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Findings on the relationship between Internet addiction and psychological symptoms in Brazilian adults

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This study evaluated the prevalence of Internet addiction (IA) and its association with negative psychological symptoms in Brazilian adults. A network analysis was conducted to estimate specific variables and their expected influence on IA. In this cross-sectional study, 15,476 adults ($M_{age} = 37.5$, $SD = 9.59$) completed an open web-based survey. Three questionnaires were used: the Internet Addiction Test (IAT), Depression Anxiety and Stress Scale (DASS-21) and Satisfaction With Life Scale (SWLS). Based on IAT scores, participants were classified as No-Risk user (NRU), Low-Risk user (LRU) or High-Risk user (HRU). We observed that 4.8% of the participants were classified in the HRU group. In addition, their risk for severe symptoms of depression was 10 times higher and, for anxiety, seven times higher than that in the NRU group ($p < .001$). Time spent using smartphones was also significantly higher in the HRU group ($M_{hours} = 5.1$, $p < .001$). The main factors associated with IA were depression, gender and anxiety, but the variable "having children" was the most influential in the IA network. These findings suggest that psychiatric symptoms are the main factors associated with IA among the adult population.

Keywords: Internet addiction; Smartphone addiction; Addictive behaviour; Psychological factor.

New media technologies have changed social interactions in different ways, and the integration of such media with the Internet is increasingly complex. According to the United Nations, the number of Internet users grew by 10% between 2014 and 2015 (UN, 2016). The same report showed that about three billion people worldwide access the Internet daily. According to a Brazilian report (CGI, 2015), 55% of the population had Internet access in 2013 and 30% accessed it from their mobile devices, which was double the 15% reported in 2011.

The overuse of digital media, or Internet addiction (IA), has been associated with a significant number of physical and mental symptoms. IA comprises types of Internet behavioural addictions, among which Internet gaming disorder is included in Section 3 of the DSM-V because of its greater clinical relevance. Although there is no consensus regarding the term "Internet addiction," it is broadly used in the scientific literature (Brand, Young, Laier, Wölfling, & Potenza, 2016; Cruz, Scatena, Andrade, & De Micheli, 2018; Malak, Khalifeh, & Shuhaiber, 2017). Several studies have identified an association between IA and psychological illnesses, especially depression and anxiety symptoms (Park, Jeon, Bae, Seong, & Hong, 2017). Two of these studies have shown that the risk of suicide is as much as three times higher for those with IA (Kim et al., 2016; Lee et al., 2016). Moreover, Internet-addicted individuals were found to be four times as likely to have a depressive disorder and two times as likely to suffer from some form of anxiety disorder (Kim et al., 2016).

Mathias Brand and colleagues proposed a theoretical framework called I-PACE (Interaction of Person-Affect-Cognition-Execution) to explain the development and maintenance of IA by integrating

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different types of biopsychological features (Brand et al., 2016). Based on empirical findings, hypoactivation of glutamatergic transmission from the prefrontal cortex may reduce the release of dopamine into the reward system. These neural changes could be shared in both mood and addictive disorders, leading to a loss of interest and pleasure. Therefore, compulsive use of the Internet (such as pornography sites) focused on social interactions could stimulate these neurotransmitters, as observed in addicted patients. On the other hand, the deprivation of Internet and smartphone use might decrease the dopamine levels in the reward system and potentiate some symptoms of anxiety.

Concerning the prevalence of IA, most studies have focused on adolescents and students, showing notably higher IA rates in Asian countries. Some authors have observed that 51% of Filipino and 48% of Japanese students meet the criteria for IA (Mak et al., 2014). In Europe, the prevalence ranges between 2 and 8% in most of the studies (Pontes, Macur, & Griffiths, 2016; Ustinaviciene et al., 2016). However, these rates seem to be increasing, as shown in a study by Kaess et al. (2016). The authors evaluated the prevalence of IA among adolescents in five European countries (Italy, Germany, Estonia, Spain and Romania) and observed that the rates had increased from 4% in 2010 to 6.9% in 2012. In Brazil, some authors have observed that 24% ($n = 159$) of the students in public schools are considered addicted to the Internet; half of them have reported using their smartphones during meals and about 30% when they were in the bathroom (Cruz et al., 2018). Regarding depression, anxiety or stress, some Brazilian studies did not detect an association with IA either among adolescents (Della-Méa et al., 2016) or young adults (Moromizato et al., 2017). Machado et al. (2018) identified an association between behavioural (aggression, attention deficit) and emotional (anxiety and depression) problems and IA in adolescents.

Although some authors have detected an inverse relationship between IA and age, this raises many concerns since there is little data regarding the adult population. In South Korea, almost 12% of adolescents and 8% of adults are regarded as Internet addicts (Heo, Oh, Subramanian, Kim, & Kawachi, 2014). In Norway, 4.1% of the people aged between 16 and 29 years and 3.3% of the people older than 30 meet the criteria for IA (Bakken, Wenzel, Gotestam, Johansson, & Oren, 2009). In Latin America, the prevalence of IA among Chilean medical students ($N = 384$; $M_{age} = 20.7$) is 11.5% (Berner, Santander, Contreras, & Gomez, 2014), but these data are limited to a specific adult sample. No studies were found that evaluate the prevalence of IA in the Brazilian population. Moreover, there is a lack of research assessing the association between IA and negative psychological factors in adults.

This study assessed the prevalence of IA in adults and described both demographic and psychological factors that could be associated with IA. We also evaluated possible factors that could be associated with IA and hypothesized that adults with IA would have a higher frequency of psychological problems, which would be the main variables linked with IA. Lastly, we used a network analysis to investigate whether these variables would have a direct or indirect effect on IA.

METHODS

Sample

This study used a cross-sectional design and comprised 15,476 adults who filled out an online questionnaire. The link to this study was disseminated to the general population through different social networks. The inclusion criteria were: individuals older than 18 years of age; permanent residents in Brazil (automatically identified from the *Internet Protocol*), and those who reported having a smartphone with Internet access. All participants signed a Free Informed Consent Form before answering the questionnaires. The database platform was designed to support the use of various digital devices to answer the questionnaires (desktop, laptop, smartphones with Android and IOS systems and tablets). All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. In addition, the university's Ethics Committee approved this study. Informed consent was obtained from all individual adult participants included in the study.

Instruments

A basic information questionnaire was used to assess both socio-demographic data (gender, education, marital status and others) and specific information about the habits of smartphone use (Tables 1, 3 and 4).

The Internet Addiction Test (IAT) was used to assess the severity of Internet use with scores ranging from 0 (no risk) to 100 (high risk). Based on other studies (Berner et al., 2014), participants were classified into three groups: No-Risk users (NRUs; 0–19 points); Low-Risk users (LRUs; 20–49 points) and High-Risk users (HRUs; 50–100 points). We considered IA only for those participants in the HRU group. By adopting this procedure, we observed a robust difference among all groups, $F(2;\ 15{,}473) = 26.8$, $\eta^2 = .78$. The internal consistency of the instrument was also considered adequate (purified Cronbach's $\alpha = .93$).

The Depression, Anxiety, and Stress Scale (DASS-21) was designed to assess such symptoms. It showed good reliability ($\alpha = .92$ for depression, .90 for stress and .86

for anxiety) in the Brazilian Portuguese version (Vignola & Tucci, 2014). We classified participants into three groups based on their score for each symptom: depression (no risk [score 0–9], moderate risk [score 10–20] and high risk [score 21 or more]); anxiety (no risk [score 0–7], moderate risk [score 8–14] and high risk [score 15 or more]); stress (no risk [scores 0–14], moderate risk [scores 15–25] and high risk [score 26 or more]). We observed significant differences between the three groups for depression, $F(2;\ 15{,}091) = 28.7$, $\eta^2 = .79$, anxiety, $F(2;\ 15{,}091) = 33.8$, $\eta^2 = .82$, and stress, $F(2;\ 15{,}091) = 19.3$, $\eta^2 = .72$.

The Satisfaction With Life Scale (SWLS) is a five-item scale designed to assess global life satisfaction with scores ranging from 5 (*dissatisfied*) to 35 (*highly satisfied*). The participants were classified into three groups: dissatisfied (score 5–14), satisfied (score 15–25) and highly satisfied (score 26 or more). The analysis of variance (ANOVA) showed a statistically significant difference among all groups, $F(2;\ 15{,}273) = 33.4$, $\eta^2 = .79$.

Data analysis

The Z score was calculated for continuous variables, and all values below or above three standard deviation units were suppressed from the analyses to reduce distortions and potential bias in the results. A total of 1632 imputations were excluded from the following variables: time spent on smartphone (450); income (350); number of messages sent daily (288); number of calls received daily (147); number of smartphone checks daily (135); number of children (112); number of messages received daily (76) and number of calls made daily (74).

The Kolmogorov–Smirnov test was used to evaluate data normality. For continuous variables, we used the ANOVA, and Levene's test to assess the homogeneity of variances. When the ANOVA detected a significant effect, we used Scheffé's *post-hoc* test to identify specific differences between groups. The Chi-Square Test (χ^2) or Fisher's Exact Test were used for nominal and categorical data. The effect size for nominal and categorical data was measured using Cramér's V according to the degrees of freedom. For the continuous data, we used eta squared (η^2), considering .0–.4 a small effect, .41–.79 a medium effect and .8–.1 a significant effect (Yamauchi, Andrade, Pinheiro, Enumo, & Micheli, 2019).

A logistic regression model was conducted with IA as the outcome variable, and the adjusted model considered gender, age and region as control variables. The following variables were included in the regression models: (a) How do you rate the time you spend using your mobile device? (0 = *Short time*, 1 = *Moderate time*, 2 = *Long time*); (b) depression (0 = *No risk*, 1 = *Moderate risk*, 2 = *High risk*); (c) anxiety (0 = *No risk*, 1 = *Moderate risk*, 2 = *High risk*); (d) stress (0 = *No risk*, 1 = *Moderate risk*, 2 = *High risk*); and (e) satisfaction with life (0 = *Dissatisfied*, 1 = *Satisfied*, 2 = *Highly satisfied*). These logistic regression models were based on previous studies (Bedendo, Andrade, Opaleye, & Noto, 2017). The level of significance in all analyses was 5%, and the software used was Statistica version 15.0 (*Statsoft Inc*®).

A network analysis model was performed to estimate which variables are directly or indirectly associated with IA. Initially, a model of partial correlation coefficients called the Gaussian graphical model (i.e. the association between the pairs of variables conditioned to all other variables investigated) was designed. Partial correlation coefficients were found based on the inverse of the standardised variance/covariance matrix in accordance with the following effect size: (0.1 = small, 0.3 = moderate and ≥0.5 = large). We used a regularisation method (Graphical Least Absolute Shrinkage and Selection Operator - GeLASSO) to control the adjustment of the model, setting small coefficients to zero (Friedman, Hastie, & Tibshirani, 2008). The best-fitted model was selected based on the extended Bayesian information criteria.

The last step involved a graphical representation in a relative space using a diagram containing vertices (variables) and edges (associations), the latter varying in thickness and colour representing magnitude and direction, respectively. A spatial localization algorithm was used to approximate or repulse variables according to their relationship. The higher the partial coefficient, the smaller the path between a pair of variables. We used two centrality measures in our model to evaluate the influence of particular nodes (variables) within a network: closeness (shortest path lengths) and expected influence (the product of the direct and indirect edges).

RESULTS

Prevalence of IA and socio-demographic findings

Out of the total sample, 6459 (41.7%) were classified as NRU, 8272 (53.5%) as LRU and 745 (4.8%) as HRU. The mean age decreased according to the severity of Internet use, with the HRU group showing the lowest mean age (Table 1). Although most participants were women ($n = 12{,}046$, 77.8%), we did not detect gender differences regarding scores on the IAT. The income of the HRU group was 10.3 and 8.6% lower than that of the NRU and LRU groups, respectively ($p < .001$). Concerning Brazilian regions, the participants were from the Southeast, followed by the Northeast, South, Midwest and North regions. We observed a higher proportion of single individuals in the HRU group than in the NRU group ($p < .001$). Additionally, we observed a significant

TABLE 1
Description of socio-demographic data and severity level of IA in Brazilian adults ($N = 15,479$)

	Group		*Group*		*Group*			
	NRU	*95% CI*	*LRU*	*95% CI*	*HRU*	*95% CI*	*Test*	*Effect size*
Age (*M*, *SD*)***	39.5 (± 7.9)	[39.3–39.8]	36.3 (± 9.8)	[36.1–36.5]	34.1 (± 10)	[33.5–34.8]	$F(2, 15,473) = 265.5$	.03
Gender (%)**							$\chi^2 = 58.6$	.06
Male	1290 (23)	[.22–.24]	1906 (19.9)	[.19–.20]	234 (31.4)	[.28–.34]		
Female	5169 (77)	[.76–.78]	6366 (80.1)	[.79–.8]	511 (68.6)	[.65, .72]		
Brazilian region (%)**							$\chi^2 = 51.4$	.04
South	966 (15)	[.14–.16]	1462 (17.7)	[.16–.18]	107 (14.4)	[.11–.17]		
Southeast	3042 (47.1)	[.45–.48]	3609 (43.6)	[.42–.44]	308 (41.3)	[.37–.45]		
North	290 (4.5)	[.04–.05]	301 (3.6)	[.03–.04]	36 (4.8)	[.03–.06]		
Northeast	1671 (25.9)	[.24–.27]	2257 (27.3)	[.26–.28]	244 (32.8)	[.29–.36]		
Midwest	490 (7.5)	[.06–.08]	643 (7.8)	[.07–.08]	50 (6.7)	[.05–.09]		
Income ($) (M, SD)[a]*	2009.40 (± 5871.86)	[5874.09–7066.47]	1995.69 (± 5768.08)	[1843.89–2147.49]	1825.94 (± 5462,62)	[1364.49–2286.87]	$F(2, 9955) = .24$	.09
Marital status (%)***							$\chi^2 = 176.9$	.11
Single	2952 (45.7)	[.44–.47]	4566 (55.2)	[.54–.56]	475 (63.7)	[.60–.67]		
Married	3507 (54.3)	[.53–.55]	3706 (44.8)	[.43–.45]	270 (36.3)	[.32–.4]		
Having children (%)***							$\chi^2 = 318,9$	.14
Yes	3902 (60.4)	[.59–.61]	3855 (46.6)	[.45–.48]	302 (40.5)	[.37–.44]		
No	2557 (39,6)	[.34–.40]	4417 (53.4)	[.52–.54]	443 (59.5)	[.55–.56]		
How do you rate the time you spend using your mobile? (%)***							$\chi^2 = 2164.6$	.26
Short time	1854 (28.7)	[.27–.3]	1039 (12.6)	[.11–.13]	43 (5.8)	[.04–.07]		
Moderate time	4036 (62.5)	[.61–.63]	4584 (55.4)	[.54–.56]	197 (26.4)	[.23–.29]		
Long time	569 (8.8)	[.08–.09]	2649 (32)	[.30–.33]	505 (67.8)	[.64–.71]		

Notes: Values are expressed as mean ± standard deviation or raw number and percentage. NRU = no-risk users ($n = 6459$), LRU = low-risk users ($n = 8272$), HRU = high-risk users ($n = 745$). *$p < .05$. **$p < .01$.
***$p < .001$.
[a]1$ = 3.22 BRL (Mean exchange rate in June 2016).

frequency of participants in the NRU group who reported having at least one child. Lastly, more than 70% of the people in the HRU group believed that they spent a long time on the Internet, as opposed to 8% in the NRU group.

Psychological problems associated with IA

Table 2 shows the distribution of severity of depression, anxiety, stress symptoms and satisfaction with life across the three groups. The time spent using a smartphone was proportional to the time of Internet use. Those from the NRU group reported using their devices around 3 hours a day, while those in the HRU group spent 5.1 hours doing so. As for using a mobile device while driving, participants in the HRU group presented a frequency four times higher than that of the NRU group.

The HRU group presented the highest number of participants classified as "Severe" according to the DASS-21 concerning all the variables analysed. In this sense, the number of participants classified as "Severe" in the HRU group was 10 times higher than that of participants classified as NRU. As for the other variables, this number was seven times higher in the HRU group for anxiety, eight times higher for stress and five times higher for satisfaction with life. Additionally, the raw scores of the DASS and SWLS instruments were almost four times higher for depression and anxiety in the HRU group than in the NRU group.

Internet use perception

Table 3 shows the Internet and smartphone use patterns of those who reported that this use interfered ("interfere group"; $n = 4634$) or not ("does not interfere group"; $n = 11,583$) in their current daily activities. We observed a slightly larger number of women who reported having problems with smartphone use. Moreover, those of the "interfere group" spent more time ($p < .001$) on their mobile devices and sent and received more text messages ($p < .001$). This same group showed higher scores for depression, anxiety and stress and lower scores for satisfaction with life ($p < .001$). Finally, the frequency of using a mobile device while driving was two times higher in this group.

TABLE 2
IA classification according to time spent using a smartphone, levels of anxiety, depression, stress and satisfaction with life in Brazilian adults ($N = 16{,}617$)

	Group		*Group*		*Group*				
	NRU	*95% CI*	*LRU*	*95% CI*	*HRU*	*95% CI*	*Test*	p	*Effect size*
Time spent using smartphone-hours (SD)	2.9 (± 2.3)	[2.8–2.9]	3.8 (± 2.6)	[3.8–3.9]	5.1 (± 3.1)	[4.9–5.4]	$F(2, 15{,}473) = 417.1$	***	.05
Do you talk on the cell phone while driving? (%)[a]							$\chi^2 = 248.7$	***	.10
Never	2922 (53.7)	[.51–.54]	3147 (45)	[.44–.46]	230 (38)	[.34–.41]			
Rarely	2307 (42.4)	[.41–.43]	3243 (46.4)	[.45–.47]	275 (45.5)	[.41–.49]			
Frequently	214 (3.9)	[.03–.04]	599 (8.6)	[.08–.09]	100 (16.5)	[.13–.19]			
Depression (%)							$\chi^2 = 1103$	***	.20
No risk	5617 (89.3)	[.88–.90]	6410 (79.4)	[.78–.80]	332 (45.7)	[.42–.49]			
Moderate risk	440 (7)	[.06–.07]	1001 (12.4)	[.11–.13]	153 (21.5)	[.18–.24]			
High risk	236 (3.8)	[.03–.04]	663 (8.2)	[.08–.09]	242 (33.3)	[.29–.36]			
Raw score	4.8 (± 6.8)	[4.6–4.9]	7.64 (± 8.3)	[7.4–7.8]	16 (± 11.4)	[15–16]	$F(2, 15{,}091) = 746.5$	***	.10
Anxiety (%)							$\chi^2 = 963$	***	.18
No risk	5556 (88.3)	[.87–.89]	6301 (78)	[.77–.79]	334 (45.9)	[.42–.49]			
Moderate risk	406 (6.4)	[.05–.07]	931 (11.6)	[.11–.12]	134 (18.4)	[.15–.21]			
High risk	331 (5.3)	[.04–.05]	842 (10.4)	[.09–.11]	259 (35.7)	[.32–.39]			
Raw score	3.4 (± 5.8)	[3.2–3.5]	5.5 (± 7.3)	[5.3–5.7]	12.5 (± 10.3)	[11–13]	$F(2, 15{,}091) = 616.1$	***	.08
Stress (%)							$\chi^2 = 1038.9$	***	.19
No risk	5562 (88.4)	[.87–.89]	6149 (76.2)	[.75–.77]	317 (43.6)	[.40–.47]			
Moderate risk	464 (7.4)	[.06–.07]	1159 (14.3)	[.13–.15]	184 (25.3)	[.22–.28]			
High risk	267 (4.2)	[.03–.04]	766 (9.5%)	[.08–.10]	226 (31.1)	[.27–.34]			
Raw score	7.9 (± 7.8)	[7.8–8.2]	11.6 (± 9.1)	[11.4–11.8]	19.2 (± 10.7)	[18–20]	$F(2, 15{,}091) = 686.4$	***	.08
Satisfaction with life (%)							$\chi^2 = 444.1$	***	.12
Dissatisfied	368 (5.7)	[.04–.05]	733 (10)	[.09–.10]	158 (21.5)	[.18–.24]			
Satisfied	2205 (34.7)	[.33–.35]	3458 (42.3)	[.41–.43]	363 (49.4)	[.45–.53]			
Highly satisfied	3800 (59.6)	[.58–.60]	3977 (48.7)	[.47–.50]	214 (29.1)	[.26–.32]			
Raw score (SD)	25.7 (± 5.8)	[25.5–25.8]	24.1 (± 6.2)	[24–24.3]	20.7 (± 6.8)	[20–21]	$F(2, 15{,}091) = 274.3$	***	.03

Notes: Some variables are described using mean ± standard deviation. Other variables are described using raw number and percentage. NRU = No-Risk users ($n = 6459$), LRU = Low-Risk users ($n = 8272$), HRU = High-Risk users ($n = 745$).
*$p < .001$.
[a]A total of 2489 were excluded from the analysis as non-drivers.

Risk factors of IA

The adjusted logistic regression models detected that those participants who perceived their time of use as "moderate" (aOR = 1.92) or "long" (aOR = 8.45) were more likely to have IA (Table 4). The time spent on a smartphone (aOR = 1.17) as well as the number of smartphone checks daily (aOR = 1.02) were also considered risk factors for IA. The psychological problems were the most robust variables associated with IA.

Network analysis

Figure 1 shows the graphical network, which comprises regularised partial correlations among many variables (nodes) related to IA. The direct variables associated with IA were gender (GE), anxiety (ANX), depression (DEP) and how the participants rated their mobile time use (MTi). All other variables in the system were indirectly associated with IA. The node MTi was most strongly correlated with IA, but strong connections also appeared between having children (HCh) (negative correlation), the number of children (NCh) and gender (GE). Strong connections were also observed between hours spent on the smartphone (TiS) and how the participants rated their mobile time use (MTi) and between the level of life satisfaction (SWL) (negative correlation) and stress (STR) with depression. Regarding the influence of particular nodes within a network, having children (HCh) was the most influencing variable or factor in the network system, as shown in the expected influence indices, followed by anxiety (ANX).

TABLE 3
Evaluation of smartphone use behaviour and severity of depression, anxiety, stress symptoms and satisfaction with life among professionals who reported that use of smartphones interferes ($n = 4634$) or does not interfere ($n = 11,583$) in their daily activities

	Interferes	*95% CI*	*Does not interfere*	*95% CI*	*Test*	p	*Effect size*
Gender (%)					$\chi^2 = 16.4$	*	.03
Male	1122 (24.2)	[.22–.25]	2466 (21.3)	[.20–.22]			
Female	3512 (75.8)	[.74–.77]	9117 (78.7)	[.78–.79]			
How do you rate your mobile time use? (%)					$\chi^2 = 1253.0$	***	.28
Short time	521 (11.2)	[.10–.12]	2550 (22)	[.21–.22]			
Moderate time	2137 (46.1)	[.44–.47]	7092 (61.2)	[.60–.62]			
Long time	1976 (42.7)	[.41–.44]	1941 (16.8)	[.16–.17]			
IAT score (SD)	29.7 (± 15.5)	[29.3–30.1]	21.0 (± 12.6)	[20.7–21.3]	$F(1, 15,474) = 1293$	***	.08
Time spent on smartphone – hours (SD)	4.0 (± 2.7)	[3.9–4.1]	3.3 (± 2.5)	[3.2–3.4]	$F(1, 15,474) = 261.3$	***	.02
Number of messages sent daily (SD)	45.7 (± 57.1)	[44.3–47.1]	32.3 (± 45.1)	[31.5–33.2]	$F(1, 15,474) = 246.8$	***	.01
Number of messages received daily (SD)	121.6 (± 171.4)	[117.2–125.9]	89.3 (± 143.5)	[86.6–92.1]	$F(1, 15,474) = 148.6$	***	.00
Number of calls made daily (SD)	4.2 (± 4.7)	[4.0–4.3]	4.4 (± 4.7)	[4.3–4.5]	$F(1, 15,474) = 10.3$	***	.00
Number of calls received daily (SD)	4.9 (± 5.2)	[4.7–5.0]	5.3 (± 5.3)	[5.2–5.4]	$F(1, 15,474) = 18.6$	***	
Do you talk on the cell phone while driving? (%)[a]					$\chi^2 = 170.4$	***	.11
Never	1648 (42.4)	[.41–.43]	4966 (50.8)	[.49–.51]			
Rarely	1806 (46.5)	[.45–.48]	4288 (43.8)	[.42–.44]			
Frequently	429 (11.1)	[.10–.12]	529 (5.4)	[.05–.06]			
Depression (SD)	8.4 (± 9.1)	[4.7–5.0]	6.2 (± 7.7)	[6.1–6.4]	$F(1, 15,092) = 221.1$	***	.01
Anxiety (SD)	6.1 (± 8.0)	[5.9–6.3]	4.5 (± 6.7)	[4.4–4.7]	$F(1, 15,092) = 153.3$	***	.00
Stress (SD)	12.2 (± 9.7)	[11.9–12.5]	9.7 (± 8.7)	[9.5–9.9]	$F(1, 15,092) = 230.9$	***	.02
Satisfaction with life (SD)	23.7 (± 6.3)	[23.6–23.9]	24.9 (± 6.1)	[24.8–25.1]	$F(1, 15,092) = 124.9$	***	.00

Notes: Values are expressed as mean ± standard deviation or raw number and percentage.
*$p < .05$. **$p < .01$. ***$p < .001$.
[a]A total of 2489 were excluded from the analysis as non-drivers.

DISCUSSION

To the best of our knowledge, this is the first study in Latin America, particularly in Brazil, to evaluate the prevalence of IA and its relationship with demographic and negative psychological factors in an adult population. Our data indicated that 4.8% ($n = 745$) of the participants have IA (HRU group) and were more likely to have depression, anxiety, stress and less satisfaction with life. Moreover, we found some risk factors for IA, particularly those related to the perception of mobile device use and the severity of psychological problems.

In our study, the prevalence of IA in adults was lower than that observed in South Korea (8%) (Heo et al., 2014) but higher than in the Norwegian population among individuals over 30 years old (3.3%) (Bakken et al., 2009). Most of the studies on the prevalence of IA have focused on adolescents or young adults and show conflicting rates of IA between many countries. For example, whereas 10% of Lithuanian adolescent boys were considered Internet addicts (Ustinaviciene et al., 2016), this prevalence was 51% among Japanese adolescents (Mak et al., 2014). In a study by Mak et al. (2014), the authors pointed out that discrepant rates can be associated with many aspects, among which are geographical and cultural specificities, different types of instruments and procedures used, specific contexts of instrument application and motivations for Internet and smartphone use.

Our data showed a higher frequency of single participants in the HRU group, as well as fewer children and lower income compared to other users. These data are consistent with those from other studies (Kaess et al., 2016; Kim et al., 2016; Wu et al., 2016) and may indicate that free time may increase the time spent on the Internet with media devices. In this sense, some studies have shown that unemployed people spend more time on the Internet with different media devices (Rumpf et al., 2014). In this study, the unemployed users were three

TABLE 4
Adjusted logistic regression models for IA risk from the IAT ($n = 15{,}476$)

	OR	*95% CI*		*aOR*	*95% CI*	
	Crude		p	*Adjusted*		p
How do you rate your mobile time use?***						
Short time	ref			ref		
Moderate time	2.03	[1.86–2.21]	***	1.92	[1.76–2.1]	***
Long time	9.50	[8.45–10.67]	***	8.45	[7.5–9.52]	***
Time spent on smartphone (hours)	1.19	[1.17–1.21]	***	1.17	[1.16–1.19]	***
Number of smartphone checks daily	1.03	[1.03–1.03]	***	1.02	[1.02–1.03]	***
Depression						
No risk	ref			ref		
Moderate risk	2.19	[1.95–2.45]	***	2.14	[1.90–2.40]	***
High risk	3.19	[2.76–3.60]	***	3.04	[2.62–3.53]	***
Anxiety						
No risk	ref			ref		
Moderate risk	2.20	[1.95–2.48]	***	2.20	[1.95–2.48]	***
High risk	2.79	[2.45–3.17]	***	2.71	[2.38–3.09]	***
Stress						
No risk	ref			ref		
Moderate risk	2.49	[2.23–2.78]	***	2.41	[2.15–2.70]	***
High risk	3.20	[2.78–3.68]	***	3.00	[2.60–3.46]	***
Satisfaction with life						
Dissatisfied	ref			ref		
Satisfied	.72	[.63–.82]	***	.72	[.63–.82]	***
Highly satisfied	.46	[.40–.52]	***	.46	[.40–.53]	***

Note: The regression model was adjusted for gender, age and region. Missing: depression ($n = 1123$); anxiety ($n = 1123$); stress ($n = 1123$) and satisfaction with life ($n = 941$).
***$p < .001$.

times more likely to use the Internet for private purposes (*OR* = 3.13; 95% CI [1.74–5.65]) than those who were employed.

Regarding adolescents, some authors observed an IA frequency almost seven times higher in Polish rural areas than in urban zones (Pawlowska et al., 2015). In that study, the authors hypothesized that free time could be associated with an increase in Internet use, but they did not evaluate the risk predictors of its use. On the other hand, some authors found a positive correlation between family income and the severity of IA symptoms. In Jordan, those students who reported higher income spent more time on the Internet (Malak et al., 2017). In this case, the relationship between income and Internet use differ from our results because many Brazilian students were supported by their parents and probably had more leisure time to use their electronic devices.

Concerning the time spent using a smartphone, the HRU participants used their devices about 5 hours a day, and these findings are in line with previous studies. Rumpf et al. (2014) found that users with IA spent 4.2 hours a day on the Internet, and those with at-risk use spent 3.1 hours a day. Our study shows that the participants in the HRU group sent and received more text messages than those in the NRU and LRU groups, even using their smartphones at inappropriate times (e.g. while driving), which can lead to traffic accidents. In this regard, participants in the HRU group had a four times higher frequency of smartphone use while driving than did the others. Such results corroborate the outcome of other published studies where a positive correlation was found between smartphone use and risk of traffic accidents (Parnell, Stanton, & Plant, 2018).

We also detected an association between psychological problems and Internet use. The frequency of participants with severe depression, anxiety and stress symptoms was respectively 10, 6 and 7 times higher in the HRU group compared with those with no Internet use problems (NRU). Similarly, Kuss et al. (2018) found higher levels of stress, depression and anxiety in adults with increased smartphone use, especially among young adults compared to older ones. Some authors also observed that stress could influence the reward system, particularly among adolescents (Frade, De Micheli, Andrade, & de Souza-Formigoni, 2013).

Regarding the network analysis, some authors found that frequency of downloads, time viewing TV series and movies, number of messages sent and being female were the main predictors of IA (Lopez-Fernandez, Männikkö, Kääriäinen, Griffiths, & Kuss, 2018). In terms of psychological problems, Koo and Kwon (2014) conducted a study of almost 60,000 South Korean adolescents and observed that the main predictors of IA were self-efficacy, depression and anxiety symptoms. On the other hand,

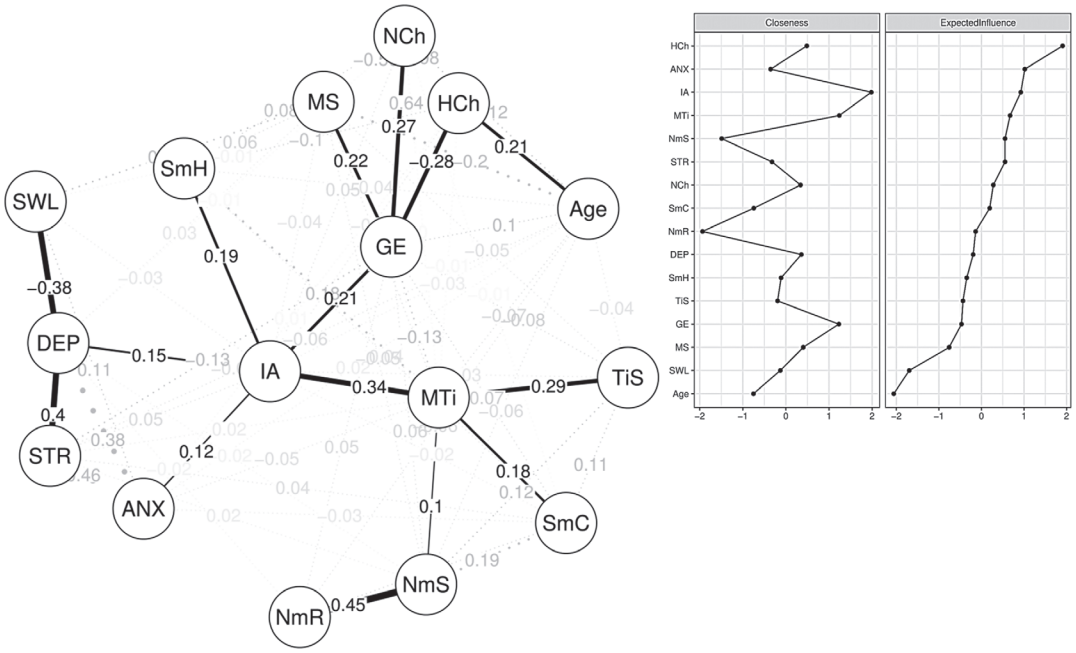

Figure 1. The association network for Internet addiction (IA). Each edge represents the zero-order correlation between two variables, and thickness signifies magnitude. Those nodes (variables) with stronger inter-associations appear in the center of the network. IA = Internet addiction, GE = Gender, MS = Marital status, Age, HCh = Having children, NCh = Number of children, SmH = Does your smartphone use harm your everyday life? MTi = How do you rate your mobile time use? TiS = Time spent on smartphone (hours), SmC = Smartphone checks daily, NmS = Number of messages sent daily, NmR = Number of messages received daily, SWL = Satisfaction With Life Scale, DEP = Depression, ANX = Anxiety, STR = Stress.

some authors (Kuss et al., 2018) observed that depression and anxiety were not predictors of problematic mobile phone use in an adult sample. According to these authors, the only significant effect found was an indirect effect of anxiety on age group, suggesting that younger people may be more anxious than older people. In this sense, it is possible that the amount of cell phone use could not be closely associated with psychological symptoms. Further, they observed a weak connection between gaming time spent and problematic use, suggesting that the amount of gaming time is weakly associated with negative psychological factors.

The main strengths of our study are a large sample size, the high response rate of the participants and the network analysis. However, this paper has some limitations that must be considered, such as the study design (cross-sectional), which did not allow us to detect causal relationships between IA and other variables. In Brazil, the IAT is the only instrument validated to assess IA in adults, and there are few instruments available to assess smartphone-related problems (Andrade et al., 2020). As new smartphones have many features and are part of people's routines, smartphone addiction could be a confounding factor for IA. We also recruited the participants by a convenience sample method, and most of them had a college degree. Thus, the educational level can be a confounding factor for the prevalence of individuals with IA, limiting the generalisation of our results.

In summary, our findings showed that 5% of the participating adults were Internet-addicted, and more than half had a low risk for IA. The frequency of psychological problems was notably higher among the Internet-addicted participants, and IA was associated with smartphone use. The highest risk factors for IA were perception of smartphone use, depression, anxiety and stress symptoms. The direct variables associated with IA were gender (GE), anxiety (ANX), depression (DEP) and how the participants rated their mobile time use (MTi), while having children (HCh) was the most influential in the network system. In the future, our team intends to design a longitudinal study to assess behavioural changes over time. These data should be considered in the development of specific policies on the prevention and promotion of mental health.

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Denise de Micheli cooperated in the technical procedures, interpretation of the data and preparation of the manuscript. All the authors are responsible for its contents, having revised and approved its final version and all the authors declare no competing interests.

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