



A three-wave panel study on longitudinal relations between problematic social media use and psychological distress during the COVID-19 pandemic

Maria Di Blasi^{a,*}, Laura Salerno^a, Gaia Albano^a, Barbara Caci^a, Giovanna Esposito^b, Silvia Salcuni^c, Omar Carlo Gioacchino Gelo^{d,e}, Claudia Mazzeschi^f, Aluette Merenda^a, Cecilia Giordano^a, Gianluca Lo Coco^a

^a Department of Psychology, Educational Science and Human Movement, University of Palermo, Viale delle Scienze, Edificio 15, 90128 Palermo, Italy

^b Department of Humanities, University of Napoli Federico II, Via Porta di Massa, 1, 80133 Napoli, Italy

^c Department of Developmental and Social Psychology, University of Padova, Via Venezia 12, 35132 Padova, Italy

^d Department of History, Society and Human Studies, Studium 2000- University of Salento, Edificio 5, Via di Valesio, 24, 73100 Lecce, Italy

^e Faculty of Psychotherapy Science, Sigmund Freud University Vienna, Freudplatz 1, 1020 Vienna, Austria

^f Department of Philosophy, Social & Human Sciences and Education, University of Perugia, P.zza Ermini 1, 06123 Perugia, Italy

ARTICLE INFO

Keywords:

COVID-19

Problematic social media use

Psychological distress

Random-Intercept Cross-Lagged Panel Model

Social media addiction

ABSTRACT

Background: It still remains unclear whether problematic social media use (PSMU) is a cause or a consequence of psychological distress. The present study aimed to investigate the temporal relationships between PSMU and psychological distress through a three-wave panel study (between April and July 2020, with an interval of 1 month between each period of time).

Methods: 3,912 adult Italian participants were surveyed during the COVID-19 pandemic for psychological distress (Depression, Anxiety and Stress Scale) and PSMU (Bergen Social Media Addiction Scale). Random-Intercept Cross-Lagged Panel Models were applied to disaggregate between-person from within-person associations as regards PSMU and an individual's distress.

Results: On a between-person level we found that adults with higher PSMU also reported heightened levels of psychological distress across the three waves. However, on a within-person level, no cross-lagged associations were found between changes in distress and subsequent changes in PSMU and vice versa. The results were largely unchanged with the inclusion of participants' gender and age or COVID-19-related fears as covariates, and when the three subscales of depression, anxiety and stress were examined in separate models.

Conclusions: The current study suggests that the link between PSMU and psychological distress is mainly driven by trait-like differences and not by state-like individual changes over time.

1. Introduction

The improvements in Internet connectivity and the increased popularity of smartphones have significantly increased the use of social media over the past few years (Statista.com, 2022). Social media (SM) are "Internet-based, disentrained, and persistent channels of mass-personal communication facilitating perceptions of interactions among users, deriving value primarily from user-generated content" (Carr & Hayes, 2015, p. 50). Previous studies outlined the positive role of SM in fostering people's well-being, by enriching everyday-user experiences, improving their social connection, social capital, learning, and search for information (Burrow & Rainone, 2017; Liu & Baumeister, 2016;

Verduyn et al., 2017). On the other hand, several reviews have highlighted the negative association, albeit small in size, between general SM activities (e.g. time spent with SM, intensity of SM use or frequency of SM checking) and well-being, depression and loneliness (Appel et al., 2020; Huang, 2017, 2021; Orben & Przybylski, 2019), and problematic social media use (PSMU) was shown to be a serious public health concern among both adolescents and young adults (Huang, 2022; Keles et al., 2020; Shensa et al., 2018).

PSMU refers to an enduring preoccupation with SM that can lead to impairments in social activities, interpersonal relationships, and/or psychological well-being (Andreassen, 2015). Similarly to other technology-mediated behavior, such as problematic smartphone use,

* Corresponding author.

E-mail address: maria.dibiasi@unipa.it (M. Di Blasi).

<https://doi.org/10.1016/j.addbeh.2022.107430>

Received 23 March 2022; Received in revised form 11 July 2022; Accepted 13 July 2022

Available online 16 July 2022

0306-4603/© 2022 Elsevier Ltd. All rights reserved.

PSMU may relate to a spectrum of similar, yet distinct problematic behavior associated with Internet use (Baggio et al., 2018; Moretta et al., 2022). There are several theoretical models highlighting the potential mechanisms underlying the development and maintenance of PSMU in the context of internet-use disorders. For example, the *Compensatory Internet Use Theory* (CIUT; Kardefelt-Winther, 2014) posits that individuals with social deficits and/or psychopathological symptoms could handle their negative emotions by overusing social networks and developing PSMU as a maladaptive coping mechanism. The Interaction of Person-Affect-Cognition-Execution (I-PACE) by Brand and colleagues (2019), provided a theoretical model for addictive behavior and posits that predisposing variables (e.g., anxiety, depression, impulsivity), along with other neurobiological, cognitive and affective processes, may interact and influence individuals' PSMU. To date, although it is accepted that the etiology of PSMU may include a combination of biological, psychological, and social factors, a consensus regarding its diagnostic criteria and reliable assessment tools is rather patchy (Wegmann et al., 2022). Some researchers defined the PSMU as characterized by "addiction-like" symptoms (e.g. salience, tolerance, mood regulation, withdrawal, conflict, relapse) (Kuss & Griffiths, 2017). Other scholars argued against the adoption of strict substance addiction criteria to describe the PSMU, given that disordered behavior and non-disordered behavior (i.e. over-engaged or heavy use) might not be distinguished consistently (Kardefelt-Winther et al., 2017). To date, empirical evidence supporting its construct validity as a behavioral addiction is still mixed (Casale, 2020; Sun, & Zhang, 2021). Thus, this umbrella-construct is broad enough to incorporate different levels of excessive or disordered use (Marino et al., 2018) characterized by a lack of self-regulation in one's use of SM (Valkenburg, 2022).

Psychological distress refers to low mental well-being conveyed through a set of painful mental symptoms, such as depression and anxiety (APA, 2020). There is still a knowledge gap related to the lack of empirical studies examining whether PSMU behavior can lead to significant psychological distress over time or vice versa. Some experimental studies evidenced that a reduction in daily Facebook use may result in lower distress and an improvement in well-being (Brailovskaia et al., 2020; Tromholt, 2016). Previous meta-analyses also evidenced a small-to-medium association between PSMU and psychological distress indicators such as symptoms of depression, anxiety, loneliness, social anxiety, and stress (Appel et al., 2020; Huang, 2022; Marino et al., 2018; Shannon et al., 2022), but clear support for a detrimental effect of PSMU is lacking. Most previous evidence is primarily cross-sectional and further research efforts are needed to examine the temporal associations between PSMU and distress, as well as their interaction over time (Henzel & Håkansson, 2021). Most importantly, prior research failed to disaggregate longitudinal data into its between- and within-person sources of variance, by examining cross lagged association between these variables. The within-person variance commonly refers to state-like changes that occur from one assessment point to the next one, while the between-person variance refers to trait-like differences between individuals (Curran & Bauer, 2011). Thus, prior longitudinal research was not able to test whether individuals who increase their PSMU above their own typical levels, can report subsequent increases in their own psychological distress or vice versa. It is also worth noting that the few prospective studies which examined the association between PSMU and psychological distress focused primarily on adolescents (Course-Choi & Hammond, 2021). Overall, these research findings suggest limited evidence for a longitudinal association between increased social media use and mental health problems (Coyné et al., 2020; Puukko et al., 2020) and that SM use may serve as an indicator rather than a determinant of risk of psychological distress (Beeres et al., 2021). In the current study, we extend previous research by examining the prospective association between PSMU and psychological distress among adults, given that there is evidence that the link between PSMU and mental health problems may be larger in older samples (Marino et al., 2018; Prizant-Passal et al., 2016).

Moreover, in the present investigation we focus on the relationship between PSMU and psychological distress in the context of the COVID-19 outbreak. Although SM use during the pandemic is thought to have had a beneficial role in buffering negative consequences linked to social isolation due to quarantine measures (Marzouki et al., 2021; Ruggieri et al., 2021), there is initial evidence that the COVID-19-related lockdown contributed to enhancing an excessive SM use, with a risk of developing maladaptive SM patterns use (Brailovskaia & Margraf, 2021). Feelings of loneliness, anxiety symptoms and COVID-19 stress (Boursier et al., 2020; Geirdal et al., 2021; Zhao & Zhou, 2021) were associated with excessive or problematic SM use in cross-sectional studies during the first wave of the pandemic. However, no previous studies examined the link between PSMU and psychological distress at different time points during the pandemic.

The aim of this study is to examine the bi-directional associations between PSMU and psychological distress during the COVID-19 pandemic with three-wave panel data. Specifically, this study contributes to the extant knowledge by examining whether the relationship between PSMU and psychological distress is driven by between-person (trait-like) or within-person (state-like) differences. We hypothesize that trait-like time-invariant components of PSMU are linked to temporary, stable differences in distress scores (between-person differences). Thus, individuals who tend to report greater PSMU than other individuals over time, will also show higher psychological distress, and vice versa. Moreover, given the limited evidence supporting cross-lagged effects between PSMU and psychological distress, we proposed the following research question: Are individual fluctuations in psychological distress over time associated with fluctuations in PSMU over time or vice versa (within-person differences)? Thus, the study will evaluate to what extent a deviation, above or below the person-specific level in psychological distress at an earlier point in time, is associated with a subsequent deviation from the person-specific level in PSMU, and vice versa.

2. Methods

2.1. Participants and procedure

For this study, three-wave panel data during the COVID-19 outbreak (i.e., T1 = 7th-24th April 2020; T2 = 18th-31st, May 2020; and T3 = 26th June-8th July 2020) were used. Each administration window on average lasted approximately 15 days (i.e. 18 days for T1, 14 days for T2 and 13 days for T3). Participants were Italian adults who were surveyed online for a large-scale national project on the mental health correlates of the COVID-19 pandemic (Di Blasi et al., 2021). The initial sample included 3,864 participants at T1, 1,174 participants at T2 and 714 participants at T3. Forty-one participants (1.0%) were excluded because they were not resident in Italy at the time the survey was completed ($n = 25$) or because of age < 18 years ($n = 16$). Since we kept missing data points when matching the data for all three waves, the analytical sample included 3,912 participants ($n = 3823$ at T1; $n = 1162$ at T2; $n = 709$ at T3). Based on data collected at T1, the sample consisted of 2,802 females (73.3%) with an average age of 36.55 years ($SD = 14.76$; age range = 18–90). Over half of the respondents (56.2%, $n = 2148$) had high education levels (i.e. degree/post-degree); only 2.8% ($n = 108$) had a diagnosis of COVID-19 and 20.4% ($n = 780$) had relatives or friends who had a diagnosis of COVID-19. Only 15 more participants (0.40%) contracted the infection across the T2 and T3 assessment points. The majority of participants (92.9%, $n = 3553$) had spent the lockdown period with relatives. The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Ethics Committee of the University of [blinded for review].

2.2. Measures

The Depression, Anxiety and Stress Scale (DASS-21; Lovibond &

Lovibond, 1995; Henry & Crawford, 2005; Bottesi et al., 2015) was used to assess psychological distress. The DASS is a 21-item measure (e.g. *I couldn't seem to experience any positive feeling at all*) assessing depression, anxiety, and stress over the past 7 days using a 4-point Likert Scale (total score ranges from 0 to 63). In line with previous studies (Bottesi et al., 2015; Henry & Crawford, 2005), we adopted the DASS total score as a measure of general psychological distress. The DASS-21 total score has excellent internal consistency in the present study (Cronbach's α : T1 = 0.950; T2 = 0.955; T3 = 0.957).

The Bergen Social Media Addiction Scale (BSMAS; Andreassen et al., 2016; Monacis et al., 2017) was used to assess the addiction-like use of SM in general over the past 7 days. The BSMAS is an adaptation of the Bergen Facebook Addiction Scale (Andreassen et al., 2012); it contains 6 items (e.g. *Felt an urge to use SM more and more?*) rated on a 5-point Likert scale (total score ranges from 6 to 30), with higher scores indicating higher addiction-like use of SM. In the present study, the BSMAS showed good internal consistency (Cronbach's α : T1 = 0.806; T2 = 0.811; T3 = 0.858).

2.3. Statistical analyses

The data were screened separately for missing values at each time point; univariate distributions (i.e. skewness and kurtosis) were also examined. The internal consistency of the scales (Cronbach's α) was computed. Descriptive statistics and Pearson correlations were computed. Patterns of missing values at each time point were examined by Little's MCAR test. A *post hoc* power analysis indicated that our study was adequately powered.

To assess the longitudinal bidirectional relationship between psychological distress (DASS-21) and PSMU (BSMAS) a series of Random Intercept-Cross-Lagged Panel Models (RI-CLPM; Hamaker et al., 2015) were estimated. By using a RI-CLPM, it is possible to simultaneously assess both cross-lagged and auto-regressive paths and distinguish between-person (time-invariant) from within-person relationships (Fig. 1). Between-components are defined with latent variables, with the

repeated measures as their indicators (with factor loadings fixed to 1), in order to understand a person's time-invariant deviation from the grand means; thus the between-components represent the stable differences between persons. Removing between-person variance is important in order to avoid biased cross-lagged paths (which mix between- and within-person information), when data have a multilevel structure (data from multiple people on multiple occasions, which is the case in this study) (Lucas, 2022). To test the RI-CLPM, the unconstrained model (Model 1) was compared with the constrained model (Model 2), in which the autoregressive and cross-lagged path coefficients were constrained to be equal over time. Four additional sensitivity analyses were conducted. The first aimed to test the RI-CLPM, controlling for age and gender. The second aimed to test the RI-CLPM, controlling for COVID-related fears (see Supplementary Materials for a detailed description of the measure for COVID-related fears), since fear of COVID-19 appears to contribute to psychological distress and high levels of PSMU (Alimoradi et al., 2022; Lin et al., 2020). The third tested whether the same results would hold with a subsample of 491 participants with complete data on all the three waves. The fourth aimed to test the RI-CLPM with the three subscales of the DASS-21 (i.e. depression, anxiety and stress) instead of the total score. The overall goodness of model-fit was assessed using the comparative fit index (CFI; values > 0.95 indicate a good fit; Schermelleh-Engel et al., 2003), and the root-mean-square error of approximation (RMSEA; values < 0.08 indicate a good fit; Hu & Bentler, 1999). Analyses were conducted in SPSS v. 22 and Mplus v. 7.0. Data are available on request from the authors.

3. Results

3.1. Preliminary analyses

Little's MCAR tests showed that at T1 and T2, the missing values were absent completely at random (T1: $\chi^2(2) = 3.052, p = .217$; T2: $\chi^2(3) = 6.559, p = .087$), whereas at T3 these values were not missing completely at random ($\chi^2(2) = 39.039, p = .000$). The missing data were

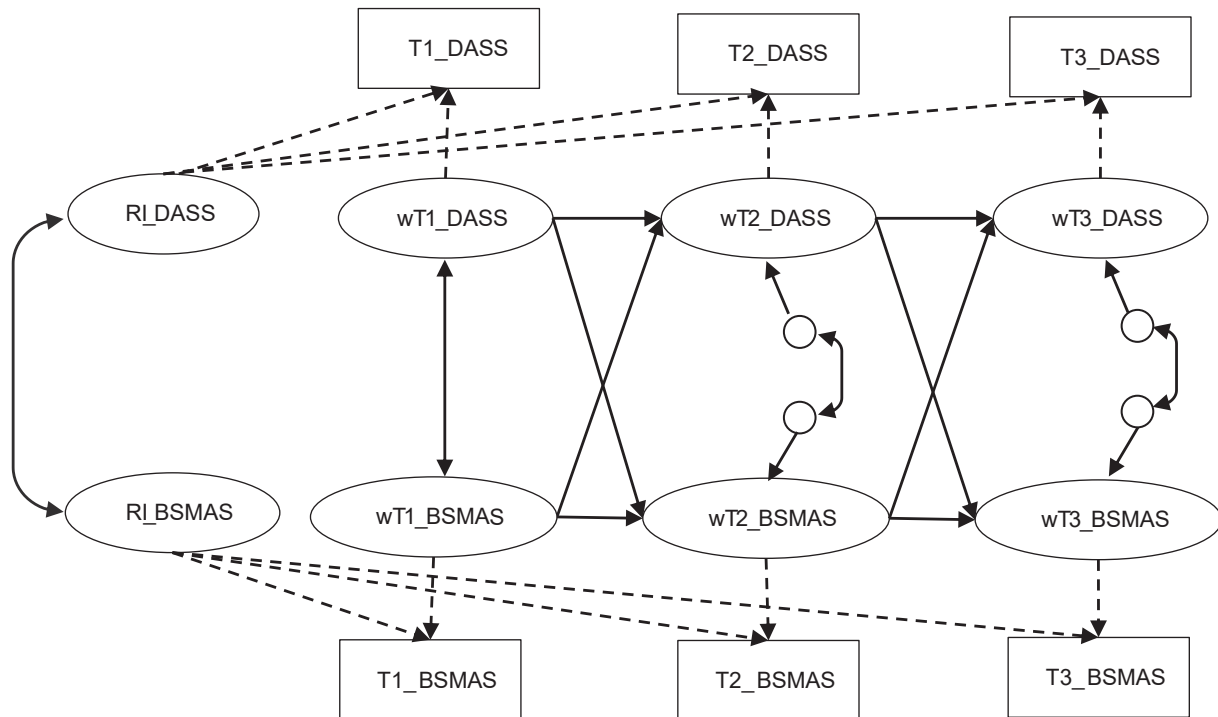


Fig. 1. Random Intercept Cross-Lagged Panel Model linking psychological distress and social media addiction. Note: DASS = Depression, Anxiety and Stress Scale; BSMAS = Bergen Social Media Addiction Scale; T1-T3 indicate the three waves of data collection; RI = Random Intercepts; Dashed lines indicate paths that were fixed to one; Analytical sample of 3,912 participants.

handled using the full information maximum likelihood (FIML) method, which has been shown to perform better than data deletion-based methods in reducing bias in longitudinal studies even with high rates of missing data (Lee & Shi, 2021).

All variables had a normal distribution ($|Sk| < 1$ and $|Ku| < 1$) (see Table 1).

3.2. Descriptive statistics and bivariate correlations

The bivariate correlations showed medium to large positive correlations between psychological distress and PSMU at each time point (Table 1).

3.3. RI-CLPMs

Table 2 shows the model fit indices for all the estimated RI-CLPMs. Regarding the comparison between the unconstrained (Model 1) and the constrained (Model 2) models, model fit estimates were good and did not change significantly when the equality constraints were added. Findings from the constrained model are presented for parsimony (Table 3). At the between-person level, there was a large positive correlation between the random intercepts of psychological distress and PSMU. Thus, on a group level, participants who reported higher psychological distress also reported higher PSMU across the three waves. Moreover, participants who experienced more psychological distress also showed more PSMU at T1. Furthermore, the results showed small correlated change at T2 and T3 between psychological distress and PSMU. Thus, when a participant's level of psychological distress decreased (or increased), the participant's levels of PSMU also decreased (or increased).

Regarding the within-person level over time, we did not find any significant cross-lagged path. Thus, experiencing more psychological distress than usual at a specific time point did not lead to more PSMU at a subsequent time point or vice versa.

3.4. Sensitivity analyses

Firstly, when participants' gender and age were included as covariates in the constrained model, the model fitted the data well ($\chi^2 = 9.561$; $df = 5$; $\chi^2/df = 1.91$; $CFI = 0.999$; $RMSEA = 0.015$; $90\% RMSEA = 0.000-0.030$) and the magnitude and significance of effects between

Table 1
Descriptive statistics and bivariate correlations between DASS-21 and BSMAS at each measurement point.

	T1 - DASS- 21	T1 - BSMAS	T2 - DASS- 21	T2 - BSMAS	T3 - DASS- 21	T3 - BSMAS
T1 - DASS-21	-					
T1 - BSMAS	.442**	-				
T2 - DASS-21	.727**	.369**	-			
T2 - BSMAS	.360**	.673**	.424**	-		
T3 - DASS-21	.660**	.297**	.727**	.315**	-	
T3 - BSMAS	.335**	.673**	.364**	.711**	.398**	-
N	3823	3823	1162	1162	709	709
M	19.30	14.17	18.58	13.25	16.28	12.51
SD	14.04	5.28	14.40	5.10	14.16	5.47
Score range	0-63	6-30	0-63	6-30	0-63	6-30
Skewness	0.712	0.508	0.754	0.615	0.978	0.855
Kurtosis	-0.165	-0.246	-0.164	-0.062	0.315	0.139
Cronbach's α	0.950	0.806	0.955	0.811	0.957	0.858

Note: DASS-21 = Depression, Anxiety and Stress Scale; BSMAS = Bergen Social Media Addiction Scale; T1 = First time point; T2 = Second time point; T3 = Third time point; M = Mean; SD = Standard Deviation; ** $p < .01$.

Table 2
Fit statistics for the RI-CLPMs between DASS-21 and BSMAS.

Model	χ^2	df	CFI	RMSEA	90% RMSEA
Model 1	2.314	1	1.000	0.018	0.000 - 0.051
Model 2	12.589	5	0.998	0.020	0.006 - 0.034

Note. Model 1 = Unconstrained RI-CLPM; Model 2 = RI-CLPM with autoregressive and cross-lagged paths constrained to be equal across time; df = degree of freedom; CFI = Comparative Fit Index; RMSEA = Root-Mean-Square Error of Approximation; Analytical sample of 3,912 participants.

Table 3
Standardized parameter estimates from the constrained RI-CLPM for psychological distress and PSMU (Model 2).

Model	β	SE	p-value
<i>Autoregressive paths</i>			
T2 DASS-21 on T1 DASS-21	0.248	0.066	0.000
T3 DASS-21 on T2 DASS-21	0.282	0.084	0.001
T2 BSMAS on T1 BSMAS	0.056	0.104	0.594
T3 BSMAS on T2 BSMAS	0.049	0.099	0.617
<i>Cross-lagged paths</i>			
T2 DASS-21 on T1 BSMAS	0.059	0.063	0.347
T3 DASS-21 on T2 BSMAS	0.058	0.063	0.359
T2 BSMAS on T1 DASS-21	0.086	0.073	0.239
T3 BSMAS on T2 DASS-21	0.089	0.077	0.248
<i>Other estimates</i>			
Correlation at T1	0.261	0.057	0.000
Residual correlation at T2	0.250	0.077	0.001
Residual correlation at T3	0.214	0.051	0.000
Between-person (RI) correlation	0.532	0.028	0.000

Note: DASS-21 = Depression, Anxiety and Stress Scale; BSMAS = Bergen Social Media Addiction Scale; T1 = First time point; T2 = Second time point; T3 = Third time point; RI = Random Intercepts; SE = Standard Error; Analytical sample of 3,912 participants.

psychological distress and PSMU remained largely unchanged (Table S1).

Secondly, a measure of participants' COVID-19 related fears was included in the constrained model (see Supplementary materials for detailed information). The model fitted the data well ($\chi^2 = 24.158$; $df = 12$; $\chi^2/df = 2.01$; $CFI = 0.998$; $RMSEA = 0.016$; $90\% RMSEA = 0.006-0.025$) and no significant changes were observed in the relationships between psychological distress and PSMU. More specifically, between-person correlations between the random intercepts of all variables remained significant, whereas the within-person cross-lagged paths between psychological distress and PSMU remained non-significant (Table S2).

Thirdly, sensitivity checks were carried out restricting the analysis to a subsample of 491 participants with complete data on all the three waves ($\chi^2 = 10.911$; $df = 5$; $\chi^2/df = 2.18$; $CFI = 0.996$; $RMSEA = 0.049$; $90\% RMSEA = 0.000-0.089$). Correlation at T1, residual correlations at T2 and T3 and between-person correlation between the random intercepts remained largely unchanged. However, regarding the within-person level over time, we found significant but small cross-lagged paths from psychological distress to PSMU (Table S3).

Fourthly, three RI-CLPMs were tested using the three subscales of the DASS-21 (i.e. depression, anxiety and stress) instead of the total score. For each model, between-person correlations between the random intercepts remained significant, whereas the within-person cross-lagged paths remained non-significant (Tables S4-S8).

4. Discussion

The current three-wave panel study examined both between- and within-person associations between psychological distress and PSMU

among adults during the pandemic, to test whether elevated levels of PSMU would be associated with subsequent change in psychological distress over time, or vice versa. In support of our hypothesis, the between-person results suggest that individuals with higher PSMU also reported higher psychological distress compared to their peers across the three waves. However, the within-person, cross-lagged results showed no associations between PSMU and psychological distress. When individuals reported higher distress than their own cross-time averages, they did not subsequently increase in PSMU or vice versa. These results were confirmed when we analyzed the three subscales of the DASS-21 (i.e. depression, anxiety and stress) in separate models.

Our findings on the trait-like relations between PSMU and psychological distress are in line with the meta-analysis by Huang (2022) which reported small to moderate correlations between PSMU and anxiety, depression, and distress. Moreover, consistently with the I-PACE theoretical model (Brand et al., 2019), this finding suggests that symptoms of psychological distress, such as depression or anxiety, may be vulnerability factors associated to Internet-use disorders, and trait-like stable differences between individuals may be detected as maintenance factors of PSMU. However, the presence of a cross-sectional, but non-longitudinal, effect found in the current study, provides no information about the temporal sequence of the two variables nor about their mutual influences over time. These results seem to be in line with prior research which disaggregated within-person and between-person levels, reporting limited evidence for a prospective association between increased SM use and mental health problems among adolescents (Beeres et al., 2021; Coyne et al., 2020; Orben & Przybylski, 2019). However, this finding suggests that there may be other processes or confounding variables at play (e.g. activities individuals engaged in when using SM, passive browsing, online social comparison). Therefore, the current findings may provide further evidence of a need for research to test more comprehensive models of the development and maintenance of PSMU, including both compensatory use expectancies (i.e. fear-driven/compensation-seeking hypothesis) and positive use expectancies (i.e. reward-driven hypothesis) (Wegman & Brand, 2019). Thus, future research should dive deeper into the temporal links between psychopathological symptoms and PSMU, but also into the motivations and expectancies regarding the applications used (Kardefelt-Winther, 2014).

It is also worth noting that autoregressive paths of psychological distress appeared to be significant, whereas autoregressive paths of PSMU appeared to be non-significant. Thus, occasions on which an individual increases his/her personal level of PSMU are not *per se* followed by subsequent time points on which he/she scored above or below the expected score on PSMU. This trend, over time, is consistent with previous studies on SM use (van der Schuur et al., 2019), Instagram use (Maes & Vandenbosch, 2022), and SM self-control failure (Du et al., 2021), wherein autoregressive paths were non-significant.

Consistently with previous research (Marino et al., 2018; Huang, 2022), in our study, the association between PSMU and distress persisted when controlling for participants' age and gender. Finally, the current investigation has relied on data collected during the pandemic. Previous studies showed mixed findings, with some studies which suggested that social restrictions and lockdown measures enhanced or exacerbated SM use, with a risk of developing a PSMU (Brailovskaia & Margraf, 2021; Marzouki et al., 2021; Ruggieri et al., 2021), whilst other studies showed that adults used SM during the COVID-19 pandemic to heighten social contacts and reduce loneliness (Boursier et al., 2020; Brailovskaia & Margraf, 2021). In previous cross-sectional studies, emotional indicators such as anxiety and stress were associated with PSMU, but only during the first lockdown (Boursier et al., 2020; Zhao & Zhou, 2021). When the Fear of COVID scale was included in the model we found trait-like associations between PSMU, distress and fear, but no cross-lagged temporal influences among these variables. These findings added a longitudinal perspective, suggesting that the association between PSMU and domains of psychological distress was stable during the pandemic, regardless of the COVID-related fear.

4.1. Strengths and limitations

The current study extends our understanding of how PSMU is associated with psychological distress, by addressing the methodological challenges from prior research (i.e. cross-sectional designs and the lack of disaggregation of within-person and between-person effects in longitudinal models; see Parry et al., 2022). Also, our results show that the concurrent association between PSMU and distress is also relevant among adult populations, whereas previous studies have mainly included adolescent and college student populations (Duradoni et al., 2020). However, the results of the study need to be interpreted in the light of some limitations. Firstly, PSMU is not classified as a disorder in any existing diagnostic system, and there is no consensus among researchers regarding the assessment of addiction-like SM use (Marino et al., 2021; Wegmann et al., 2022). Secondly, in the current study no information was collected about the amount of time spent on SM, as well as the type of activity enjoyed online, nor the mode of interaction. Thirdly, our sample comprised adult participants, mostly females. Thus, further replication is needed with data derived from samples with balanced gender ratio, and a wider participants' age range, to examine how PSMU differs between adults and adolescents (Ho et al., 2017). Fourthly, in the current study we examined overall levels of the individual's psychological distress and further research is necessary to examine differential effects of PSMU dependent on mental health domains such as feelings of loneliness or relational problems, which may have been especially relevant during the pandemic. Moreover, the participation rate at T3 was low. Although the results of attrition analysis to examine the patterns of missing values were satisfactory, as was the adoption of the FIML method, the current study estimates are model-based, and should be treated with caution. It is also worth noting that the BSMAS and DASS assessments were one month apart, and it cannot be excluded that mutual influences between variables in a shorter period of time may differ from those reported in the current study. Therefore, further research is needed to replicate our findings with shorter measurement gaps, such as a daily diary study. Finally, the study is limited by the use of self-report measures. Although both measures have been extensively validated and used in this field, future research should use objective measures.

Beyond these limitations, practical implications can be drawn from this study for clinical interventions. Specifically, our findings indicated that PSMU and psychological distress are intertwined over time. Hence, particular attention should be paid to detecting potential comorbidities when planning therapeutic interventions focused on problematic social media use, given that symptoms of PSMU and of psychological distress may interact to exacerbate the individual's wellbeing.

4.2. Conclusion

In summary, although available evidence suggests that PSMU may be associated with functional impairment, psychological distress, and decreased well-being (Brand et al., 2020), the findings of this study showed no evidence for a temporal association between PSMU and psychological distress. Our results suggest that the link between PSMU and psychological distress is mainly driven by trait-like differences and not by state-like individual changes over time. Further longitudinal research is needed to investigate whether PSMU may be a risk indicator for detecting comorbid problems with mental health problems. In this flourishing research field, future studies should be recommended to adopt sophisticated methodological strategies supporting a more robust understanding as to whether and how PSMU influences an individual's distress or vice versa.

Role of Funding Source

G.A. was funded by a scholarship from the FFR 2019/2020 fund of the Department of Psychology, Educational Sciences and Human

Movement, University of Palermo.

6. Contributors

G.L.C. and M.D.B.: Conceptualization and Writing – original draft. L.S.: Methodology and Formal Analysis. G.A.: Data Curation and Writing – review & editing. B.C. and A.M.: Resources and Supervision. G.E., S.S., O.G.G., C.M., and C.G.: Investigation, Validation, and Writing – review & editing.

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.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.addbeh.2022.107430>.

References

- Alimoradi, Z., Ohayon, M. M., Griffiths, M. D., Lin, C. Y., & Pakpour, A. H. (2022). Fear of COVID-19 and its association with mental health-related factors: Systematic review and meta-analysis. *BJPsych Open*, *8*(2). <https://doi.org/10.1192/bjo.2022.26>
- Andreassen, C. S. (2015). Online social network site addiction: A comprehensive review. *Current Addiction Reports*, *2*(2), 175–184. <https://doi.org/10.1007/s40429-015-0056-9>
- Andreassen, C. S., Billieux, J., Griffiths, M. D., Kuss, D. J., Demetrovics, Z., Mazzoni, E., & Pallesen, S. (2016). The relationship between addictive use of social media and video games and symptoms of psychiatric disorders: A large-scale cross-sectional study. *Psychology of Addictive Behaviors*, *30*(2), 252. <https://doi.org/10.1037/adb0000160>
- Andreassen, C. S., Torsheim, T., Brunborg, G. S., & Pallesen, S. (2012). Development of a Facebook addiction scale. *Psychological Reports*, *110*, 501–517. <https://doi.org/10.2466/02.09.18.PR0.110.2.501-517>
- American Psychological Association (APA) (2020). *Dictionary of Psychology: Psychological distress*. <https://dictionary.apa.org/psychological-distress>.
- Appel, M., Marker, C., & Gnams, T. (2020). Are social media ruining our lives? A review of meta-analytic evidence. *Review of General Psychology*, *24*(1), 60–74.
- Baggio, S., Starcevic, V., Studer, J., Simon, O., Gainsbury, S. M., Gmel, G., & Billieux, J. (2018). Technology-mediated addictive behaviors constitute a spectrum of related yet distinct conditions: A network perspective. *Psychology of Addictive Behaviors*, *32* (5), 564–572. <https://doi.org/10.1037/adb0000379>
- Beeres, D. T., Andersson, F., Vossen, H., & Galanti, M. R. (2021). Social media and mental health among early adolescents in Sweden: A longitudinal study with 2-year follow-up (KUPOL Study). *Journal of Adolescent Health*, *68*(5), 953–960. <https://doi.org/10.1016/j.jadohealth.2020.07.042>
- Bottesi, G., Ghisia, M., Altoè, G., Conforti, E., Melli, G., & Sica, C. (2015). The Italian version of the Depression Anxiety Stress Scales-21: Factor structure and psychometric properties on community and clinical samples. *Comprehensive Psychiatry*, *60*, 170–181.
- Boursier, V., Gioia, F., Musetti, A., & Schimmenti, A. (2020). Facing loneliness and anxiety during the COVID-19 isolation: The role of excessive social media use in a sample of Italian adults. *Frontiers in Psychiatry*, *11*, 586222. <https://doi.org/10.3389/fpsy.2020.586222>
- Brailovskaia, J., Ströse, F., Schillack, H., & Margraf, J. (2020). Less Facebook use—More well-being and a healthier lifestyle? An experimental intervention study. *Computers in Human Behavior*, *108*, 106332. <https://doi.org/10.1016/j.chb.2020.106332>
- Brailovskaia, J., & Margraf, J. (2021). The relationship between burden caused by coronavirus (Covid-19), addictive social media use, sense of control and anxiety. *Computers in Human Behavior*, *119*, 106720.
- Brand, M., Rumpf, H. J., Demetrovics, Z., Müller, A., Stark, R., King, D. L., & Potenza, M. N. (2020). Which conditions should be considered as disorders in the International Classification of Diseases (ICD-11) designation of “other specified disorders due to addictive behaviors”? *Journal of Behavioral Addictions*. <https://doi.org/10.1556/2006.2020.00035>
- Brand, M., Wegmann, E., Stark, R., Müller, A., Wölfling, K., Robbins, T. W., & Potenza, M. N. (2019). The Interaction of Person-Affect-Cognition-Execution (I-PACE) model for addictive behaviors: Update, generalization to addictive behaviors beyond internet-use disorders, and specification of the process character of addictive behaviors. *Neuroscience & Biobehavioral Reviews*, *104*, 1–10. <https://doi.org/10.1016/j.neubiorev.2019.06.032>
- Burrow, A. L., & Rainone, N. (2017). How many likes did I get? Purpose moderates links between positive social media feedback and self-esteem. *Journal of Experimental Social Psychology*, *69*, 232–236. <https://doi.org/10.1016/j.jesp.2016.09.005>
- Carr, C. T., & Hayes, R. A. (2015). Social media: Defining, developing, and divining. *Atlantic Journal of Communication*, *23*, 46–65. <https://doi.org/10.1080/15456870.2015.972282>
- Casale, S. (2020). Problematic social media use: Conceptualization, assessment and trends in scientific literature. *Addictive Behaviors Reports*, *12*, 100281. <https://doi.org/10.1016/j.abrep.2020.100281>
- Coyne, S. M., Rogers, A. A., Zurcher, J. D., Stockdale, L. A., & Booth, M. (2020). Does time spent using social media impact mental health?: An eight year longitudinal study. *Computers in Human Behavior*, *104*, 106160.
- Course-choi, J., & Hammond, L. (2021). Social media use and adolescent well-being: A narrative review of longitudinal studies. *Cyberpsychology, Behavior and Social Networking*, *24*(4), 223–236. <https://doi.org/10.1089/cyber.2020.0020>
- Curran, P. J., & Bauer, D. J. (2011). The disaggregation of within-person and between-person effects in longitudinal models of change. *Annual Review of Psychology*, *62*, 583–619. <https://doi.org/10.1146/annurev.psych.093008.100356>
- Di Blasi, M., Gullo, S., Mancinelli, E., Freda, M. F., Esposito, G., Gelo, O., Lagetto, G., Giordano, C., Mazzeschi, C., Pazzagli, C., Salcuni, S., & Lo Coco, G. (2021). Psychological distress associated with the COVID-19 lockdown: A two-wave network analysis. *Journal of Affective Disorders*, *284*, 18–26. <https://doi.org/10.1016/j.jad.2021.02.016>
- Du, J., Kerkhof, P., & van Koningsbruggen, G. M. (2021). The reciprocal relationships between social media self-control failure, mindfulness and wellbeing: A longitudinal study. *PLoS ONE*, *16*(8), e0255648. <https://doi.org/10.1371/journal.pone.0255648>
- Duradoni, M., Innocenti, F., & Guazzini, A. (2020). Well-being and social media: A systematic review of Bergen addiction scales. *Future Internet*, *12*(2), 24. <https://doi.org/10.3390/fi12020024>
- Geirdal, A.Ø., Ruffolo, M., Leung, J., Thygesen, H., Price, D., Bonsaksen, T., & Schoultz, M. (2021). Mental health, quality of life, wellbeing, loneliness and use of social media in a time of social distancing during the COVID-19 outbreak. A cross-country comparative study. *Journal of Mental Health*, *30*(2), 148–155. <https://doi.org/10.1080/09638237.2021.1875413>
- Hamaker, E. L., Kuiper, R. M., & Grasman, R. P. P. (2015). A critique of the cross-lagged panel model. *Psychological Methods*, *20*(1), 102–116. <https://doi.org/10.1037/a0038889>
- Henry, J. D., & Crawford, J. R. (2005). The short-form version of the Depression Anxiety Stress Scales (DASS-21): Construct validity and normative data in a large non-clinical sample. *British Journal of Clinical Psychology*, *44*, 227–239.
- Henzel, V., & Håkansson, A. (2021). Hooked on virtual social life. Problematic social media use and associations with mental distress and addictive disorders. *PLoS ONE*, *16*(4), e0248406.
- Ho, S. S., Lwin, M. O., & Lee, E. W. J. (2017). Till logout do us part? Comparison of factors predicting excessive social network sites use and addiction between Singaporean adolescents and adults. *Computers in Human Behavior*, *75*, 632–642. <https://doi.org/10.1016/j.chb.2017.06.002>
- Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, *6*(1), 1–55. <https://doi.org/10.1080/10705519909540118>
- Huang, C. (2017). Time spent on social network sites and psychological well-being: A meta-analysis. *Cyberpsychology, Behavior, and Social Networking*, *20*, 346–354. doi: 10.1089/cyber.2016.0758.
- Huang, C. (2021). Correlations of online social network size with well-being and distress: A meta-analysis. *Cyberpsychology: Journal of Psychosocial Research Cyberspace*, *15*(3).
- Huang, C. (2022). A meta-analysis of the problematic social media use and mental health. *International Journal Social Psychiatry*, *68*, 12–33. <https://doi.org/10.1177/0020764020978434>
- Karddefelt-Winther, D. (2014). A conceptual and methodological critique of internet addiction research: Towards a model of compensatory internet use. *Computers in Human Behavior*, *31*, 351–354. <https://doi.org/10.1016/j.chb.2013.10.059>
- Karddefelt-Winther, D., Heeren, A., Schimmenti, A., Van Rooij, A., Maurage, P., Carras, M., Edman, J., Blaszczynski, A., Khazaal, Y., & Billieux, J. (2017). How can we conceptualize behavioural addiction without pathologizing common behaviours? *Addiction*, *112*(10), 1709–1715. <https://doi.org/10.1111/add.13763>
- Keles, B., McCrae, N., & Grealish, A. (2020). A systematic review: The influence of social media on depression, anxiety and psychological distress in adolescents. *International Journal of Adolescence and Youth*, *25*(1), 79–93.
- Kuss, D. J., & Griffiths, M. D. (2017). Social Networking Sites and addiction: Ten lessons learned. *International Journal of Environmental Research and Public Health*, *14*(3), 311. <https://doi.org/10.3390/ijerph14030311>
- Lee, T., & Shi, D. (2021). A comparison of full information maximum likelihood and multiple imputation in structural equation modeling with missing data. *Psychol Methods*, *26*(4), 466–485. <https://doi.org/10.1037/met0000381>
- Lin, C. Y., Broström, A., Griffiths, M. D., & Pakpour, A. H. (2020). Investigating mediated effects of fear of COVID-19 and COVID-19 misunderstanding in the association between problematic social media use, psychological distress, and insomnia. *Internet Interventions*, *21*, 100345. <https://doi.org/10.1016/j.invent.2020.100345>
- Liu, D., & Baumeister, R. F. (2016). Social networking online and personality of self-worth: A meta-analysis. *Journal of Research in Personality*, *64*, 79–89. <https://doi.org/10.1016/j.jrp.2016.06.024>
- Lovibond, P. F., & Lovibond, S. H. (1995). The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behaviour Research and Therapy*, *33*, 335–343.
- Lucas, R. E. (2022, February 14). It's time to abandon the cross-lagged panel model. <https://doi.org/10.31234/osf.io/pkcc7>.
- Maes, C., & Vandenbosch, L. (2022). Adolescent girls' Instagram and TikTok use: Examining relations with body image-related constructs over time using random intercept cross-lagged panel models. *Body Image*, *41*, 453–459. <https://doi.org/10.1016/j.bodyim.2022.04.015>

- Marino, C., Gini, G., Vieno, A., & Spada, M. M. (2018). The associations between problematic Facebook use, psychological distress and well-being among adolescents and young adults: A systematic review and meta-analysis. *Journal of Affective Disorders*, 226, 274–281.
- Marino, C., Canale, N., Melodia, F., Spada, M. M., & Vieno, A. (2021). The overlap between problematic smartphone use and problematic social media use: A systematic review. *Current Addiction Reports*, 8(4), 469–480. <https://doi.org/10.1007/s40429-021-00398-0>
- Marzouki, Y., Aldossari, F. S., & Veltri, G. A. (2021). Understanding the buffering effect of social media use on anxiety during the COVID-19 pandemic lockdown. *Humanities and Social Sciences Communications*, 8(1), 1–10.
- Monacis, L., De Palo, V., Griffiths, M. D., & Sinatra, M. (2017). Social networking addiction, attachment style, and validation of the Italian version of the Bergen Social Media Addiction Scale. *Journal of Behavioral Addictions*, 6(2), 178–186. <https://doi.org/10.1556/2006.6.2017.023>
- Moretta, T., Buodo, G., Demetrovics, Z., & Potenza, M. N. (2022). Tracing 20 years of research on problematic use of the internet and social media: Theoretical models, assessment tools, and an agenda for future work. *Comprehensive Psychiatry*, 152286. <https://doi.org/10.1016/j.comppsy.2021.152286>
- Orben, A., & Przybylski, A. K. (2019). The association between adolescent well-being and digital technology use. *Nature Human Behaviour*, 3, 173–182. <https://doi.org/10.1038/s41562-018-0506-1>
- Parry, D. A., Fisher, J. T., Mieczkowski, H., Sewall, C. J. R., & Davidson, B. I. (2022). Social media and well-being: A methodological perspective. *Current Opinion in Psychology*, 45, [101285]. <https://doi.org/10.1016/j.copsyc.2021.11.005>
- Prizant-Passal, S., Shechner, T., & Aderka, I. M. (2016). Social anxiety and internet use—A meta-analysis: What do we know? What are we missing? *Computers in Human Behavior*, 62, 221–229. <https://doi.org/10.1016/j.chb.2016.04.003>
- Puukko, K., Hietajärvi, L., Maksniemi, E., Alho, K., & Salmela-Aro, K. (2020). Social media use and depressive symptoms—A longitudinal study from early to late adolescence. *International Journal of Environmental Research and Public Health*, 17(16), 5921.
- Ruggieri, S., Ingoglia, S., Bonfanti, R. C., & Lo Coco, G. (2021). The role of online social comparison as a protective factor for psychological wellbeing: A longitudinal study during the COVID-19 quarantine. *Personality and Individual Differences*, 171, 110486. <https://doi.org/10.1016/j.paid.2020.110486>
- Schermelleh-Engel, K., Moosbrugger, H., & Müller, H. (2003). Evaluating the fit of structural equation models: Tests of significance and descriptive goodness-of-fit measures. *Methods of Psychological Research Online*, 8(2), 23–74.
- Shannon, H., Bush, K., Villeneuve, P. J., Hellemans, K. G., & Guimond, S. (2022). Problematic social media use in adolescents and young adults: systematic review and meta-analysis. *JMIR Mental Health*, 9(4), e33450.
- Shensa, A., Sidani, J. E., Dew, M. A., Escobar-Viera, C. G., & Primack, B. A. (2018). Social media use and depression and anxiety symptoms: A cluster analysis. *American Journal of Health Behavior*, 42(2), 116–128.
- Statista.com (2022). Mobile social media worldwide. Retrieved May, 10, 2022 from: <https://www.statista.com/topics/2478/mobile-social-networks/#dossierKeyfigures>.
- Sun, Y., & Zhang, Y. (2021). A review of theories and models applied in studies of social media addiction and implications for future research. *Addictive Behaviors*, 114, 106699. <https://doi.org/10.1016/j.addbeh.2020.106699>
- Tromholt, M. (2016). The Facebook experiment: Quitting Facebook leads to higher levels of well-being. *Cyberpsychology, Behavior, and Social Networking*, 19(11), 661–666. <https://doi.org/10.1089/cyber.2016.0259>
- Valkenburg, P. M. (2022). Social media use and well-being: What we know and what we need to know. *Current Opinion in Psychology*, 45, 101294. <https://doi.org/10.1016/j.copsyc.2021.12.006>
- van der Schuur, W. A., Baumgartner, S. E., & Sumter, S. R. (2019). Social media use, social media stress, and sleep: Examining cross-sectional and longitudinal relationships in adolescents. *Health Communication*, 34(5), 552–559. <https://doi.org/10.1080/10410236.2017.1422101>
- Verduyn, P., Ybarra, O., Résibois, M., Jonides, J., & Kross, E. (2017). Do social network sites enhance or undermine subjective well-being? A critical review. *Social Issues and Policy Review*, 11, 274–302. <https://doi.org/10.1111/sipr.12033>
- Wegmann, E., & Brand, M. (2019). A narrative overview about psychosocial characteristics as risk factors of a problematic social networks use. *Current Addiction Reports*, 6(4), 402–409. <https://doi.org/10.1007/s40429-019-00286-8>
- Wegmann, E., Billieux, J., & Brand, M. (2022). Internet-use disorders: A theoretical framework for their conceptualization and diagnosis. In D. Stein, N. Fineberg, & S. Chamberlain (Eds.), *Mental health in a digital world* (pp. 285–305). Elsevier.
- Zhao, N., & Zhou, G. (2021). COVID-19 stress and addictive social media use (SMU): Mediating role of active use and social media flow. *Frontiers in Psychiatry*, 12, 635546. <https://doi.org/10.3389/fpsy.2021.635546>