Sleep Medicine 98 (2022) 152–157

Contents lists available at ScienceDirect

Sleep Medicine

journal homepage: www.elsevier.com/locate/sleep

Sleep dissatisfaction is a potential marker for nomophobia in adults

Haitham A. Jahrami [a, b, *], Feten Fekih-Romdhane [c, d], Zahra Q. Saif [a], Omar A. Alhaj [e], Maha M. AlRasheed [f, g], Seithikurippu R. Pandi-Perumal [h, i], Ahmed S. BaHammam [j, k], Michael V. Vitiello [l]

[a] Ministry of Health, Bahrain
[b] College of Medicine and Medical Sciences, Arabian Gulf University, Bahrain
[c] The Tunisian Center of Early Intervention in Psychosis, Psychiatry Department "Ibn Omrane", Tunisia
[d] Tunis El Manar University, Faculty of Medicine of Tunis, Tunisia
[e] Department of Nutrition, Faculty of Pharmacy and Medical Science, University of Petra, Amman, Jordan
[f] Clinical Pharmacy Department, College of Pharmacy, King Saud University, Riyadh, Saudi Arabia
[g] Princess Nora bint Abdul Rahman University, Riyadh, Saudi Arabia
[h] Somnogen Canada Inc., College Street, Toronto, Canada
[i] Saveetha Medical College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamil Nadu, India
[j] Department of Medicine, College of Medicine, University Sleep Disorders Center, King Saud University, Saudi Arabia
[k] The Strategic Technologies Program of the National Plan for Sciences and Technology and Innovation in the Kingdom of Saudi Arabia, Riyadh, Saudi Arabia
[l] Psychiatry & Behavioral Sciences, Gerontology & Geriatric Medicine, and Biobehavioral Nursing, University of Washington, Seattle, WA, 98195-6560, United States

ARTICLE INFO

Article history:
Received 22 February 2022
Received in revised form
16 June 2022
Accepted 1 July 2022
Available online 11 July 2022

Keywords:
Anxiety disorders
Dyssomnias
Insomnia severity index
Neurotic disorders
Sleep disorders
Sleep satisfaction
Sleep-wake disorders

ABSTRACT

Introduction: NOMOPHOBIA is a term used to describe an anxiety disorder in which people fear being disconnected from their mobile phones. Strong associations between nomophobia and insomnia have previously been documented. However, there is no clear explanation for this relationship between the two disorders. The present study was designed to first determine the diagnostic precision of the Insomnia Severity Index (ISI) various components in detecting or classifying nomophobia; and second, examine the diagnostic performance of the identified ISI components in classifying nomophobia.
Methods: From a previous study 549 participants completed demographic information, the Nomophobia Questionnaire (NMP-Q), and the ISI. The sample was divided into two parts so that each part represented the original sample, using a 40% (n = 209) allocation for sample 1 and 60% (n = 340) for sample 2. To determine common components between nomophobia and insomnia, an exploratory factor analysis was performed using sample 1 to determine the diagnostic precision of the ISI's various components in detecting or classifying nomophobia. A test of the ISI and a cut-off value (ISI-4 $\geq$2) was then conducted on Sample 2 to determine whether they would accurately identify significant nomophobia.
Results: Sleep dissatisfaction was a common component of insomnia and nomophobia. Sleep dissatisfaction had excellent diagnostic accuracy in detecting individuals with nomophobia (sensitivity 75.13%, specificity 100%, Youden' index 0.75, area under curve 0.88).
Conclusion: Questioning patients sleep dissatisfaction may serve as a marker for both nomophobia and insomnia, both of which may demand more comprehensive evaluation.
© 2022 Elsevier B.V. All rights reserved.

1. Introduction

In 2008, the United Kingdom Post Office coined the term "nomophobia" (no mobile phone phobia) regarding the fear of being without a mobile phone device in a public environment [1]. It ordered the research firm YouGov to analyze whether phone users in the UK were anxious without their mobile phones [2]. In a survey in 2012, 13 million British people were considered to have nomophobia, representing 53% of mobile phone users [2]. This term has been construed using the DSM-5 definition, as a phobia of a particular thing [3]; in this case separation from or lack of adequate function from a mobile phone. A person's low self-esteem and extrovert nature may play a role when they use the phone excessively [4]. Globally, this problem is becoming more prevalent; a

* Corresponding author: College of Medicine and Medical Sciences, Arabian Gulf University, P.O. Box: 26671, Manama, Bahrain.
E-mail address: HJahrami@health.gov.bh (H.A. Jahrami).

https://doi.org/10.1016/j.sleep.2022.07.001
1389-9457/© 2022 Elsevier B.V. All rights reserved.

recent systematic review and meta-analysis of 20 publications, encompassing 12,462 individuals from 10 countries, revealed that the pooled prevalence of moderate-to-severe nomophobia is approximately 71%, with severe nomophobia being around 21% [1]. University students are most commonly impacted, with a high prevalence 25.5% [95%CI 18.5%–34%] of severe nomophobia [1]. Nomophobia as a specific phobia is characterized as a distinct clinical syndrome by symptoms in which a person feels anxiety or fear regarding the loss of their smartphone or connectivity [1]. Nomophobia is more common in individuals with anxiety and panic disorders [5]. For example, researchers in Brazil reported that half of the participants with panic disorders felt secure with their mobile phones [5].

A prior review found that the prevalence of moderate to severe nomophobia was 71% (50% moderate and 21% severe); however, clinical burden and associated impairment were not established [1]. While most cases respond to behavioral treatments (mainly cognitive behavioral therapy), an intense pharmacological intervention was necessary in very severe cases [3,6,7].

Several mental disorders, including social anxiety/social phobia [4,8], panic disorder [5], may contribute to nomophobia symptoms. People with nomophobia often cannot distinguish between a mobile phone addiction and an anxiety disorder manifesting through nomophobia [5,8]. People suffering from nomophobia may exhibit several symptoms and signs of anxiety including breathing difficulties, trembling, sweating, agitation, and disorientation, which are non-specific symptoms and can manifest in other mental disorders [3,7]. Moreover, nomophobia can be comorbid with other mental disorders; therefore, due diligence must be practiced to ensure a correct diagnosis [3].

Several studies have been done to explore the strength of association between nomophobia and insomnia [9–11]. Previous studies involving multiple age groups from different countries and using multiple designs (cross-sectional, case-control, and cohort) have documented a robust, consistent association between nomophobia and insomnia [9–13]. For example, based on the results of an exploratory cross-sectional survey of young adults in Bahrain, it was found that there was a significant association between nomophobia and insomnia using the insomnia severity index (ISI) [1]. In another study from Bahrain, nomophobia was shown to be strongly related to ISI assessed insomnia but not to age, gender, BMI, or screen size of the mobile device in adults [10]. Using the ISI, a significant relationship between insomnia and nomophobia was found in Iranian adolescents [9]. In a study among Japanese teenagers, insomnia scores measured using the Athens insomnia scale (AIS) significantly correlated with the time spent on mobile phones [12]. And most recently, a case-control study from Saudi Arabia using the AIS showed that both eSport players and the general population have a similar strength of association between nomophobia and insomnia symptoms [13].

The above-mentioned studies support a clear positive association between nomophobia and insomnia, which was previously unknown. However, there is no conclusive explanation for why or how this association exists. Ideally, both nomophobia and insomnia should be assessed using a clinical evaluation supplemented with self-report questionnaires. From a research context, we hypothesize that a symptom or a group of symptoms overlap between both nomophobia and insomnia and are responsible for the strong association between both disorders. Therefore, the present study was designed to first determine the diagnostic precision of the ISI's various components in detecting or classifying nomophobia; and second, examine the diagnostic performance of the identified ISI components in classifying nomophobia.

2. Methods

2.1. Design and setting of the study

This study employs a secondary data analyses of a previously reported group of young adults in Bahrain [10]. In some countries (such as Bahrain), crowdsourcing platforms such as Amazon Mechanical Turk are not traditionally used for research purposes. However, the concept of crowdsourcing, which is defined as the process of soliciting volunteers from a heterogeneous group of individuals by means of an open call [14], is utilized heavily using social media platforms, which is now being termed as 'social media crowdsourcing'. A recent systematic review and meta-analysis of ninety-six studies showed that crowdsourcing approaches to data collection are viable and effective ways to improve our knowledge [15]. In our research, we mimicked a crowdsourcing platform by soliciting responses to self-administered, structured questionnaires from a large pool of participants via various instant messaging chat groups (WhatsApp Messenger, Line, Viber, Blackberry Messenger (BBM), Telegram Messenger, IMO, and Discord) and social media (Facebook, Twitter, and Instagram) announcements.

Calls for participation were between August and September 2020 and included various common interest groups, e.g., study (e.g., classroom groups), hobbies (e.g., fishing, photography), small community groups (e.g., local neighborhood), and microblogging groups. To ensure a heterogenous sample, the dedicated data collection uniform resource locator (i.e., weblink) of each group was closed upon reaching 25–30 participants.

Participants were encouraged to forward/crowdsource the survey link to colleagues, friends, and family members who might meet the eligibility requirements. To eliminate missing data, we used mandatory fields for all variables in our survey. The electronic survey was created using the Checklist for Reporting Results of Internet E-Surveys [16]. The study implemented the STROBE [17] recommendations to improve the standard of research design and documentation.

2.2. Considerations related to ethics

The Helsinki Declaration of 1964 and its amendments were applied in all phases of the research process. This study was evaluated and approved by Bahrain's Secondary Healthcare Research Ethics Committee (REC), approval code REC/EF/14/10/2020. Before data collection, participants provided written informed electronic consent.

2.3. Sample size and study participants, and resampling methods

We used a convenience, self-selecting, non-probability sample of young adults with at least one mobile device who were cooperative to contribute in the study, aged 18 to 35, of both sexes. A brief screening, direct questioning, skip logic algorithm was used to exclude participants with an established diagnosis of mental illness. Also excluded from the study were self-reports that indicated having a physician's diagnosis or regular treatment for cardiovascular disease, chronic respiratory problems, diabetes mellitus, gastroesophageal reflux disease, neurological disorders, renal disease, or thyroid disease.

The previously collected grab sample of 549 individuals [10] was divided into two parts so that each part represents the original sample, using a 40% (n = 209) allocation for sample 1 (testing sample) and 60% (n = 340) for sample 2 (validation sample). Sample characteristics for both samples were limited to age, sex,

NMPQ scores, and ISI scores.

2.4. Research measures

The nomophobia questionnaire (NMP-Q) was used to quantify the degree of phobia/anxiety participants experienced when they were without their smartphone or mobile device [18]. The NMP-Q consists of 20 questions rated on a seven-point Likert-like scale that ranges from 1 ("strongly disagree") to 7 ("strongly agree") [18]. Sample NMP-Q items are: "I would feel anxious because I could not instantly communicate with my family and/or friends" and "I would be uncomfortable because I could not stay up-to-date with social media and online networks".

The absence of nomophobia is assigned a score of 20; mild nomophobia is assigned a score of 21–59; moderate nomophobia is assigned a score of 60–99, and severe nomophobia is assigned a score of 100–140 [18]. A validated Arabic version of the NMP-Q was used in this study. It is a psychometric instrument with good psychometric properties, with a high reliability Cronbach's alpha coefficient of approximately 0.90 (90%) [19]. Moreover, in the Arabic version, a four-factor structure predicted the factor structure found in the original NMP-Q [19]. Results of factor analysis showed that NMP-Q has strong discriminant and convergent validity according to Tucker–Lewis's index (TLI); the Bentler's comparative fit index (CFI); the Bollen's incremental fit index (IFI), Akaike information criterion (AIC), and Joreskog's goodness-of-fit index (GFI/adjusted GFI) values all are >0.90 [19]. At cut-off of >60 the NMP-Q had high sensitivity (>0.90) and specificity (>0.93) [20].

The insomnia severity index (ISI) was used to evaluate the severity of diurnal and nocturnal insomnia symptoms [21]. The ISI measures various components of insomnia: "difficulty falling asleep or staying asleep, waking up early, sleeping efficiency, interfering with functioning, and anxiety caused by sleep disruption" [22]. Based on a five-point Likert scale (0 = no problem, 4 = severe problem), each component was rated for the prior two weeks [22]. A total score of 0–7 represents no clinically relevant insomnia, 8–14 represents subthreshold insomnia, 15–21 represents clinical insomnia (moderate severity), and 22–28 represents clinical insomnia (severe) [22]. The ISI psychometric properties are excellent, and an Arabic version of it has been validated [23]. The ISI has a sensitivity of 86% and a specificity of 88% [22]. A score of 15 or more on the ISI test is considered insomnia in clinical and epidemiological groups [22]. The psychometric properties of the ISI were recently evaluated using a systematic appraisal of the procedural details of studies investigating its dimensions [24].

2.5. Statistical analyses

The descriptive statistics were used to describe the samples; specifically, we used mean and standard deviation or frequency count and proportion. The two samples were compared for differences; for categorical and continuous variables, we used Chi^2 (χ^2) analyses and t-tests, respectively. Regarding effect size calculations, Cramer's V effect sizes were provided for categorical variables, and for continuous variables, Cohen's d. The effect sizes of Cramer's V were classified as follows: small 0.10, medium 0.30, and large 0.50 [25]. Cohen's d was classified as small 0.25, medium 0.50, and big 0.80 [26].

To determine common components between nomophobia and insomnia, procedure exploratory factor analysis (EFA) was performed using sample 1. EFA was performed using the minimum residual solution, which provides a solution by adjusting the diagonal elements of the correlation matrix; the optimal function is used to minimize the squared residual when the factor model is the eigenvalue decomposition of the reduced matrix [27]. In addition, an oblique rotation in the form of oblique minimum was used to read the factorial loading because it was hypothesized that the two factors are correlated with each other [28]. Before commencing EFA, sample 1 was evaluated using Kaiser-Meyer-Olkin (KMO) sampling adequacy and the Bartlett test of sphericity [29]. A KMO value greater than 0.5 and a significance level for Bartlett's test below 0.05 suggest a significant correlation between the two variables [29].

Sample 1 was analyzed to determine the diagnostic precision of the ISI's various components in detecting or classifying nomophobia. Diagnostic accuracy was gauged by calculating the area under the receiver operating characteristic curve (AUC). AUC or receiver operating characteristic curve (ROC) curves are graphical illustrations of the diagnostic ability of binary classifier systems, as their discrimination threshold is varied [30]. An AUC value of 0.5–0.7 was interpreted as poor, 0.7 to 0.8 as fair, 0.8 to 0.9 as good, and >0.9 as excellent from the various ISI components [31]. We defined the cutting-off score with the maximal Youden index (sensitivity + specificity - 1) for detecting the 20-component NMPQ and reported the positive predictive value (PPV), negative predictive value (NPV), and Cohen's kappa for each ISI component in isolation and combination with each other [32,33]. A test of the ISI and cut-off was then conducted on Sample 2 to examine the diagnostic performance of the identified ISI components in classifying nomophobia. Data were analyzed using Stata version 17 software package of Stata for Windows 2021, StataCorp Inc [34]. The P-value < 0.05 was considered statistically significant.

3. Results

As was intended the two samples are similar. The mean age was about 27.2 years for both groups. Male participants represented 49% and 46%, for sample 1 and sample 2, respectively, p = 0.42, Cramer's V = 0.05. Clinical insomnia (moderate-severe) was 17% and 16% for sample 1 and sample 2, respectively, p = 0.54, Cramer's V = 0.04. Severe level of nomophobia was 22% and 21% for sample 1 and sample 2, respectively p = 0.64, Cramer's V = 0.02. In the two samples, university students accounted for approximately 45%, while approximately 35% were full-time employees, and the remaining 20% were unemployed or homemakers.

Table 1 shows the results of the EFA procedure of the NMPQ and ISI components from sample 1. Assumptions check included Bartlett's test of sphericity was p < 0.001 and Kaiser-Meyer-Olkin (KMO) test for sampling adequacy was 0.95 and indicate that factor analysis is highly robust. Results of EFA showed that ISI component "four" (***i.e.,*** ISI-4) was the only component to load into both factors; factor 1 (NMPQ) and factor 2 (ISI). ISI-4 asks "How satisfied/dissatisfied are you with your current sleep pattern?" [22]. Individuals were defined as dissatisfied with sleep if they chose dissatisfied or very dissatisfied.

High discriminant and convergent validity were observed in the factorial solution as all NMPQ components loaded under factor 1 (loadings ranged between 0.52 and 0.81) and all ISI components loaded under factor 2 (loadings ranged from 0.57 to 0.87).

Results of sensitivity (%), specificity (%), PPV (%), NPV (%), Youden's index, AUC, and metric scores of various ISI components in identifying individuals with ≥60-point cut-off for NMPQ (***i.e.,*** moderate-severe nomophobia) from sample 1 are presented in Table 2. Only component ISI-4 showed very good diagnostic accuracy in identifying individuals with ≥60-point cut-off for NMPQ (***i.e.,*** moderate-severe nomophobia) from sample 1 AUC = 0.88, Youden's index 0.75. Fig. 1 presents the ROC curve for the ability of ISI components to identify significant nomophobia (NMPQ score of ≥60).

After determining the important components and cut-offs for

Table 1
Exploratory factor analysis of ISI and NMP-Q using Sample 1 (N = 209).

Component	Factor 1	Factor 2
NMPQ-1	0.67	
NMPQ-2	0.67	
NMPQ-3	0.67	
NMPQ-4	0.72	
NMPQ-5	0.81	
NMPQ-6	0.75	
NMPQ-7	0.71	
NMPQ-8	0.63	
NMPQ-9	0.66	
NMPQ-10	0.52	
NMPQ-11	0.66	
NMPQ-12	0.62	
NMPQ-13	0.62	
NMPQ-14	0.63	
NMPQ-15	0.64	
NMPQ-16	0.68	
NMPQ-17	0.57	
NMPQ-18	0.64	
NMPQ-19	0.68	
NMPQ-20	0.63	
ISI-1		0.75
ISI-2		0.71
ISI-3		0.81
ISI-4	0.41	0.57
ISI-5		0.82
ISI-6		0.70
ISI-7		0.87

Notes: Factor analysis was performed using the 'minimum residual' extraction method was used in combination with 'oblimin' rotation. Results suppresses factor loading <0.3. Assumptions check included Bartlett's test of sphericity was $p < 0.001$ and Kaiser-Meyer-Olkin (KMO) test for sampling adequacy was 0.95; ISI = insomnia severity index components; NMP-Q = nomophobia questionnaire components.

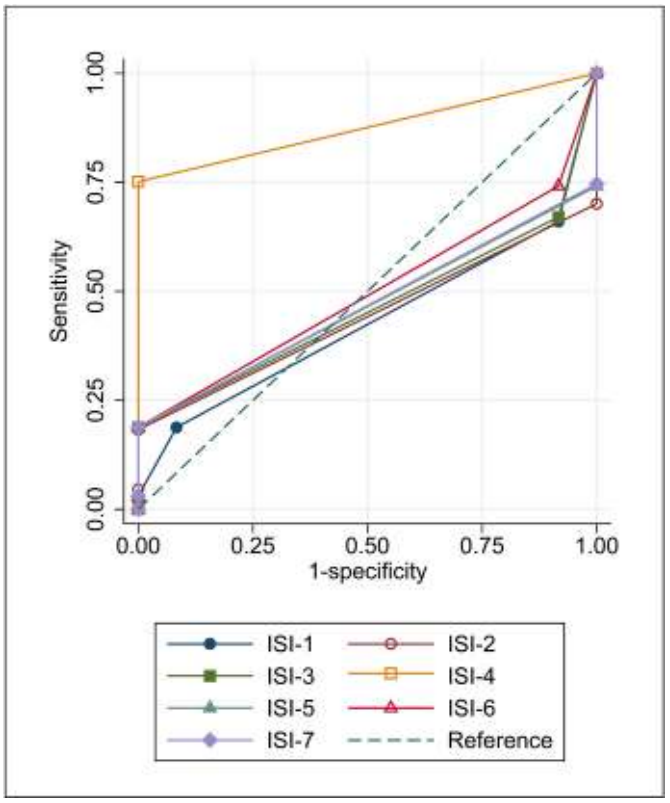

Fig. 1. ROC curve for the ability of ISI components to identify significant nomophobia (NMPQ score of ≥60).

the ISI components in sample 1, ISI-4 was tested its ability to accurately identify individuals with significant nomophobia in sample 2 (Table 3). The results for sample 2 for component ISI-4 were comparable with those obtained with sample 1, AUC = 0.86, Youden's index 0.72. Adding any other ISI component to ISI-4 did not improve diagnostic accuracy.

4. Discussion

The results of our study reveal that sleep dissatisfaction is a common component of both insomnia and nomophobia. Sleep dissatisfaction demonstrated high diagnostic accuracy in identifying cases with significant nomophobia. Our findings indicate that a query about sleep dissatisfaction might be used to quickly and effectively classify people with mild-severe nomophobia for research purposes or further clinical evaluation of nomophobia and/or insomnia.

Research has shown that sleep dissatisfaction is an important factor in measuring the severity of insomnia in the general population; sleep dissatisfaction has also been found to be a successful indicator of psychiatric disorders, such as depression, anxiety [35]. Ohayon and Paiva reported a severity gradient in insomnia symptoms ability to identify psychiatric disorders among participants from just one insomnia symptom through those with two or three insomnia symptoms but no sleep dissatisfaction to those with at least one insomnia symptom and sleep dissatisfaction [35]. The majority of sleep dissatisfaction individuals (86%) had specific sleep or mental problems; this percentage was reduced to 50.6% when only one insomnia symptom without sleep dissatisfaction was recorded [35]. Several recent studies supported this predictive power of sleep dissatisfaction in highlighting underlying psychiatric disorders [36], including depressive symptoms [37–40], stress [38,41], and anxiety [39,42].

Another study showed that sleep dissatisfaction might be more indicative of underlying pathology (***e.g.***, upper airway disease, mental disorders, or environmental factors) than classic insomnia symptoms, such as difficulty initiating or maintaining sleep [43,44]. The prevalence of sleep or mental disorders (including anxiety disorders) is eight times higher in sleep-dissatisfied individuals [43]. There is also a significant link between sleep dissatisfaction

Table 2
Operating characteristics for the ISI components in Sample 1 (n = 209) as a classifier for moderate-severe nomophobia.

Component	Cut point	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Youden's index	AUC	Metric Score
ISI-1	≥3	18.78%	91.67%	97.37%	6.43%	0.10	0.43	1.10
ISI-2	≥3	18.27%	100.00%	100.00%	6.94%	0.18	0.44	1.18
ISI-3	≥3	18.78%	100.00%	100.00%	6.98%	0.19	0.46	1.19
ISI-4	≥2	75.13%	100.00%	100.00%	19.67%	0.75	0.88	1.75
ISI-5	≥3	18.78%	100.00%	100.00%	6.98%	0.19	0.46	1.19
ISI-6	≥3	18.78%	100.00%	100.00%	6.98%	0.19	0.50	1.19
ISI-7	≥3	18.78%	100.00%	100.00%	6.98%	0.19	0.47	1.19

Notes: Moderate-severe nomophobia was measured using the NMP-Q; ISI = insomnia severity index; NMP-Q = nomophobia questionnaire; PPV = positive predictive values; NPV = negative predictive values; AUC = area under curve.

Table 3
Operating characteristics for the ISI components in Sample 2 (n = 340) as a classifier for moderate-severe nomophobia using cut-off scores derived from Sample 1.

Component	Cut point	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Youden's index	AUC	Metric Score
ISI-4	≥2	72.05%	100.00%	100.00%	16.67%	0.72	0.86	1.72
ISI-4 + ISI-1	≥3	52.17%	100.00%	100.00%	10.47%	0.52	0.70	1.52
ISI-4 + ISI-2	≥3	52.17%	100.00%	100.00%	10.47%	0.52	0.71	1.52
ISI-4 + ISI-3	≥3	54.04%	100.00%	100.00%	10.84%	0.54	0.74	1.54
ISI-4 + ISI-5	≥3	53.73%	100.00%	100.00%	10.78%	0.54	0.76	1.54
ISI-4 + ISI-6	≥3	52.48%	100.00%	100.00%	10.53%	0.52	0.75	1.52
ISI-4 + ISI-7	≥3	55.90%	100.00%	100.00%	11.25%	0.56	0.73	1.56

Notes: Moderate-severe nomophobia was measured using the NMP-Q; ISI = insomnia severity index; NMP-Q = nomophobia questionnaire; PPV = positive predictive values; NPV = negative predictive values; AUC = area under curve.

and other issues; for instance, road traffic accidents were twice as likely to occur with drivers who were sleep dissatisfied compared to insomniacs without sleep dissatisfaction [36,43]. Subjects with sleep dissatisfaction sought help for their sleep problems more than ten times as often and used sleep medications five times as often as insomnia subjects without sleep dissatisfaction [36,43,45,46].

A study published in 2021, using data collected during the COVID-19 era, documented that component ISI-4 from the ISI (sleep dissatisfaction) was also linked to both of the two main clusters of insomnia symptoms (***i.e.,*** nocturnal symptoms and daytime symptoms), providing further evidence that dissatisfaction with sleep leads to other sleep pathology [47]. Thakral and colleagues in a study that developed a very brief insomnia severity scale found that ISI-4 was the component that best predicted insomnia severity [48]. This was confirmed by a similar brief scale development study that also reported that ISI-4 best predicted insomnia severity in a clinical population [49]. These studies all indicate that questioning an individual's sleep dissatisfaction may serve as an important marker for clinically significant insomnia. The implication of this finding (i.e., ISI-4's ability to be a marker for nomophobia) is very important for clinicians. Individuals seeking treatment for insomnia could be screened first for nomophobia so that interventions can be tailored to tackle the root cause. Thus, a clinician might address both nomophobia and insomnia. However, the bidirectional relationship is very important, and therefore, severe cases seeking treatment for nomophobia need to be screened for insomnia before pharmacological treatments are offered, particularly if it involves sleep aids such as benzodiazepines, which might cause dependence.

Blue light emitted from screens might be a contributing factor to sleep dissatisfaction. In a previous study, living in an area with excessive outdoor nighttime lights increased the likelihood of having a delayed phase circadian rhythm disorder and dissatisfaction with sleep quantity and quality [50].

This study has some limitations. We studied only healthy young adults, which may limit the generalizability of our conclusions to other age groups. The use of a convenience sample also limits the generalizability of the results to the entire population. The potential confounding effect of the COVID-19 pandemic on anxiety [51] and insomnia [52,53] is also one limitation of our study. Methods of variance may overestimate the association between studied variables. Our analyses and interpretations are based on self-reported sleep dissatisfaction measurement, which is part of the ISI. Finally, the study was cross-sectional and future longitudinal studies are essential to rule out if partially treated or residual insomnia was responsible for the results obtained. Despite these limitations, the study's main merit is its contribution to the field by suggesting and establishing that sleep dissatisfaction can be a potential marker of nomophobia.

5. Conclusions

The present study provides novel data demonstrating that sleep dissatisfaction can effectively classify nomophobia severity. Using sleep dissatisfaction as a potential marker for nomophobia can also aid in detecting nomophobia-related insomnia, which may necessitate a more in-depth evaluation. The validity of sleep dissatisfaction as a predictor of nomophobia needs to be confirmed in other populations, including those in other communities, different age groups, and health care settings.

References

[1] Humood A, et al. The prevalence of nomophobia by population and by research tool: a systematic review, meta-analysis, and meta-regression. Psych 2021;3(2).
[2] Nikhita CS, Jadhav PR, Ajinkya SA. Prevalence of mobile phone dependence in secondary school adolescents. J Clin Diagn Res 2015;9(11):06–9.
[3] Bragazzi NL, Del Puente G. A proposal for including nomophobia in the new DSM-V. Psychol Res Behav Manag 2014;7:155–60.
[4] Bianchi A, Phillips JG. Psychological predictors of problem mobile phone use. Cyberpsychol Behav 2005;8(1):39–51.
[5] King AL, et al. "Nomophobia": impact of cell phone use interfering with symptoms and emotions of individuals with panic disorder compared with a control group. Clin Pract Epidemiol Ment Health 2014;10:28–35.
[6] Darvishi M, et al. Investigating different dimensions of nomophobia among medical students: a cross-sectional study. Open access Macedonian J Med Sci 2019;7(4):573–8.
[7] Bhattacharya S, et al. NOMOPHOBIA: NO MObile PHone PhoBIA. J Fam Med Prim Care 2019;8(4):1297–300.
[8] King A, et al. Nomophobia: Dependency on virtual environments or social phobia? Comput HB 2013;29(1):140–4.
[9] Lin CY, et al. Longitudinal relationships between nomophobia, addictive use of social media, and insomnia in adolescents. Healthcare (Basel) 2021;9(9).
[10] Jahrami H, et al. Nomophobia is associated with insomnia but not with age, sex, BMI, or mobile phone screen size in young adults. Nat Sci Sleep 2021;13:1931–41.
[11] Jahrami H, et al. The association between symptoms of nomophobia, insomnia and food addiction among young adults: findings of an exploratory cross-sectional survey. Int J Environ Res Publ Health 2021;18(2):711.
[12] Tamura H, et al. Association between excessive use of mobile phone and insomnia and depression among Japanese adolescents. Int J Environ Res Publ Health 2017;14(7):701.
[13] AlMarzooqi MA, et al. Symptoms of nomophobia, psychological aspects, insomnia and physical activity: a cross-sectional study of ESports players in Saudi Arabia. Healthcare 2022;10(2).
[14] Paniagua J, Korzynski P. Social media crowdsourcing. 2017. p. 1–5.
[15] Wang C, et al. Crowdsourcing in health and medical research: a systematic review. Infect Dis Pov 2020;9(1):8. 8.
[16] Eysenbach G. Improving the quality of web surveys: the checklist for reporting results of Internet E-surveys (CHERRIES). J Med Internet Res 2004;6(3):e34.
[17] von Elm E, et al. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. Bmj 2007;335(7624):806–8.
[18] Yildirim C, Correia A-P. Exploring the dimensions of nomophobia: development and validation of a self-reported questionnaire. Comput Hum Behav 2015;49.
[19] Al-Balhan EM, et al. Psychometric evaluation of the Arabic version of the nomophobia questionnaire: confirmatory and exploratory factor analysis - implications from a pilot study in Kuwait among university students. Psychol Res Behav Manag 2018;11:471–82.

[20] Yildirim C. Exploring the dimensions of nomophobia: developing and validating a questionnaire using mixed methods research. Iowa State University; 2014.
[21] Morin CM. Insomnia: psychological assessment and management. Guilford press; 1993.
[22] Morin CM, et al. The Insomnia Severity Index: psychometric indicators to detect insomnia cases and evaluate treatment response. Sleep 2011;34(5):601–8.
[23] Suleiman KH, Yates BC. Translating the insomnia severity index into Arabic. J Nurs Scholarsh 2011;43(1):49–53.
[24] Manzar MD, Jahrami HA, Bahammam AS. Structural validity of the Insomnia Severity Index: a systematic review and meta-analysis. Sleep Med Rev 2021;60:101531.
[25] Sun S, Pan W, Wang LL. A comprehensive review of effect size reporting and interpreting practices in academic journals in education and psychology. J Educ Psychol 2010;102(4):989.
[26] Cohen J. Stafisfical power analysis for the behavioural sciences. second ed. NJ: Erlbaum: Hillside; 1988.
[27] Comrey AL. The minimum residual method of factor Analysis. Psychol Rep 1962;11(1):15–8.
[28] Gorsuch RL. Factor analysis. Erlbaum Associates; 1983. Hillsdale, New Jersey: L.
[29] Child D. The essentials of factor analysis. Cassell Educational; 1990.
[30] Fawcett T. An introduction to ROC analysis. Pattern Recogn Lett 2006;27(8):861–74.
[31] Swets JA. Measuring the accuracy of diagnostic systems. Science 1988;240(4857):1285–93.
[32] Youden WJ. Index for rating diagnostic tests. Cancer 1950;3(1):32–5.
[33] Fluss R, Faraggi D, Reiser B. Estimation of the Youden Index and its associated cutoff point. Biom J 2005;47(4):458–72.
[34] Stata. Stata multivariate statistics reference manual : release 17. College Station, Tex. : StataCorp LP; 2021 [2021] ©2021.
[35] Ohayon MM, Paiva T. Global sleep dissatisfaction for the assessment of insomnia severity in the general population of Portugal. Sleep Med 2005;6(5):435–41.
[36] Ohayon MM. Prevalence and comorbidity of sleep disorders in general population. Rev Prat 2007;57(14):1521–8.
[37] Anjum A, et al. Depressive symptom and associated factors among school adolescents of urban, semi-urban and rural areas in Bangladesh: a scenario prior to COVID-19. Front Psychiatr 2021;12:708909.
[38] Woo KS, et al. Mental health, smartphone use type, and screen time among adolescents in South Korea. Psychol Res Behav Manag 2021;14:1419–28.
[39] Buckner JD, et al. Social anxiety and insomnia: the mediating role of depressive symptoms. Depress Anxiety 2008;25(2):124–30.
[40] Morin CM, et al. Epidemiology of insomnia: prevalence, self-help treatments, consultations, and determinants of help-seeking behaviors. Sleep Med 2006;7(2):123–30.
[41] Tatsuse T, Sekine M. Job dissatisfaction as a contributor to stress-related mental health problems among Japanese civil servants. Ind Health 2013:2012. 0058.
[42] Ohayon MM. Prevalence and correlates of nonrestorative sleep complaints. Arch Intern Med 2005;165(1):35–41.
[43] Ohayon MM, Zulley J. Correlates of global sleep dissatisfaction in the German population. Sleep 2001;24(7):780–7.
[44] Ohayon MM, Partinen M. Insomnia and global sleep dissatisfaction in Finland. J Sleep Res 2002;11(4):339–46.
[45] Ohayon MM, Lemoine P. Sleep and insomnia markers in the general population. L'Encephale 2004;30(2):135–40.
[46] Ohayon MM, et al. DSM-IV and ICSD-90 insomnia symptoms and sleep dissatisfaction. Br J Psychiatry 1997;171:382–8.
[47] Bai W, et al. Network analysis of insomnia in Chinese mental health professionals during the COVID-19 pandemic: a cross-sectional study. Nat Sci Sleep 2021;13:1921–30.
[48] Thakral M, et al. ISI-3: evaluation of a brief screening tool for insomnia. Sleep Med 2021;82:104–9.
[49] Kraepelien M, et al. A very brief self-report scale for measuring insomnia severity using two items from the Insomnia Severity Index - development and validation in a clinical population. Sleep Med 2021;81:365–74.
[50] Ohayon MM, Milesi C. Artificial outdoor nighttime lights associate with altered sleep behavior in the American general population. Sleep 2016;39(6):1311–20.
[51] da Silva ML, et al. A systematic review of the prevalence of anxiety symptoms during coronavirus epidemics. J Health Psychol 2021;26(1):115–25.
[52] Jahrami H, et al. Sleep problems during the COVID-19 pandemic by population: a systematic review and meta-analysis. J Clin Sleep Med 2021;17(2):299–313.
[53] Jahrami HA, et al. Sleep disturbances during the COVID-19 pandemic: a systematic review, meta-analysis, and meta-regression. Sleep Med Rev 2022;62:101591.