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Night-time use of electronic devices, fear of missing out, sleep difficulties, anxiety, and well-being in UK and Spain: a cross-cultural comparison

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Abstract
Electronic devices such as smartphones have become a primary part of young people's lives. Fear of missing out seems to influence the ability to set boundaries around sleep time. This study aims to explore (1) the use of electronic media devices in pre-sleep time, quality of sleep, anxiety, and well-being in females and males' university students in the UK and Spain, (2) whether university students' fear of missing out (FoMO) is associated with a higher usage of electronic devices at night-time by gender. A cross-sectional, quantitative design through Qualtrics.com was used. Samples were formed by N = 159 British participants, and N = 172 Spanish. Findings from this study suggest that fear of missing out in females is a predictor, in both countries, of electronic devices usage at night-time but not in males. Night-time usage of electronic devices is a predictor of: higher sleep difficulties in British males and females and in Spanish females, higher FoMO in females from both countries but not in males, and higher negative experiences in Spanish females. Night-time usage of electronic devices did not predict satisfaction with life or loneliness. There is a lack in the literature examining general electronic devices usage habits during night-time, fear of missing out, well-being and mental health, a lack of cross-cultural studies and that consider well-being not with positive or negative factors but from a broad perspective of the construct. Findings suggest the necessity to evaluate students' levels of FoMO in clinical practice, especially in females, and to incorporate this construct in prevention and intervention programs.

Keywords Electronic devices · Night-time usage · Fear of missing out · Anxiety · Well-being · Sleep

Introduction

There is an increase in studies examining the potential risks of electronic media devices use on psychological health and well-being (Asad et al., 2023; Caba-Machado et al., 2023). However, there is an insufficient foundation of evidence or a comprehensive model in this area of research (Višnjić et al., 2018). The ever-increasing use of electronic media devices makes a constant challenge of investigation for researchers in this area. Additionally, the concern on some psychological health aspects and well-being is especially relevant in university student populations. This is because university students endure a special period of challenges and risks, which can result in higher rates of mental disorders' symptoms (Pedrelli et al., 2015; Zivin et al., 2009). Moreover, students are the most frequent users of technology (Wentworth & Middleton, 2014).

A higher use of electronic media devices may cause various physical and psychological health problems and can have an impact on several aspects of the individual's life (Alotaibi et al., 2022; Demirci et al., 2015; Izmaku & Gashi, 2023). For instance, using technology before bed has been linked to difficulty falling asleep, repeated awakenings at night, or early wake times (Hershner & Chervin, 2014; Maurya et al., 2022). Despite these symptoms, students have intense use of electronic devices in the hour before going to sleep (Krishnan et al., 2020; Orzech et al., 2016). A study conducted by Moulin, (2015) found through reported use

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of media and reported sleep inadequacy, that participants spent a substantial time of the evening using electronic media and that this use was related to lower quality of sleep. In addition, some studies have suggested that keeping the electronic devices in the bedroom is related to poorer sleep in students (Adachi-Mejia et al., 2014; Exelmans & Van den Bulck, 2016; Whipps et al., 2018). Also, prior to bedtime, the time spent using the devices seems important. For instance, a study conducted by Orzech et al., (2016) found that in the 2 h prior to bedtime, a longer use of digital media was associated with poorer sleep outcomes. The impacts on sleep are related to several mechanisms including the displacement of sleep due to technology use, the stimulating effects that increase the physical arousal in the user and the effects of light from the screen that affects physiological markers such as melatonin (Cain & Gradisar, 2010; Chinoy et al., 2018; Pagano et al., 2023). Furthermore, sleep has a significant impact on health, wellbeing, and overall quality of life. However, heavy smartphone use alone has no detrimental effects on wellbeing, since not all smartphone users use their devices in the same way. Therefore, learning more about electronic devices use, and to incorporate effective pedagogical practices in education can help users make the best use of the technology's benefits and avoid its drawbacks (Kheirinejad et al., 2023; Kosov et al., 2023).

One emerging concept that may influence the ability to set boundaries around sleep time and the use of technology is 'the fear of missing out' (FoMO) (Rogers & Barber, 2019; Scott & Woods, 2018; Tandon et al., 2021). This construct is defined as the pervasive apprehension that rewarding experiences and events are taking place, and that one might be missing them (Przybylski et al., 2013). In relation to Facebook use and FoMO, Przybylski et al. (2013) found an association between higher Facebook use, FoMO and use of Facebook before falling asleep at night. Thus, the desire to be social and FoMO, seems to compel students to keep their electronic devices near bed at night, which may influence their quality of sleep, and ultimately their well-being. These relationships can be understood from Deci and Ryan's (1985) self-determination theory, which theorizes that optimal levels of well-being are reached when basic needs are satisfied, while the non-satisfaction of needs such as relationship needs would lead to a detriment of well-being. In this line, FoMO would be a product of unsatisfied relationship needs. In addition, the Interaction of Person Affect-Cognitive-Execution model (I-PACE) also explains these relationships (Brand et al., 2019). This is because the model establishes that certain dispositional variables influence problematic Internet use. Furthermore, these variables, such as personality traits, cognitions, psychopathology, and biological predispositions, can lead to cognitive and affective responses. FOMO would therefore be a cognitive response, more specifically a cognitive bias in Internet use. Although these theories reflect the importance of FoMO, it should be mentioned that it is not clear how the gender variable influences this construct, as although Rozgonjuk et al., (2021) found no gender differences while other studies found that women scored higher (Beyens et al., 2016; Elhai et al., 2018; Stead & Bibby, 2017). In consequence, the consideration of FoMO and gender could shed light on the comprehension of well-being in relation to technological devices use.

Moreover, it is important to note that in the investigation of sleep quality, recognition of sleep patterns such as the climate and latitude of the country in where the participants are living seem to have sparked interest of researchers and clinical practitioners (M. Z. H. et al., 2022; Smith et al., 2002; Tonetti et al., 2012). For instance, several studies have reported relations between latitude and Morningness-Eveningness chronotype. Morningness (going to bed earlier and getting up earlier) or eveningness (going to bed later and getting up later) preference, showing that a higher evening orientation was correlated with an increasing distance from the equator (Borisenkov, 2010; Randler & Rahafar, 2017) and the latter orientation was associated with lower subjective sleep quality (Roeser et al., 2012). Although whether there is a significant difference between countries regarding the use of electronic devices during night-time—based on the morningness-eveningness preference or the climate—remains an open question that has not been explored yet, it is out of the scope of this study. Consequently, in this study we select two different latitudes, Spain and UK and we hypothesise that there will be a significant difference between them regarding the use of electronic devices at night-time and sleep quality that could be attributed to latitude, climate and/or cultural factors. In addition to these factors, it is important to mention that there are other factors related to the use of social networks that change cross-culturally, such as motivations for use (Jackson & Wang, 2013; Kim et al., 2011). Although this is known, there is a lack of cross-cultural studies examining FOMO, sleep quality and nighttime usage of electronic devices (MacKenzie et al., 2022). Therefore, conducting cross-cultural studies in this field would allow a more complete understanding of the complex relationship between technology, mental health, and sleep.

Furthermore, it is worth mentioning that research examining technology use and sleep difficulties has focused on problematic technology use, such as Internet and smartphone use (Luqman et al., 2021). The problem underlying this, is that Problematic Internet usage has been the topic of much debate because is not yet recognized as a disorder. Indeed, the variety in its conceptualization and assessment has made many researchers hesitant, and they are not afraid to call it a minefield (Nogueira-López et al., 2023; Ryding & Kaye, 2018). Moreover, Problematic Internet use is a broad concept that encompasses a variety of activities (Baggio et al., 2018; Starcevic & Aboujaoude, 2017). For these reasons,

some authors claimed that Problematic Internet use is not a valid construct and that future studies should incorporate specific behaviors or activities performed online (e.g., social media usage) (Nogueira-López et al., 2023). Therefore, this study will focus on a specific behavior such as the use of electronic devices at nighttime.

In addition, although research points to electronic devices usage as a potential risk factor for sleep quality in populations of different ages, and especially in adolescents (Pagano et al., 2023), to the best of the author's knowledge, there are no studies examining general electronic devices usage habits during night-time, FoMO, anxiety levels, and well-being- considering this construct broadly based on the idea of Burke and Kraut, (2016). These authors state that it is necessary to consider the construct of well-being in a broad manner, taking into account all indicators of well-being, whether positive or negative. This is important because most of the studies in the literature unpack these components of well-being in such a way that they focus on one or several indicators but leave out many others that may also play a relevant role in the relationships between FOMO, night-time use of devices and sleep quality. Thus, it still needs to be determined how the associations between nighttime usage of digital media, FoMO and anxiety, satisfaction with life (SWL), loneliness, positive and negative experience, and social support unfold. In this sense, this study differs from previous studies in that it incorporates these variables to address this gap in the literature and will also consider cultural differences by having samples from two different countries, as well as gender differences. Thus, the current study's aims are to explore (1) the use of electronic media devices in pre-sleep time, levels of quality of sleep, anxiety, and well-being in university students in the UK and Spain, (2) whether university students' fear of missing out (FoMO) is associated with a higher usage of electronic devices at night-time.

Method

Participants and procedure

Participants were required to be university students aged 18 or older. Both users and non-users of several digital technologies, new applications and SNS were invited to participate. Samples were formed by N = 159 British participants, and N = 172 Spanish. The web host used for the questionnaires and data collection was Qualtrics.com. This study had been approved by the Universities's Ethics Committee prior to its commencement.

The questionnaires were administered to Schools within Liverpool John Moores University (UK), as well as in the University of Granada (Spain). The participants in the UK were aged between 18 and 45 years, with a mean (*M*) of 23.08 and a standard deviation (*SD*) of 5.45; and in Spain between 18 and 30 years, with a mean of 20.17 *SD* = 2.35. With reference to gender: in the UK 79.2% were females (N = 126), in Spain 87.8% were females.

The UK sample included participants studying a: level 8 course (PhD or professional doctorate) (13.8%) N = 22, level 7 course (PGCERT, PGDIP, Masters) (17.6%) N = 28, level 6 (3rd year) (22.6%) N = 36, level 5 (2nd year undergraduate) (14.5%) N = 23, level 4 (1st year undergraduate) (26.4%) N = 42, and level 3 (foundation) (5%) N = 8. Moreover, 97.5% were full-time students N = 155.

The Spanish sample included participants studying a level 8 course (PhD or professional doctorate) (0.56%) N = 1, level 7 course (PGCERT, PGDIP, Masters) (1.13%) N = 2, level 6 (3rd year and 4th year) (9.9% and 2.3%) N = 17, level 5 (2nd year undergraduate) (27.9%) N = 48, and level 4 (1st year undergraduate) (58.1%) N = 100. In addition, 98.3% were full-time students N = 169. The current study is part of a published thesis (Machado, 2022).

Materials

Levels of anxiety were assessed through the State-Trait Anxiety Inventory (STAI; (Spielberger, 1983). The state portion of the STAI consists of 20 statements that assess feeling states with Likert-type response options ranging 1 = not at all to 4 = very much so. The trait portion of the STAI assessed anxiety-proneness, to examine how people generally feel. This has the same number of items and response format as its state counterpart. Higher scores indicate greater anxiety. The possible range of scores in this scale for the Trait and the State subscales is between 20 and 80.

For well-being the validated scales used, included aspects of social and psychological well-being. The different scales used are presented below.

The Satisfaction With Life (Diener et al., 1985) is formed by 5 items using a 7-point scale that ranges from, 1 = strongly disagree to, 7 = strongly agree. Scores were not reversed, as higher scores indicate higher levels of SWL. The possible range of scores in this scale is between 5 and 35.

The UCLA Loneliness Scale (Russell, 1996) is formed by 20 items. The response scale ranges from O ("I often feel this way"), S ("I sometimes feel this way"), R ("I rarely feel this way"), N ("I never feel this way"). The scores are O's = 4, all S's = 3, all R's = 2, and all N's = 1. Therefore, higher scores indicate higher levels of loneliness. The possible range of scores in this UCLA Loneliness scale is between 20 and 80.

The Scale of Positive and Negative Experience (SPANE; Diener et al., 2011) includes 12 items. The response scale ranges from 1 to 6: Very Rarely or Never = 1, Rarely = 2, Sometimes = 3, Often = 5, Very Often or Always = 6. Higher scores indicate the higher experience of positive or negative feelings. The possible range of scores in this scale for the Positive and the Negative experience is between 6 and 36 in each dimension.

The Multidimensional Scale of Perceived Social Support (MSPSS) (Zimet et al., 1988) is a 12-items measure with a response scale from 1 "Very Strongly Disagree" to 7 "Very Strongly Agree". Higher scores indicate higher levels of perceived social support. The possible range of scores in the MSPSS is between 12 and 84 in each dimension.

Sleep was measured using Pittsburgh Sleep Quality Index (Buysee et al., 2016). The PSQI is a 19-item self-report questionnaire that measures sleep quality during the previous month to discriminate between good and poor-quality sleep. The PSQI generates seven domains for subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, sleep medication, and daytime dysfunction, with each component score ranging from 0 to 3. Higher scores on PSQI denote more sleep problems. The possible range of scores in the PSQI is between 0 (no difficulty) and 21 (severe difficulties).

The Fear of Missing Out scale (FoMOs; Przybylski et al., (2013) was used to measure participants' fear of missing out. The scale consists of 10 items with a response Likert scale ranging from 1 (Not at all true of me) to 5 (Extremely true of me). Higher scores indicate higher levels of FoMO. The possible range of scores in the Fear of Missing Out scale is between 10 and 50.

The measure assessing typical electronic devices usage at night-time included 8 items that were developed in the current study (Annex 1). An example of these items is: "How often do you use electronic device(s) (computer, Ipad/tablet, cell phone/smartphone, etc.) nightly in the 2 h before going to bed?'. This block was formed by different responses scales. For item 1 (At nighttime, do you have a cut-off point to stop using your electronic device or do you keep going until you are too tired to continue?) the response scale was 1 = I have a cut-off point or 2 = I keep going until I am too tired. For the next items: item 2 (Are you strict at switching your electronic device(s) off at a set time nightly?), item 3 (How often do you use electronic device(s) (computer, Ipad/tablet, cell phone/smartphone, etc.) nightly in the 2 h before going to bed?), item 5 (How often do you use your electronic device(s) while you are already in bed), item 7 (Is your electronic device(s) in the bedroom while you sleep?) and item 8 (Are you likely to go back to your electronic device(s) (because you have forgotten something, or a notification arrives to your devices) right away after you get in bed to sleep?), the response scale range from 1 = Never to 5 = Always. Finally, for the item 4 (If you use electronic device(s) in the 2 h before sleep, how much longer do you use them?) and item 6 (If you use electronic device(s) in bed, how much longer do you use them?) the response scale includes 1 = 0 min, 2 = 5–15 min, 3 = 15–30 min, 4 = 30–45 min, 5 = 45–60 min, and 6 = More than 60 min. The sum of all the scores constitutes the global punctuation of night-time use of electronic devices (NUD). Higher punctuation indicates higher usage of electronic devices at night-time. The possible scores range from 8 to 39.

Statistical Analyses

Using SPSS 29.00, all data were explored and screened to see the patterns that emerged and to test the quality of the data. In the first place this was through descriptive statistics such as means, standard deviations, range, frequency, and charts such as histograms. The data were tested for reliability (alpha—looking for 0.7 or above) and normality through skewness and kurtosis (looking for absolute values below 3 for skewness and 10 for kurtosis) (Kline, 2011).

Relationships between variables were tested initially through simple bivariate correlations. Further analyses included simple linear regressions by gender and country, through which night-time usage of electronic devices was postulated as predictor of sleep difficulties, loneliness, FoMO, SWL, positive experience and negative experience. Furthermore, another simple linear regression was conducted in which FoMO was postulated as a predictor of a higher usage of electronic devices at night-time (controlling for age, trait and state anxiety, perceived social support, loneliness, SWL, and positive and negative experience).

Results

Descriptive Statistics

The descriptive statistics shown in Table 1 demonstrate that the data were normally distributed, with scores for both skewness and kurtosis being small across all the measures. Furthermore, reliability is demonstrated with adequate Cronbach's α scores.

In the 10 constructs presented in Table 1, the UK participants have reported higher levels on 7 of these, with the Spanish participants reporting higher on 3. However, the higher UK scores reflect maladaptive cognitive, affective, and behavioural responses on issue such as sleep, anxiety, fear of missing out, loneliness and night-time use of electronic devices. For the Spanish respondents, indicators are generally more adaptive in relation to SWL, social support and positive SPANE. Moreover, the individual differences

Table 1 Descriptive statistics for the total of the study variables and for separate items of night-time usage of electronic devices

Scales	Country	*M*	*SD*	Cronbach's α	Skewness	Kurtosis	Maximum	Minimum
PSQI	UK	7.83	3.77	0.72	0.61	-0.16	17	1
	Spain	6.35	3.16	0.70	0.76	0.67	17	1
Spane P	UK	20.81	4.50	0.90	-0.40	0.16	30	7
	Spain	22.80	4.03	0.90	-0.25	-0.17	30	12
Spane N	UK	16.51	4.72	0.85	0.36	-0.15	30	6
	Spain	15.32	4.12	0.81	0.29	-0.09	29	7
FOMO	UK	23.48	7.60	0.85	0.46	-0.53	43	10
	Spain	22.66	6.65	0.84	0.79	0.45	43	11
SWL	UK	21.40	6.92	0.88	-0.24	-0.83	35	6
	Spain	25.11	5.93	0.86	-0.69	0.02	35	8
UCLA	UK	44.95	12.30	0.94	0.26	-0.64	77	21
	Spain	39.82	10.43	0.94	0.48	-0.43	66	21
MSPSS	UK	64.17	14.30	0.91	-0.99	0.92	84	12
	Spain	69.56	12.36	0.93	-1.36	2.12	84	15
STAI-T	UK	51.19	11.55	0.90	0.28	-0.60	78	26
	Spain	42.95	10.84	0.91	0.22	-0.53	70	22
STAI-S	UK	44.83	13.29	0.95	0.25	-0.51	77	21
	Spain	37.98	9.94	0.92	0.59	0.02	70	20
NUD	UK	32.35	5.30	0.81	-1.0	0.79	44	19
	Spain	30.76	4.68	0.74	-0.40	-0.22	39	17
2 h	UK	4.75	0.55	-	-2.64	8.09	5	2
	Spain	4.48	0.78	-	-1.99	5.06	5	1
Dur2hr	UK	4.94	1.16	-	-0.95	-0.002	6	2
	Spain	4.74	1.17	-	-0.59	0.18	6	2
BedU	UK	4.28	1.08	-	-1.65	2.08	5	1
	Spain	4.10	1.01	-	-0.11	0.18	5	1
DurB	UK	4.28	1.56	-	-0.42	-1.07	6	1
	Spain	3.98	1.39	-	-0.07	0.18	6	1

PSQI = Pittsburgh Sleep Quality Index; Spane P = Positive Experience; Spane N = Negative Experience; FOMO = Fear of Missing Out; SWL = satisfaction with life; UCLA = loneliness; MSPSS = perceived social support; STAI-T = anxiety trait; STAI-S = anxiety state; NUD = night-time usage of electronic devices; *2 h* = electronic devices usage 2 h before going to sleep; Dur2hr = duration of electronic devices usage in the 2 h before going to sleep; BedU = electronic devices usage in bed; DurB = duration of electronic devices usage while already in bed

within each group reflected in variances (standard deviations) are generally stronger than the mean differences between the two groups. Also, the differences in variances between the two groups are generally not accentuated with a few exceptions.

Moreover, Table 1 presents the descriptive statistics of the total as well as the items of interest that belong to the instrument for measuring night-time use of electronic devices. Mean differences between the two groups are minimal, as are the variances.

Correlational Analysis

The measures were correlated to identify the relationship between the variables in each country, as shown in Table 2. Significant relationships were found between all study variables in both countries ($p < 0.05$). Contrary to expectations, in the sleep quality and FoMO variables, the association found in Spain and the UK was not statistically significant ($p > 0.05$). Furthermore, in the Spanish sample, the relationship between NUD, SWL, UCLA, and MSPSS was not statistically significant ($p > 0.05$).

Moreover, correlations between separate items from the block of night-time usage of electronic devices and the variables of interest are presented in Table 3.

There was a non-significant correlation between electronic devices usage 2 h before going to sleep and higher sleep problems in the Spanish sample ($r = 0.08$, $p > 0.05$), while in the British sample, this correlation was significant but small ($r = 0.19$, $p < 0.05$). In addition, in both samples non-significant associations were found between electronic devices usage 2 h before going to sleep and positive experience, negative experience (except for the Spanish sample ($p < 0.05$), SWL, and loneliness ($p > 0.05$). Furthermore, a significant, negative, and small correlation between electronic devices usage 2 h before going to sleep and perceived social support ($r = -0.16$, $p < 0.05$) was found.

Table 2 Intercorrelations for study variables disaggregated by country

Variables	1	*2*	*3*	4	5	6	7	8	9	10
1. PSQI	-	-0.47**	0.53**	0.15	-0.55**	0.53**	-0.34**	0.61**	0.59**	0.35**
2. SpaneP	-0.27**	-	-0.68**	-0.16*	0.65**	-0.65**	0.58**	-0.72**	-0.77**	-0.27**
3. SpaneN	0.49**	-0.53**	-	0.30**	-0.57**	0.60**	-0.36**	0.80**	0.82**	0.29**
4. FOMO	0.10	-0.20*	0.21**	-	-0.25**	0.32**	-0.06	0.34**	0.27**	0.28**
5. SWL	-0.28**	0.66**	-0.39**	-0.08	-	-0.66**	0.57**	-0.66**	-0.66**	-0.25**
6. UCLA	0.28**	-0.60**	0.46**	0.17*	-0.56**	-	-0.65**	0.73**	0.68**	0.24**
7. MSPSS	-0.19*	0.47**	-0.23**	0.05	0.52**	-0.69**	-	-0.47**	-0.47**	-0.26**
8. STAIT	0.43**	-0.69**	0.68**	0.38**	-0.56**	0.65**	-0.40**	-	0.87**	0.29**
9. STAIS	0.42**	-0.61**	0.65**	0.30**	-0.54**	0.57**	-0.41**	0.78**	-	0.27**
10. NUD	0.27**	-0.19*	0.29**	0.25**	-0.02	0.06	0.10	0.19*	0.19*	-

The results for the UK sample ($n = 159$) are shown above the diagonal. The results for the Spain sample ($n = 172$) are shown below the diagonal. PSQI = Pittsburgh Sleep Quality Index; Spane P = Positive Experience; Spane N = Negative Experience; FOMO = Fear of Missing Out; SWL = satisfaction with life; UCLA = loneliness; MSPSS = perceived social support; STAI-T = anxiety trait; STAI-S = anxiety state; NUD = night-time usage of electronic devices. *$p \leq 0.05$, **$p \leq 0.01$

Table 3 Intercorrelations between separate items of night-time usage of electronic devices and the variables of interest disaggregated by country

Variables	*1*	*2*	*3*	*4*	***5***	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*
1. 2h	-	*0.48***	*0.51***	*0.35***	*0.19**	*-0.14*	*0.14*	*0.25***	*-0.14*	*0.13*	*-0.16**	*0.17**	*0.16*
2. Dur2hr	*0.56***	-	*0.53***	*0.68***	*0.21***	*-0.13*	*0.07*	*0.09*	*-0.14*	*0.14*	*-0.23***	*0.14*	*0.11*
3. BedU	*0.40***	*0.32***	-	*0.69***	*0.24***	*-0.20**	*0.28**	*0.28***	*-0.15*	*0.15*	*-0.13*	*0.22***	*0.23***
4. DurB	*0.34***	*0.50***	*0.70***	-	*0.28***	*-0.26***	*0.22***	*0.20***	*-0.21***	*0.24***	*-0.24***	*0.25***	*0.24***
5. PSQI	*0.08*	*0.18**	*0.12*	*0.23***	-	*-0.47***	*0.53***	*0.15*	*-0.55***	*0.53***	*-0.34***	*0.61***	*0.59***
6. SpaneP	*0.01*	*-0.16**	*-0.08*	*-0.21***	*-0.27***	-	*-0.68***	*-0.17**	*0.65***	*-0.65***	*0.58***	*-0.72***	*-0.77***
7. SpaneN	*0.16**	*0.19**	*0.23***	*0.26***	*0.50***	*-0.53***	-	*0.30***	*-0.57***	*0.60***	*-0.36***	*0.80***	*0.82***
8. FOMO	*0.17**	*0.21***	*0.13*	*0.24***	*0.10*	*-0.20**	*0.21***	-	*-0.25***	*0.32***	*-0.06*	*0.34***	*0.27***
9. SWL	*0.10*	*-0.11*	*0.05*	*0.02*	*-0.28***	*0.66***	*-0.40***	*-0.08*	-	*-0.66***	*0.57***	*-0.66***	*-0.665*
10. UCLA	*0.04*	*0.10*	*-0.03*	*0.05*	*0.28***	*-0.60***	*0.46***	*0.17**	*-0.56***	-	*-0.65***	*0.73***	*0.68***
11. MSPSS	*0.03*	*0.00*	*0.20***	*0.12*	*-0.19**	*0.47***	*-0.23***	*-0.05*	*0.52***	*-0.69***	-	*-0.47***	*-0.47***
12. StaiT	*0.03*	*0.12*	*0.12*	*0.23***	*0.43***	*-0.69***	*0.68***	*0.38***	*-0.56***	*0.65***	*-0.40***	-	*0.87***
13. StaiS	*-0.01*	*0.12*	*0.12*	*0.23***	*0.42***	*-0.61***	*0.65***	*0.30***	*-0.54***	*0.57***	*-0.41***	*0.79***	-

2h = electronic devices usage 2 h before going to sleep; Dur2hr = duration of electronic devices usage in the 2 h before going to sleep; BedU = electronic devices usage in bed; DurB = duration of electronic devices usage while already in bed. The results for the UK sample (n = 159) are shown above the diagonal. The results for the Spain sample (n = 172) are shown below the diagonal. *$p \leq 0.05$, **$p \leq 0.01$

A longer usage of electronic devices in the 2 h prior to bedtime was found to be positively and significatively correlated with sleep difficulties, in the Spanish ($r = 0.18$, $p < 0.05$) and British ($r = 0.21$, $p < 0.01$) samples. The item assessing electronic devices usage while already in bed followed a similar pattern to the previously explained one, and findings indicate different correlations based on the country. A longer usage of electronic devices in bed was correlated in the British sample with higher sleep difficulties; positive experience; negative experience; SWL; loneliness; perceived social support; trait anxiety; and state anxiety ($p < 0.01$). In addition, in the Spanish sample a longer usage of electronic devices in bed was correlated with more sleep difficulties, negatively with positive experience, and positively with negative experiences, and trait and state anxiety ($p < 0.01$). However, there was no correlation found with SWL, loneliness, and perceived social support ($p > 0.05$).

Regression analysis

Simple linear regression analyses were calculated through SPSS 29.00, to predict sleep difficulties, positive experience, negative experience, SWL, loneliness, perceived social support, trait anxiety, and state anxiety, based on night-time usage of electronic devices.

In order to run the linear regression analysis, assumptions were checked. Firstly, the scatterplot showed that there was linear relationship between the variables. Moreover, the

scatterplot of standardised predicted values versus standardised residuals, showed that the data met the assumptions of homogeneity of variance and linearity, and the residuals were approximately normally distributed, which helps avoid Type I and II errors (Osborne & Waters, 2019). Furthermore, it was confirmed that multicollinearity was not a concern, with Variance Inflation Factors (VIFs) below recommended levels (Kutner et al., 2005).

Age, trait anxiety and perceived social support were regarded as control variables in the present study.

Night-time usage of electronic devices significantly predicts sleep difficulties in the British sample: in males F (4, 27) = 7.89, $p \leq 0.001$, $R^2 = 0.539$ ($\beta = 0.467$, $p = 0.006$), and females F (4, 119) = 22.40, $p \leq 0.001$, $R^2 = 0.430$ ($\beta = 0.182$, $p = 0.016$); and in the Spanish sample, although night-time usage of electronic devices did not significantly predict sleep difficulties in males F (4, 16) = 1.76, $p = 0.186$, $R^2 = 0.306$, significantly predicted it in females F (4, 146) = 13.48, $p \leq 0.001$, $R^2 = 0.270$ ($\beta = 0.17$, $p = 0.023$).

Moreover, when predicting loneliness, night-time usage of electronic devices did not have a significant impact on it in the British sample: males F (4, 27) = 24.19, $p = 0.685$, $R^2 = 0.782$ and females F (4, 120) = 58.08, $p = 0.372$, $R^2 = 0.659$. In the Spanish sample as there was non-significant correlations between night-time use and loneliness, no regression analyses were conducted.

Furthermore, night-time usage of electronic devices significantly predicted FoMO only in females in both samples: British F (4, 120) = 7.13, $p = 0.030$, $R^2 = 0.192$ ($\beta = 0.194$, $p = 0.03$) and Spanish F (4, 146) = 9.24, $p = 0.007$, $R^2 = 0.202$ ($\beta = 0.21$, $p = 0.007$); but the regression was non-significant for males in the British and neither the Spanish sample ($p \geq 0.05$).

When controlling for the previous control variables as well as for loneliness, sleep difficulties and FoMO, night-time usage of electronic devices did not significantly predict SWL in the British sample and neither in the Spanish in males and/or females ($p \geq 0.05$). Additionally, it also did not predict positive experience ($p \geq 0.05$) in any sample based on gender and neither negative experience ($p \geq 0.05$) except for negative experience in Spanish females F (7, 143) = 27.48, $p = 0.006$, $R^2 = 0.574$ ($\beta = 0.16$, $p = 0.006$).

Another simple linear regression was conducted (controlling again for age, trait and state anxiety, perceived social support, loneliness, SWL, and positive and negative experience) to predict usage of electronic devices at night-time based on levels of FoMO. In the British sample a significant regression equation was found only for females F (10, 109) = 3.89, $p < 0.001$ with an R2 of 0.263 ($\beta = 0.20$, $p = 0.033$), while it was not significant for males F (10, 21) = 2.019, $p = 0.084$ with an R^2 of 0.490. Moreover, in the Spanish sample a significant regression equation was found again only in females F (10, 140) = 3.80, $p = 0.002$ with an R^2 of 0.214 ($\beta = 0.24$, $p = 0.003$), but non-significant for males F (10, 10) = 1.49, $p = 0.945$ with an R^2 of 0.599.

Discussion

Research examining technology use and sleep difficulties has focused on problematic technology use, such as internet and smartphone use (Luqman et al., 2021). However, to the best of the author's knowledge, there are no studies examining general electronic devices usage habits during night-time, FoMO, well-being and anxiety levels. Identifying factors that influence sleep (such as the electronic devices usage) and psychological constructs that predict this usage, such as FoMO, can help to develop targeted intervention programs. In addition, addressing gender or cultural differences provides a more targeted approach that can be more effective in prevention and intervention. Therefore, the present study overcomes this gap in the literature and provides an extension of knowledge regarding nighttime use of electronic devices, FoMO, well-being and mental health variables.

Regarding the first objective, to explore the use of electronic media devices in pre-sleep time, sleep difficulties, and well-being in university students in the UK and Spain, results revealed that this night-time usage of electronic devices is a predictor of higher sleep problems difficulties in British males and females and in Spanish females. Moreover, night-time usage of electronic devices is a predictor of higher levels of FoMO in females from both countries but not in males, and higher negative experiences in Spanish females. Furthermore, regarding the second objective, findings reveal that the construct of fear of missing out acts as a predictor, in both countries, of electronic devices usage at night-time in females but not in males. Moreover, the results found in relation to FoMO, are consistent with previous studies indicating that people with high levels of FoMO want to be connected with others and not miss out on what others are doing (Abeele & Rooij, 2016; Beyens et al., 2016; Przybylski et al., 2013). Which may lead to problematic smartphone use (Wolniewicz et al., 2018) and as the current study suggest to that nightly use to the detriment of sleep quality. In relation to gender, this result suggesting more problems in women than in men can be explained by the fact that it seems that women from different European countries show a more restless sleep than the male gender (Baranowski & Jabkowski, 2023). In addition, according to previous research, women tend to spend more time on their smartphones (Ergin & Ozer, 2023) and Spanish females have higher levels of nomophobia than men (Caba-Machado et al., 2023). A possible explanation could be that women have a greater psychological need for connection than men, which translates into greater social motivation in the use of their smartphones (Fischer-Grote et al., 2019). And as

Przybylski et al. (2013) explained, that psychological need tends to increase FoMO levels. Therefore, pertaining to the contribution of this study to clinical practice in psychology, the results suggest the necessity to evaluate students' levels of FoMO, especially in women, and treat it through cognitive behaviour therapy if necessary (Gupta & Sharma, 2021). Another contribution of this study is the differences found between the two countries Spain and UK in the relationships between the variables of the study. In this sense, in the UK sample there are significant correlations between night-time use of electronic devices with SWL, loneliness, and perceived social support, however, these correlations are not significant in the Spanish sample. In this line, it is worth mentioning that the mean of night-time use of electronic devices in the UK is slightly higher than in Spain, as well as the mean of sleep difficulties. This result does not seem to be consistent with what has been found in other studies such as that of Lopez-Fernandez (2015), which found a lower prevalence of problematic smartphone use in the UK compared to Spain, respectively 5.1% versus 14.9%. However, these data may differ due to the varied use of measurement instruments, which are sometimes unspecific and too long. Moreover, technology evolves so fast that it has brought about new changes in just a few years, and the findings of this study show that in terms of well-being, UK students have a slight detriment compared to Spanish students, which may influence maladaptive patterns such as night-time use of electronic devices, which in turn acts as a vicious circle on well-being indicators. In any case, this result evidences the need to include cross-cultural studies in this area of research since there is a lack of cross-cultural studies examining the impact of the geographical location on the relation between FoMO and night-time usage of electronic devices, as well as between FoMO and problematic usage of SNS (Fioravanti et al., 2021). Therefore, cross-cultural studies are of key importance in this area of research (Tandon et al., 2021), because understanding sociocultural factors and the environment in which the usage takes place, can provide new resources to develop a more adaptive and responsible usage that do not compromise well-being and mental health. However, regarding the predictor role of FoMO to electronic devices usage at night-time, congruent results were found in both countries. This finding supports the value of this relatively new construct, which remains relatively unknown to mental health professionals and clinicians.

This study has important implications for sleep and technology usage research and has applied value in an area that has growing attention in the media, that is sleep hygiene. Features associated with this have included keeping the bedroom at an appropriate temperature, avoiding large meals late at night, and minimising the admission of light to the bedroom. More recently attention has been given to the use of digital devices immediately before going to bed and whilst in bed (Krishnan et al., 2020; Orzech et al., 2016). Previous work has concluded that light from screens can counter the effects of melatonin to induce sleep (Cain & Gradisar, 2010), and that a reduction of blue light can improve the quality of sleep (Randjelović et al., 2023). In this sense, the present study could indicate that regardless of the levels of anxiety and well-being of the individual, the use of electronic devices at night predicts sleep difficulties, which in turn could lead to a worsening of well-being and mental health (Castiglione-Fontanellaz et al., 2023). Moreover, this study has also underlined fear of missing out as a cognitive factor that can add to the physiological factors in preventing sleep. This may mean that the psychological factors "switch on" after the devices have been switched off. As previously noted, many students report poor quality sleep (e.g., (Adachi-Mejia et al., 2014; Exelmans & Van den Bulck, 2016; Whipps et al., 2018), and this may have adverse knock-on for their wellbeing, quality of life and academic studies.

The present study has attempted to capture in more detail than previous work the outworking and implications of maladaptive habits for wellbeing and mental health outcomes (with possible implications for day-to-day functioning in the academic context). The consistent patterns that have emerged across positive and negative constructs strongly accentuate the potential breadth of sleep quality impairment on individuals. Of course, the use of digital devices may not be the only factor at play in such processes, but the patterns observed here may be an indicator of their unique importance. It should also be noted that all four indicators of digital device night-time use were implicated maladaptively in student wellbeing.

This study can be linked with previous work through the use of the validated PSQI measure as an indicator of sleep-related problems. A growing trend in study guides is the inclusion of a section or chapter on wellbeing and mental health and on physical wellbeing related to diet, exercise, and work-life balance (e.g., McMillan, 2021). However, this most recent edition of this study guide only provides a brief mention of sleep, although it gives attention to wellbeing, stress, exercise, mental health and includes mindfulness and growth mindset. Findings from the present study indicate that sleep quality and sleep hygiene should be included and emphasised as an essential part to help students maximise the quality of the student experience.

Despite that this study has added to previous research, limitations should be considered. Firstly, inferences about causality or directions of relations cannot be made due to the cross-sectional nature of this study. In addition, the use of self-report measures provides the limitation of a proneness to respond in a socially desirable manner. These concerns can be counter-balanced, however, by the validity statistics presented, and by the relationships found in the expected

directions (both positive and negative). Future research should be carried out with samples that include broader age ranges, to consider adolescence and its different stages (early, middle, late, and emerging adulthood) (Salmela-Aro, 2011), since this is another stage of special psychological vulnerability where the peer group, the feeling of belonging, and the online reality becomes very important. Additionally, it would be interesting to take into account other individual differences such as Morningness-Eveningness chronotype.

Appendix

Table 4

Table 4 Night-time use of electronic devices (NUD)

Please, select a response that best describe your general use of electronic devices						
1. At nighttime, do you have a cutoff point to stop using your electronic device or do you keep going until you are too tired to continue?	I have a cut off point			I keep going until I am too tired		
2. Are you strict at switching your electronic device(s) off at a set time nightly?	Never	Seldom	Sometimes	Often	Always	
3. How often do you use electronic device(s) (computer, Ipad/tablet, cell phone/smartphone, etc.) nightly in the 2 h before going to bed?	Never	Seldom	Sometimes	Often	Always	
4. If you use electronic device(s) in the 2 h before sleep, how much longer do you use them?	0 min	5–15 min	15–30 min	30–45 min	45–60 min	More than 60 min
5. How often do you use your electronic device(s) while you are already in bed?	Never	Seldom	Sometimes	Often	Always	
6. If you use electronic device(s) in bed, how much longer do you use them?	0 min	5–15 min	15–30 min	30–45 min	45–60 min	More than 60 min

Table 4 (continued)

Please, select a response that best describe your general use of electronic devices					
7. Is your electronic device(s) in the bedroom while you sleep?	Never	Seldom	Sometimes	Often	Always
8. Are you likely to go back to your electronic device(s) (because you have forgotten something, or a notification arrives to your devices) right away after you get in bed to sleep?	Never	Seldom	Sometimes	Often	Always

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Data availability The data that support the findings of this study are available in the repository: https://osf.io/5scb7/?view_only=de34082b5aaf460fb79a14b701e403e1

Declarations

Ethics approval 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.

Informed consent Informed consent procedure was obtained from the participants.

Competing interests The authors have no competing interests to disclose.

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