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Psychological and Behavioral Impacts of Internet Addiction among Adolescents and Young Adults

Short Title: Internet addiction and impacts on mental health

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Abstract

Objective: The constant access to online content has raised concerns worldwide. Excessive engagement with digital platforms can contribute to significant mental health challenges, including increased levels of depression, anxiety, and stress. This phenomenon is related to impairments in neuroanatomical areas leading to adverse outcomes. The study aimed to analyze the associations between internet addiction (IA), depression, anxiety, stress, and a diversity of sociodemographic variables, including gender, social media use, employment status, sleep, and physical activity patterns.

Methods: A sample of 618 adolescents and young adults in southern Brazil was analyzed (mean age: 23.34). Participants filled an online form and statistical analysis was conducted.

Results: The results show that depression, anxiety, and stress levels were higher in women ($p < 0.001$), whereas IAT scores did not reach statistical significance, despite being higher in women ($p = .06$). Those who are employed may have lower levels of IA; poor sleep habits are associated with higher internet addiction and social media use is associated with poorer mental health and IA ($p< 0.001$).

Conclusion: Mental health support and internet use limits should be offered to the general population in terms of prevention and treatment of these conditions.

Keywords: Internet Addiction Disorder, Anxiety Disorders, Psychological Stress, Depression, Mental Health.

Introduction

The rapid integration of internet-based technology into daily life has transformed how adolescents and young adults engage socially, academically, and recreationally.[1] With smartphones and other devices readily available, young people have nearly constant access to online content, social media, and digital interactions, which has raised new concerns about the psychological impact of excessive or problematic internet use that may lead to internet addiction.[2]

Recent studies underscore that excessive engagement with digital platforms can contribute to significant mental health challenges, including increased levels of anxiety, depression, and stress, particularly among adolescents who may be more vulnerable to these effects due to ongoing developmental changes.[3-5] The phenomenon has been reported in different studies, including neuroanatomical ones.[6,7] A review shows that problematic use of technology, such as smartphones and the internet, might affect executive functions, as addictive behaviors may induce changes in neural networks. Functional Magnetic Resonance Imaging (fMRI) studies have shown differences in functional activities according to levels in internet and smartphone use, revealing that behavioral addictions are associated with impairments in cognitive control related to reward processing.[7]

This association between internet addiction and impairments in cognitive control results in a variety of adverse behavioral outcomes. Factors such as disrupted sleep patterns and drug use have also been reported in different studies, in addition to psychological distress.[8,9] As drug use is related to inhibitory control issues, the phenomenon is also seen in internet users. In an American study, conducted using

secondary data from the 2019 Country-level drug overdose death in the National Vital Statistics System and data from 2019 country-level broadband internet in Microsoft's Airband Initiative, the authors reported that broadband internet use was positively associated with increased drug overdose deaths. Thus, having access to and the ability to use broadband internet services can affect public health outcomes.[10]

Another variable that draws attention is the difference in addiction levels between men and women and some studies around the world present that men exhibit higher levels of addiction than women[11-13] while others present that women are the ones with higher levels.[14,15] Being unemployed and practicing physical activity are also variables that might be associated with levels of internet use. Some studies have already investigated these variables[16,17] but it is important to further comprehend these associations in different populations.

This study aims to deepen the understanding of these associations by analyzing data from a sample of adolescents and young adults in the south of Brazil, given that, as seen in a prior study[4], the Brazilian population has been using the internet extensively. Our analysis examines correlations between these variables and a range of sociodemographic and behavioral factors, including age, sex, employment status, sleep difficulties, physical activity, drug use, and social media use. Our hypotheses were: a) There were differences in levels of internet addiction when comparing adolescents and young adults, being adolescents more addicted; b) There were differences in levels of internet addiction according to gender; c) Higher levels of psychological distress, such as depression, anxiety, and stress is seen in people who are more addicted; d) There were associations among sleeping patterns, drug use, work status, physical activity habits, and internet addiction.

Methods

Study Design, participants, and ethical procedures

This cross-sectional exploratory study included 618 adolescents and young adults aged 15-36 years (mean age: 23.34) in southern Brazil. The survey was conducted from October to December 2023 integrating respondents from some Brazilian states, being most of them from the south of the country. The QR code to access the research was published on social media platforms, the institution’s website and posters around the campus. In order to reach a great number of participants, the

survey was managed using the Google Forms tool. Ethical approval for this study was obtained from the Research Ethics Committee of the Federal University of Rio Grande do Sul (CAAE: 69.629.323.6.0000.5334). Consent for respondents above 18 years old as well as for adolescents' parents was developed and comprised in the survey. Detailed information on technical and ethical topics of the research was properly described.

Instruments:

Internet Addiction: The Internet Addiction Test (IAT) was used. The test was developed by Young (1998)[2] and adapted to the Brazilian context by Conti et al. (2012)[18] with Cronbach's alpha values very close (0.85) to those of the original study (0.54 to 0.82). The instrument is a self-administered Likert scale composed of 20 questions with points ranging from Rarely (1) to Always (5). The higher the score, the greater the severity of the dependency, which can vary from 0 to 100 points, and the results can be categorized as normal (0-30 points), light (31-49 points), moderate (50-79 points) and severe (80-100 points). In our study, we used the cutoff 60 (moderate to severe) of the Brazilian version of the IAT-Total scale to classify IA.

Psychological Distress: Depression, Anxiety, and Stress Scale (DASS21) was used to measure depression, anxiety, and stress.[19] It is a Likert scale instrument, consisting of 21 items, in which the participant selects options from 0-3 (does not apply to me applies a lot to me).

Symptoms of anxiety and depression are grouped into three basic structures: a) presence of negative affect, depressed mood, insomnia, discomfort, and irritability; b) presence of specific symptoms of depression (anhedonia, absence of positive affect); c) specific symptoms of anxiety (somatic tension and hyperactivity). [19]

Social Media Use: Social Media Engagement Questionnaire (SMEQ), which was developed by Przybylski et al. (2013)[38] aims to understand the phenomenon of Fear of Missing Out (FOMO), which contemplates the need to stay connected to social networks. The questionnaire has five items that measure engagement on social media. The items are answered using a stimulus question, and participants must indicate the frequency of use on a response scale ranging from 0 (none day) to 7 (every day). The

questionnaire was validated and adapted for the Brazilian context, presenting the same psychometric quality as the original with an internal consistency coefficient of 0.90 (McDonald's ω).[20]

Social-demographic and lifestyle information: A sociodemographic questionnaire was developed exclusively for this research. The characteristics include sex, gender, age, state, work, sleeping patterns, exercising habits, psychological/psychiatric diagnostic, drug use, and internet use.

Statistical analysis

All data analysis was conducted in Jamovi (Version 2.4) and we used descriptive statistics to characterize the sample regarding sociodemographic variables. Regarding relationships between our variables, we used Spearman correlation for the continuous variables such as DASS21, IAT, and SMEQ, and the point-biserial correlation for the association between the continuous and categorical variables, including age, sex, employment status, sleep difficulties, physical activity, and drug use.

Regarding gender differences in DASS21 total scores, anxiety, stress, depression, internet addiction, and social media engagement, Welch's t-test was used. Finally, we modeled a path analysis, to analyze predictors of Internet Addiction Test (IAT) scores, Depression Anxiety Stress Scale (DASS21) total scores, and Social Media Engagement (SMEQ). The model was estimated using Maximum Likelihood (ML) with bias-corrected bootstrap resampling, based on 5000 simulations. For the IAT we used the predictors of Work status, Sleep Difficulties, SMEQ, and DASS21 total scores. For the DASS21 we used Age, Sex, Physical Activity, Sleep Difficulties, Drug Use, and Work. Regarding the Social Media Engagement Questionnaire (SMEQ) we used DASS21 total scores as the only predictor (Figure 1).

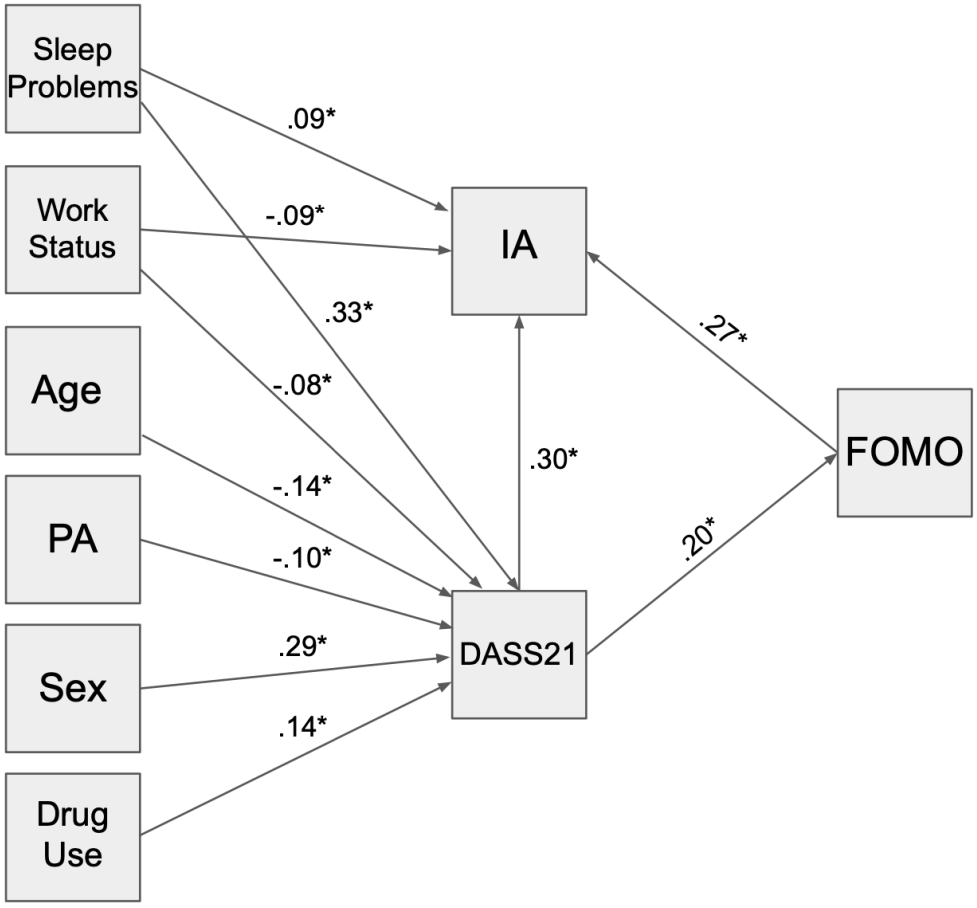

Figure 1 - *Path Model with Standardized Values*

Results

This study had 618 participants, 422 women (68.3%), 190 men (30.7%), and 6 with other gender identities (1.0%) with a mean age of 23.33 (SD=5. 98, Min=14; Max=36). More information about the sociodemographic characteristics of the sample is presented in Table 1.

Table 1 - *Sociodemographic characteristics*

Variables	
Ethnicity	
Black	14 (2,3%)
White	527 (85,3%)
Brown	73 (11,5%)

Indigenous	1 (0,2%)
Asian	5 (0,8%)
Sexual Orientation	
Heterosexual	490 (79.3%)
Homosexual	35 (5,7%)
Bisexual	84 (13,6%)
Others	9 (1,5%)
Work status	
Employed	520 (84.1%)
Unemployed	98 (15.9%)
Physical Activity	
Physically Active	432 (69.9%)
Not Physically Active	186 (30.1%)
Sleep Difficulties	
Yes	262 (42,4%)
No	356 (57,6%)
Drug Use	
Yes	199 (32,3%)
No	419 (67,7%)
Mental Health Problems	
Yes	208 (33,7%)
No	410 (66,3%)

Regarding mental health variables, the sample presented a mean of 49.37 (SD=12.74, Min=21 Max=91) in the IAT and a mean of 20.58 (SD=13.85, Min=0, Max=63) in the DASS21 total score. Furthermore, Welch's t-test comparing men and women demonstrated significant differences, with DASS21 scores being higher in the group of women (M=23.06, SD=13.65) than in men (M=14.38, SD= 11.59), $t(424)= -8.10$, $p < 0.001$, Cohen's $d = -0.685$. For the IAT, men (M=47.83, SD=12.85) also presented lower levels than women (M=49.9, SD=12.57), $t(371)= -1.86$, but it was not statistically significant, $p = 0.06$, Cohen's $d = - 0.163$. More information regarding sex differences is shown in Table 2.

Table 2 - *Difference Between Men (N=196) and Women (N=423) in Study Variables*

Variable	Men Mean (SD)	Women Mean (SD)	Welch's *t*	*df*	*p*	Mean Difference	Cohen's *d*
Age	21.94 (5.92)	24.04 (5.90)	-4.06	363	.001	-2.10	-0.355
IAT	47.83 (12.85)	49.90 (12.57)	-1.86	357	.064	-2.36	-0.163
DASS21	14.38 (11.59)	23.06 (13.65)	-8.10	424	.001	-8.68	-0.685
Stress	5.65 (4.35)	8.95 (4.76)	-8.43	396	.001	-3.30	-0.724
Anxiety	3.32 (3.69)	6.32 (4.75)	-8.47	461	.001	-2.00	-0.705
Depression	5.42 (4.99)	7.80 (5.54)	-5.28	402	.001	-2.38	-0.452
SMEQ	20.89 (9.14)	22.12 (8.37)	-1.23	337	.115	-1.23	-0.140

* N for males = 196, N for females = 423. IAT = Internet Addiction Test. DASS21 = Depression, Anxiety, and Stress Scale-21. SMEQ = Social Media Engagement Questionnaire.

Regarding the association between the study variables, the Spearman correlation demonstrated significant and positive associations between the symptoms of stress, anxiety, depression, and total DASS-21 score with internet addiction and social media engagement. The observed correlations were of moderate magnitude between .307 and .434, with the depression subscale scores showing the highest correlation. On the other hand, contrary to the study hypotheses, the age of the participants did not show a significant association with internet addiction levels (Table 3).

Table 3 - *Correlation Matrix*

	Age	IATTotal	SMEQ	DASS21_Total	DASS21_Stress	DASS21_Anxiety	DASS21_Depression	Gender	Work Status	Drug Use	Sleep Difficulties	Physical Activity
Age	-											
IATTotal	-.052	-										
SMEQ	-.029	.340***	-									
DASS21_Total	-.114**	.415***	.214***	-								
DASS21_Stress	-.115**	.367***	.193***	.912***	-							
DASS21_Anxiety	-.096*	.307***	.158***	.899***	.800***	-						
DASS21_Depression	-.078	.434***	.219***	.895***	.708***	.695***	-					
Gender	.173***	.076	.052	.301***	.317***	.326***	.215***	-				
Work Status	.262***	-.132***	-.008	-.150***	-.128**	-.110**	-.161***	.015	-			
Drug Use	.189***	.100*	.123**	.116**	.092*	.096*	.129**	.034	.110**	-		
Sleep Difficulties	-.091*	.231***	.105**	.372***	.341***	.340***	.345***	.015	-.139***	.032	-	
Physical Activity	.006	-.058	-.031	-.179***	-.141***	-.171***	-.200***	-.153***	.072	.037	-.101*	-

Note. $p < .05$, *$p < .01$, **$p < .001$

Path Analysis

The fit indices indicate that the proposed model exhibits an excellent fit to the data. The chi-square (χ^2) of the model is 12.0 with 10 degrees of freedom ($p = 0.285$), suggesting that the model does not significantly differ from the observed data. The Comparative Fit Index (CFI) and the Incremental Fit Index (IFI) both have values of 0.996, while the Tucker-Lewis Index (TLI) is 0.985, all indicating an excellent fit. Additionally, the Root Mean Square Error of Approximation (RMSEA) is 0.018, with a 95% confidence interval ranging from 0.000 to 0.049 and a p-value of 0.954, confirming a very good fit.

The DASS21 total score is influenced by several variables. Sleep ($\beta = 0.3275$, $p < 0.001$) is the main positive predictor, suggesting that poorer sleep quality is associated with higher DASS21 symptoms. Drug use also has a significant positive effect ($\beta = 0.1392$, $p < 0.001$), as does sex ($\beta = 0.2940$, $p < 0.001$), where being female is associated with higher mental health issues. Age, on the other hand, has a negative effect ($\beta = -0.1404$, $p < 0.001$), indicating that older individuals tend to report lower mental health issues. Physical exercise ($\beta = -0.0977$, $p = 0.008$) presented a negative effect, suggesting that it may be associated with lower symptoms.

The total internet addiction score (IAT) is positively associated with DASS21 ($\beta = 0.3009$, $p < 0.001$) and SMEQ ($\beta = 0.2683$, $p < 0.001$), indicating that individuals with higher stress levels and greater engagement with social media report higher internet addiction. Interestingly, work ($\beta = -0.0887$, $p = 0.03$) had a negative relationship, suggesting that those who work more may have lower internet addiction. Sleep also had a positive effect ($\beta = 0.0904$, $p = 0.017$), which may indicate that poorer sleep habits are associated with higher internet addiction. Finally, social media engagement had a significant positive association with DASS21 ($\beta = 0.2020$, $p < 0.001$), suggesting that individuals with higher mental health issues tend to use social media more. Figure 1 shows the path model with standardized values and Table 4 shows all parameter estimates for the model.

Table 4 - *Parameter Estimates of Path Analysis Model*

DV	Predictor	Estimate	SE	95% CI (Lower)	95% CI (Upper)	β	z	p
IAT	Work	-0.088	0.040	-0.168	-0.007	-0.088	-2.17	.030
IAT	DASS21	0.300	0.041	0.220	0.382	0.300	7.28	<.001
IAT	SMEQ	0.268	0.038	0.192	0.343	0.268	6.98	<.001
IAT	Sleep	0.090	0.038	0.017	0.167	0.090	2.38	.017
SMEQ	DASS21	0.202	0.040	0.120	0.280	0.202	4.97	<.001
DASS21	Age	-0.140	0.035	-0.209	-0.071	-0.140	-3.97	<.001
DASS21	Sleep	0.327	0.036	0.256	0.400	0.327	9.00	<.001
DASS21	Work	-0.076	0.038	-0.157	-0.003	-0.076	-1.99	.047
DASS21	PA	-0.097	0.037	-0.170	-0.025	-0.097	-2.64	.008
DASS21	Drugs	0.139	0.034	0.071	0.208	0.139	4.02	<.001
DASS21	Sex	0.294	0.034	0.226	0.359	0.294	8.56	<.001

*IAT = Internet Addiction Test; DASS21 = Depression Anxiety Stress Scales; SMEQ = Social Media Engagement Questionnaire; PA = Physical Activity. SE = Standard Error; CI = Confidence Interval.

The findings indicate that DASS21 is positively associated with social media use and internet addiction, while variables such as age and physical exercise may act as protective factors. Work appears to have an unexpected negative effect on internet addiction, warranting further investigation. Overall, the results highlight the importance of behavioral and psychosocial factors in regulating mental health problems and internet use.

Discussion

This study investigated the associations between Internet Addiction, depression, anxiety, stress, social media use, drug use, exercise habits, unemployment, and sleeping patterns in adolescents and young adults. In our study, females were shown to have higher levels of internet use than males. Our results corroborated other studies that report similar conclusions.[3,21]

These gender differences were seen in a study developed to examine the differences between men and women in the use of the internet, social media, and

related features. Plausible differences were seen, especially regarding prosocial behavior, which means that women were more able to maintain interpersonal relationships and the capacity to feel empathic in social contexts (care-oriented behaviors), even though they have higher levels of phone obsession and need for control. Using the internet and social media maintains care-oriented behaviors which may lead to more time on-line.[21] This phenomenon tries to explain the differences in use.

Gender differences were seen not only in IA levels but also in psychological distress, such as depression, anxiety, and stress levels. Regarding depression, most studies have already shown that the prevalence is higher in women.[22,23] Several hypotheses exist to explain major depressive disorder pathogenesis, which includes the monoamine; Hypothalamic-Pituitary-adrenal (HPA) axis dysfunction; Structural and functional brain remodeling; social psychological, genetic, and epigenetic anomaly, and inflammatory hypothesis.[24]

Following the inflammatory hypothesis, a systematic review and meta-analysis examined whether inflammatory immune peripheral markers of depression are sex-specific and found that women had higher levels of C-reactive protein (CRP) and interleukin-6 (IL-6) when compared to men.[25] Further studies should be conducted to investigate this variable and its association with internet addiction.

The association between internet addiction and depressive symptoms is clear. Using social media sites is considered a coping strategy, as loneliness and social isolation are common among people with depression.[26,27] Greater severity of depressive symptoms involves higher levels of internet and social media addiction. [28]

Our study also aimed to confirm the hypothesis that adolescents would have higher levels of addiction compared to young adults, however, the age of the participants did not show a significant association with internet addiction levels. This result emphasizes that, although adolescents tend to be more vulnerable to addictions due to levels of impulsivity, young adults and adults also frequently engage in smartphone/internet use. In an experimental study conducted in the Netherlands, the researchers targeted to answer questions regarding youths' use of smartphones, including behaviors, motivations, and feelings. The results indicated great diversity in smartphone use (social media, messaging, browsing), common feelings of boredom leading to the use, and that 88 out of 114 participants started using their phones as

soon as they were left alone in the laboratory. This increases concerns about elevated time spent on smartphones, as the participants described that opening and scrolling on social media was almost an automatic and habitual act.[29]

In neuroimaging studies, brain abnormalities and neuroanatomical changes, which include a set of cognitive processes (thinking, planning, self-monitoring, self-control, time management, and organization), are seen in adolescents and young adults, consequently, further studies should investigate this phenomenon, once, differences in age are not enough to explain possibilities of internet addiction.[7]

Regarding social-demographic and lifestyle information, in our study, it was seen that sleep difficulties, depression, anxiety, and stress were significant predictors of internet addiction. Poor quality of sleep and the association with these variables were seen in a diversity of studies, with different populations.[30,31] To further understand the use, it is important to find out which activities make people engage, although we did not include these factors in our analysis, except for social media use.

However, it is known that engaging in games is common among adolescents and young adults.[32] The association between gaming addiction and poor sleep quality was reported in a longitudinal study carried out with a cohort of 41,215 students assessed internet gaming disorder (IGD), depression, and sleep distress three different times and observed that adolescents with sleep distress, low resilience, and IGD exhibited higher rates if depression across the three times.[33] Based on the findings of this study, it is observed that those who are employed and practice physical activities may have lower internet addiction levels, and consequently lower risk for psychological distress. The same outcomes revealing the importance of practicing physical activities in the reduction of Internet Addiction were seen in earlier studies.[34,35] Having a job was also seen as a protective factor to reduce internet use and psychological distress. Unemployment affects one in five individuals worldwide, and previous studies have found positive correlations between unemployment, anxiety, and depressive disorders.[36] Higher levels of Internet Addiction were reported in unemployed people, as shown in a study conducted with 3007 individuals from Germany, emphasizing that the more time spent at home, the more internet they used.[37]

A few studies have examined protective factors for internet addiction, but it is known that life satisfaction might mitigate the time spent online.[38] In our study, being employed was considered a protective factor for internet addiction, but according to

other research, more than having a job, a more protective factor would be having a satisfying job[39], and this phenomena should be better investigated in future studies.

These findings suggest that different strategies should be developed to warn people about the risks involved in excessive internet use. Psychoeducational programs should be developed as well as treatment plans for those who suffer from these conditions, once, being addicted to the internet is associated with mental issues, such as depression, anxiety, and stress. Regarding psychotherapy programs, several models have been developed, using cognitive behavioral therapy, which is shown to be favorable in the treatment.[40,41]

Conclusions

The study shows that there were significant and positive associations between the symptoms of stress, anxiety, depression, and total DASS-21 score with internet addiction and social media engagement. Women tend to have higher levels of internet addiction and psychological distress than men. There are no differences in addiction levels between adolescents and young adults. It was also seen that individuals with higher stress levels and greater engagement with social media report higher internet addiction, those who work more may have lower internet addiction, poorer sleep habits are associated with higher internet addiction. And individuals with higher mental health issues tend to use social media more. The results complement other studies and raise concerns about the consequences of the excessive use of the internet. It is important for professionals to develop psychoeducational programs to alert individuals of the problems caused by excessive use. Treatment plans should also be offered, including protocols for interventions.

Our study has some limitations such as we did not analyze which activities the participants most commonly engage in online, apart from social media use. It is important to analyze the activities that influence the time spent online. Another limitation is that it is a cross-sectional study, and a longitudinal study would be positive to understand behavioral changes and the method of record-based recruitment suggests that the sample may consist of young individuals already “digitally engaged”. Thus, External generalization of the study is difficult since the sample is comprised mainly of young people and our study focused only on the male/female binary which does not represent the entire Brazilian population.

Some suggestions for future studies can be mentioned. Studies should be developed to include internet addiction as a developmental dependence in disorders manuals, other studies to investigate specific online activities, once, identifying them, would allow for better targeting of prevention and intervention strategies. Besides, conducting longitudinal studies, expanding sample representativeness, would be essential to monitor changes in use and mental health patterns over time. Furthermore, other studies could include the analysis of moderators and mediators, such as family factors, social support, personality traits, and enhancing self-report measures with objective monitoring would be important to mitigate recall bias and under or overestimation of internet use.

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