



Social relationships and social media addiction among adolescents: Variable-centered and person-centered approaches

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ABSTRACT

Social media addiction (SMA) among adolescents is associated with many maladaptive developmental outcomes and thus has been a concern in many countries. Guided by the bioecological systems theory and the self-determination theory, this study examined the associations between social relationships (i.e., parent-adolescent, teacher-student, and peer relationships) and SMA among adolescents, as well as the underlying mechanisms. Valid participants were 844 Italian high school students (358 boys, 42.42%), aged from 13 to 20 years old ($M = 16.89$, $SD = 1.58$). Latent profile analysis identified four relationship profiles: the mixed (6.04%), the adequate (57.35%), the vulnerable (29.74%), and the highly vulnerable (6.87%). The mediating role of psychological need satisfaction was found in the association between social relationships and SMA using both variable-centered and person-centered approaches. These findings highlight the impact of interpersonal and psychological factors on adolescent SMA.

With the rapid development of mobile internet technology, social media addiction (SMA) has become a widespread problem in many countries among adolescents who tend to have a higher addiction prevalence than university students and community adults (Cheng et al., 2021). SMA is defined as a maladaptive psychological dependence on social media that manifests itself in behavioral addiction symptoms (Sun & Zhang, 2021). Previous research has shown that SMA or problematic social media use is related to many maladaptive developmental outcomes in adolescents, including low life satisfaction (Eijnden et al., 2018), poor academic performance (Sampasa-Kanyinga et al., 2019), depression (Wang et al., 2018), and even higher suicide risk (Luo et al., 2021). Therefore, it is of great importance to investigate the antecedent factors of SMA and the underlying mechanisms.

1. Social relationships and adolescents' social media addiction

According to the bioecological systems theory (Bronfenbrenner & Morris, 2006), the development of children and adolescents is determined not only by their own physical and mental maturity, but also by the comprehensive and complex interactions of the contextual/social factors on them. Among the complex systems, the family system and the school system are of particular importance in providing psychological support to children and adolescents in the era of COVID-19 pandemic

(Zhou, 2020). In the present study, we focus on the associations between interpersonal relationship factors and adolescent SMA, including the relationship between parents and adolescents in the family system, and the relationship between teachers and students, as well as the relationship between peers, in the school system.

As a prominent factor in the family system, the relationship between parents and adolescents plays a significant role in the development of SMA in adolescents. According to attachment theory (Bowlby, 1982), the secure attachment orientation, that results from the interactions with primary caregivers (usually parents), is beneficial for children's and adolescents' development. A secure attachment style is related to less problematic social media use (for a review, see Sun & Zhang, 2021). Adolescents tend to have fewer problems about SMA when they have secure attachment with their parents. Consistent with this theoretical perspective, there is a large body of research suggesting that a good parent-adolescent relationship reduces the level of SMA (Bilgin et al., 2020; Bloemen & De Coninck, 2020; Geurts et al., 2022; Koning et al., 2018). For example, Geurts et al. (2022) found that only the parent-adolescent factor was a significant predictor when the antecedent factors of problematic social media use in the family (sub)system were examined simultaneously. For adolescents, perceived high-quality relationship with parents is a protective factor for fear of missing out (Bloemen & De Coninck, 2020), which is positively correlated with

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problematic social media use (for meta-analysis, see [Fioravanti et al., 2021](#)). In addition, Internet-specific parenting (restrict Internet-specific rules) negatively predicted social media disorder symptoms in adolescents ([Koning et al., 2018](#)).

Besides parent-adolescent relationship in the family system, the teacher-student relationship and peer relationship, as two main factors in the school system, may also be related to SMA. Seeing from the stage-environment fit perspective, the mismatch between adolescents' needs and their social environment (e.g., school system) can lead to problematic developmental outcomes ([Eccles et al., 1993](#)). According to social control theory ([Hirschi, 1969](#)), adolescents' bonding with their teachers, measured as the strength of affective ties, may serve as a social control to prevent adolescents from engaging in problematic behaviors (e.g., Internet addiction, and SMA). Consistent with this theory, empirical studies also indicated that better teacher-student relationship was associated with lower levels of overall Internet addiction or smartphone addiction ([Jia et al., 2017](#); [Shi et al., 2022](#); [Wang et al., 2011](#)). However, these studies only targeted on general addiction and the mechanisms underlying this relationship remained unclear. The relationship between the teacher-student relationship and SMA (as a specific addiction), as well as the underlying mediating mechanisms, should be further explored. In addition, according to the social compensation theory ([Boniel-Nissim & Sasson, 2018](#)), adolescents who have poor relationship with peers may turn to the Internet (e.g., social media) to compensate their social needs. However, among the few empirical studies we could find, not all of them is consistent with this theoretical perspective. For example, [Bae \(2015\)](#) found that peer relationship was a protective factor for smartphone addiction, while [Huang et al. \(2021\)](#) found that good peer relationship increased the risk of social media addiction in adolescents. Therefore, the association between peer relationships and SMA should also be explored further.

Based on the above-mentioned theoretical and empirical evidence, we hypothesize that parent-adolescent and teacher-student relationship negatively predicted adolescent SMA, while we do not hypothesize the association between peer relationship and SMA because of the few and inconsistent results.

1.2. The mediating role of basic need satisfaction

Adolescents' interpersonal relationships may have an influence on their SMA, and the mechanisms underlying this relationship need to be further explored. According to the self-determination theory, social factors that support the satisfaction of basic needs are associated with better developmental outcomes ([Deci & Ryan, 2000](#)), including less SMA ([Masur et al., 2014](#)). Consistently, accumulating empirical evidence also suggests that basic needs satisfaction may play a mediating role in the associations between social relationships and SMA: On the one hand, many studies indicated that social interpersonal relationships may influence the degree of adolescents' psychological needs satisfaction ([Froiland et al., 2019](#); [Gao et al., 2021](#); [Kocayoruk, 2012](#); [SunGao, Xiang, Chen, Liu, & Chen, 2020](#); [Tilga et al., 2018](#)). Specifically, [Sun et al. \(2020\)](#) found that poor parent-child relationship was associated with dissatisfaction of basic psychological needs, which may further trigger adolescents' tendency to use mobile technologies addictively. [Froiland et al. \(2019\)](#) found that the teacher-student relationship was positively and moderately correlated with basic needs satisfaction. In addition, perceived support from peers, which is strongly related to peer relationships, had a positively significant effect on adolescents' psychological need satisfaction ([Tilga et al., 2018](#)). On the other hand, empirical research also documented that thwarted basic need satisfaction further makes adolescents more vulnerable to addictive social media use ([Chen, 2019](#); [Masur et al., 2014](#); [Sun & Zhang, 2021](#)). Considering both the theoretical and empirical evidence together for the first and second stage of the mediating process, we hypothesize that social relationships (including parent-adolescent, teacher-student, and peer relationships) exert an influence on SMA via basic psychological

needs satisfaction. To our knowledge, no previous study has simultaneously examined the mediating mechanism underlying the associations between these three social relationships and SMA.

1.3. The person-centered perspective

To date, variable-centered approach has been used in many of the previous studies to examine the relationships between interpersonal/environmental factors and adolescents' social media behaviors. However, this widely used approach fails to simultaneously capture the heterogeneity of the social relationships from different (sub)systems that adolescents perceive in their lives, because it ignores the fact that the average values of variables in the population cannot quantify different participants' response patterns ([Bergman & Trost, 2006](#); [Schwartz et al., 2011](#)). Due to this limitation, a person-centered approach was recommended to identify the response patterns because it is able to consider different aspects from a relatively comprehensive and holistic perspective ([Bergman & Trost, 2006](#)). By applying the person-centered approach, it can be identified that the profiles of adolescents with similar response patterns on their relationships with parents, teachers, and peers ([Schwartz et al., 2011](#)). Therefore, in addition to the variable-centered approach, this approach was also used in the present study to explore adolescents' relationship profiles and how these profiles are related to SMA.

1.4. The current study

Despite the established association between problematic social media use and negative developmental outcomes in adolescents, the social/interpersonal factors that contribute to this behavior, as well as the psychological mechanisms involved, are not yet fully understood. Furthermore, previous investigations have largely neglected the implementation of a person-centered approach that can effectively capture the heterogeneity of social relationship composition, potentially compromising the reliability and validity of their findings. In order to address these gaps in knowledge, the current study was conducted. In summary, based on the theories and empirical research mentioned above, the aims of the current study were to: (1) examine the direct effects of the parent-adolescent relationship, the teacher-student relationship, and the peer relationship simultaneously on adolescents' social media addiction, which reveals the unique effects after controlling for other relationships; (2) explore the potential mediating effects of basic need satisfaction in the associations between social relationships and social media addiction; (3) identify the relationship profiles using a person-centered approach; and (4) examine the mediating role of basic need satisfaction between relationship profiles and social media addiction.

2. Method

2.1. Participants and procedure

After removing invalid participants ($n = 58$), the valid participants were 844 students (358 boys, 42.4%) from five different grade levels (Grade 9: $n = 99$, Grade 10: $n = 113$, Grade 11: $n = 122$, Grade 12: $n = 136$, Grade 13: $n = 374$) in high schools located in the northwest Italy. The mean age was 16.89 years old ($SD = 1.58$), ranging from 13 to 20 years (Grade 9: $M = 14.22$, $SD = 0.63$, 13–18 years; Grade 10: $M = 15.08$, $SD = 0.52$, 14–17 years; Grade 11: $M = 16.21$, $SD = 0.72$, 15–19 years; Grade 12: $M = 17.26$, $SD = 0.58$, 16–20 years; Grade 13: $M = 18.23$, $SD = 0.51$, 17–20 years). For more demographic information, please see [Table 1](#). All students could read and write Italian. Participation in the research was voluntary.

After obtaining the ethical approval (IRB n. 0675,955) from the ethics committee at the authors affiliated university, high schools were contacted through public contact information and through the authors' personal social network. Prior to the data collection, consents to

Table 1
Participants' characteristics of demography.

	Frequency	Percentage
Gender		
female	486	57.6%
male	358	42.4%
Age		
13	1	0.1%
14	90	10.7%
15	112	13.3%
16	105	12.4%
17	120	14.2%
18	337	39.9%
19	65	7.7%
20	14	1.7%
Maternal/Paternal highest education level^a		
Middle school and below	193/214	22.9%/25.4%
Vocational school	142/170	16.8%/20.1%
High school	237/224	28.1%/26.5%
Bachelor and above	263/229	31.2%/27.1%
Missing	9/7	1.1%/0.8%
Maternal/Paternal age		
30–40	110/42	13.0%/5.0%
40–50	487/379	57.7%/44.9%
50–60	232/366	27.5%/43.4%
60–70	4/42	0.5%/5.0%
70–80	0/2	0.0%/0.2%
Missing	11/13	1.3%/1.5%

Note.

^a Maternal/Paternal highest education level: data on the left of the slash line are maternal highest education level and on the right of the slash are paternal level; the same for Maternal/Paternal age.

participate were signed by the students and their parents. Data were collected in classrooms by trained research assistant in spring 2022. Standard instructions were given. Participants were informed that they could withdraw from the study at any time and that their responses would be used only for research purposes without violating their personal information privacy. All the ethical codes of the Italian Association of Psychology were strictly followed.

2.2. Measures

2.2.1. Parent-adolescent relationship

The Parent-Adolescent Relationship Scale (PARS, Burke et al., 2021) was used to measure the relationship between adolescents and their parents. The PARS is a 15-item scale with three subdimensions: involvement (5 items, e.g., “We spend time together doing activities we each like”, Cronbach's alpha = .61), connectedness (7 items, e.g., “My parent encourages me to talk about my thoughts and feelings”, Cronbach's alpha = .61), and hostility (3 items, e.g., “My parent criticises me”, Cronbach's alpha = .60). Adolescents were asked to rate each statement on a 6-point scale (0 = *Not at all true*, 5 = *Nearly always or always true*). Scores for the dimension were calculated by averaging all items within each subscale respectively. The total score was calculated by summing the two standardized positive dimension scores and subtracting the standardized negative dimension score, resulting in a final parent-adolescent relationship score with a higher value representing a better relationship. This scale was translated into Italian by a back-translation procedure. The confirmatory factor analysis revealed that the construct validity of PARS was acceptable: $\chi^2/df = 3.53$, RMSEA = 0.06, CFI = 0.94, TLI = 0.92, SRMR = 0.05. The reliability of PARS was acceptable in present sample (Cronbach's alpha = .62).

2.2.2. Teacher-student relationship

The Student Perception of Affective Relationship with Teacher Scale (SPARTS), developed by Koomen and Jellesma (2015), was used to measure the teacher-student relationship. The 25-item version of SPARTS (Longobardi et al., 2016) includes three dimensions: closeness

(8 items, e.g., “When I feel uncomfortable, I go to my teacher for help and comfort”, Cronbach's alpha = .86), conflict (10 items, e.g., “I easily have quarrels with my teacher.”, Cronbach's alpha = .81), and negative expectations (7 items, e.g., “I wish my teacher knew me better”, Cronbach's alpha = .66). Each statement was rated by students on a 5-point scale (1 = *No, that is not true*, 5 = *Yes, that is true*) according to how true it was in their own situation. Many previous studies (e.g., Longobardi et al., 2016) indicated acceptable reliability and validity of SPARTS among Italian participants. In the current sample, this scale showed acceptable reliability (Cronbach's alpha = .88). Dimension scores were calculated by summing the items within each subscale respectively. The final teacher-student relationship score was calculated as the standardized positive dimension subtracting by two standardized negative dimensions, with a higher value indicating a better relationship between adolescents and their teachers.

2.2.3. Peer relationship

The Peer Relationship Item Bank (PRIB), developed by DeWalt et al. (2013), was used to measure peer relationships among adolescents. The full version of the PRIB contains 15 items (e.g., “I felt accepted by other kids my age.”). Adolescents were required to rate the items on a 5-point scale (1 = *Never*, 5 = *Almost always*). The final score was calculated as the sum of all 15 items, with a higher value indicating a better peer relationship. The construct validity of PRIB is adequate based on a confirmatory single factor model: $\chi^2/df = 2.63$, RMSEA = 0.05, CFI = 0.96, TLI = 0.95, SRMR = 0.04. In the present sample, PRIB had good reliability (Cronbach's alpha = .91).

2.2.4. Basic psychological need satisfaction

Basic psychological need satisfaction was measured using the General Need Satisfaction Scale (GNSS, Gagné, 2003) which was adapted from a measure of need satisfaction in the workplace (Ilardi et al., 1993). The GNSS includes three dimensions: autonomy (7 items, e.g., “I feel like I can decide for myself how to live my life.”, Cronbach's alpha = .70), competence (6 items, e.g., “Most days I feel a sense of accomplishment from what I do.”, Cronbach's alpha = .67), and relatedness (8 items, e.g., “People in my life care about me.”, Cronbach's alpha = .80). Adolescents rated each statement on a 7-point scale (1 = *Not true at all*, 7 = *Definitely true*). The overall satisfaction score was calculated as the mean of the three subdimensions, with a higher value indicating better needs satisfaction. The construct validity of GNSS was acceptable: $\chi^2/df = 3.86$, RMSEA = 0.05, CFI = 0.91, TLI = 0.90, SRMR = 0.05. In the current sample, reliability was good (Cronbach's alpha = .86).

2.2.5. Social media addiction

The Bergen Social Media Addiction Scale (BSMAS, Andreassen et al., 2016) developed based on six core elements of addiction (Griffiths, 2005), was used to measure the level of social media addiction in adolescents. The Italian version of BSMAS (Monacis et al., 2017) consists of 6 items (e.g., “How often during the last year have you tried to cut down on the use of social media without success?”). Adolescents had to rate each item on a 5-point scale (1 = *Very rarely*, 5 = *Very often*). The final addiction score was calculated by summing all item ratings, with a higher score representing a higher degree of addiction. The Cronbach's alpha of the BSMAS in the current sample was .74, indicating acceptable internal consistency.

2.3. Data analysis

Descriptive and basic analyses were performed in SPSS 26 (IBM Corp, Armonk, NY, USA), and other analyses (e.g., LPA and mediating analyses) were performed in Mplus 8.3 (Muthén & Muthén, Los Angeles, CA, USA). The percentage of missing values ranged from 0.1% to 2.1% for variables of interest, and 13.2% of cases had missing values on at least one variable. Missing values were at random and were handled by multiple imputation (Little et al., 2016). Specifically, the multiple

imputation function of Mplus was used to generate 50 imputed records, which is the recommended minimum of 20 imputed records for most situations (Graham et al., 2007). All variables and key covariates (e.g., age, gender) examined were included in the imputation model. Subsequently, each imputed data set was examined and analyzed. All descriptive information in these datasets was within a reasonable range. Subsequently, these imputed data results were pooled according to Rubin's (1987) rules. The results obtained with listwise deletion were similar to those obtained with multiple imputation. Therefore, the pooled results were used as the final results. To obtain a relatively comprehensive overview, the data were analyzed from both a variable-centered and a person-centered perspective.

On the one hand, the widely used variable-centered approach was used. First, the descriptive and correlative values of the variables under study were calculated. Second, the direct effect of adolescents' social relationships on social media addiction, as well as the mediating role of basic needs satisfaction in the associations, was examined. Third, the bootstrap method, as one of the most accurate techniques (MacKinnon et al., 2004), was used to generate the 95% confidence interval (CI). The bootstrap sample was 5000, and the 95% CI without zero indicates a significant effect (Shrout & Bolger, 2002).

On the other hand, the person-centered approach was also used. First, latent profile analysis was conducted to identify relationship profiles based on three indicators (i.e., parent-adolescent relationship, teacher-student relationship, and peer relationship). The decision on the number of profiles was made mainly based on the following fit indices: (1) Akaike Information Criterion (AIC), (2) Bayesian Information Criterion (BIC), (3) adjusted Bayesian Information Criterion (aBIC), (4) entropy (0.7 or higher, Reinecke, 2006), (5) Lo-Mendell-Rubin adjusted likelihood ratio test (LMR), (6) bootstrapped likelihood ratio test (BLRT). The number of profiles from one to five was examined. After determining the number of profile, multivariate analysis of variance (MANOVA) was performed to examine the differences in the indicators between profiles (Lan, 2022). Finally, mediating analysis with multi-categorical antecedents was conducted to further explore the mediating role of basic need satisfaction between relationship profiles and adolescent social media addiction. Indirect effects were also examined using a bootstrap method with a sample of 5000.

3. Results

3.1. Descriptive statistics and correlations

Table 2 shows the descriptive statistics (i.e., mean, standard deviation) and the correlations of all the variables studied. All three relationships demonstrated a positive association with basic need satisfaction, and a negative association with social media addiction. However, the negative correlation between peer relationships and social media addiction was nonsignificant (only marginally significant, $p = .08$), indicating that this relationship may warrant more attention and

further investigation.

3.2. Test for the direct and mediating effects

First, the direct effects of the three relationships on social media were examined. The results of the path analysis showed that both parent-adolescent relationship ($\beta = -.10$, $SE = 0.04$, 95% $CI = [-0.17, -0.02]$, $p = .013$) and the teacher-student relationship ($\beta = -0.20$, $SE = 0.04$, 95% $CI = [-0.27, -0.13]$, $p < .001$) were negatively associated with social media addiction. However, peer relationship did not significantly relate to social media addiction ($\beta = .05$, $SE = 0.04$, 95% $CI = [-0.03, 0.12]$, $p = .109$). Next, the mediating role of basic need satisfaction was examined. The results are illustrated in Fig. 1. Basic need satisfaction was positively impacted by parent-adolescent relationship, teacher-student relationship, and peer relationship simultaneously. Furthermore, a significant negative correlation was observed between basic needs satisfaction and social media addiction, suggesting that individuals who experience a greater fulfillment of their basic needs may be less susceptible to developing addictive behaviors related to social media use. None of the 95% CIs generated by the bootstrap procedure included zero, indicating the significant indirect effects of basic needs satisfaction in the associations between parent-adolescent relationships and SMA ($\beta = -0.06$, 95% $CI = [-0.10, -0.04]$), between the teacher-student relationship and SMA ($\beta = -0.06$, 95% $CI = [-0.09, -0.04]$), and between the peer relationship and SMA ($\beta = -0.13$, 95% $CI = [-0.19, -0.08]$).

3.3. Identifying the relationship profiles

The results of the LPA analysis were presented in Table 3. The model with four profiles fitted the data relatively well. In particular, the entropy of this model was relatively high. The LMR and BLRT were significant, indicating that the four-profile model fitted better than the three-profile model. Moreover, although the entropy of the four-profile model was slightly lower than the five-profile model, the smallest profile in the four-profile model accounted for more than 5% of the total sample (Marsh et al., 2009). Therefore, the four-profile solution was chosen as the final model.

Then the MANOVA was conducted on the profile indicators (i.e., parent-adolescent, teacher-student, and peer relationships) for the four-profile model, and the results are shown in Table 4. In profile 1 ($n = 51$, 6.04%), adolescents had relatively high parent-adolescent relationship, low teacher-student relationship, but the lowest peer relationship. In profile 2 ($n = 484$, 57.35%), adolescents had the relatively best relationship with their parents, teachers, and peers. In profile 3 ($n = 251$, 29.74%), adolescents had a relatively weak parent-adolescent relationship, the lowest teacher-student relationship, and a relative moderate peer relationship. In profile 4 ($n = 58$, 6.87%), all the three relationships were the lowest. Following the previous study (Schwartz et al., 2011), the profiles from profile 1 to profile 4 were respectively labelled as

Table 2
Descriptive statistics and correlations of the variables ($N = 844$).

Variables	1	2	3	4	5	6	7
1. Age	–						
2. Gender	-.07	–					
3. Parent-Adolescent Relationship	.01	-.09*	–				
4. Teacher-Student Relationship	.07*	-.05	.28***	–			
5. Peer Relationship	.04	-.12***	.36***	.20***	–		
6. Basic Need Satisfaction	.03	-.24***	.50***	.42***	.65***	–	
7. Social Media Addiction	-.08*	.27***	-.16***	-.25***	-.06†	-.27***	–
<i>M</i>	16.89	1.58	0.00	0.00	59.20	4.80	16.01
<i>SD</i>	1.58	0.50	2.33	2.22	10.71	0.85	5.11
<i>Skewness</i>	-0.48	-0.31	-0.54	-0.31	-0.97	-0.21	0.20
<i>Kurtosis</i>	-0.86	-1.91	-0.11	-0.02	0.81	-0.30	-0.46

Note. Gender (1 = male, 2 = female). * $p < .05$, *** $p < .001$, † $p = .08$.

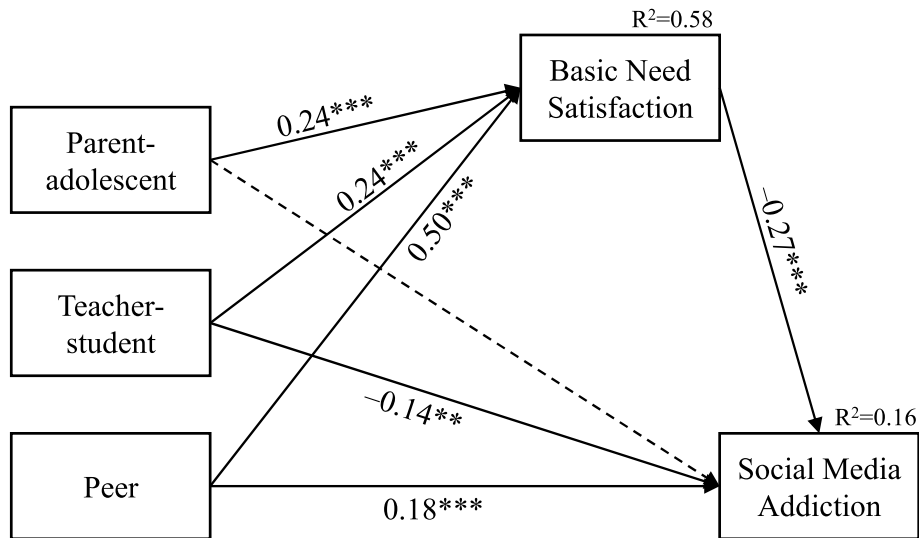


Fig. 1. The mediating effect of basic need satisfaction between relationships and social media addiction. Note. $N = 844$; The path coefficients were standardized; Age and gender were controlled.

Table 3
Fit indices for relationship profiles in adolescents.

Number of profiles	AIC	BIC	aBIC	Entropy	LMR	BLRT	Smallest profile
1 Profile	16990.930	17019.359	17000.304	-	-	-	100% ($N = 844$)
2 Profiles	16751.214	16798.595	16766.838	0.833	238.854***	247.716***	15.76% ($n = 133$)
3 Profiles	16700.223	16766.557	16722.097	0.644	56.881	58.991***	15.17% ($n = 128$)
4 Profiles	16645.240	16730.527	16673.364	0.733	60.729***	62.983***	6.04% ($n = 51$)
5 Profiles	16621.429	16725.669	16655.804	0.745	30.673	31.811***	3.08% ($n = 26$)

Note. $N = 844$; AIC = Akaike information criteria, BIC = Bayesian information criterion, aBIC = adjusted BIC, LMR = Lo-Mendell-Rubin adjusted likelihood ratio test, BLRT = bootstrapped likelihood ratio test; *** $p < .001$.

Table 4
Mean differences of the indicators in four relationship profiles.

Indicators	$M (SD)$ Range				F	
	Total sample ($N = 844$)	Profile 1: Mixed ($n = 51$)	Profile 2: Adequate ($n = 484$)	Profile 3: Vulnerable ($n = 251$)		Profile 4: Highly Vulnerable ($n = 58$)
Parent-adolescent relationship	0.00 (2.33) -7.68~4.72	0.80 ^a (1.51) -2.19~3.94	1.46 ^b (1.27) -1.43~4.72	-2.05 ^c (1.40) -7.01~0.50	-4.04 ^d (1.53) -7.68~-1.52	564.16***
Teacher-student relationship	0.00 (2.22) -7.62~5.49	-0.68 ^a (2.41) -7.50~3.40	0.72 ^b (1.94) -4.72~5.49	-0.95 ^a (2.18) -6.51~4.13	-1.34 ^a (2.14) -7.62~-2.75	47.54***
Peer relationship	59.20 (10.71) 15.00~75.00	38.00 ^a (6.78) 15.00~47.00	63.92 ^b (6.63) 46.88~75.00	59.10 ^c (7.16) 45.00~75.00	38.80 ^a (6.67) 24.00~51.00	416.70***

Note. The means with different superscripts different significantly with each other by profiles; *** $p < .001$.

mixed, adequate, vulnerable, and highly vulnerable (see Fig. 2).

3.4. The mediating effects from the person-centered perspective

First, the correlations between the profile probabilities and the variables studied were calculated (see Table 5). Adolescents' basic need satisfaction was negatively correlated with the probabilities of the mixed, the vulnerable, and the highly vulnerable profiles, while it was positively associated with the probability of the adequate profile. SMA was positively correlated with the probabilities of the vulnerable profile and the highly vulnerable profile, and it was negatively associated with the probabilities of the adequate profile. The correlation between the mixed profile and SMA was not significant.

Taking the mixed profile as the reference group, the mediating role of basic need satisfaction between the profiles and SMA was analyzed. As illustrated in Fig. 3, compared to students in the mixed group, students

in the adequate group and in the vulnerable group tended to report higher levels of basic need satisfaction, while students in the highly vulnerable group tended to have lower levels of basic need satisfaction. In addition, the study found a negative relationship between basic needs satisfaction and social media addiction, suggesting that individuals who report greater satisfaction of their basic needs may be less likely to develop problematic behaviors related to social media use. All the 95% CIs for the relative indirect effects did not include zero. Therefore, the relative indirect effects of basic need satisfaction were significant in the associations between the adequate profile and SMA ($\beta = -0.14$, 95% CI = [-0.21, -0.09]), between the vulnerable profile and SMA ($\beta = -0.05$, 95% CI = [-0.09, -0.03]), and between the highly vulnerable profile and SMA ($\beta = 0.03$, 95% CI = [0.02, 0.05]).

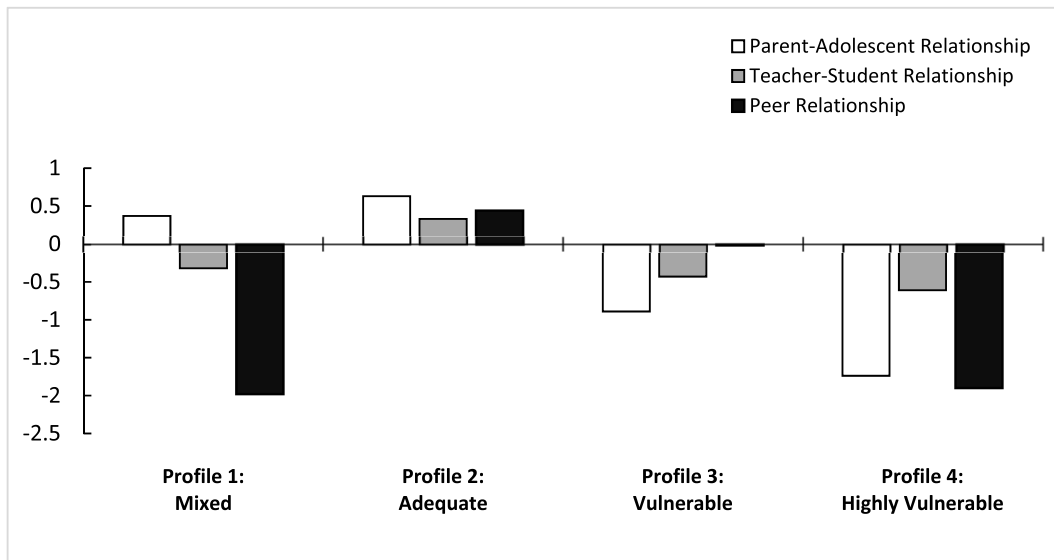


Fig. 2. Z-scores of the indicators in each profile. Note. the longitudinal axis is the z-score of each indicator.

Table 5 Correlations of the profile probabilities and studied variables (N = 844).

Variables	1	2	3	4	5	6
1. Probability_P1_Mixed	-					
2. Probability_P2_Adequate	-.37***	-				
3. Probability_P3_Vulnerable	-.18***	-.68***	-			
4. Probability_P4_Highly Vulnerable	.01	-.44***	-.12***	-		
5. Basic Need Satisfaction	-.28***	.63***	-.28***	-.47***	-	
6. Social Media Addiction	.03	-.21***	.19***	.07*	-.27***	-

Note. *p < .05, ***p < .001.

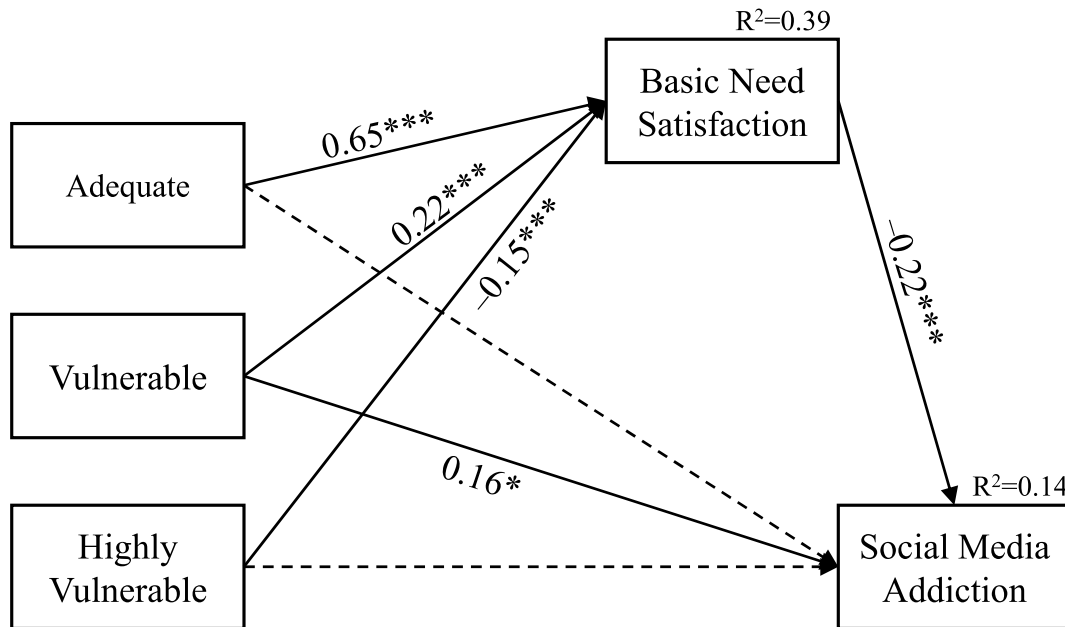


Fig. 3. The mediating effect of basic need satisfaction between relationship profiles and social media addiction. Note. The mixed profile was taken as the reference group; The path coefficients were standardized. Age and gender were controlled.

4. Discussion

In the current study, based on the bioecological systems theory

(Bronfenbrenner & Morris, 2006) and the self-determination theory (Deci & Ryan, 2000), we examined the relationships between adolescents' social relationships (i.e., parent-adolescent, teacher-student, and

peer relationships) and social media addiction, as well as the mediating role of basic psychological need satisfaction using both variable-centered and person-centered approach. As the first study to examine these three social relationships in the field of social media addiction simultaneously, some interesting results were found in this study.

First, it was found that adolescents' social relationships (i.e., parent-adolescent, teacher-student, and peer relationships) play a critical role in SMA. Parent-adolescent relationship and teacher-student relationship directly associated with SMA in adolescent in a negative way. These results are consistent with previous studies indicating that these two social relationships are protective factors for adolescent online addictive behaviors (Bilgin et al., 2020; Geurts et al., 2022; Shi et al., 2022). This may be because adolescents who have better relationships with their parents and teachers tend to have relatively secure attachment styles, which further reduce the likelihood of being addicted to social media (Sun & Zhang, 2021). They have less distress and conflict with parents at home and with teachers at school, and thus may be more likely to follow their parents' (i.e., Internet-specific parenting, Koning et al., 2018) and teachers' instructions on social media use. And eventually, they have lower levels of SMA. However, we did not find a simple direct effect of peer relationship on SMA, although previous research has documented such an association (e.g., Huang et al., 2021). One possible explanation is that peer relationship might be both protective and risk factors for adolescents' SMA simultaneously. As a protective factor, peer relationships positively affect adolescents' satisfaction of basic psychological needs (as illustrated in our mediating model), which further decreasing the likelihood of adolescents' online social compensation seeking behaviors (Boniel-Nissim & Sasson, 2018) and ultimately decreasing the likelihood that they become addicted to social media (Chen, 2019; Masur et al., 2014). On the other hand, as a risk factor, it might particularly be related to the close relationships with deviant peers, which plays a significant role in adolescent deviance (Ardelt & Day, 2002), and eventually makes adolescents vulnerable to SMA. These positive and negative effects are intertwined, resulting the insignificant direct effect of peer relationship on SMA. Future studies could further explore and disentangle these effects.

Second, the satisfaction of basic psychological need needs was found to play a mediating role in the association between adolescents' social relationships (i.e., parent-adolescent, teacher-student, and peer relationships) and SMA. These findings are consistent with self-determination theory (Deci & Ryan, 2000). In the first half of the mediating procedure, relationships with parents, teachers, and peers were positively associated with adolescents' psychological need satisfaction, which is also in line with previous research (e.g., Froiland et al., 2019; Sun et al., 2020; Tilga et al., 2018). According to Collins and Laursen (2004), it is the content and quality of parent-adolescent relationships that determine the nature and extent of parental influence on adolescent. A positive parent-adolescent relationship can meet adolescents' basic psychological needs through family processes, including family routines, parental monitoring, and supportiveness (Hair et al., 2008). In the school/community context, teacher-student relationship and peer relationship play similar roles in satisfying adolescents' psychological needs when controlling parents-adolescents relationship. These findings support the self-determination theory (Deci & Ryan, 2000) that optimal social interpersonal factors are beneficial for adolescents' need satisfaction, which further protects them from unhealthy addictive behaviors. Another notable finding is that the total indirect effect of peer relationship through basic need satisfaction was negative, while the residential direct effect was positive. This result suggests that peer relationship, as a protective and risk factor for SMA, can reduce SMA through satisfying basic needs and increase SMA through other mediators simultaneously. Future studies should further investigate the underlying mechanisms. In the second half of the mediating process, basic needs satisfaction negatively related to adolescents' SMA. This result supports the social compensation theory (Boniel-Nissim & Sasson,

2018). Students with lower psychological need satisfaction longitudinally report higher levels of academic, social, and personal-emotional maladjustment (Ratelle & Duchesne, 2014). Furthermore, the dissatisfaction of basic needs and maladjustment may motivate adolescents to turn to social media for searching online interpersonal compensations, ultimately making adolescents vulnerable to addictive social media use (Sun & Zhang, 2021).

Finally, adolescents' relationship profiles, as well as their associations with the satisfaction of basic need and SMA, were discovered. Four relationship profiles were identified in our Italian adolescent sample: the mixed profile, the adequate profile, the vulnerable profile, and the highly vulnerable profile (see Fig. 2 for details). These profiles were similar to those found in previous research (Schwartz et al., 2011). Compared to previous research, the mixed group is noteworthy. In this group, parent-adolescent relationship was relatively high even though other relationships were relatively negative. This is consistent with previous research showing that Italian adolescents' maternal attachment was higher than in other countries (Li et al., 2014). Moreover, the satisfaction of basic needs played a mediating role between the profiles and SMA, when the mixed profile was taken as the reference. A counterintuitive result is that basic needs satisfaction was positively related to the vulnerable profile (see Fig. 3). This means that adolescents in the vulnerable group have higher levels of need satisfaction than adolescents in the mixed group. Compared to the mixed group, adolescents in the vulnerable group had a significantly better relationship with peers, while their relationship with parents was worse. These findings indicate that peer factors are becoming more important than parental factors in meeting basic needs during the developmental stage of adolescence (Gao et al., 2022). Therefore, some intervention programs aimed at improving adolescents' psychological need satisfaction might try to spare some of the attention/effort from family factors to peer factors.

Although some meaningful results were found, there are some limitations with this study. Firstly, due to the cross-sectional nature of the current study, no conclusion can be drawn about the direction and causality of the relationships among the studied variables, despite the solid theoretical and empirical foundations for our model. Longitudinal and/or experimental method should be employed in the future research. Secondly, all data were self-reported, which may undermine the validity of the measurements. In the future, multiple informants (e.g., teachers, parents, peers) should be recruited, and multiple methods (e.g., peer nomination) could be used. Thirdly, while a back-translation procedure was employed and some translation guidelines were followed for certain scales (e.g., PARS), it is important for future research to conduct further validation of these scales, including criterion validity and test-retest reliability. Finally, only Italian adolescents were included as the participants. The generalization of our conclusions to adolescents from other countries/cultures is problematic. It is recommended that cross-cultural research be conducted to explore potential cultural differences.

Credit author statement

Shanyan Lin: Conceptualization, Methodology, Formal analysis, Writing – original draft, Writing- Reviewing. Sofia Mastrokourou: Writing – original draft, Supervised formal analysis, Writing- Reviewing, Investigation. Claudio Longobardi: Conceptualization, Methodology, Writing – original draft, Writing- Reviewing, Supervised.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent

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

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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