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ORIGINAL ARTICLE

Adaptation of the European Portuguese Version of the Nomophobia Questionnaire for Adolescents, Factor Structure and Psychometric Properties

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Abstract
Nomophobia can be defined as a digital age phobia consisting of an excessive fear of being without a smartphone. Nomophobia negatively impacts physical and mental health, particularly in children and adolescents. This study aimed to test the factor structure and psychometric properties of the European Portuguese version of the Nomophobia Questionnaire for Adolescents (NMP-Q–A). Sample 1 comprised 338 adolescents (58.6% girls), with a mean age of 13.55 ($SD = 2.07$) years old, and was used to examine the factor structure of the NMP-Q–A, its psychometric properties and the association with other constructs. Sample 2 included 193 adolescents (53.9% boys), with a mean age of 13.61 ($SD = 0.80$) years old and was used to further test the NMP-Q–A factor structure. One higher-order factor with four lower-order factors structure revealed a good fit to the data in both samples. The NMP-Q–A showed good reliability, construct and concurrent validity. Girls showed higher nomophobia. Adolescents showing more nomophobia revealed more smartphone addiction and psychopathological symptoms and lower quality of life. The NMP-Q–A showed to be a valid and reliable measure to be used in clinical and educational settings.

Keywords Nomophobia · Adolescence · Assessment · Confirmatory factor analysis · Psychometric properties

According to a recent systematic review of the literature, nomophobia may be considered a public health problem, characteristic of the digital age and consisting of an excessive

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fear of being out of contact with a smartphone (Rodríguez-García et al., 2020). It has been defined as corresponding to the experience of anxiety, discomfort and nervousness, emerging from being without access to a mobile phone, spending a large amount of time using this device and checking it, as well as fearing to lose it (Bragazzi & Del Puente, 2014; King et al., 2014). Nomophobia has been conceptualised in different ways, with some authors presenting it as a situational phobia (e.g. Yavuz et al., 2019; Yildirim & Correia, 2015), others as a behavioural addiction disorder (e.g. Kuss et al., 2018; Tran, 2016), or a mobile attachment, resulting in separation anxiety (Konok et al., 2017; Nie et al., 2020). In the current study and according to the theoretical framework of King et al. (2014), "nomophobia is a term that refers to a collection of behaviours or symptoms related to mobile phone use. Nomophobia is a situational phobia related to agoraphobia and includes the fear of becoming ill and not receiving immediate assistance" (p. 28).

A recent systematic review (León-Mejía et al., 2021) found that studies addressing the prevalence of nomophobia show a disparity in results, with percentages of nomophobia prevalence varying from 6 to 73%, and percentages of people being at risk of presenting nomophobia ranging from 13 to 79% (León-Mejía et al., 2021). Given the high prevalence of nomophobia (Gurbuz & Ozkan, 2020; Jilisha et al., 2019), particularly in young people (León-Mejía et al., 2021), as well as its relationship with emotional-behavioural problems in adolescents, when assessing psychological difficulties in this population, problems associated with the use of information and communication technologies (ICT) should therefore be contemplated.

Nowadays, smartphones are widely spread, and children and adolescents tend to start using such devices early. The younger generations have been commonly designated as "Digital Natives", "Net-Generation" or "Generation Z" (Cirilli & Nicoli, 2019) and use the Internet for several activities (e.g. social media, study, work, social networking and games) (Jeong et al., 2016; Wang et al., 2015). This massive use of smartphones seems to promote the increase of nomophobia prevalence, particularly among the young generation (Sharma et al., 2015; Sureka et al., 2020; Yildirim et al., 2016), and previous research has identified children and adolescents as specifically vulnerable to the harmful effects of technology (Hasebrink et al., 2009). In fact, a relationship between nomophobia and age has been found in previous studies, with younger participants more prone to nomophobia (see León-Mejía et al., 2021, for a review). Overall, adolescence is a developmental period comprising numerous age-related challenges and possibilities, including adjustment difficulties and mental health problems. More than 50% of psychological difficulties tend to arise during adolescence (World Health Organization, 2018), and nomophobia seems to be one of them.

Nomophobia has been shown to be related to smartphone addiction (Durak, 2018), Internet addiction (Gezgin et al., 2018), social media usage/addiction (Durak, 2018, 2019; Sırakaya, 2018) and cyberbullying (Catone et al., 2020). Additionally, a relationship between nomophobia and lower academic performance and attention has also been reported (Mendoza et al., 2018). Furthermore, nomophobia has been associated with depression and stress in a sample of college students (Sureka et al., 2020). More recently, Mehmet et al. (2021) found that smartphone daily usage increase is also associated with feelings of loneliness and anxiety and, therefore, more nomophobia levels.

In the face of this increasing phenomenon, several instruments have been developed to assess nomophobia or related constructs, such as the Cellular Phone Dependence (Toda et al., 2004), the Mobile Phone Problem Use Scale (Bianchi & Phillips, 2005), the Cell-Phone Over-Use Scale (Jenaro et al., 2007), the Mobile Phone Addiction Scale (Leung, 2008), the Mobile Phone Involvement Questionnaire (Walsh et al., 2010), the Smartphone Addiction Scale–Short Version (Kwon et al., 2013) and the Problematic Use of Mobile

Phone Scale (Merlo et al., 2013). Other studies used questionnaires specifically developed for the assessment of nomophobia but no psychometric properties are available (e.g. Dongre et al., 2017; Pavithra et al., 2015). The Nomophobia Questionnaire (Yildrim & Correia, 2015) is the most used self-report instrument for assessing nomophobia. It has been translated and studied in various languages: Italian (Adawi et al., 2018), Chinese (Ma & Liu, 2018), Persian (Lin et al., 2018), Arabic (Al-balhan et al., 2018), Brazilian Portuguese (Silva et al., 2020) and European Portuguese (Galhardo et al., 2020). Specifically adapted for adolescents, there is a Spanish version available (González-Cabrera et al., 2017).

Similarly to the original version of the NMP-Q (Yildirim & Correia, 2015) (and other language versions), the European Portuguese version, NMPQ-PT (Galhardo et al., 2020), for adults, revealed a four-factor structure. Although this version showed to be valid and reliable, it was studied in a sample of adults (age ranging from 18 to 59 years old) from the general population.

Considering the relevance of nomophobia during the adolescence developmental period, the current study aimed to adapt the NMPQ-PT (Galhardo et al., 2020) for adolescents and to confirm its factor structure, reliability and validity. Moreover, gender differences and association with age and years of education, and associations with other variables (depression, anxiety and stress, smartphone addiction, and quality of life), were investigated. Finally, cut-off values were calculated.

According to the literature, it is predicted the adequacy of a one second-order factor explaining the four nomophobia factors of the NMP-Q–A, similar to the one found in the original version (Yildirim & Correia, 2015) and the European Portuguese version for adults (Galhardo et al., 2020). It is also expected that the NMP-Q–A shows good reliability and validity results. When addressing gender differences, our prediction was that girls would score higher than boys, as reported by the majority of studies (for a review, see León-Mejía et al., 2021). Regarding the association between the NMP-Q–A and age, it is estimated a negative correlation, with younger participants scoring higher in the NMP-Q–A (León-Mejía et al., 2020, 2021). When considering associations with other variables, it is expected a positive correlation between the NMP-Q–A and psychopathological symptoms (depression, anxiety and stress, smartphone addiction), and a negative correlation between the NMP-Q–A and quality of life. Finally, as this is the first Portuguese study exploring cut-off values, there were no specific hypotheses.

Materials and Methods

Participants

This study was conducted in two distinct convenience samples collected from four public schools in the centre region of Portugal. Sample 1 (three schools) comprised 338 adolescents, 198 girls (58.6%) and 140 (41.4%) boys, aged between 10 and 19 years old ($M = 13.35$; $SD = 2.07$), from the 5th to the12th (years of education $M = 7.64$, $SD = 1.91$).

Sample 2 (one school) was collected 9 months later in a public school and was used to confirm the scale structure. It included 193 adolescents (89 girls and 104 boys) aged 12 to 16 years old ($M = 13.61$; $SD = 0.80$), presenting a mean of 8.39 ($SD = 0.49$) years of education.

Instruments

Nomophobia Questionnaire (Yildirim & Correia, 2015; Portuguese version by Galhardo et al., 2020) The Nomophobia Questionnaire (NMP-Q) encompasses 20 items designed to measure nomophobia. Items are rated on a 7-point Likert scale, ranging from *strongly disagree* (1) to *strongly agree* (7). Both the original version and the Portuguese version showed a four-factor structure, addressing the dimensions (1) not being able to communicate, (2) losing connectedness, (3) not being able to access information and (4) giving up convenience. The NMPQ-PT study revealed a Cronbach alpha of 0.96 (Galhardo et al., 2020).

Depression, Anxiety and Stress Scales-21 (Lovibond & Lovibond, 1995; Portuguese version by Pais-Ribeiro et al., 2004) The Depression, Anxiety and Stress Scales-21 (DASS-21) encompass three subscales addressing anxiety symptoms (7 items), depression symptoms (7 items) and stress symptoms (7 items). Respondents are asked to answer the 21 items using a 4-point scale, ranging from did *not apply to me at all* (0) *to applied to me very much, or most of the time* (3). In the Portuguese version's validation study, a Cronbach's alpha of 0.85 for the depression subscale, 0.74 for anxiety and 0.81 for stress were found (Pais-Ribeiro et al., 2004). In sample 1, Cronbach alpha values were 0.87, 0.83 and 0.88, for the depression, anxiety and stress subscales, respectively.

Smartphone Addiction Scale–Short Version (Kwon et al., 2013; Portuguese version by Água et al. in press) The Smartphone Addiction Scale–Short Version (SAS-SV) was designed to evaluate the degree of addiction to smartphones in teenagers. This short version comprises 10 items (e.g., "Won't be able to stand not having a smartphone" or "Having my smartphone in my mind even when I am not using") answered on a 6-point Likert scale from *completely disagree* (1) to *completely agree* (6). The Portuguese version revealed good internal consistency with a Cronbach alfa of 0.86. Precisely the same Cronbach alfa of 0.86 was found in the current study.

KIDSCREEN-10 Index (Ravens-Sieberer et al., 2014; Portuguese version by Matos et al., 2012) The KIDSCREEN-10 is a European cross-cultural and standardised measure of children and adolescents' health-related quality of life. This shortened version comprises only one factor (Global health-related quality of life). The KIDSCREEN-10 items address a set of affective symptoms (e.g. depressed mood, cognitive symptoms of disturbed concentration, psycho-vegetative aspects of vitality, energy and feeling well, and psychosocial aspects correlated with mental health). Each item is rated according to a 5-point scale ranging from *never* (1) to *always* (6). In this self-report instrument Portuguese version, a Cronbach alpha of 0.78 was found. In the current study, the KIDSCREEN-10 also revealed a Cronbach alpha of 0.78.

Procedures

Based on the Portuguese version of the Nomophobia Questionnaire (NMP-Q-PT; Galhardo et al., 2020), an adaptation of the instructions and items' content was made for adolescents. Conceptually, the questionnaire items are similar in the adolescents' and adults' versions. Nevertheless, changes in the wording of the scale instructions and the graphic presentation were made, considering the participants' age. Furthermore, the items were adapted using

a more adolescents' friendly language, namely the use of the simple present tense (e.g. "I feel annoyed if I cannot look information up on my smartphone when I want to do so" versus "I would be annoyed if I could not look information up on my smartphone when I wanted to do so"). Given that items 10 to 20 are related to emotional states that may arise and be associated with the smartphone's lack/deprivation, a brief sentence ("If I do not have my smartphone with me: …") was added as a clue.

A small pilot study was conducted ($N = 20$) to analyse the NMP-Q–A items' comprehensibility. The 20 adolescents that took part in this pilot study volunteered to give feedback on the instructions and items' clarity. Participants completed the NMP-Q–A during a class with the class director and one of the study researchers. These 20 adolescents reported no difficulties in understanding the NMP-Q–A instructions and items. Therefore, this version was used in subsequent procedures.

The study received the approval of the Ethical Committee of the (blind for review) (CE-P04-18). Participants' recruitment was carried out in four public schools (sample 1 was collected in three schools and sample 2 was collected in one school) of Portugal's centre region by the second author (convenience sample). The study was presented to the schools' headteachers, and the schools were invited to participate. Schools' headteachers indicated the classes participating in the study. The authorisation was mandatory from the students' parents/legal guardians before administering the study protocol. Students' participation was voluntary, and adolescents were assured that their answers were confidential and used exclusively for research purposes. Students were requested to provide their written informed consent. Sample 1 students completed the self-report instruments (paper–pencil format) in the classroom (group setting) for approximately 15 min, and sample 2 only filled in the NMP-Q–A. Recruitment procedures for sample 2 were similar to those previously described, but the recruitment took place at a different school in the same district. The self-report instruments were administered by the second author.

Data analysis strategy

The analyses were computed using the Predictive Analytics Software (PASW, version 26, SPSS, Chicago, IL, USA) and the Analysis of Moment Structures (AMOS, version 24, Amos Development Corporation, Crawfordville, FL, USA). Sample 1 was used to examine the factor structure of the NMP-Q–A, through confirmatory factor analyses (CFA), its psychometric properties and the association with other constructs. The NMP-Q–A structure adequacy was further tested in sample 2, through confirmatory factor analyses (CFAs), with the estimation method of Maximum Likelihood. Uni- and multivariate normality of the data were analysed. All items presented skewness and kurtosis values pointing to the inexistence of severe violation to a normal distribution ($Sk < |3|$ and $Ku < |10|$; Finney & DiStefano, 2006; Kline, 2005). The existence of outliers was examined through the Mahalanobis distance (MD^2). Similarly to what was adopted in the Portuguese NMPQ-PT version study (Galhardo et al., 2020), the one higher-order factor with four-order factors and a unidimensional model and an uncorrelated four-factor model were tested. Furthermore, a three-factor model was tested given that a previous study (Adawi et al., 2018) reported a three-factor structure. The chi-square statistic and the following goodness-of-fit indices were used to inspect the model adequacy: the Comparative Fit Index (CFI), the Goodness of Fit Index (GFI), the Tucker and Lewis Index (TLI), the Root-Mean Square Error of Approximation (RMSEA) and the Standardised Root Mean Square Residual (SRMR). The CFI, the GFI and the TLI indicate an adequate model fit to the data when

values range between 0.90 and 0.95 (Hu & Bentler, 1999). Regarding the RMSEA, values lower than 0.10 are acceptable, with a 95% confidence interval; for the SMRM, values ranging between 0.05 and 0.08 suggest an acceptable model fit (Hu & Bentler, 1999; Kline, 2005). For model comparison, the Expected Cross-Validation Index (MECVI) was used (lower values are indicative of better fit). Moreover, the $\Delta\chi^2$ index (chi-square difference between rival models) was computed. Standardised regression weights and squared multiple correlations were used to analyse the items' local adjustment. Standardised regression weights higher than 0.40 and squared multiple correlations higher than 0.25 were considered adequate (Tabachnick & Fidell, 2007). Each item mean, standard deviation and item-total correlations were computed. NMP-Q–A reliability was examined by calculating the Cronbach alphas and Composite Reliability (CR; Peterson & Kim, 2013) for each subscale's total score and the NMP-Q–A total score. Cronbach's alphas or CR above.70 are indicative of good reliability (Field, 2013). Independent samples *t*-tests were calculated to examine differences between boys and girls, and Cohen's *d* was used to address effect sizes. According to Cohen et al. (2003), effect sizes between 0.20 and 0.49 are considered small, between 0.50 and 0.79 medium and above 0.80, large. Associations between the NMP-Q–A total score and subscales and other measures addressing similar constructs and measures of related constructs were estimated through Pearson correlations. Pearson correlation coefficients between 0.10 and 0.39 are considered weak, between 0.40 and 0.69 moderate and above 0.70 strong (Dancey & Reidy, 2017). Categorisation regarding nomophobia was defined according to the restrictive statistic criterion of the 15th, 80th and 95th percentiles, corresponding to "no nomophobia", "at risk of nomophobia" and "with nomophobia", respectively. This criterion has been previously used in studies addressing cut-off points for the NMP-Q (e.g. González-Cabrera et al., 2017; León-Mejía et al., 2020). One-way ANOVAs were computed for mean comparisons on the studied variables based on the four nomophobia categories resulting from the cut-off values. ANOVAS' effect sizes were computed using partial eta square (η^2). Partial η^2 values of 0.01 are considered small, 0.06 medium and 0.14 large effect sizes (Tabachnick & Fidell, 2007).

Results

NMP-Q–A Confirmatory Factor Analysis

CFA was conducted in sample 1 ($N = 338$) in accordance to the analyses performed for the NMP-Q adults' version. Therefore, a unidimensional model (model 1) was tested and revealed a poor fit to the data: CMIN/df = 6.54, $\chi^2_{(170)} = 1111.12$, $p < 0.001$; GFI = 0.67; CFI = 0.79; TLI = 0.76; RMSEA = 0.13 [0.12–0.14]; SRMR = 0.08. Model 2 was an uncorrelated four-factor model, with covariances between the four nomophobia factors fixed to 0. Model 2 also showed a poor fit to the data: CMIN/df = 7.40, $\chi^2_{(170)} = 1258.48$, $p < 0.001$; GFI = 0.72; CFI = 0.75; TLI = 0.72; RMSEA = 0.14 [0.13–0.15]; SRMR = 0.38. A three-factor model (model 3) was also tested and showed an adequate fit to the data: (CMIN/df = 2.98, $\chi^2_{(167)} = 497.63$, $p < 0.001$; GFI = 0.87; CFI = 0.93; TLI = 0.91; RMSEA = 0.08 [0.07–0.08]; SRMR = 0.06; MECVI = 1.75. Finally, the one higher-order factor with four lower-order factor model was tested (model 4). Each item was specified to load on its respective lower-order factor as proposed by the original authors of the scale and also found in the adults' Portuguese version. Model 4 (theoretical model; Fig. 1) revealed a good fit to the data (CMIN/df = 2.64, $\chi^2_{(166)} = 438.22, < 0.001$; GFI = 0.89; CFI = 0.94;

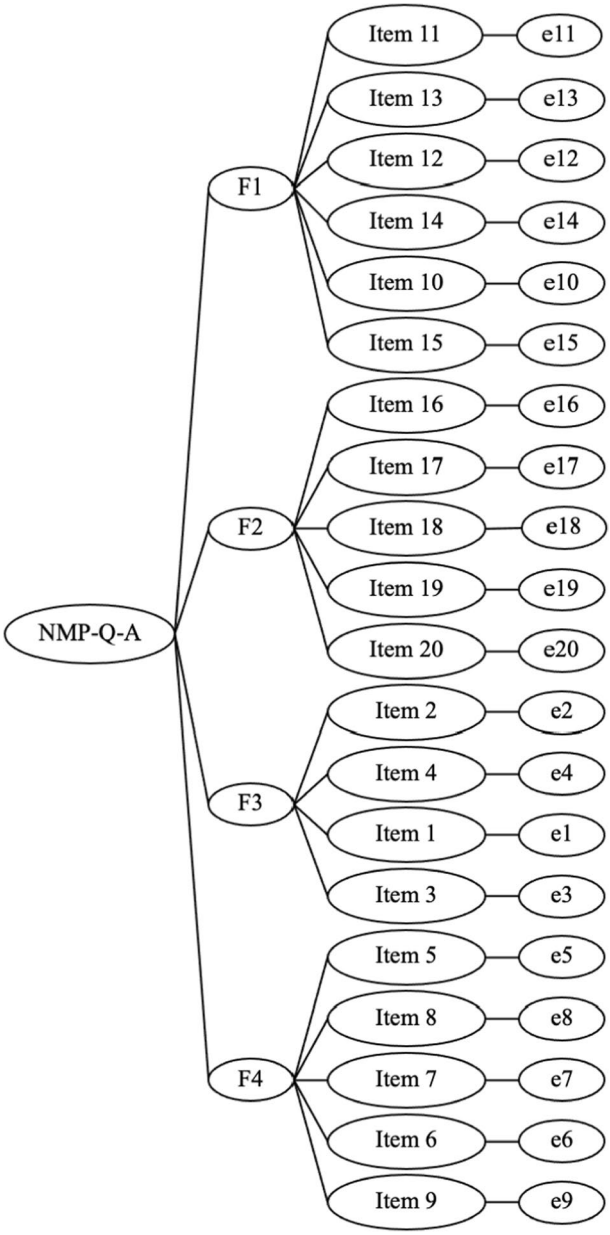

Fig. 1 Theoretical model of the Nomophobia Questionnaire for adolescents (NMP-Q–A)

TLI = 0.93; RMSEA = 0.07 [0.06–0.08]; SRMR = 0.05; MECVI = 2.66). Furthermore, the comparison of the models through $\Delta\chi^2$ index (chi-square difference between rival models) indicated a better fit for this model, $\Delta\chi^2_{(1)} = 59.41$, $p < 0.050$.

Given that model 3 showed an adequate fit to the data, it was also tested in sample 2 and revealed the following fit results: CMIN/df = 2.81, $\chi^2_{(167)} = 469.67$, $p < 0.001$; GFI = 0.79; CFI = 0.88; TLI = 0.86; RMSEA = 0.10 [0.09–0.11]; SRMR = 0.07; MECVI = 2.92. The

adequacy of the hierarchical model with one second-order factor explaining the four nomophobia factors was further confirmed in sample 2 ($N = 193$). CFA results revealed an adequate fit to the data (CMIN/df = 2.49, $\chi^2_{(166)} = 412.85$, $p < 0.001$; GFI = 0.82; CFI = 0.90; TLI = 0.89; RMSEA = 0.09 [0.08–0.10]; SRMR = 0.07; MECVI = 2.66). Table 1 displays factor loadings and multiple correlations found in sample 1 and sample 2.

NMP-Q–A items revealed standardised regression weights ranging from 0.55 (item 8) to 0.90 (item 18) in sample 1 and from 0.57 (item 6) to 0.88 (item 13) in sample 2. The NMP-Q–A reliability was also confirmed by squared multiple correlations results, both in sample 1 and in sample 2, with values ranging from 0.30 (item 8) to 0.80 (item 17) in sample 1 and from 0.32 (item 6) to 0.76 (item 13) in sample 2. Correlations results between the NMP-Q–A and the four subscales, in sample 1, varied from moderate ($r = 0.55$; $p < .001$) to strong ($r = 0.92$; $p < .001$) (Table 2).

Item reliability analysis

The NMP-Q–A skewness values varied between 0.004 (item 15) and 1.34 (item 19), and kurtosis values ranged from 0.54 (item 6) to 1.30 (item 7), indicative of no severe violations of normal distribution (Kline, 2005). The NMP-Q–A revealed good internal consistency, with a Cronbach alpha of 0.95 for the total scale and Cronbach alpha values ranging from 0.81 to 0.92 for the NMP-Q–A dimensions (Table 2). Additionally, the construct validity of the NMP-Q–A was confirmed by calculating composite reliability (CR). A CR value of 0.96 was found for the NMP-Q–A total score, and CR values for the four NMP-Q–A dimensions varied between 0.82 and 0.92. Corrected item-total correlations ranged from $r = 0.53$ (item 3) to $r = 0.79$ (item 18).

Data concerning sex, age and years of education

The NMP-Q–A total score and subscale comparison between boys and girls revealed significant differences in the total score ($t_{(338)} = -2.61$, $p = 0.010$), in the F1 "Not being able to communicate" ($t_{(338)} = -3.87$, $p < 0.001$), and in the F4 "Giving up convenience" ($t_{(338)} = -3.87$, $p < 0.001$), with girls presenting significant higher scores than boys. All effect sizes, as measured by Cohen's d, were small (Table 3).

Age was not associated with the NMP-Q–A total score ($r = 0.03$, $p = 0.616$), nor with any of the NMP-Q–A subscales ($p > 0.050$). A similar result was found regarding the association between years of education and the NMP-Q–A total score ($r = 0.04$, $p = 0.522$). Once more, no significant correlation results were found between years of education and the NMP-Q–A subscales ($p > 0.050$).

Associations with other variables

Concurrent validity was assessed by calculating correlation coefficients between each of the NMP-Q–A subscales and total score and other measures tapping other constructs (depression, anxiety and stress, smartphone addiction and quality of life). Results are displayed in Table 4.

Results showed weak to moderate correlations. The highest value was found between the NMP-Q–A total score and the SAS-SV ($r = 0.66$, $p < 0.001$), whereas the lower value

Table 1 NMPQ-A items' means (M), standard deviations (SD), corrected item-total correlations, standardised regression weights (SRW) and squared multiple correlations (SMCs) (sample 1: $N=338$; sample 2: $N=192$)

Items	*M*(*SD*)	Corrected item-total correlation	CFA (Sample 1)		CFA (Sample 2)	
			SRW	***SMC***	***SRW***	***SMC***
Factor 1						
10. I would feel anxious because I could not instantly communicate with my family and/or friends	3.91 (2.05)	.74	.80	.64	.77	.59
11. I would be worried because my family and/or friends could not reach me	4.29 (1.96)	.61	.76	.57	.81	.66
12. I would feel nervous because I would not be able to receive text messages and calls	3.62 (2.00)	.76	.85	.72	.81	.65
13. I would be anxious because I could not keep in touch with my family and/or friends	3.77 (1.94)	.68	.84	.70	.88	.77
14. I would be nervous because I could not know if someone had tried to get a hold of me	3.71 (1.97)	.70	.81	.66	.77	.59
15. I would feel anxious because my constant connection to my family and friends would be broken	3.91 (1.93)	.65	.83	.70	.83	.69
Factor 2						
16. I would be nervous because I would be disconnected from my online identity	2.87 (2.02)	.74	.84	.70	.81	.65
17. I would be uncomfortable because I could not stay up-to-date with social media and online networks	2.94 (1.90)	.77	.89	.80	.86	.74
18. I would feel awkward because I could not check my notifications for updates from my connections and online networks	3.06 (1.94)	.79	.90	.81	.76	.57
19. I would feel anxious because I could not check my email messages	2.17 (1.54)	.55	.65	.42	.69	.47
20. I would feel weird because I would not know what to do	3.17 (2.01)	.64	.65	.42	.76	.57
Factor 3						
1. I would feel uncomfortable without constant access to information through my smartphone	3.47 (1.70)	.65	.77	.60	.82	.67
2. I would be annoyed if I could not look information up on my smartphone when I wanted to do so	3.25 (1.78)	.63	.78	.61	.78	.62
3. Being unable to get the news (e.g. happenings, weather, etc.) on my smartphone would make me nervous	3.34 (1.93)	.53	.62	.38	.73	.53
4. I would be annoyed if I could not use my smartphone and/or its capabilities when I wanted to do so	3.96 (1.97)	.68	.75	.56	.77	.59
Factor 4						
5. Running out of battery in my smartphone would scare me	3.53 (2.09)	.65	.68	.46	.68	.46
6. If I were to run out of credits or hit my monthly data limit, I would panic	2.64 (1.95)	.65	.69	.48	.57	.32

Table 1 (continued)

Items	*M*(*SD*)	Corrected item-total correlation	CFA (Sample 1)		CFA (Sample 2)	
7. If I did not have a data signal or could not connect to Wi-Fi, then I would constantly check to see if I had a signal or could find a Wi-Fi network	3.63 (2.11)	.66	.71	.50	.65	.43
8. If I could not use my smartphone, I would be afraid of getting stranded somewhere	3.07 (1.95)	.56	.55	.30	.60	.35
9. If I could not check my smartphone for a while, I would feel a desire to check it	3.39 (2.05)	.70	.74	.55	.83	.69

Table 2 Correlations between the NMP-Q–A factors, NMP-Q-A total score, Cronbach α, composite reliability (CR) and average variance extracted (AVE)

	F 1	F 2	F 3	F 4	Cronbach α	CR	AVE
F 1	––				.92	.92	.77
F 2	.64**	––			.89	.89	.75
F 3	.55**	.69**	––		.82	.82	.66
F 4	.69**	.77**	.74**	––	.81	.83	.59
NMP-Q–A	.87**	.88**	.82**	.91**	.95	.96	––

** $p < .001$

Table 3 Mean comparisons between boys and girls in NMP-Q–A total score and dimensions

	Boys ($n = 140$)		Girls ($n = 198$)		$t(336)$	p	
	M	*SD*	*M*	*SD*			Cohen's *d*
NMP-Q-PT total	66.78	28.06	75.04	29.15	− 2.61	.010	.29
F1-Not being able to communicate	20.74	9.95	24.94	9.76	− 3.87	< .001	.43
F2-Losing connectedness	13.94	7.48	14.40	8.09	− .54	.593	.06
F3-Not being able to access information	13.57	5.86	14.35	5.96	− 1.19	.235	.13
F4-Giving up convenience	15.07	7.09	17.11	7.82	− 2.45	.015	.27

Table 4 Correlations between the NMP-Q–A (total score and dimensions), the DASS-21 subscales, the SAS-SV and the KIDSSCREEN-10 ($N = 338$)

	DASS-21 Depression	DASS-21 Anxiety	DASS-21 Stress	SAS-SV	KIDSCREEN-10
NMP-Q-PT total	.32**	.29**	.35**	.61**	− .28**
F1-Not being able to communicate	.31**	.27**	.34**	.45**	− .26**
F2-Losing connectedness	.27**	.22**	.28**	.56**	− .21**
F3-Not being able to access information	.19**	.19**	.22**	.56**	− .20**
F4-Giving up convenience	.32**	.30**	.34**	.59**	− .28**

** $p < .001$

was found between the NMP-Q–A F3 "Not being able to access information" and the DASS-21 Depression subscale ($r = 0.19$, $p < 0.001$).

Cut-off values

In sample 1, NMP-Q–A total scores ranged from 21 to 147, with a mean score of 71.62 ($SD = 28.95$). Considering the 15th, 80th and 95th percentiles, the scores were 38.85, 96.00 and 122.00, correspondingly. These scores were considered "no nomophobia", "at risk of nomophobia" and "with nomophobia". According to these percentiles, 50 adolescents (14.8%) scored below the 15th percentile, 222 (65.7%) scored between the 15th and the

80th percentile, 51 (15.1%) between the 80th and the 95th percentile and 15 (4.4%) scored above the 95th percentile.

Mean comparisons between the four nomophobia groups regarding smartphone addiction, depression, anxiety and stress symptoms, as well as quality of life, showed significant differences, with a $\eta^2 p = 0.78$. Table 5 displays these results.

In general, more severe nomophobia categories showed high levels of smartphone addiction and psychopathological symptoms and lower levels of quality of life.

Discussion

There is a consensus in recognising the relevance of studying nomophobia as a digital era phenomenon negatively impacting adolescents' developmental trajectory. For that purpose, some self-report instruments have been developed for assessing this construct in clinical and educational settings. The current study addressed the adaptation and validation of the NMPQ-PT (Galhardo et al., 2020) for adolescents (NMP-Q–A). The NMP-Q–A was adapted from the European Portuguese version for adults, a brief, reliable and valid self-report measure assessing nomophobia (Galhardo et al., 2020). Additionally, gender differences and association with age and years of education, as well as associations with depression, anxiety and stress, smartphone addiction and quality of life, were investigated, and cut-off values were also calculated.

Several NMP-Q–A models were tested in two adolescents' samples through a CFA, confirming the four-factor structure's adequacy underlying one higher-order factor (Nomophobia). Besides an NMP-Q–A total score, four distinct yet related subscales were found: (1) Not being able to communicate; (2) losing connectedness; (3) not being able to access information and (4) giving up convenience. According to the recommended standards, global and local adjustment indices were also indicative of the suitability of the NMP-Q–A factor structure and its items adequacy (e.g. Tabachnick & Fidell, 2007). In general, these findings are in line with the ones found in the NMP-Q original version (Yildirim & Correia, 2015), as well as in other languages versions (e.g. Galhardo et al., 2020; Lin et al., 2018; Ma & Liu, 2018; Silva et al., 2020), for adults. Therefore, it seems that the four-factor solution emerges in the majority of the studies conducted using the NMP-Q. The exception is Adawi et al.'s (2018) study, where a three-factor solution was found through exploratory factor analysis in an adults' sample. The three-factor model of the NMP-Q–A tested in sample 1 also revealed an adequate fit to the data and it was further tested in sample 2. Nevertheless, CFA results in sample 2 revealed a poor fit to the data, suggesting that the four-factor model seem to be the more suitable one. Concerning previous studies in adolescents, our findings are similar to the ones found by González-Cabrera et al. (2017) and by León-Mejía et al. (2020), who also found a four-factor solution.

NMP-Q–A reliability analyses revealed that the total NMP-Q–A score presented excellent reliability. Values indicating good reliability were also found for the NMP-Q–A subscales, assessed by Cronbach alpha and composite reliability. The item-total correlation analyses confirmed the items' quality and adequacy to each respective subscale and overall scale.

Regarding sex differences, girls scored higher than boys in the NMP-Q–A total score and the subscales (1) not being able to communicate and (4) giving up convenience, with small effect sizes. These results suggest that girls tend to show general higher levels of nomophobia and seem to present more feelings of failing to communicate and being

Table 5 Mean comparisons between the four nomophobia groups regarding smartphone addiction, depression, anxiety and stress symptoms, and quality of life

	Below 15th percentile (A) ($n=50$)		**Between 15 and 80th percentile (B)** ($n=222$)		**Between 80 and 95th percentile (C)** ($n=51$)		**Above 95th percentile (D)** ($n=15$)				
	M	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***	***F*** (3,334)	***p***	**Post hoc**
SAS-SV	16.48	7.40	23.30	8.71	31.10	7.85	39.40	9.20	42.48	< .001	A < B, C, D; B < C, D; C < D
DASS-21 Depression	2.86	3.57	4.75	4.69	7.22	5.10	8.00	5.60	9.68	< .001	A < C, D B < C, D
DASS-21 Anxiety	2.38	3.63	3.74	3.97	5.57	4.85	5.60	4.67	6.08	< .001	A < B, C, D B < C
DASS-21 Stress	3.20	3.92	5.36	4.63	8.10	5.05	8.60	6.36	11.45	< .001	A < B, C, D B < C
KID SCREEN-10	39.90	5.48	36.89	6.06	35.35	5.81	33.93	8.89	6.31	< .001	A > B, C, D

prevented from being reached by other people. They also seem to experience more convenience provided by smartphones and the desire to own them. In general, these results are reported by the majority of the studies addressing nomophobia in adolescents (e.g. León-Mejía et al., 2020; Moreno-Guerrero et al., 2020). Nevertheless, another study conducted in adolescents revealed that boys presented higher nomophobia levels when compared with girls (Sharma et al., 2019).

Contrary to our prediction, no significant correlations were found between the NMP-Q–A total score and age or years of education. This result differs from the one found by León-Mejía et al. (2020), given that these authors found a significant negative association between the MNP-Q total score and participants' age. One possible explanation for this may be that our sample is a much homogeneous one in terms of age (10–19 years old, with a mean age of 13 years old). Participants' age in the study conducted by León-Mejía et al. (2020) ranged from 12 to 24 years old, with a mean age of 18 years old, including adolescents and young adults. Moreover, this result must be interpreted with caution, given that the sample size may influence the level of significance.

In the current study, positive weak correlations were found between nomophobia and symptoms of depression, anxiety and stress and a negative weak association with adolescents' quality of life. This pattern was also reported by Kuscu et al. (2020) and Gonçalves et al. (2020) regarding depression and anxiety symptoms and specifically in adolescents by Sharma et al. (2019), who found that nomophobia was significantly connected with depression, anxiety and poor quality of life. In a broader perspective, although not addressing the particular construct of nomophobia, previous research has highlighted the impact of problematic mobile phone use with symptoms of depression and anxiety (e.g. Yang et al., 2020 for a review and meta-analysis).

As expected, a moderate correlation was found between nomophobia scores and smartphone addiction scores. This relationship had already been suggested in previous studies (e.g. Durak, 2018; King et al., 2013), with Bian and Leung (2015) making the distinction that in nomophobia, individuals experience fear or anxiety over not using a smartphone and in smartphone addiction individuals markedly use a smartphone irrespective of detrimental consequences. Nevertheless, these two constructs' conditions are closely related (Tran, 2016), and share symptoms (Bragazzi & Del Puente, 2014) and comorbid disorders (King et al., 2013).

The cut-off points found in our study were, in general, higher than those reported by León-Mejía et al. (2020), and with a large effect size. This result needs to be further confirmed due to differences in these two studies samples regarding age.

The current study results need to be interpreted considering some limitations. To ensure the plausibility of the NMP-Q–A structure, future research should confirm this structure in other adolescents' non-clinical and clinical samples, as well as in other languages. Although the NMP-Q–A factor structure was tested in two samples, these samples sizes are at the limit for conducting CFA and this should also be acknowledged. Test–retest reliability should also be calculated in future studies, given that, although initially defined, the Covid-19 pandemic and the consequent schools' closure did not allow to collect the retest data. Particularly regarding the NMP-Q–A cut-off values found, the current sample has major limitations due to the small size and its representativeness.

Regardless of the limitations, the NMP-Q–A showed to be a valid and reliable measure of nomophobia, comprising the possibility to assess not only a global nomophobia score but also the distinct yet related four dimensions. The NMP-Q–A may be a helpful measure to be used by researchers, clinicians and school psychologists, contributing to a broader understanding of the role nomophobia may play during the developmental period

of adolescence. The NMP-Q–A may also be an effective tool for screening nomophobia in adolescents and signal those with nomophobia or at risk of developing nomophobia providing the chance to implement intervention programmes at schools or other settings. Furthermore, the availability of the NMP-Q–A may be especially useful for the design of more tailored interventions as well as preventive programmes.

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Data availability The data that support the findings of this study are available from the corresponding author upon reasonable request.

Declarations

Informed Consent All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000 (5). Informed consent was obtained from all patients for being included in the study.

Conflict of Interest The authors declare no competing interests.

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