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Relationship between FoMO, Problematic Social Media Use, Self-Esteem, Negative Affectivity and Physical Exercise. A Structural Equation Model

Anastasios Dadiotis[a] and Petros Roussos[a]

Corresponding Author: Anastasios Dadiotis, email: dadiotisanastasios@gmail.com

Affiliation:

a. National and Kapodistrian University of Athens School of Philosophy: Ethniko kai Kapodistriako Panepistemio Athenon Philosophike Schole

Abstract

The fear of missing out (FoMO) is characterized in the literature as a fear that others are having rewarding experiences while one is missing out, and a constant need to keep connected with one's social network. Driven by Social Determination Theory (SDT) FoMO has been linked with Problematic Social Networking Sites use (PSNSU), negative affectivity (NA), self-esteem (SE) and sleep disturbances. The present study reports findings from 512 individuals (79.1% women, mean age 30.5 years, *SD*= 8.61). Structural equation modelling (SEM) suggests that the duration of SNSs use and the numbers of SNSs platforms actively used partially mediated the relationship between FoMO and PSNSU. In turns, PSNSU partially mediated the relationship between FoMO and NA. Furthermore, the present study has extended the literature by incorporating the Vulnerability Model in the FoMO concept, identifying that SE partially mediated the relationship between FoMO and NA, while NA fully mediated the relationship between FoMO and sleeping disturbances. Accordingly, the present has extended previous research findings in showing exercise as a potential protective factor to prevent against FoMO. Practical and theoretical implications are discussed.

Keywords: Fear of missing out, FoMO, social media, Social networking sites, addiction, depression, anxiety, sleep, exercise

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Introduction

Social Networking Sites (SNSs), such as Facebook, Instagram and Twitter, are defined as online communities where users may create unique public profiles, meet new people with shared interests, and connect with real-life friends (Kuss & Griffiths, 2011). According to recent statistics 3.78 billion people globally use at least one SNS and this number is expected to reach 4.5 billion in 2025 (*Number of Social Media Users 2025*, n.d.). As more and more people use SNSs there has been a surge in scholarly interest in the psychosocial aspects that contribute to high SNSs use. The fear of missing out (FoMO) (Przybylski et al., 2013) was originally proposed to identify a possible path to high SNSs use.

FoMO is characterized in the literature as a fear that others are having rewarding experiences while one is missing out, and a constant need to keep connected with one's social network. The first element corresponds to the mental part of anxiety (e.g. rumination, worry) while the second element entails a behavioral technique targeted at reducing such worry, similar to how compulsion in obsessive-compulsive disorder (albeit maladaptively) reduces anxiety. FoMO has been studied under the Self-Determination Theory (SDT; (Deci & Ryan, 2013) scope. SDT proposes that satisfaction of three basic needs – autonomy, relatedness and competence – is the basis of effective mental health and self-regulation (Deci & Ryan, 2013). According to Przybylski et al. (2013), FoMO is induced by psychological inadequacies in people's relatedness, and competence needs. Therefore, it has been suggested that SNSs are an excellent tool for satisfying the need to be constantly linked with what others are doing and develop social competence (Przybylski et al., 2013).

Regarding the link between FoMO and SNSs use in general, a recent meta-analysis identified a small to moderate effect size (Fioravanti et al., 2021). However, considering SNSs use a distinction can be made between the "depth" and the "breadth". Depth corresponds to factors such as duration of SNSs usage while the breadth of SNSs use refers to

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the number of SNSs platforms actively utilized (Franchina et al., 2018). A number of studies have identified moderate to large relationships between FoMO and frequency of SNSs use regarding different demographic groups such as college students, adolescents, and adults. (Elhai, Yang, et al., 2020). Similarly, Franchina et al., (2018) identified FoMO as a positive predictor of the number of SNSs platforms that adolescents have. This finding is in line with Uses and Gratifications Theory (UGT). UGT proposes that based on their individuals' characteristics, people have distinct needs that they want to be satisfied by mass media. Moreover, an individual's unique need would lead them to consume a certain type of media to fulfill that need (Blumler, 1979).

Another important aspect of FoMO, is the plausible link between mental health and well-being. According to the literature, FoMO has shown moderate association with neuroticism (Rozgonjuk et al., 2020), small to moderate negative association with self-esteem (Buglass et al., 2017) and small to moderate association with negative affect (Wolniewicz et al., 2020). Furthermore, a recent meta-analysis revealed a moderate effect between FoMO and depression, and a large effect between FoMO and anxiety (Fioravanti et al., 2021), while a large positive correlation has been identified between FoMO and perceived stress (Elhai et al., 2021). Furthermore, it should be noted that FoMO has also been linked with poorer physical wellbeing, such as, poor eating habits and sedentary lifestyle, bad posture, and subsequent musculoskeletal pain via higher SNSs use (Gupta & Sharma, 2021). In addition, a number of studies have identified that elevated levels of FoMO are associated with sleep disturbances (e.g. Adams et al., 2020; Shoval et al., 2021).

Scholars have also been investigating the possibility that FoMO may drive not only SNSs use, but also the onset of excessive SNSs usage (Fioravanti et al., 2021). Problematic SNSs use (PSNSU) has been described as the use of SNSs that can cause problems in psychological, social and, occupational aspects of one's life (Marino et al., 2016), and reflects

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addictive-like symptoms and unique traits such as a preference for online social engagement as a strategy to regulate the mood (Marino et al., 2018b). Within the scope of the biopsychosocial model, this symptoms are tolerance, conflict, salience, withdrawal symptoms and mood modification (Kuss & Griffiths, 2011). A recent meta-analysis has identified a moderate to large effect size between FoMO and PSNSU (Fioravanti et al., 2021). Moreover, variables such as the depth and the breadth of SNSs use that have been associated with FoMO, as previously mentioned, have also been correlated with PSNSU. For instance, regarding the breadth, Pontes et al., (2018) found that the group of participants at higher risk for PSNSU maintained more SNSs platforms than the participants who were at reduced risk of PSNSU. In regards to the depth, a number of studies have identified time spent on SNSs as a predictive factor of PSNSU (Chen et al., 2020; Leong et al., 2019; Lin et al., 2017).

A number of studies have identified a potential link between PSNSU and mental health (e.g. M. D. Griffiths et al., 2014; Hussain & Griffiths, 2018; Marino et al., 2018a). For instance, PSNSU has been correlated with lower life satisfaction (Longstreet & Brooks, 2017) and well-being (Wirtz et al., 2020). In addition, there is a rather solid concurrent relationship between PSNSU and psychiatric symptoms such as anxiety, depression and stress (Cunningham et al., 2021; Hussain & Griffiths, 2018). Recent meta-analyses have identified a weak to moderate relationship between PSNSU, and mental health problems (Cunningham et al., 2021; Huang, 2020; Marino et al., 2018a).

Aim

Our aim was to identify specific patterns of SNSs use, driven by FoMO, that can predict PSNU. In addition, we try to identify possible underlying mechanisms that link FoMO to negative affectivity (NA) and sleep disorders. Finally, we try to recognize the role of physical exercise in relation to FoMO. Findings from this study are important as they can support prevention and intervention strategies.

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Hypotheses

In regards to SDT, FoMO should be linked with increased duration of SNSs use as a way to fulfill individuals' needs of relatedness and competence (Przybylski et al., 2013). Moreover, according to UGT the use of various SNSs platforms may relieve different needs. Therefore, FoMO should be linked with more time spent on SNSs, and more SNSs platforms used by individuals.

Hypothesis 1.

Individuals who experience more FoMO, spend more time on SNSs (H1a; the depth of SNSs use) and use more SNSs platforms (H1b; the breadth of SNSs).

When people use SNSs excessively it can become problematic. As mentioned above, several studies have identified the link between PSNSU and increased time spent on SNSs (Chen et al., 2020; Leong et al., 2019; Lin et al., 2017) as well as users having more accounts on SNSs (Pontes et al., 2018). Thus, greater depth and breadth of SNSs use should be linked with more PSNSU. Hence, we expect:

Hypothesis 2.

Individuals who spent more time on SNSs (H2a; depth) and use more SNSs platforms (H2b; breadth), report higher PSNSU.

According to previous studies, individuals with greater FoMO report higher levels of PSNSU (Fioravanti et al., 2021). Moreover, a greater level of FoMO relates to greater depth and breadth of SNSs usage (reviewed in H1a and H1b). To our knowledge, this is the first study that incorporates the depth and the breadth of SNSs usage as mediating variables of the association of FoMO with PSNSU. Therefore, we expect:

Hypothesis 3

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Individuals who report higher levels of FoMO, report higher levels of PSNSU (H3a).

The depth (H3b) and the breadth (H3c) of SNSs use should mediate the relationship between FoMO and PSNSU.

FoMO relates to mental health and wellbeing. According to SDT, unfulfilled social needs that are the origin of FoMO can influence negative affectivity (Przybylski et al., 2013). While it is also plausible that negative affectivity may be an antecedent of FoMO, in the present study we conceptualize FoMO as a precursor of negative affectivity guided by SDT.

Hypothesis 4

Individuals who report higher levels of FoMO, report higher levels of psychiatric symptoms (H4a) and lower levels of self-esteem (H4b).

Although previous studies have examined the concept of vulnerability in the context of FoMO and PSNU (e.g. Buglass et al., 2017; Servidio, 2021), to our knowledge there is no study that examines vulnerability in relation to FoMO and NA. According to the vulnerability model (VM) low levels of self-esteem pose as a risk factor for psychopathology (Orth & Robins, 2013). Moreover, higher levels of FoMO relate to higher negative affectivity (reviewed in H4a). Hence we expect:

Hypothesis 5

Individuals who report lower levels of SE, report higher levels of NA (H5a) and SE mediate the relationship between FoMO and psychopathology (H5b).

A number of studies have identified the association between PSNSU and NA such as depression, anxiety and stress (Cunningham et al., 2021; Hussain & Griffiths, 2018). Moreover, higher levels of FoMO relate to higher NA (reviewed in H4a). Hence, we expect:

Hypothesis 6

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Individuals with higher levels PSNSU, report higher levels of NA (H6a) and PSNSU mediates the relationship between FoMO and, NA (H6b).

As stated before, a link between FoMO and sleep disturbances have been identified in the literature (Adams et al., 2020; Shoval et al., 2021). Moreover, it is well established that sleep disturbances have a strong link with NA such as depression (Nutt et al., 2008), anxiety (Staner, 2003) and stress (Lo Martire et al., 2020). Thus, we expect:

Hypothesis 7

Individuals with a higher level of FoMO, report more sleep disturbances (H7a). Individuals with higher levels of NA will report higher levels of sleep disturbances (H7b). Moreover, NA should mediate the link between FoMO and sleep disturbances (H7c).

To our knowledge, there is no study examining the direct link between FoMO and the level of physical activity. However, it has been suggested that physical activity serves as a protective factor against anxiety symptoms (McDowell et al., 2019) that is one of the two key components of FoMO (Przybylski et al., 2013), as stated and before. Hence, we expect:

Hypothesis 8

Individuals with higher levels of physical activity, report lower levels of FoMO.

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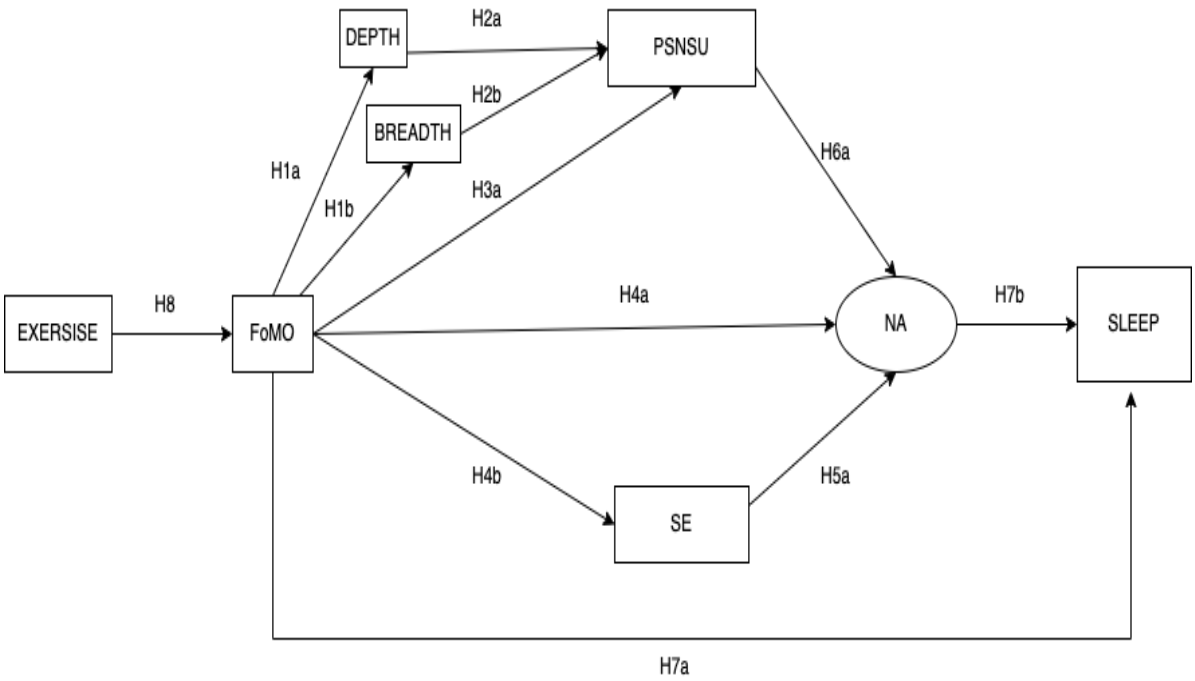
Fig. 1

The overall conceptual model that incorporates hypotheses 1 to 8



Note: Fear of Missing Out (FoMO), Problematic Social Networking Site Use (PSNSU), time spent on SNSs (DEPTH), total number of SNSs platforms (BREADTH), Negative Affectivity (NA), Self-Esteem (SE), Sleep Disturbances (SLEEP), hours per week of systematic exercise (EXERCISE). The oval represents a latent variable, while rectangles indicate observed variables. For visual simplicity, factor loadings paths from the latent variables are not displayed.

Moreover, to further examine the role of exercise in regards to FoMO, we examined the moderating effect of exercise on the concurrent association of FoMO with depression, stress ,and anxiety. It has been suggested that exercise can act as a buffer against psychological problems (Ai et al., 2021; Craike et al., 2010). Hence, we expect:

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Hypothesis 9

Exercise should moderate the association of FoMO with depression (H9a), stress (h9b), and anxiety (h9c).

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Materials and Methods

Participants and Procedure

In spring 2021 we recruited participants online via university mailing lists and various SNSs groups. After being fully informed of the objectives of the study and giving their full consent, participants were asked to complete a series of questionnaires, anonymously, hosted by google forms. In exchange for participation, no compensation was given. Completion time was approximately 13 minutes. The inclusion criteria were the participants 1) to be able to read and write in Greek 2) to be over 18 and 3) to obtain at least 1 SNS personal account. The sample consisted of 405 (79.1%) women and 107 (20.9%) men. The average age was 30.5 (SD= 8.61) ranging from 18 to 70. The majority of the participants were employed (n=316, 61.7%) followed by students (n=152, 29.7%), and unemployed individuals (44, 8.6%).

Measures

Demographics

Demographics that enquired included age, gender and employment/student status.

Depth of SNSs used

The depth of SNSs used was assessed by the hours spent in SNSs per day

Breadth of SNSs used

Based on previous research (*Most Used Social Media 2021*, n.d.), a list of the most popular SNSs accounts was constructed. The breadth of SNSs use was assessed by asking the participants whether they obtained an account in each platform (1=yes, 0=no), and then computing the sum of the active accounts for each participant.

PSMSU

PSMSU of the past 12 months was assessed by using the Greek version of the Bergen Social Media Addiction Scale (BSMAS) (Dadiotis et al., 2020). The BSMAS is consisted of 6 items representing key addiction components. Every item is rated on a 5-point Likert scale

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ranging from 1 (very rarely) to 5 (very often). The internal consistency of BSMAS was acceptable (a=0.77).

FoMO

FoMO was assessed by using the FOMO scale (Przybylski et al., 2013). The FOMO scale is consisted of 10 items assessing the FoMO construct. Items are based on current experience and rated on a 5-point Likert Scale ranging from 1 (Not at all true to me) to 5 (Extremely true for me). FoMO scale is considered to have a one-dimensional structure (Can & Satici, 2019; Przybylski et al., 2013). Since there is no Greek version of FoMO scale, the FoMO scale was was translated to Greek and then back-translated by independent translators. The back-translation was then compared with the original scale and adjustments were made as necessary. The final version was administered to 12 people who were debriefed after completing the inventory in order to check for clarity and comprehensibility of the items. The internal consistency of FOMO scale was acceptable (a=0.83).

Negative Affectivity

NA was assessed by using the Depression Anxiety Stress Scale -21 items (DASS-21). The DASS-21 is consisted of three 7-item scales that assess depression, anxiety, and stress. Every item is rated on a 4-point Likert scale ranging from 0 (did not apply to me at all) to 3 (applied to me very much or most of the time). It has been found that the Greek version of DASS-21 can be used as a reliable, and valid instrument in the Greek non-clinical population (Pezirkianidis et al., 2018). The internal consistency of DASS was acceptable (α=0.90 for stress, 0.86 for anxiety, and 0.90 for depression).

SE

SE was assessed by using the Greek version of Rosenberg's Self Esteem Scale (RSES). RSES is consisted of 10 items rated on a 4-point Likert Scale ranging from 1

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(strongly agree) to 4 (strongly disagree) (Galanou et al., 2014). The internal consistency of RSES was acceptable (a=0.78).

Sleep Disturbances

Sleep disturbances were assessed by the Greek version of the Pittsburg Sleep Quality Index (PSQI) (Perantoni et al., 2012). PSQI contains 19 self-report items in 7 clinically derived domains of sleep disturbances, scored as a single factor. The internal consistency of PSQI was acceptable (a=0.72).

Exercise

To assess the level of physical activity of the participants we asked them to report how many hours per week they engage in systematic exercise.

Statistical Analysis

Since the surveys were hosted in google forms, participants were required to answer all questions before submitting their results, therefore, they were no missing values. Before performing any analysis, the data were examined for normality and multicollinearity. Regarding normality of the distributions, because the standard errors in large samples (N>300) are often small, it is recommended to access normality using the histogram and absolute values of skewness and kurtosis. The recommended critical values for skewness and kurtosis are 2 and 7 respectively (Kim, 2013). Regarding multicollinearity, variance inflation factors (VIF; <10) and tolerance (> 0.1) values were examined. In addition, the multivariate outliers were examined using Mahalanobis' distance and the critical value for every case based on x^2 distribution.

Because the FOMO scale was never used in a Greek sample before CFA was conducted to examine the instrument's construct validity. FOMO scale items has 5 ordinal responses, therefore we treated items as ordinal in CFA, using a polychoric correlation matrix and a diagonally weighted least squares (DWLS) estimation (Li, 2016). Following CFA, Structural

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Equation Modelling (SEM) was performed to analyze the dataset and identify the proposed paths among the variables using Maximum Likelihood (ML) method. We tested the model depicted in Fig1. All variables were estimated as observed variables, with the exception of NA, which was estimated as a latent variable using CFA with depression, stress and, anxiety being the factors. Goodness of fit for CFA and SEM was assessed by χ^2 and its degrees of freedom (df) For χ^2 values associated with p>0,5 were considered good-fitting models, although it has to be mentioned that the p-value of this test is sensitive to large sample size (N<400). In addition, the root mean square error of approximation (RMSEA) with its 90% confidence intervals (CI), the standardized root mean square residuals (SRMR), the comparative fit index (CFI) and the Tucker-Lewis Index (TLI) were used. For RMSEA values < 0.06 is acceptable while for SRMR values < 0.08. For CFI and TLI values > 0.95 were considered as indicators of good fit (Brown, 2006).

Regarding the mediation, we computed the cross product of the two direct paths coefficient to obtain the indirect path coefficient. To calculate the standard error of indirect effects the delta method was used. The results were obtained by bootstrapping 10000 times. For the moderation analysis, as in the case of mediation, the results were obtained by bootstrapping 10000 times. Statistical significance level was set at α=0.05. For the statistical analyses R version 4.1.2 (*R Core Team, 2021*) and “psych”(Revelle, 2021) , “lavaan” (Rosseel et al., 2021), and “interactions” (Long, 2021) packages were used.

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Results

Descriptive statistics and Bivariate Correlations

In total 514 questionnaires were collected. Two participants were removed as multivariate outliers according to Mahalanobis' distance. Therefore, the present study involved 512 participants. Regarding the time spent daily on SNSs platforms (depth), approximately 10%, 45%, 35% and 10% of the participants spent 0-1, 1-3, 3-6 and over 6 hours, respectively. In regards to the number of SNSs platforms obtained by the participants (breadth), 6% of the participants obtained 2 or fewer platforms, approximately 45% obtained 3 or 4 platforms, 40% obtained 5 or 6 platforms and 10 % of the participants obtained more than 7 platforms. Descriptive statistics and bivariate correlations are presented in table 1 and bivariate correlations in table 2. Both FoMO and PSNSU correlated significantly with all study variables. All study variables were normally distributed according to skewness and kurtosis criteria while there were no issues regarding multicollinearity.

Table 1

Descriptive statistics of study's variables

	DEPTH	BREADTH	FoMO	PSNSU	STRESS	DEP	ANX	SLEEP	EXER	SE
Mean	4.55	3.8	26.72	15.73	8.77	6.96	4.65	6.47	2.9	28.55
SD	1.4	2.3	7.7	5.08	5.8	5.8	4.8	3.68	2.8	5.54

Note: Fear of Measing Out (FoMO), Problematic Social Networking Site Use (PSNSU), time spent on SNSs (TIME), total number of SNSs platforms (PLATFORMS), depression (DEP), anxiety (anx), hours of systematic exercise per week (EXER), Self-Esteem (SE), Sleep Disturbances (SLEEP).

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Table 2

Correlation Matrix

	FoMO	BREADTH	DEPTH	PSNSU	STRESS	DEP	ANX	SLEEP	SE	EXER
FoMO	-									
BREADTH	0.19***	-								
DEPTH	0.21***	0.15***	-							
PSNSU	0.47***	0.27***	0.31***	-						
STRESS	0.47***	0.06	0.17***	0.47***	-					
DEP	0.44***	0.06	0.17***	0.35***	0.78***	-				
ANX	0.35***	0.11*	0.07	0.34***	0.75***	0.47***	-			
SLEEP	0.25***	0.04	0.13**	0.23***	0.49***	0.53***	0.47***	-		
SE	-0.34***	-0.02	-0.19***	-0.23***	-0.38***	-0.50***	-0.33***	-0.33**	-	
EXER	-0.13***	0.02	-0.07	-0.08	-0.13**	-0.14**	-0.14**	-0.15***	0.10*	-

Note: * -<.05, **p<0.01, ***p<.001; Fear of Measing Out (FoMO), Problematic Social Networking Site Use (PSNSU), time spent on SNSs (TIME), total number of SNSs platforms (PLATFORMS), depression (DEP), anxiety (anx), hours of systematic exercise per week (EXER), Self-Esteem (SE), Sleep Disturbances (SLEEP).

FOMO scale CFA

To examine the instrument's construct validity a unifactorial model was assessed with DWLS method. The one factor model demonstrated some adequate, but not good, fit,

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[$\chi^2(35)=273.4$; $p<0.001$; $\chi^2/df=7.81$; RMSEA=0.115; 90%CI=0.103-0.128; SRMR=0.103; CFI=0.914; TLI=0.889]. Because the fit was not acceptable a careful investigation of the modification indices (MIs) was performed. According to the MIs, it was suggested to add a covariance path among the error terms of items 1 and 2 (MI=99.25) and among the error terms of items 7 and 9. A CFA containing these paths was then performed, which showed a good fit [$\chi^2(33)=106.908$; $p<0.001$; $\chi^2/df=3.24$; RMSEA=0.066; 90% CI=0.052-0.08; SRMR=0.065; CFI=0.973; TLI=0.964). The aforementioned covariances can be theoretically justified. Item 1 refers to a fear that others enjoy more rewarding experiences than the individual, while item 2 refers to more rewarding experiences of friends specifically. Friends can be conceptualized as a subgroup of others, thus, explaining the shared variance. Item 7 refers to a frustration when an individual misses an opportunity to a planned get-together, while item 9 refers to frustration when an individual misses an opportunity to meet friends. A planned get-together can be considered also as an opportunity to meet with friends, thus, explaining the shared variance.

SEM

Fig. 2 displays standardized path coefficients for the SEM which overall demonstrated an excellent fit [$\chi^2(29)=78.74$; $p<0.001$; $\chi^2/df=2.7$; RMSEA=0.058; 90% CI=0.043-0.073; SRMR=0.044; CFI=0.97; TLI=0.954). The path coefficients indicated the validity of each hypothesis as can be seen in table 3. Additionally, the research model explained 12% of the variance of SE, 29% of the variance in PSNSU, 40% of the variance of NA and, 34% of the variance of sleep disturbances.

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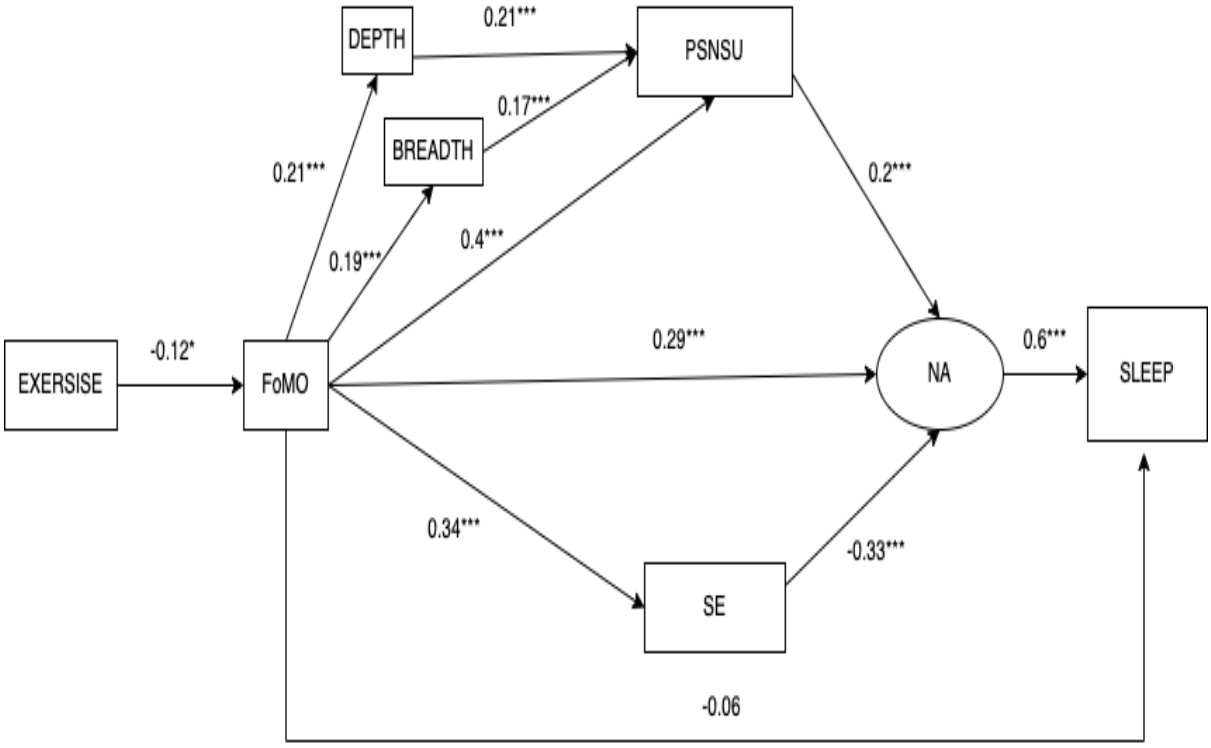
Fig. 2

Standardized path coefficients for the SEM model.



Note: Fear of Missing Out (FoMO), Problematic Social Networking Site Use (PSNSU), time spent on SNSs (DEPTH), total number of SNSs platforms (BREADTH), Negative Affectivity (NA), Self-Esteem (SE), Sleep Disturbances (SLEEP), hours per week of systematic exercise (EXERCISE). The oval represents a latent variable, while rectangles indicate observed variables. For visual simplicity, factor loadings paths from the latent variables are not displayed. * -<.05, **p<0.01, ***p<.001

Table 3

Results of hypotheses testing

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Hypothesis	Path	β	Significance	Support
H1a	FoMO -> DEPTH	0.21	<0.001	Yes
H1b	FoMO -> BREADTH	0.19	<0.001	Yes
H2a	DEPTH -> PSNSU	0.21	<0.001	Yes
H2b	BREADTH -> PSNSU	0.17	<0.001	Yes
H3a	FoMO -> PSNSU	0.40	<0.001	Yes
H4a	FoMO -> NA	0.28	<0.001	Yes
H4b	FoMO -> SE	-0.34	<0.001	Yes
H5a	SE -> NA	-0.38	<0.001	Yes
H6a	PSNSU -> NA	0.18	<0.001	Yes
H7a	FoMO -> SLEEP	-0.06	0.209	No
H7b	NA->SLEEP	0.61	<0.001	Yes
H8	EXERCISE -> FoMO	-0.12	0.011	Yes

Note: Fear of Measing Out (FoMO), Problematic Social Networking Site Use (PSNSU), time spent on SNSs (DEPTH), total number of SNSs platforms (BREADTH), Negative Affectivity (NA), Self-Esteem (SE), Sleep Disturbances (SLEEP), hours per week of systematic exercise (EXERCISE).

Mediation analysis

Results of the analysis showed that, time spent online and the number of platforms of SNSs that an individual use, partially mediates the relationship between FoMO and PSNSU. PSNSU and SE partially mediate the relationship between FOMO and NA, while NA fully mediate the relationship between FOMO and sleep disturbances. Table 4 present the details about the direct, indirect, and total effects concerning mediation analysis.

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Table 4

Results of Mediation analysis

Hypothesis	Path	effect	se	LLCI	ULCI
H3b	FoMO->DEPTH->PSNSU	0.04	0.01	0.020	0.065
Total effect of FoMO->PSNSU through DEPTH		0.44	0.04	0.371	0.517
H3c	FoMO->BREADTH->PSNSU	0.03	0.010	0.012	0.050
Total effect of FoMO->PSNSU through BREADTH		0.43	0.04	0.357	0.507
H5b	FoMO->SE->NA	0.13	0.024	0.034	0.112
Total effect of FoMO->NA through SE		0.41	0.4	0.323	0.497
H6b	FoMO->PSNSU->NA	0.07	0.020	0.034	0.112
Total effect of FoMO->NA through PSNSU		0.35	0.046	0.263	0.442
H7c	FoMO->NA-> SLEEP	0.17	0.034	0.106	0.238
Total effect FoMO->SLEEP through NA		0.11	0.047	0.02	0.205

Note: Fear of Measing Out (FoMO), Problematic Social Networking Site Use (PSNSU), time spent on SNSs (DEPTH), total number of SNSs platforms (BREADTH), negative affectivity (NA), Self-Esteem (SE), Sleep Disturbances (SLEEP).

Moderation analysis

To investigate the buffering effect of exercise in the association between FoMO and mental health a series of moderation analyses was conducted. The results showed that exercise negatively moderates B= -0.02, standard error= 0.009, 95% CI [-0.04, -0.006], t=-2.73, p=0.006 the association between FoMO and anxiety, R^2= 0.14, $F(3, 508)=28.06$, P<0.001. However, this was not the case for the association of FoMO with depression and stress. The details can be found in table 5 and Fig. 3.

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Table 5

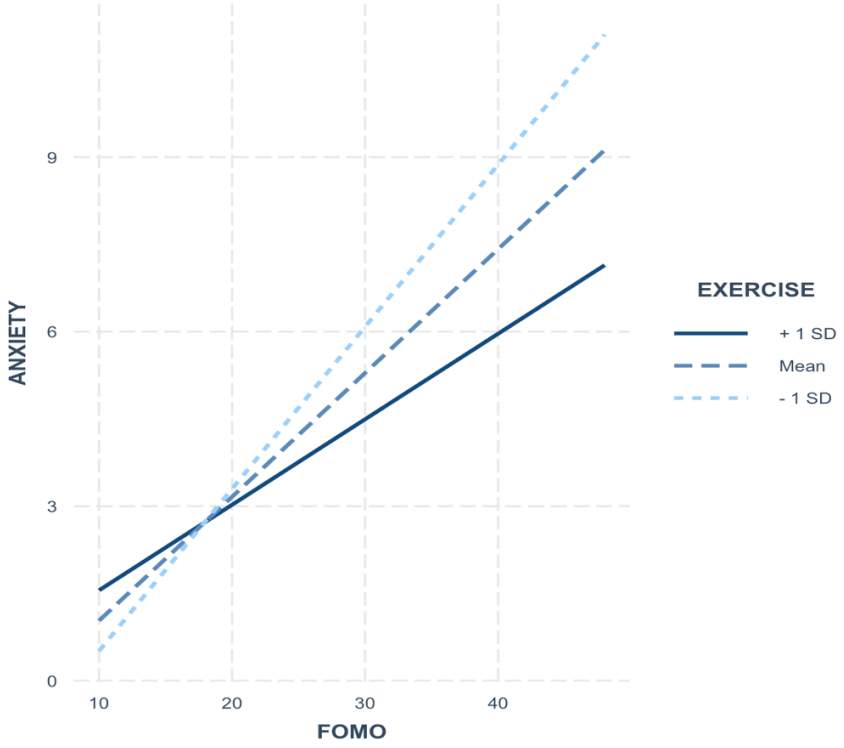
Simple Slope Estimates

	B	se	LLCI	ULCI	Z	p
Average	0.213	0.0256	0.1630	0.264	8.31	< .001
Low (-1SD)	0.279	0.0366	0.2080	0.351	7.62	< .001
High (+1SD)	0.147	0.0335	0.0821	0.214	4.39	< .001

Note: shows the effect of the predictor (FoMO) on the dependent variable (ANXIETY) at different levels of the moderator (EXERCISE)

Fig 3

The effect of the predictor (FoMO) on the dependent variable (ANXIETY) at different levels of the moderator (EXERCISE)



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Discussion

The aim of the current study was to investigate the predictive role of FoMO on NA and sleep disturbances, as well as the mediating effect of PSNU and SE. In addition, we investigated specific ways of SNSs use, driven by FoMO, that can predict PSNU. Finally, we explored the buffering role of physical exercise in relation to FoMO and mental health.

Firstly, the results confirm that FoMO has a significant association with PSNSU both directly and indirectly through the depth and breadth of SNSs use. Regarding the direct link between FoMO and PSNSU results are in line with previous findings (Fioravanti et al., 2021). It has been suggested that individuals that are highly worried that they miss rewarding experiences and/or a chance for social interactions are more likely to exhibit insufficient self-regulation in their SNSs usage because of the need to stay constantly connected to what others are doing and to ameliorate feelings of anxiety of being socially excluded (Fioravanti et al., 2021). In this line of thought excessive SNSs usage that eventually leads to PSNSU can be considered as a dysfunctional copying strategy. This is also complemented by the finding that greater depth and breadth in SNSs usage mediate the association of FoMO with PSNSU. Regarding the mediating effect of the depth and breadth of SNSs use on the aforementioned association this is a novel finding. Franchina et al., (2018) have found that FoMO was a positive predictor of the depth and breadth of SNSs usage, however, this is the first study to identify that greater depth and breadth of SNSs usage, driven by FoMO, may predict greater levels of PSNSU. Regarding the depth of SNSs use, it is possible that individuals who report higher levels of FoMO may spend more time checking up on others on SNSs. However, the more time people spent on checking others on SNSs, the more likely to discover events they have missed, therefore, using SNSs may become an additional source of FoMO resulting in a vicious circle, gradually altering SNSs use to PSNSU. Concerning the breadth of SNSs usage, it has been suggested that different media may satisfy different needs (Franchina et al., 2018).

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For instance, it has been found that SNSs users differ in the gratifications they acquire from different platforms such as Instagram, Facebook and Twitter (Alhabash & Ma, 2017). Individuals experiencing higher levels of FoMO may actively engage in a greater number of platforms in order to check on different groups of people, events or certain information that do not want to miss out. However, as in the case of the depth of usage, this can become an additional source of FoMO that leads to a vicious circle that eventually may alter SNSs usage to PSNSU.

Concerning the association of FoMO with NA, statistical analysis suggested that FoMO has a direct significant association with NA. This finding is in line with previous research (Elhai, Yang, et al., 2020; Fioravanti et al., 2021). In addition, this is, also, in line with SDT's theoretical conceptualization that experiencing high levels of FoMO is considered as a predictor of NA (Przybylski et al., 2013). Under the scope of SDT, it is plausible that unfulfilled social needs that are embedded in FoMO can influence NA such as depression, anxiety, and stress. On the other hand, it has also been proposed that NA may be an antecedent of FoMO (Elhai, Yang, et al., 2020). FoMO may be a maladaptive copying mechanism to psychopathology (Elhai et al., 2019). In other words, it is yet unclear whether FoMO generates NA, or whether FOMO is caused by NA, or if there is a bidirectional association. However, results from longitudinal studies provide an early support that FoMO appears to induce NA over short periods of time (1 week) (Elhai, Rozgonjuk, et al., 2020; Milyavskaya et al., 2018). Future research should focus on longitudinal designs and experiments to clarify the direction of this association. Moreover, NA fully mediated the relationship between FoMO and sleeping problems. Previous research has identified the deleterious effects of NA such as depression, stress and, anxiety on sleep quality (Lo Martire et al., 2020; Nutt et al., 2008; Staner, 2003). For example, sleep disturbances, such as difficulty initiating or maintaining sleep, are considered as core symptoms in depression

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(Nutt et al., 2008), while stress- induced activation of the hypothalamic-pituitary-adrenal (HPA) axis, one of the primary neuroendocrine stress systems, results in wakefulness and sleep dysregulation (Han et al., 2012). Thus, the results of the current study suggest that one of the possible underlying mechanisms of the association between FoMO and sleep disturbances may be negative affectivity.

FoMO has, also, an indirect significant association with NA via PSNSU. This finding is in line with previous research (Fabris et al., 2020). As discussed above, FoMO driven SNSs use may be considered as a dysfunctional strategy that may lead to PSNSU and ultimately increase NA. In support of this line of thought, it has been suggested that excessive use, increased monitoring, and compulsive checking of SNSs have been linked to the onset of mental health problems in a limited number of individuals (Oberst et al., 2017). However, it is critical to note that a causal relationship between PSNSU and NA has not yet been established and it is possible that there is a bi-directional relationship. Future research should focus on longitudinal designs and experiments to clarify the direction of this association.

A novel, interesting result emerging from the current study concerns the negative mediating effect of SE in the association of FoMO with NA. Although, no previous studies investigated the indirect effect of FoMO on NA via SE, our results seem to be in line with the theoretical concepts of SDT and VM (Deci & Ryan, 2013; Orth & Robins, 2013). In line with SDT, higher levels of FoMO predict lower levels of SE. As stated above, one of the key components of FoMO is the fear that others have more rewarding life experiences. This belief may lead to social comparisons with other people. Previous research has identified that social comparison may lead to decreased SE (Jiang & Ngien, 2020). In turns, our results suggest that lower levels of SE predicted a higher level of NA, which is in line with VM. VM proposes that individuals with a lower level of SE are at greater risk to develop mental health problems (Orth & Robins, 2013). For example, it has been suggested that low levels of self-

esteem may result in depression as it contributes to its growth and preservation through intrapsychic processes (e.g. rumination) as well as interpersonal strategies (e.g. excessive reassurance-seeking, rejection sensitivity) (Orth & Robins, 2013). All in all, FoMO may create vulnerability in individuals by decreasing SE which in turn may evolve into NA.

Finally, results showed that more hours of systematic physical exercise negatively predicted FoMO. This is a novel finding as no previous research has examined the relationship between physical activity and FoMO in the context of SNSs. Moreover, moderation analysis identified that physical exercise buffers the association between FoMO and anxiety. However, this was not the case for depression and stress. In a physiological level exercise may increase the levels of Brain-derived Neurotropic Factor, which may help reduce anxiety symptoms (Asmundson et al., 2013) that is one of two key components of FoMO (Przybylski et al., 2013). In addition, in a psychological level, systematic exercise seems to improve self-efficacy (Petruzzello et al., 1991), which is one of the three main psychological needs, according to SDT, that are embedded in FoMO. Therefore, by reducing antecedent needs exercise may help alleviate FoMO.

Practical and Theoretical Implications

The present study conceptualized and examined a SEM model to identify potential pathways between FoMO, PSNSU, NA, and well-being. Findings from this study have important theoretical, and practical implications for further research of FoMO. At a theoretical level, the current study contributes to the literature by incorporating the vulnerability model of SE in the context of FoMO research and illuminating potential underlying mechanisms between FoMO and negative affectivity. Future research should examine more refined specifications of SE such as physical attractiveness, social skills, and academic/job competence. Moreover, by exploring the breadth and depth of SNSs use, the present study contributes to the literature by identifying potential behavioral underlying

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mechanism of the association between FoMO and PSNSU. The results have also practical implications. The current study provided evidence for promoting SE and systematic physical exercise in the clinical implications for relieving FoMO and NA. Interventions targeting FoMO using socio-technical approaches, such as FoMO-R method (Alutaybi et al., 2020), may benefit by incorporating systematic physical exercise as it seems that not only may act as a protective factor against FoMO but also may buffer the relationship between FoMO and anxiety. Future research should try identify specific aspects of systematic physical exercise such as duration, type, and intensity that may produce more benefits. Moreover, future studies should try to identify additional protective factors to further enrich clinical intervention and prevention programs.

Limitations and Future research

We acknowledge several limitations. First, negative affectivity measures were self-administered, without structured diagnostic interviews to assess stress, depression, and anxiety. Furthermore, SNSs breadth and width involved self-report measures. Future research should employ recorded behavior such as objective smartphone data as it is more accurate (Montag et al., 2015). Second, we used a convenience sample, unlikely representative of the general population. Future research should focus on national and representative samples. Lastly, the design of our study was cross-sectional thus causal conclusions cannot be made. Future research should focus on longitudinal and experimental designs to draw much-needed conclusions regarding the directionality.

Conclusion

Based on SDT, the present study tested a SEM model and found that breadth and width of SNSs use partially mediated the relationship between FoMO and PSNSU. In turns, PSNSU partially mediated the relationship between FoMO and NA. Furthermore, the present study has extended the literature by incorporating the VM model in the FoMO concept,

identifying that SE partially mediated the relationship between FoMO and NA, while NA fully mediated the relationship between FoMO and sleeping disturbances. Accordingly, the present has extended previous research findings in showing exercise as a potential protective factor to prevent against FoMO.

Ethical Statement

The authors declare that no funds, grants, or other support were received during the preparation of this manuscript.

The authors have no relevant financial or non-financial interests to disclose.

Informed consent was obtained from all individual participants included in the study.

This study is a part of a bachelor's thesis, therefore ethical approval was granted by the Exam Committee (Supervisor and Examiner).

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