications. Nevertheless, 55.19 % (N = 101) of the participants who are categorized as *Severe* condition do not prefer the use of mobile applications for mental care.

The reasons the respondents preferred mobile apps over consultations with a mental health specialist are presented in Table 4. In particular, 59 respondents were concerned with the cost, 22 cited stigmas, 17 did not have sufficient knowledge of mental health, and six cited distance. The reasons for preferring mobile apps included the limited

Table 3
Q1–Q4 results.

Question/Answer	Total (N = 608)		Female (N = 450)		Male (N = 158)		
	Count	%	Count	%	Count	%	
Q1: Awareness of mobile mental care apps	Yes	221	36.3 %	173	38.4%	48	30.4%
	No	387	63.7%	277	61.6%	110	69.6%
Q2: Previous use of mobile mental care apps	Yes	53	8.7 %	41	9.1 %	12	7.6 %
	No	555	91.3%	409	90.9%	146	92.4%
Q3: Willingness to use mobile mental care apps in the future	Yes	337	55.4 %	268	59.6 %	69	43.7%
	I do not know	213	35.0%	148	32.9%	65	41.1 %
	No	58	9.5 %	34	7.6 %	24	15.2%
Q4: Preference of using a mobile mental care apps over consulting with a mental health professional	Yes	117	19.2%	86	19.1 %	31	19.6%
	I do not know	157	25.8%	116	25.8%	41	25.9%
	No	334	54.9 %	248	55.1%	86	54.4%

Table 4

Q4.1 results: Reasons given for preferring the use of mental care mobile apps instead of consulting specialists.

Reason	Count	%
Cost problems	59	50.4 %
Stigma related to mental problems	22	18.8%
I don't have enough knowledge (information) on mental health	17	14.5%
Distance from mental health professionals	6	5.1%
Shortage in mental health professionals	3	2.6%
Bad experiences with therapists	2	1.7%
Privacy and security of mental apps	2	1.7%
It is supportive if the problem is not serious	2	1.7%
Save time and access at any time	2	1.7%
For the state of isolation owing to the COVID-19 pandemic	1	0.9%
For a first assessment	1	0.9%

number of available mental health professionals, previous negative experiences with mental specialists, privacy and security, the severity of the mental state, the access of and time-saving associated with mobile apps, the current social isolation required by the lockdown, and difficulties in obtaining an initial appointment.

The functionalities that the respondents wanted in mental care mobile apps are displayed in Table 5. In total, 174 of the participants did not have clear ideas regarding the features that they wanted in mobile apps, 105 wanted free guides that contained expert advice, and 67 wanted the app to include meditation exercises for stress and anxiety management. Finally, 29 stated such mobile apps should be endorsed by mental healthcare professionals.

4. Discussion

4.1. GHQ-12

The GHQ-12 test revealed a substantial prevalence of psychological

Table 5
Q5 results: Functionalities respondents wanted in a mental care mobile app.

Reason	Count	%
I do not know	174	28.60%
Free guides with expert advice	105	17.20 %
Online therapy with a specialist	78	12.8%
Meditation exercises to stress and anxiety management	67	11.00%
General answers	58	9.70%
Supported by professionals in psychiatry and psychology	29	4.80%
Exercises and daily support routines with a goal's indicators	28	4.60%
Invalid answers	24	3.90 %
Tips to increase confidence in specific moments	18	3.00%
Overcoming interviews of people who have suffered problems	14	2.30%
Test that facilitates the detection of the issues and advice to solve them	13	2.10%

issues among university students in Spain during COVID-19. The results concurred with the expected prevalence of negative feelings, including fear, worry, and stress [28].

Globally, 322 million and 264 million individuals are estimated to be suffering from depression and anxiety, respectively [29]. Furthermore, 85 % of patients with depression have significant anxiety, and 90 % with anxiety disorder suffer from depression [30]. In this study, 44.7 % of the students were classified as having *high* anxiety and depression, 31.6 % as *severe*, and 23.7 % as *normal*.

Preliminary evidence suggests that depression, anxiety, and stress are common psychological responses to COVID-19 [31]. Several landmark studies have evinced the critical impact of COVID-19 on mental health. A systematic review on the impact of COVID-19 on mental health in the general population reported that symptoms of anxiety, depression, and stress were prevalent in several countries [32]. Studies conducted in China have yielded similar findings [32,33]; a significantly higher prevalence of anxiety and depression was found among young people [34]. Another study identified a higher prevalence of anxiety and depression among the Polish population compared to that of the Chinese, which was mainly associated with not wearing face masks; both populations had a high prevalence of post-traumatic stress disorder symptoms [35]. In the United Kingdom, the percentage of individuals with a probable anxiety disorder was found to have almost doubled during COVID-19, with a higher prevalence of anxiety and depression among the younger population [36]. Similar results were reported in Germany [37], with a high prevalence of anxiety and depression among the general population and particularly among young people. The results of the GHQ-12 test herein concur with other studies that have addressed COVID-19's impact on university students. In France, a high prevalence of anxiety, depression, and stress among university students was identified [38,39]. Similar results were found in Bangladesh [40] and China [41].

Furthermore, there was a higher prevalence among students whose family members and relatives had COVID-19 [41]. In this study, the high prevalence of anxiety and depression may be related to the time of the research, which was conducted during the advanced stages of the pandemic in July 2020. In Spain, another study reported that levels of stress, anxiety, and depression were generally low during the initial stages of the pandemic; however, these levels increased when the period of confinement was extended [42]. The same study was repeated three weeks later and revealed significantly higher levels of anxiety, depression, and stress among the participants, with a higher prevalence among young people [43].

The results herein revealed that the prevalence of social dysfunction was *high* and *severe* in 53.6 % and 33.7 % of the students, respectively. Social dysfunction is related to individuals' ability to execute and enjoy their normal daily activities. During the pandemic, almost all the students' day-to-day activities were cancelled owing to the safety regulations, thereby explaining the students' high scores on this measure.

Furthermore, 57.4 % of the respondents were classified as *normal* in relation to the loss of confidence. This factor in the GHQ-12 is mainly

related to losing confidence and experiencing feelings of worthlessness, which are generally related to personality traits. Therefore, it was not expected to have a substantial effect on the results because the pandemic may not have had a considerable impact on this factor. However, it may indicate more serious psychological issues among those who had high scores for this factor. Feelings of worthlessness are indicators of serious psychological problems as individuals may feel imprisoned in their own life situations and not trust themselves and others. Consequently, it may lead to destructive feelings such as shame, guilt, stigmatization, alienation, and anguish [44]. Worthlessness is also associated with exposure to severe trauma and when combined with major depressive disorder may lead to suicide attempts [45].

4.2. Attitudes

Most of the participants had no previous knowledge of mental care mobile apps. Even if individuals are aware of such apps, they may lack knowledge concerning the functionalities thereof. Thus, it is essential to introduce these apps in the education system. Only 53 (8.7 %) of participants (9.1 % of females and 7.6 % of males) stated previous use of mobile mental care apps. This could be mainly linked to the identified lack of awareness. However, those participants constitute only 24 % of the 221 individuals who stated prior awareness of mobile mental care apps, which might be an indicator that even in cases of awareness on the existence of such apps, there might be the lack of knowledge on functionalities, treatment modalities, services offered by those apps, and effectiveness of such apps. Indeed, even when students are aware of mobile mental care apps existence, they are not using them, which might point to the need of not only increase awareness but also increase knowledge on their benefits in order to increase the trust in such apps and promote their use.

Research [45] has suggested that adolescents with depression spend more time using social networks than those without. Therefore, social networks could be used effectively to promote the use of mental care mobile apps, as studies have shown that they are widely used among young people [46,47]. Furthermore, concerning the individuals who do not have previous knowledge on this kind of mobile apps (N = 387), 51.4 % state that they do not prefer to use mobile applications for mental health. Therefore, the lack of awareness and knowledge is highly correlated with the unwillingness to use mobile apps for mental health.

Similar to previous studies [48,49], the results herein suggested that women are more open to using mobile apps than men. With females (59.6 %) being more open to using such apps in the future than males (41.1 %).

In this study, 54.9 % of the respondents reported that they would prefer consulting a professional over using an app. Although several studies have presented promising results for the use of mobile apps for mental health, human care is necessary to treat mental health problems. Moreover, mobile apps are not suitable for all psychological issues [48, 50,51]. It is necessary to involve mental healthcare professionals in the co-design of these apps and apply psychological theories such as cognitive behavioral therapy and mindfulness based therapy [52].

Some respondents who indicated a preference for mobile apps over consultations with healthcare practitioners cited the reason as cost. Only 20 % of the population have access to professional care in high-income countries [45,53]. Families' financial difficulties may force them to avoid professional care. Thus, improving access to mental healthcare is imperative.

The stigmas associated with psychological problems were also given as a reason for preferring mobile apps. Studies have found that stigmas are closely associated with a lack of treatment opportunities [54,55,56]. Although levels of education have improved in the last two decades, discrimination against those with psychological difficulties remains [57].

Access to specialists is also a relevant challenge. Several studies have revealed the impact of the accessibility or the lack of mental healthcare

[58–60]. Smartphones are an integral part of individuals' daily routine [61]. Therefore, a joint effort from interdisciplinary fields is necessary to develop new strategies to enhance their impact on society and the economy.

Mental care apps are considerably underused, which is closely related to an absence of information on the features of such apps. Several studies on meditation treatments delivered through mobile apps have reported effective results [62–64].

Studies conducted on the application of gamification on mental health apps have reported promising results [61,62,66]. Several participants in the present research noted the necessity of including gamification features to ensure that the app is used consistently. However, 24 respondents indicated they only trusted personal care.

Although mental care mobile apps are a practical approach validated by several studies [63–65,68,69], their use has several limitations. Previous studies have revealed the need to develop guidelines to evaluate mental care mobile apps and to incorporate the citation of sources and privacy information to the end-users [70]. One study [71] concluded that more than 50 % of patients in all age groups had accepted the daily use of mental care mobile apps. Moreover, another study [72] suggested that such apps should be promoted because of their positive impact on public health. Furthermore, relevant recommendations for the development of such apps have been presented [67]. In summary, it is recommended that similar studies should be conducted in several locations to understand user requirements for these apps. Users' needs are crucial to developing effective and efficient mobile apps for enhanced healthcare. These requirements may differ depending on the users' location and age [70]. Therefore, it is imperative to ensure that such apps are designed and developed with the involvement of mental health professionals [73]. Furthermore, it is crucial to present scientifically validated content to the users and introduce enhanced features such as gamification.

5. Limitations

This study might have several limitations. First, most of the respondents were female. Second, the utilization of other satisfaction scales would have enhanced the findings on the students' attitudes. Third, additional questions that examined attitudes toward mental care mobile apps would have extended the findings. Finally, conducting face-to-face interviews would have allowed the researchers to explore the respondents' preferences and attitudes toward mental care apps in-depth.

6. Conclusions

COVID-19 has an impact on several aspects of life, including health, finance, and education. This study investigated its impact on the psychological state of Valladolid University students using the GHQ-12. Moreover, it explored students' attitudes and willingness to use mobile apps for their mental care. This study shows that most of the participants are in the *High* scale concerning almost all psychological factors with exception to loss of confidence. In total, 52.1 %, 44.7 % and 53.6 % of the participants are in the *High* scale concerning GHQ-12, anxiety and depression, and social dysfunction, respectively. The results indicated that although students are in need of psychological support during this pandemic, it has been difficult to access mental help in the traditional manner (i.e., by consulting with a mental healthcare professional). Mobile mental care apps may prove beneficial in such situations. The findings herein could support future research activities on the design and development of mobile apps for mental health for university students in Spain. The reasons reported to prefer the use of mobile mental care apps instead of consulting with a specialist and the functionalities that the participants want to see on mobile applications are a critical base of knowledge to support the design of novel applications in this field. Future work will be conducted on the development of a mobile

application for mental health.

Authors contributions

All authors contributed to the creation of the manuscript. GM and ND: design, conception, acquisition and interpretation of data, analysis of questionnaire answers, drafting of the manuscript, revision. SO: design, conception, statistical support, critical revision. ITD and BSA: distribution of the questionnaire, collection of Data and critical revision.

Summary Points:

- The majority of the participants are females (74 %), 52.4 % of the participants are between 20–23 years old, and 31.3 % are from the social and legal sciences field.
- The results show that most of the participants are in the High scale concerning almost all psychological factors with exception to loss of confidence.
- In total, 52.1 %, 44.7 % and 53.6 % of the participants are in the High scale concerning GHQ-12, anxiety and depression, and social dysfunction, respectively.
- 387 (36.3 %) participants did not have heard of mobile applications for mobile health.
- 91.3 % (N = 555) of the individuals never use a mobile application for mental health.
- 79.2 % (N = 42) of the users who have used mobile applications for mental health are willing to use them in the future.
- From the participants who prefer to use mobile applications in comparison to a consultation with a mental health specialist, 50.4 % state the cost as the main reason.
- This work suggests that students are in need of psychological support during this crisis

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.ijmedinf.2020.104369>.

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