

Response to Reviewer 1 Comments

General Comments:

I appreciate the opportunity to review this manuscript and hope my comments assist in the revision process. The material is interesting and the topic is timely and relevant. The method seems to have been followed faithfully and the authors were well-positioned to conduct the analysis. Despite these positives, in my view, the paper needs more work before it could be published and I have made some specific suggestions below.

Point 1: Indicate the study's design in the title, abstract and method section.

Response 1: Thanks for your helpful advice. We have added more detailed descriptions of the study's design in the abstract and method section, which are listed as follows:

“Using a multistage stratified random sampling method, a cross-sectional survey was conducted among 692 engineering undergraduates from a top engineering university in China, and data were collected by self-reported electronic questionnaires. The data included demographic characteristics, such as age, gender, the Smartphone Addiction Scale-Short Version (SAS-SV), the 9-item Patient Health Questionnaire (PHQ-9), and the Pittsburgh Sleep Quality Index (PSQI).”

“.....This study adopted a multistage stratified random sampling method; first, five engineering schools were randomly selected from 25 engineering schools in the university, and then the respondents were randomly chosen according to the size of each school and the number of students in different years. Given the pandemic limiting the face-to-face investigation, the survey team sent electronic questionnaire links to the selected participants' mobile phone numbers or email accounts. All participants were notified of the purpose of the study and gave informed consent to participate. It took approximately 20 minutes on average to complete the questionnaire, after which students received a cash reward ranging from 8 to 15 CNY. To avoid duplications or fraud in the online survey, the links were exclusive to each student and automatically became invalid after students completed and submitted the questionnaire. Participants were required to complete all questions before submitting the questionnaire. The participants in the study were Chinese engineering undergraduates aged 18-24. The study was reviewed by the ethics committee of Tianjin University and used the STROBE cross-sectional reporting guidelines.”

Point 2: Whereas all the information provided in the abstract is important, there is a lot of information presented that could be condensed to give a briefer overview of the paper.

Response 2: Thanks for the constructive suggestion. Based on your kind advice and the format required by the journal, we have adjusted and streamlined the abstract to make it more concise and clearer. The revised abstract is as follows:

“BACKGROUND: Existing research has demonstrated that depression is positively related to smartphone addiction, but the role of sleep has not been discussed thoroughly, especially among engineering undergraduates affected by the COVID-19

pandemic.

AIM: To evaluate sleep as a mediator of the association between smartphone addiction and depression among engineering undergraduates.

METHODS: Using a multistage stratified random sampling method, a cross-sectional survey was conducted among 692 engineering undergraduates from a top engineering university in China, and data were collected by self-reported electronic questionnaires. The data included demographic characteristics, such as age, gender, the Smartphone Addiction Scale-Short Version (SAS-SV), the 9-item Patient Health Questionnaire (PHQ-9), and the Pittsburgh Sleep Quality Index (PSQI). Pearson correlation and multiple linear regression analyses were used to examine the association between smartphone addiction and depression, while structural equation models were established to evaluate the possible mediating role of sleep.

RESULTS: Based on the cutoffs of the SAS-SV, the rate of smartphone addiction was 63.58 percent, with 56.21 percent for women and 65.68 percent for men, among 692 engineering students. The prevalence of depression among students was 14.16 percent, with 17.65 percent for women, and 13.18 percent for men. Smartphone addiction was positively correlated with depression, and sleep played a significant mediating effect between the two, accounting for 42.22 percent of the total effect. In addition, sleep latency, sleep disturbances, and daytime dysfunction significantly mediated the relationship between depression and smartphone addiction. The mediating effect of sleep latency was 0.014 ($P < 0.01$; 95% CI = [0.006, 0.027]), the mediating effect of sleep disturbances was 0.022 ($P < 0.01$; 95% CI = [0.011, 0.040]), and the mediating effect of daytime dysfunction was 0.040 ($P < 0.01$; 95% CI = [0.024, 0.059]). The influence of sleep latency, sleep disturbances, and daytime dysfunction accounted for 18.42%, 28.95%, and 52.63% of the total mediating effect, respectively.

CONCLUSION: The results of the study suggest that reducing excessive smartphone use and improving sleep quality can help alleviate depression.”

Point 3: Introduction - The paper does not cite an appropriate range of literature sources. Overall organization and clarity throughout the manuscript should be improved. For the introduction, a restructuring of the writing to provide more coherent and connected ideas and sections would be valuable. Brief synopsis or synthesis of ideas and relationships between or within constructs would improve flow dramatically.

Response 3: We appreciate your careful reading. As suggested by the reviewer, we adjusted literature sources, and improved the overall organization and clarity throughout the manuscript. As for the introduction, we have reorganized the structure to make it more coherent. Please refer to the manuscript given that the restructuring involves considerable changes.

The changes in references are list as follows. For instance, we have removed some inappropriate references, such as:

Auerbach RP, Alonso J, Axinn WG, Cuijpers P, Ebert DD, Green JG, Hwang I, Kessler RC, Liu H, Mortier P, Nock MK, Pinder-Amaker S, Sampson NA, Aguilar-Gaxiola S, Al-Hamzawi A, Andrade LH, Benjet C, Caldas-de-Almeida JM,

Demyttenaere K, Florescu S, de Girolamo G, Gureje O, Haro JM, Karam EG, Kiejna A, Kovess-Masfety V, Lee S, McGrath JJ, O'Neill S, Pennell B-E, Scott K, ten Have M, Torres Y, Zaslavsky AM, Zarkov Z, Bruffaerts R. Mental disorders among college students in the World Health Organization World Mental Health Surveys. *Psychol Med* 2016; 46: 2955–2970.

Faisal RA, Jobe MC, Ahmed O, Sharker T. Mental Health Status, Anxiety, and Depression Levels of Bangladeshi University Students During the COVID-19 Pandemic. *Int J Ment Health Addict* 2022; 20: 1500–1515.

Abdulwahed M. Technology Innovation and Engineering' Education and Entrepreneurship (TIEE) in Engineering Schools: Novel Model for Elevating National Knowledge Based Economy and Socio-Economic Sustainable Development. *Sustainability* 2017; 9: 171.

Zhang C, Hao J, Liu Y, Cui J, Yu H. Associations Between Online Learning, Smartphone Addiction Problems, and Psychological Symptoms in Chinese College Students After the COVID-19 Pandemic. *Front Public Health* 2022; 10.

Zhang MX, Chen JH, Tong KK, Yu EW, Wu AMS. Problematic Smartphone Use during the COVID-19 Pandemic: Its Association with Pandemic-Related and Generalized Beliefs. *Int J Environ Res Public Health* 2021; 18: 5724.

Bhat S, Chokroverty S. Sleep disorders and COVID-19. *Sleep Med* 2022; 91: 253–261.

Jones EAK, Mitra AK, Bhuiyan AR. Impact of COVID-19 on Mental Health in Adolescents: A Systematic Review. *Int J Environ Res Public Health* 2021; 18: 2470.

Gandaputra SA, Waluyo I, Efendi F, Wang J-Y. Insomnia Status of Middle School Students in Indonesia and Its Association with Playing Games before Sleep: Gender Difference. *Int J Environ Res Public Health* 2021; 18: 691.

Lei LY-C, Ismail MA-A, Mohammad JA-M, Yusoff MSB. The relationship of smartphone addiction with psychological distress and neuroticism among university medical students. *BMC Psychol* 2020; 8: 1–9.

Meanwhile, we have added some new references, such as:

Deng J, Zhou F, Hou W, Silver Z, Wong CY, Chang O, Drakos A, Zuo QK, Huang E. The prevalence of depressive symptoms, anxiety symptoms and sleep disturbance in higher education students during the COVID-19 pandemic: A systematic review and meta-analysis. *Psychiatry Res* 2021; 301: 113863.

Wacks Y, Weinstein AM. Excessive Smartphone Use Is Associated With Health Problems in Adolescents and Young Adults. *Frontiers in Psychiatry* 2021; 12.

Rozgonjuk D, Elhai JD. Emotion regulation in relation to smartphone use: Process smartphone use mediates the association between expressive suppression and problematic smartphone use. *Curr Psychol* 2021; 40: 3246–3255. Elhai JD, Dvorak RD, Levine JC, Hall BJ. Problematic smartphone use: A conceptual overview and systematic review of relations with anxiety and depression psychopathology. *Journal of Affective Disorders* 2017; 207: 251–259.

Tang W, Hu T, Hu B, Jin C, Wang G, Xie C, Chen S, Xu J. Prevalence and correlates of PTSD and depressive symptoms one month after the outbreak of the

COVID-19 epidemic in a sample of home-quarantined Chinese university students. *Journal of Affective Disorders* 2020; 274: 1–7.

Odriozola-González P, Planchuelo-Gómez Á, Irurtia MJ, de Luis-García R. Psychological effects of the COVID-19 outbreak and lockdown among students and workers of a Spanish university. *Psychiatry Research* 2020; 290: 113108.

Son C, Hegde S, Smith A, Wang X, Sasangohao F. Effects of COVID-19 on College Students' Mental Health in the United States: Interview Survey Study. *J Med Internet Res* 2020; 22: e21279.

Chun J. Conceptualizing effective interventions for smartphone addiction among Korean female adolescents. *Children and Youth Services Review* 2018; 84: 35–39.

Chun J, Shim H, Kim S. A Meta-Analysis of Treatment Interventions for Internet Addiction Among Korean Adolescents. *Cyberpsychology, Behavior, and Social Networking* 2017; 20: 225–231.

Lan Y, Ding J-E, Li W, Li J, Zhang Y, Liu M, Fu H. A pilot study of a group mindfulness-based cognitive-behavioral intervention for smartphone addiction among university students. *Journal of Behavioral Addictions* 2018; 7: 1171–1176.

Lu C, Zou L, Becker B, Griffiths M, Yu Q, Chen S-T, Demetrovics Z, Jiao C, Chi X, Chen A, Yeung A, Liu S, Zhang Y. Comparative Effectiveness of Mind-Body Exercise Versus Cognitive Behavioral Therapy for College Students with Problematic Smartphone Use: A Randomized Controlled Trial. *IJMHP* 2020; 22: 271–282.

Barber LK, Cucalon MS. Modifying the Sleep Treatment Education Program for Students to include technology use (STEPS-TECH): Intervention effects on objective and subjective sleep outcomes. *Stress and Health* 2017; 33: 684–690.

Schlarb AA, Friedrich A, Claßen M. Sleep problems in university students - an intervention. *NDT* 2017; 13: 1989–2001.

Saruhanjan K, Zarski A-C, Bauer T, Baumeister H, Cuijpers P, Spiegelhalder K, Auerbach RP, Kessler RC, Bruffaerts R, Karyotaki E, Berking M, Ebert DD. Psychological interventions to improve sleep in college students: A meta-analysis of randomized controlled trials. *Journal of Sleep Research* 2021; 30: e13097.

Point 4: Introduction-What is the study's biggest contribution? The contribution should be clearly stated in the introduction. The reader would like to know why the study conducted in such a study sample is so crucial.

Response 4: Thanks for your kind comments. We have summarized the research gaps by reviewing the literature, and emphasized the contribution of the present study.

“There are several research gaps according to the review of relevant studies. First, most of these studies are based on the general population of college students or medical students. More pertinent research needs to be explicitly explored for students of different majors, such as engineering students. Second, college students' mental health status has considerably changed since the outbreak of COVID-19, with a large proportion of students suffering from severe depression and anxiety. Therefore, it is necessary to explore the changes in depression, mobile phone addiction, and sleep status of college students under the influence of COVID-19 and investigate their relationship in this specific context. Third, the role of sleep in the relationship between

mobile phone addiction and depression has been poorly analyzed. Although a few studies have confirmed that sleep mediates the relationship between smartphone addiction and depression, special attention has been given to engineering students, and the mediating role of sleep needs to be further discussed.

Therefore, this study carried out a cross-sectional survey among engineering students in the context of the COVID-19 pandemic. It adds to the literature mainly by analyzing the relationship between smartphone addiction, sleep, and depression among Chinese engineering students during COVID-19 and investigating the mediating role of sleep in the relationship between smartphone addiction and depression.”

Point 5: Method - Was this study part of a larger study with more variables? Has any of this data been published?

Response 5: The survey conducted by the study was a comprehensive one on the development of engineering college students, which involves variables such as basic personal information (including age, grade, major, high school type, college entrance examination scores, etc.), learning situation (including academic performance, time arrangement, learning approaches etc.), physical and mental health, and university satisfaction. The relevant data have not been published.

Point 6: Method -Is it necessary to clarify the method employed?

Response 6: Thanks for your helpful advice. We have clarified the methods employed in the statistical analyses section as suggested.

“First, descriptive statistical analysis was conducted to demonstrate the general situation of smartphone addiction, overall sleep quality, and depression among engineering students and to compare differences in gender subgroups with the t test. Second, the correlation between smartphone addiction, sleep, and depression was explored with Pearson's correlation analysis. Third, the influence of smartphone addiction on depression among engineering students was examined with multiple linear regression. Depression level was the outcome variable in the regression models, while smartphone addiction level and sleep quality were the core independent variables. It controlled for confounding variables such as students' age, gender, ethnicity, political status, only child status and family socioeconomic status. To identify the effects of different variables, we successively included control variables, smartphone addiction, and sleep in the multiple regression model. Specifically, Model 1, $Y = \beta_0 + \beta_1 x' + \varepsilon$, was developed first to include control variables on engineering students' depression. Mobile phone addiction was further included in Model 2, $Y = \beta_0 + \beta_1 x' + \beta_2 SA + \varepsilon$. The seven sleep index components were then incorporated into Model 3, $Y = \beta_0 + \beta_1 x' + \beta_2 SA + \beta_3 SleepQuality + \beta_4 SleepLatency + \beta_5 SleepDuration + \beta_6 HabitualSleepEfficiency + \beta_7 SleepDisturbances + \beta_8 SleepMedication + \beta_9 DaytimeDysfunction + \varepsilon$. Y denotes the level of depression of engineering students at college. SA represents the degree of smartphone addiction. x' represents the control variables, including students' age, gender, ethnicity, political status, only child status, family socioeconomic status, and whether their father received higher education. ε defines the error. Finally, a structural equation model was built to examine the mediating role of sleep in the

relationship between smartphone addiction and depression. Data analysis was performed by Stata SE 15."

Point 7: Method - In your methods section, say that you used the STROBE cross-sectional reporting guidelines.

Response 7: Thanks for your constructive suggestion. We have added the following statement at the end of the first paragraph of the Participants and procedure section.

"The study was reviewed by the ethics committee of Tianjin University and used the STROBE cross-sectional reporting guidelines."

Point 8: Method - Survey distribution methods [website - link, email invite,...]?

Response 8: Thanks for your careful reading. We have elaborated the survey distribution methods, which are also listed as follows:

"The data were collected from an online survey of 692 engineering undergraduates at a top university in China in December 2021... Given the pandemic limiting face-to-face investigation, the survey team sent electronic questionnaire links to the selected participants' mobile phone numbers or email accounts... To avoid duplications or fraud in the online survey, the links were exclusive to each student and automatically became invalid after students completed and submitted the questionnaire..."

Point 9: Method - Provide a clear description of the selection criteria of participants. Were the sample sizes sufficiently powered to detect effects? How did the researchers decide on the sample size?

Response 9: We feel grateful for the thoughtful questions. In the first paragraph of the Participants and procedure section, we have added a description of the selection criteria for participants, and given that there are approximately 11000 engineering undergraduate students in the university, this study selected a sample size of about 700, accounting for 6.36% of the total, indicating a certain representativeness of the samples.

"This study adopted a multistage stratified random sampling method; first, five engineering schools were randomly selected from 25 engineering schools in the university, and then the respondents were randomly chosen according to the size of each school and the number of students in different years...The participants in the study were Chinese engineering undergraduates aged 18-24. "

Point 10: Method- Some subjects refused to participate. Response rate?

Response 10: Thanks for your helpful advice. Given that this study distributed electronic questionnaires, and only participants who had read and agreed to the informed consent form entered the questionnaire, the response rate was indeed 100%. Yet, some of the answers did not meet the requirements and were removed after careful checking, and the final effective sample size was 692 (98.86% out of the total 700 questionnaires).

Point 11: Method- The ethical aspects in collecting data are not specifically clarified, independently of the voluntary nature of the subject's participation, variables such as

the approval by the local IRB, sharing and use of data and informed consent are not patent.

Response 11: Thanks for your kind comments. Indeed, all participants have signed an informed consent form, and the recruitment and collection procedures were approved by the Human Research Ethics Committee of Tianjin University. We have added relevant expressions in Participants and procedure section, which are also as follows:

“.....All participants were notified of the purpose of the study and gave informed consent to participate.....The study was reviewed by the ethics committee of Tianjin University and used the STROBE cross-sectional reporting guidelines.”

Point 12: Method- There is little explanation as to why you analyze your data in the way that you do, or why your methods are appropriate (statistical procedures).

Response 12: Thank you for the valuable advice. We have added detailed explanation of statistical procedure. Please find the relevant expressions as follows:

“First, descriptive statistical analysis was conducted to demonstrate the general situation of smartphone addiction, overall sleep quality, and depression among engineering students and to compare differences in gender subgroups with the t test. Second, the correlation between smartphone addiction, sleep, and depression was explored with Pearson's correlation analysis. Third, the influence of smartphone addiction on depression among engineering students was examined with multiple linear regression. Depression level was the outcome variable in the regression models, while smartphone addiction level and sleep quality were the core independent variables. It controlled for confounding variables such as students' age, gender, ethnicity, political status, only child status and family socioeconomic status. To identify the effects of different variables, we successively included control variables, smartphone addiction, and sleep in the multiple regression model. Specifically, Model 1, $Y = \beta_0 + \beta_1 x' + \varepsilon$, was developed first to include control variables on engineering students' depression. Mobile phone addiction was further included in Model 2, $Y = \beta_0 + \beta_1 x' + \beta_2 SA + \varepsilon$. The seven sleep index components were then incorporated into Model 3, $Y = \beta_0 + \beta_1 x' + \beta_2 SA + \beta_3 \text{SleepQuality} + \beta_4 \text{SleepLatency} + \beta_5 \text{SleepDuration} + \beta_6 \text{HabitualSleepEfficiency} + \beta_7 \text{SleepDisturbances} + \beta_8 \text{SleepMedication} + \beta_9 \text{DaytimeDysfunction} + \varepsilon$. Y denotes the level of depression of engineering students at college. SA represents the degree of smartphone addiction. x' represents the control variables, including students' age, gender, ethnicity, political status, only child status, family socioeconomic status, and whether their father received higher education. ε defines the error. Finally, a structural equation model was built to examine the mediating role of sleep in the relationship between smartphone addiction and depression. Data analysis was performed by Stata SE 15.”

Point 13: Method- The process of analysis should be made as transparent as possible. What strategies were used to avoid duplications or fraud in the online survey? Did you analyze any potential non-response bias? And early vs late bias? Did you check if data can suffer from common method bias?

Response 13: We feel grateful for your professional and valuable opinions. We have

done our utmost to avoid duplication and fraud issues, and relevant procedures have been elaborated in the Participants and Procedure section. As for the common method bias, we have stated possible bias of this study in the limitation section:

“.....To avoid duplications or fraud in the online survey, the links were exclusive to each student and automatically became invalid after students completed and submitted the questionnaire. Participants were required to complete all questions before submitting the questionnaire.....”

“The study has several limitations. First, the self-reported data by students may have measurement errors. For example, students may underestimate their smartphone addiction tendency, sleep disorders, and depressive symptoms. Second, other possible influencing factors of depression, such as stress and self-esteem, were not included in this study's analysis framework for assessment. Third, there may exist sample selection bias in the analysis results since written informed consent was obtained before students entered the questionnaire, and those who refused to consent were not included in the sample of this study. Fourth, the cross-sectional data used in this study make it difficult to identify the causal relationship between smartphone addiction and depression.”

Point 14: Results - A better visual structure of tables (boldface variables with statistical significance) would improve the readability.

Response 14: Thanks for the thoughtful advice. According to your suggestion, we have made the significant variables and values in Tables 1, 2, 3, and 4 bold in order to make the table more readable.

Point 15: Results - How did the authors handle missing data?

Response 15: Thanks for your thoughtful question. There was indeed no missing data for variables such as smartphone addiction, depression, and sleep in the survey.

Point 16: Discussion - Some of the contributions that are highlighted here could be flagged in the introduction for a more consistent narrative throughout the paper. I believe there should be better integration of the results with the existing literature.

Response 16: Thanks for your constructive suggestions. Your kind suggestions have benefited us a lot. We have rewritten the introduction to more clearly express the contributions of our research. As you suggested, in order to better link our research results with the existing literature, we have modified the discussion section thoroughly, which can be found in the discussion section in the manuscript.

Point 17: Discussion - A stronger discussion of implications for future research and potential intervention work is needed. While there is a brief section on implications, there is much to be discussed for policymakers regarding future research. I believe this will considerably strengthen this interesting paper.

Response 17: We appreciate your valuable suggestions. The goal of our study is to provide some practical suggestions for intervention in the occurrence of depression among college students. We have rewritten the relevant part, and the modified expressions are as follows:

“This study suggests that colleges and universities can alleviate depression among students by intervening in smartphone addiction and improving sleep. Studies have discussed effective interventions to reduce smartphone addiction, such as self-awareness and self-control, involuntary restriction, and peer support. College students in adulthood should be soberly aware of the harm of smartphone addiction and seek scientific interventions when necessary. For instance, cognitive behavioral therapy (CBT) was proven effective in a meta-analysis of treatment interventions for adolescents with internet addiction. The group mindfulness-based cognitive-behavioral intervention (GMCI) and mind-body exercise (ME) have been shown to be helpful in the intervention of smartphone addiction among Chinese college students. Thus, cognitive behavioral interventions and mind-body exercises (e.g., QigongBaduanjin) should be encouraged. For involuntary restraint, using technology against itself, a new mode of intervention for treating smartphone addiction, focuses on monitoring and limiting the use of smartphones with functionalities built into the smartphone and third-party apps. Empirical studies have found that ways to limit notifications and reduce screen time are becoming more widely accepted. Social support, such as favorable peer relationships and harmonious family relationships, is also a protective factor against smartphone addiction. In addition, colleges and universities should also make efforts to expand the accessibility of mental health services to alleviate smartphone addiction.

In addition, physical exercise is the most common way to enhance sleep quality, and sleep therapy training is also practical in improving the sleep situation of college students. For example, sleep training programs for university students with sleep problems proved feasible to significantly enhance students' sleep quality. Psychological interventions such as cognitive behavior therapy for insomnia (CBT-I) have also been recommended to improve sleep. Other interventions, such as improving sleep hygiene, relaxation, mindfulness and hypnotherapy, also play a role in improving sleep quality. Therefore, college students should be encouraged to strengthen their physical exercise, improve their sleeping conditions and restrict mobile phone use to ensure sleep time and quality. For students with serious sleep problems, necessary psychological intervention and medical treatment should be carried out in time to avoid deterioration of the problem and more severe sleep disorders and psychological problems.”

Point 18: Discussion - Theoretical and methodological limitations should be emphasized more deeply.

Response 18: Thanks for your suggestion. We have revised the limitations of this study. The content of this section is as follows:

“The study has several limitations. First, the self-reported data by students may have measurement errors. For example, students may underestimate their smartphone addiction tendency, sleep disorders, and depressive symptoms. Second, other possible influencing factors of depression, such as stress and self-esteem, were not included in this study's analysis framework for assessment. Third, there may exist sample selection bias in the analysis results since written informed consent was obtained before students entered the questionnaire, and those who refused to consent were not included in the sample of this study. Fourth, the cross-sectional data used in this study make it difficult

to identify the causal relationship between smartphone addiction and depression. Future studies may investigate the causal relationship between smartphone addiction and depression based on longitudinal data and incorporate more factors into the theoretical mechanisms to discover more effective measures.”

Point 19: CHECKLIST FOR STYLE. The manuscript will serve a broad audience of students, researchers, and practitioners, however, the manuscript needs to be carefully and attentively proofread, because some sentences are awkwardly constructed, punctuation is deficient, and therefore reading is occasionally difficult to follow. That leads me to believe that it needs careful editing by a native English speaker

Response 19: Thanks for your suggestion. We have sent it to a professional English language editing company and have obtained the English Language Certificate.

Response to Reviewer 2 Comments

Point 1: It has been a very good work for the literature. Congratulations. I have stated a few small correction suggestions in the file. Sincerely.

Response 1: Thank you for your comments. We have made revisions in accordance with the questions raised by all of the reviewers and checked the format and language according to the requirements of the journal. All revisions have strived to meet the publication standards of the journal.