Profiles on Adolescent Internet Addiction: A Taxonomy with Latent Profiling Analysis

Perfis na Dependência de Internet em Adolescentes: Análise Taxonómica de Perfis Latentes

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ABSTRACT

Introduction: Addictive use of the Internet among adolescents has been linked to a negative psychosocial development, but more detailed information about Internet addiction (IA) profiles is warranted. The aim of this study was to identify IA profiles in adolescents based on psychometric properties from the Internet Addiction test (IAT), and to assess the associations between the profiles and personal/social behaviors.
Material and Methods: A cross-sectional study was performed at public schools from a Portuguese region, using a survey that included the IAT. We performed a latent profiling analysis to identify the profiles of adolescent based on the six IAT dimensions.
Results: From the 1915 responses, students' mean age was 15 ± 1.82 years, 53% were female. IA was found in 16.5%. Four models were estimated with latent profiling analysis. Analysis of the models by fit statistics, integrated completed likelihood and Lo-Mendell-Rubin likelihood ratio test, indicated a better solution with four profiles: Profile 1 – Worrisome lack of control users, Profile 2 – Balanced users, Profile 3 – Worrisome anticipation users, Profile 4 – Problematic users.
Conclusion: This study provides a characterization of different patterns in adolescents' traits and behaviors associated with Internet addiction. Preventive approaches may be useful to reduce IA.
Keywords: Adolescent; Adolescent Behavior; Internet Addiction Disorder; Online Social Networking; Portugal

RESUMO

Introdução: A dependência da Internet em adolescentes tem sido associada a problemas no seu desenvolvimento psicossocial. Porém, a literatura carece de dados sobre diferentes perfis do uso de Internet. Este estudo pretendeu identificar perfis de dependência de Internet (DI), baseado nas características psicométricas do *Internet Addiction test* (IAT), verificando associações entre os perfis e comportamentos sociais.
Material e Métodos: Estudo transversal realizado em escolas públicas de uma região Portuguesa mediante questionário que incluiu o IAT. Realizou-se uma análise de perfis latentes (APL) para identificar perfis de adolescentes, com base nos seis domínios do IAT.
Resultados: Dos 1915 participantes, a idade média foi 15 ± 1,82 anos; 53% eram do sexo feminino. Identificou-se DI em 16,5%. A análise de modelos por qualidade de ajuste e rácio de verossimilhança de Lo-Mendell-Rubin revelou um modelo adequado com 4 perfis: 1 – Utilizadores com dificuldade de controlo; 2 – Utilizadores equilibrados; 3 – Utilizadores com problemas de antecipação; 4 – Utilizadores problemáticos.
Conclusão: Este estudo permitiu a caracterização de diferentes padrões e comportamentos de adolescentes na DI, pelo que se alerta para uma abordagem preventiva na redução da DI.
Palavras-chave: Adolescente; Comportamento do Adolescente; Perturbações de Adição à Internet; Portugal; Redes Sociais Online

INTRODUCTION

Technology is fast evolving with enhanced access to all kinds of information and resources through the Internet.[1] It has become an essential tool in our daily social, professional and academic life, among others. However, its excessive use has raised concerns about potential harmful health-related consequences,[2] especially within vulnerable groups of people, such as adolescents. It is estimated that close to 75% of European adolescents spend up to four hours a day on online activities.[3,4] Moreover, since they have not entirely developed their critical thinking skills and sense of boundaries, addiction is more likely in this age group. Kimberly Young firstly mentioned Internet addiction (IA) in 1996. Although ongoing research continues on this subject, IA classification is still controversial, with empirical studies providing inconsistent criteria to define IA.[5] Different scales

have been used to assess IA, of which Young's Internet Addiction test (IAT) is one of the most used and accepted.[3] This test evaluates the degree to which Internet use affects daily routine, social life, productivity, sleeping patterns, and feelings. In Portugal, few studies have reported adolescent IA rates, ranging roughly from 16% - 19%.[3,6,7] This trend was slightly higher than the previously reported margins of Internet addiction, using the same tool.[8]

Several studies using the IAT have shown a negative impact of Internet addiction in adolescents' psychosocial development,[9,10] affecting academic performance, family relationships, and emotional development. Most of the evidence on the effects of excessive Internet use concerns health, namely obesity and lack of sleep. More recently, a focus on the influence of parental control and other

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psychosocial factors on IA has been explored, with results indicating a negative association with parental control. When students reported having any parental control over their Internet use, Internet addiction was less likely to occur.[6]

To better understand how psychologic factors may influence the risk of IA, studies were conducted to assess the widely used psychometric properties of the IAT. From these, six main dimensions that factor heavily on IA were identified – salience, excessive use, neglect of work, anticipation, lack of control, and social life neglect. Salience, excessive use, lack of control, and social life neglect are positively correlated with increased Internet use. Similarly, younger and more recent Internet users were shown to have more problems with neglecting work or social life than longer-term users.[11]

Since these issues are a growing concern in our modern world, identifying contributing factors is essential to improve prevention and intervention in IA. Hence, the aims of our study are to ascertain different patterns in the characteristics and behaviours of adolescents with Internet addiction in order to identify profiles; Identify which psychometric properties from the IAT are correlated with personal and social behaviours in our sample of adolescents.

MATERIAL AND METHODS
Study design and sample
An observational and analytical cross-sectional survey-based study was performed in the public schools of Cova da Beira region. Both elementary and secondary schools, ac-

counting for 3788 students from grades seven through 12, were invited to participate. Approval by the Portuguese Ministry of Education and the Portuguese Data Protection Authority was obtained before the study. Written consent was obtained from all participants or, where it was applied, from their legal guardians. Participating students were asked to fill in a questionnaire under their teacher's supervision. The questionnaire had three different sections. The first one addressed sociodemographic factors, health-related questions, and lifestyle habits regarding Internet usage in and out-of-school. The second and third sections consisted of two scales that approached general well-being and Internet addiction risk. Students who did not get/return a signed consent form and those older than 17-years and 365 days were excluded from the study.

Internet addiction assessment
Internet Addiction was assessed by using a previously validated Portuguese version of Young's Internet Addiction Test,[2] which consisted of 20 questions with possible answers ranging from "1" (Never) to "5" (always), along with the "not applicable" option of "0".[2] Since each question followed a Likert-scale answer, the cut-off of > 2.5 points was established to ascertain an increased usage of Internet (as seen in Fig. 1). The maximum collective score was 100, with higher values indicating greater risk from Internet usage.[12] Average Internet users (IAT 0 - 50) and Internet-addicted users (IAT 51 - 100) were characterized accordingly. The collected data produced a highly consistent internal reliability (Cronbach α = 0.85). The IAT is composed of 20 items
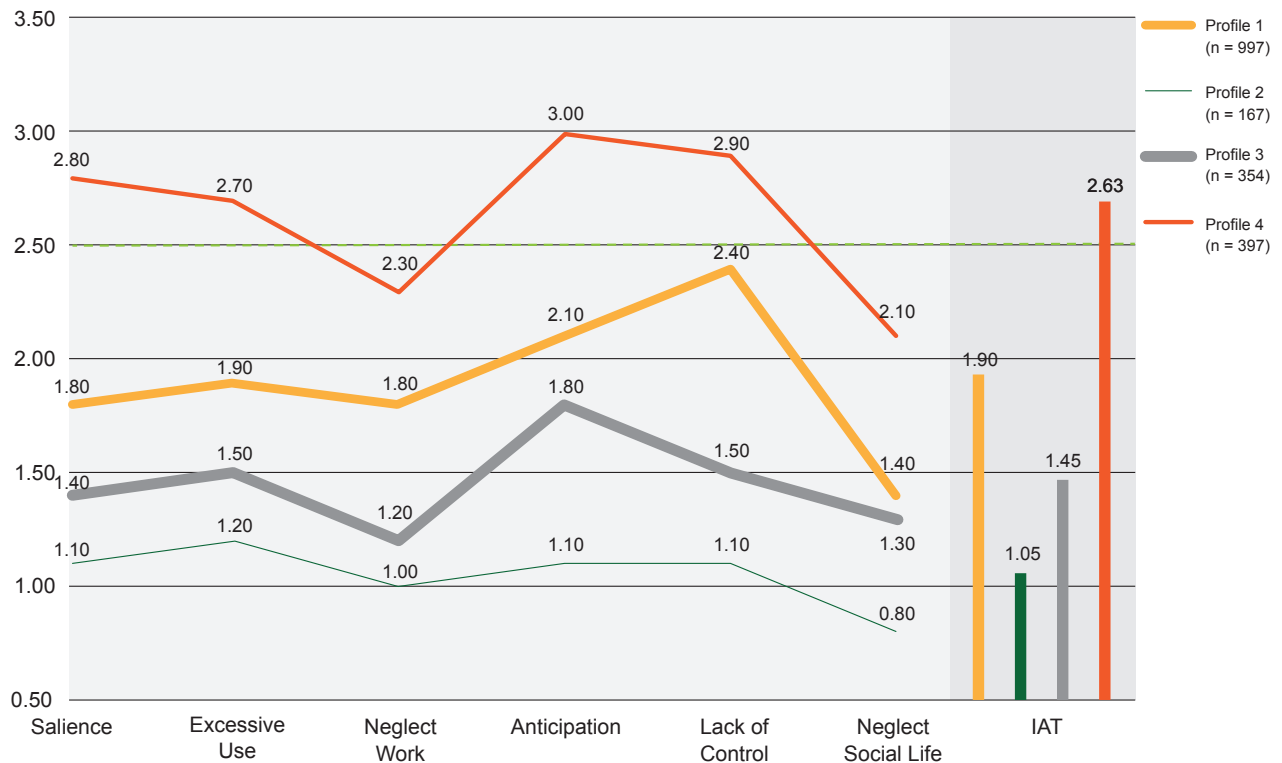

Figure 1 – Means by profile
*: green-dashed line represents the cut-off for increased Internet use

and was primarily developed as a unidimensional instrument. Meanwhile, different validations have shown a factor structure with a variable number of dimensions. Kimberly Young recommended six dimensions.[11,13,14]

- Salience (items 10, 12, 13, 15, and 19) - high scores on these items suggest that the "respondent most likely feels preoccupied with the Internet, hides the behavior from others, and may display a loss of interest in other activities and/or relationships only to prefer more solitary time online";
- Excessive Use (items 1, 2, 14, 18, and 20) - High ratings on these questions indicate that the "respondent engages in excessive online behavior and compulsive usage, and is intermittently unable to control time online that he or she hides from others";
- Neglect Work (item 6, 8, and 9) – the subjects' "performance and productivity are most likely compromised due to the amount of time spent online and the respondent may become defensive or secretive about the time spent online";
- Anticipation (items 7 and 11) - indicates that "respondent most likely thinks about being online when not at the computer and feels compelled to use the Internet when offline";
- Lack of Control (items 5, 16, and 17) - high scores on these items suggest that the "respondent has trouble managing his or her online time, frequently stays online longer than intended, and others may complain about the amount of time he or she spends online";
- Neglect Social Life (item 3 and 4) - the subject "most likely uses online relationships to cope with situational problems and/or to reduce mental tension and stress." and "uses the Internet to establish social connections that may be missing in his or her life".

General demographics

General sociodemographic data were obtained alongside specific psychosocial variables (Table 1). An adequate amount of sleeping time during weekdays was classified according to the guidelines of the American Academy of Pediatrics and presented as recommended (9 - 12 hours in children aged 8 - 12 years, and 8 - 10 hours for children

aged 13 - 18 years) or less than recommended.[15] Parental behaviour was assessed by asking participants if their parents controlled overall Internet use and online time, and online-viewed content.

Latent profile analysis

We performed a latent profile analysis[16] (LPA) using the Mclust package[17] with R version 3.5.3 (R Core Team 2019) to identify profiles of teenagers with similar values in the six Internet addiction dimensions. LPA is a latent variable technique with the same objective as cluster analysis - to identify groups of observations with similar values on grouping variables[18] but with the difference that LPA is model-based and cluster analysis is not.[19] Therefore, LPA has the advantages of (1) accommodating data with a variety of forms; (2) using more rigorous criteria to decide the final model, including fit measures; (3) using the model parameter estimates of one sample to compute the posterior probabilities and assign cluster membership to observations in other samples.[19] This latter advantage allows the classification of individuals into the groups in posterior studies.

RESULTS
Descriptive statistics

A total of 1915 eligible responses were obtained. The participants' mean age was 15 years (SD = 1.82). The prevalence of IA was 16.5% in our sample, with a mean average IAT score of 39 (SD = 12).

All correlation coefficients between IAT dimensions and IAT score were statistically significant (Table 1). The highest correlations were obtained between IAT score and neglect social life (0.84) and salience (0.78), followed by the correlation between excessive use and lack of control (0.58), and then excessive use and salience (0.55). The lowest correlation was verified between anticipation and neglect of social life (0.21). Age was positively correlated with IAT score and all IAT dimensions, except salience and lack of control. BMI z-scores showed no significant correlation with IAT.

As shown in Table 2, there was a slight predominance of females; 24% of the students self-reported health issues and 46% reported not practicing any extracurricular sports activities. The majority stated they slept well and had no

Table 1 – Descriptive statistics and correlations. Mean, standard deviation, distribution, and correlation across IAT dimensions.

Variable	n	Mean	Median	SD	Histogram	1	2	3	4	5	6	7	8	9
1. Salience	1915	1.91	1.8	0.76		1								
2. Excessive Use	1915	1.95	1.8	0.69		0.55*	1							
3. Neglect Work	1915	1.78	1.8	0.76		0.40*	0.52*	1						
4. Anticipation	1915	2.21	1.8	0.93		0.48*	0.46*	0.36*	1					
5. Lack of Control	1915	2.28	1.7	0.91		0.46*	0.58*	0.43*	0.39*	1				
6. Neglect Social Life	1915	1.52	2	0.88		0.31*	0.26*	0.23*	0.21*	0.12*	1			
7. IAT	1915	1.71	2.3	0.67		0.78*	0.48*	0.38*	0.41*	0.34*	0.84*	1		
8. Age	1915	15	15	1.82		0.01	0.07*	0.15*	0.07*	-0.07*	0.20*	0.14*	1	
9. BMI (z-score)	1775	0	-0.02	0		0.00	-0.03	0.03	-0.02	-0.02	0.04	0.03	0.24*	1

*: Pearson correlation with $p < 0.01$; 1: Salience; 2: Excessive Use; 3: Neglect Work; 4: Anticipation; 5: Lack of Control; 6: Neglect Social Life; 7: IAT: Internet Addiction test; 8: Age; 9: BMI [z(score)]: Z-score for body mass index

Table 2 – Sample description and *t*-tests

Variable	n	%	SAL	EXU	NGW	ANT	LOC	NSL	IAT	Age (mean in years)	BMI (mean z-score)
Gender											
Female	1019	53	1.96*	1.95	1.82†	2.19	2.22†	1.74*	1.85*	15.02	-0.02
Male	891	47	1.87	1.94	1.74	2.23	2.32	1.32	1.59	14.93	0.03
With health issues											
No	1443	76	1.90	1.95	1.78	2.22	2.25	1.53	1.72	14.94	-0.04*
Yes	454	24	1.96	1.94	1.78	2.20	2.36	1.48	1.72	15.08	0.14
Sleeps well											
No	171	9	2.06*	2.15*	2.01*	2.23	2.37	1.52	1.79	15.64*	0.14†
Yes	1706	90	1.90	1.92	1.76	2.21	2.27	1.51	1.70	14.90	-0.02
Practices sports											
No	873	46	1.96†	1.96	1.80	2.25	2.33†	1.52	1.74	15.24*	0.04
Yes	1035	54	1.88	1.93	1.77	2.18	2.23	1.51	1.70	14.75	-0.03
Hard to make friends											
No	1627	85	1.89*	1.93†	1.76†	2.20	2.27	1.54*	1.71	14.91*	-0.03†
Yes	276	15	2.05	2.04	1.87	2.30	2.29	1.38	1.72	15.34	0.14
Parents control Internet											
No	961	50	1.96*	2.00*	1.86*	2.26†	2.26†	1.59*	1.77*	15.68*	0.04
Yes	943	50	1.86	1.88	1.70	2.16	2.29	1.45	1.66	14.26	-0.04

*: *p* < 0.01; †: *p* < 0.05
SAL: Salience; EXU: Excessive Use; NGW: Neglect Work; ANT: Anticipation; LOC: Lack of Control; NSL: Neglect Social Life; IAT: Internet Addiction test; BMI: body mass index

difficulty making friends. Half of the students reported no parental control over their Internet use. It was noteworthy that the variable with a stronger association with IAT was parental control. Indeed, lack of parental control was significantly associated with higher scores on all IAT dimensions, except lack of control. While health problems showed no significant association with IAT, sleeping well and sports practice were associated with lower scores on some IAT dimensions.

Model estimation and selection

Profiles of teenagers with similar values in the six Internet Addiction dimensions were identified with latent profile analysis (LPA). Four models were estimated with LPA using maximum likelihood, ranging from two to seven profiles. We used three criteria to find the optimal latent profile solution.[18] Firstly, we examined fit statistics (Table 5), namely the Akaike Information criterion (AIC) and the Bayesian Information criterion (BIC). Secondly, we considered overall uncertainty in posterior classification, assessed by entropy[20] included in the integrated completed likelihood – ICL.[21] Finally, we used the Lo-Mendell-Rubin[22] likelihood ratio test (LRT) and the bootstrap likelihood ratio test (BLRT) with *p* < 0.01. AIC, BIC, and ICL decreased until the model with four profiles. The five-profiles model showed low overall uncertainty in posterior classification, with entropy = 0.836. The Lo-Mendell-Rubin likelihood ratio test (LRT) showed that the model with four profiles (LRT = 57.33, *p* < 0.0001, see Table 5) was better than the model with three (LRT = 145.18, *p* < 0.0001) and better than the model with five profiles (LRT = 123.10, *p* < 0.0001).

Classification accuracy of the model

The probabilities of correct classification of observations are shown in the main diagonal of Table 6, ranging from 0.893 to 0.997.

We conducted a supervised classification with eigenvalue decomposition discriminant analysis – EDDA[23] to further assess the correct classification of observations. A model was fit with a randomly chosen training subsample. This model was then used to classify data in the testing subsample, with data assigned to the profile corresponding to the model with the highest posterior probability.[16]

The classification accuracy of the testing subsample was 96%, as shown in Table 7. Classification accuracy is much greater than one-fourth of the achieved by chance [24] when considering the maximum chance criterium[25] of 50.6%. The value of Press's Q = 1545.9 (N = 575, n = 552, K = 4) is greater than 6.63 (critical value from the chi-square distribution with one degree of freedom and confidence of 99%), thus confirming that results exceeded the classification accuracy expected by chance.[24]

Description of profiles

The means for each Internet addiction dimension and the global IAT and profile size are plotted by profile in Fig. 1. Profiles are described in the following sub-sections:

Profile 1 – Worrisome lack of control users - the largest group, representing 52% of the sample's teenagers (n = 997). This group scores negatively (less than 2.5, below the green, dotted bottom line) in all dimensions (Table 3), although close to the bottom line, hence its members are called worrisome lack of control users. Despite all these

Table 3 – Means and standard deviations of Profiles and ANOVA tests

Profile	SAL	EXU	NGW	ANT	LOC	NSL	IAT
P1	1.85 (0.52)	1.91 (0.48)	1.88 (0.63)	2.19 (0.75)	2.46 (0.69)	1.44 (0.71)	1.96 (0.31)
P2	1.12 (0.22)	1.2 (0.23)	1.07 (0.16)	1.19 (0.32)	1.19 (0.26)	0.84 (0.45)	1.1 (0.13)
P3	1.44 (0.34)	1.56 (0.33)	1.22 (0.27)	1.84 (0.54)	1.50 (0.40)	1.37 (0.67)	1.49 (0.19)
P4	2.83 (0.81)	2.71 (0.81)	2.33 (0.95)	3.03 (1.11)	2.97 (0.99)	2.12 (1.18)	2.66 (0.33)
F	575.888	448.338	265.143	266.323	432.916	118.867	442.392
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Standard deviations in parenthesis.
SAL: Salience; EXU: Excessive Use; NGW: Neglect Work; ANT: Anticipation; LOC: Lack of Control; NSL: Neglect Social Life; IAT: Internet Addiction test

users lacking control, they are just shy of positive values and feature the highest difference between neglect social life and the other dimensions. Neglect dimensions (both work and social life) have the smallest means in all profiles. Curiously, this profile also singles-out users with equal parental control rates or absence thereof (Table 4).

Profile 2 – Balanced users – This was the smallest group, representing 9% of the sample (n = 167). This group showed the smallest means in all six dimensions; therefore, it was named balanced users. Balanced users represent the most homogeneous group, with the smallest standard deviations for all the dimensions. Interestingly, character-istics such as female predominance and highest parental control rate, compared with other profiles, are noteworthy (Table 4).

Profile 3 – Worrisome anticipation users - includes al-most one-fifth of the teenagers (18%, N = 354). This group

has rather small means in most dimensions, scoring slightly higher in anticipation and excessive use. For that reason, the group was named worrisome anticipation users. Here we also highlight users with the least difficulty in making friends (Table 4).

Profile 4 – Problematic users - represents 21% of par-ticipants (N = 397). This group has the highest means of all the profiles, and most of them present values above the bottom line. Besides, it was the most heterogeneous group, with the highest standard deviation across all the dimen-sions. This group is the only one with positive means in the Internet addiction dimensions and a positive global IAT. In this profile, a slight predominance of the male gender, more difficulty in befriending, and lower parental control rate stood out compared with the other profiles (Table 4).

Table 4 – Profiles' description and chi-squared tests

Variable	n	%	Profile 1	Profile 2	Profile 3	Profile 4
Gender*						
Female	1019	53%	54%	59%	52%	49%
Male	891	47%	46%	40%	47%	50%
With health issues						
No	1443	76%	75%	81%	75%	76%
Yes	454	24%	25%	18%	24%	23%
Sleeps well						
No	171	9%	10%	7%	7%	9%
Yes	1706	90%	90%	92%	93%	90%
Practices sports						
No	873	46%	45%	44%	46%	48%
Yes	1035	54%	55%	54%	54%	51%
Hard to make friends†						
No	1627	85%	85%	88%	89%	82%
Yes	276	15%	15%	11%	10%	17%
Parents control Internet*						
No	961	50%	50%	44%	46%	58%
Yes	943	50%	50%	54%	53%	41%

*: p < 0.01; †: p < 0.05; ‡: p < 0.1

Table 5 – Model fit for the different profile solutions

Solution	AIC	BIC	ICL	LRT	BLRT
Two profiles	23612	23834	24691	362.59	0.000
Three profiles	23275	23570	24364	145.18	0.000
Four profiles	23156	23523	24323	57.33	0.000
Five profiles	23211	23564	24487	123.10	0.000
Six profiles	23027	23539	24884	69.87	0.000
Seven profiles	22983	23567	25024	55.7	0.000

AIC: Akaike Information criterion; BIC: Bayesian Information criterion; ICL: integrated completed likelihood; LRT: Lo-Mendell-Rubin likelihood ratio test; BLRT: bootstrap likelihood ratio test; VVE model: ellipsoidal, variable volume, variable shape, equal orientation bootstrap with 5000 replications

DISCUSSION

In line with previous studies,[3,26,27] our results indicated a significant rate of adolescents that are addicted to the Internet.

As previously reported, the six IAT dimensions were positively correlated.[11,13] The highest correlation was obtained between lack of control and excessive use and between salience and excessive use. These results are corroborated by previous studies.[11,28]

Collectively, we identified four main profiles of adolescents on different aspects of Internet addiction. Regarding balanced users (Profile 2), all dimensions exhibited small means, indicating a healthy use of the Internet. We observed a slightly higher score on the excessive use criteria, perhaps reflecting the widespread use of the Internet in the youth's daily life. This group had the highest proportion of females, and highest parental control. These results are in line with previous studies. A recent study reported that 'healthy users' of the Internet and smartphones also showed a higher proportion of females and a better psychosocial profile.[29] Regarding health status, Suris *et al* have reported that average Internet users reported health problems less frequently.[12] However, this was not significantly different among IA profiles in our study.

Conversely, as seen in problematic users (Profile 4), male gender, low parental control, and difficulties befriending people have been implicated as important associated factors of Internet addiction. Recent studies[27,30,31] indicate greater propensity of males to be addicted to the Internet. Also consistent with the literature is the greater influence of parental monitoring in Internet use-related problems in their children.[31] Overall, the evidence shows that parental monitoring can prevent adolescents from becoming overinvolved on the Internet.[6,32] We reported no significant highlights concerning sleep and sports in the balanced users' profile. Nonetheless, other studies have associated better sleep,[3,12] higher levels of physical activity,[12] and satisfactory peer relationships with lower levels of IA.[33] When looking at the ability to make friends, the problematic users' profile exhibited hardship. Adolescents overinvolved on the Internet show instability in significant relationships[34] and difficulty in other leisure experiences.[35] Moreover, good peer relationships are correlated with low levels of Internet addiction,[33] implying that adolescents with unsatisfactory peer relationships rely on the Internet to relieve their loneliness.

Our study also identified two specific groups of adolescents who singled-out a specific IAT dimension that was concerning. In the case of lack of control users (Profile 1), a trend towards an increased rate of lack of control regarding Internet use was seen. Poor control regarding Internet use has been associated with users' increased sensitivity to rewards and, on the other hand, insensitivity towards punishments that derive from decision-making tasks.[36] Moreover, effective regulation, which is how we self-regulate our actions, may change one's emotional state, and may actively be involved in the development of addictive behaviors. Interestingly, a study reported that the ability to regulate affection predicted time using the Internet, whereas other psychological problems such as depression, loneliness, or social anxiety did not.[37] Male adolescents in this group were also more prone to lack of control than females, which is congruent with males being more engaged in high-risk online behaviors.[6]

Regarding anticipation as a troublesome problem (Profile 3), it is known that craving or anticipation of pleasurable relief is a subjective phenomenon, almost exclusively based on self-reports.[36] Notwithstanding, craving criteria have been linked to behavioural addictions such as IA.[36] In profile three, we noticed an increase in the score of anticipation criteria compared with other factors. Furthermore, this group was also linked to a lower degree of parental control of Internet use. As mentioned before, parental control has a protective effect on Internet addiction among adolescents[6] and alludes to two different kinds of control – psychological and behavioural. The latter, which deals with solicitation and restriction actions, was shown to be a healthier approach by parents in order to keep their children's addiction in check.[6,38] Since anticipation is largely a behavioral problem, this group's results may be associated with parental control status.

Given that IA relates to these worrisome psychological

Table 6 – Average latent profile probabilities for most likely profile membership (row) by latent profile (column)

Profile	1	2	3	4
1	0.997	0.000	0.000	0.003
2	0.000	1	0.000	0.000
3	0.107	0.000	0.893	0.000
4	0.077	0.000	0.009	0.915

Table 7 – Results of the supervised classification

Profile	Predicted in training (n = 1340)					Predicted in testing (n = 575)			
	1	2	3	4		1	2	3	4
1.	704	0	2	0		290	0	0	1
2.	0	109	3	0		0	55	0	0
3.	17	0	225	0		12	0	100	0
4.	16	0	1	263		9	0	1	107

Main diagonals contain correct classifications.
Classification error in the training set is 2.9% and 4.0% in the testing set.

traits it is important to consider what interventions are available to address these issues. Several studies have been conducted to assess how pharmacological and non-pharmacological therapies may mediate Internet addiction.[39] Results have not been consensual or generalizable given different methodologies, especially in adults. However, in adolescents and young adults, the literature has shed light on how to tackle this matter, and family-based approaches seem to offer advantages in addiction.[39] Family therapy focused on resolving conflicts, improving communication, reframing addiction symptoms, and discussing states of change showed significant reductions in Internet addiction severity.[40–42] Conversely, correctional programs seem to be largely ineffective. Cognitive-behavioral and motivational interventions may also help mediate Internet addiction since they are already used effectively in other mental health conditions.[43] Whenever modifiable risk factors for IA are identified, a few of which this study highlighted (eg.: low parental control, hardship in befriending), specific interventions should be taken into consideration when developing prevention and intervention strategies for IA.

Some limitations to our study should be noted. Firstly, this was a cross-sectional study, which means causal inferences cannot be established. Secondly, as this was a survey-based study with self-reported answers, a response bias needs to be considered. Participants using the self-report scales may misunderstand the questions or try to create a positive or negative impact by giving false or misleading responses depending on social desires. Finally, the sample was composed of students in public schools and may not represent all adolescents.

Despite limitations to this study, identifying clusters of adolescents with specific alarming symptoms toward a worsening IA can be a helpful tool for further research. Since this subject is an increasing problem among adolescents it is important to develop multidisciplinary preventative interventions for clinicians, families, schools, and students in order to enhance their awareness about the unfavourable traits of IA.

CONCLUSION

This study's results are an important step in characterizing different patterns in adolescents' characteristics and behaviors associated with Internet addiction and to raise awareness of preventive actions to decrease IA. Latent class analysis-based classification rather than total score-based classification may provide more accurate and detailed information about participants' Internet addiction profiles.

Healthcare professionals dealing with adolescents should be aware of the increasing online and social media platforms emerging nowadays and should be involved in prevention efforts to help adolescents avoid Internet addiction disorder.

AUTHORS CONTRIBUTION

MVM: Conception/design of the work. Acquisition, analysis, and interpretation of data for the work. Draft of the paper and critical review.

RGR: Acquisition, analysis, and interpretation of data for the work. Draft of the paper and critical review.

PSC, SF: Conception/design of the work. Acquisition, analysis, and interpretation of data for the work. Draft of the paper and critical review.

PROTECTION OF HUMANS AND ANIMALS

The authors declare that the procedures were followed according to the regulations established by the Clinical Research and Ethics Committee and to the Helsinki Declaration of the World Medical Association updated in 2013.

DATA CONFIDENTIALITY

The authors declare having followed the protocols in use at their working center regarding patients' data publication.

COMPETING INTERESTS

All authors report no competing interests.

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REFERENCES
1. Lortie CL, Guitton MJ. Internet addiction assessment tools: dimensional structure and methodological status. Addiction. 2013;108:1207-16.
2. Pontes HM, Patrão IM, Griffiths MD. Portuguese validation of the Internet Addiction Test: an empirical study. J Behav Addict. 2014;3:107-14.
3. Ferreira C, Ferreira H, Vieira MJ, Costeira M, Branco L, Dias N, et

al. Epidemiology of internet use by an adolescent population and its relation with sleep habits. Acta Med Port. 2017;30:524-33.

4. Health Behaviour in School-aged Children (HBSC). HBSC-2013/14, ed.1.0 Study Documentation. [cited 2021 Jan 22]. Available from: https://www.uib.no/sites/w3.uib.no/files/attachments/hbsc-2013_14_ed.1.0.pdf.

5. Cash H, Rae C, H. Steel A, Winkler A. Internet addiction: a brief summary of research and practice. Curr Psychiatry Rev. 2012;8:292-8.

6. Martins MV, Formiga A, Santos C, Sousa D, Resende C, Campos R, et al. Adolescent internet addiction – role of parental control and adolescent behaviours. Int J Pediatr Adolesc Med. 2020;7:116-20.

7. Viveiro C, Marques M, Passadouro R, Moleiro P. Os adolescentes e a internet: padrões de (ab)uso. Adolescência Saúde. 2014;11:7-18.

8. Kuss D, Griffiths M, Karila L, Billieux J. Internet addiction: a systematic review of epidemiological research for the last decade. Curr Pharm Des. 2014;20:4026-52.

9. Iacovelli A, Valenti S. Internet addiction's effect on likeability and rapport. Comput Human Behav. 2009;25:439-43.

10. Kaess M, Durkee T, Brunner R, Carli V, Parzer P, Wasserman C, et al. Pathological Internet use among European adolescents: psychopathology and self-destructive behaviours. Eur Child Adolesc Psychiatry. 2014;23:1093-102.

11. Widyanto L, McMurran M. The psychometric properties of the internet addiction test. CyberPsychology Behav. 2004;7:443-50.

12. Suris J, Akre C, Piguet C, Ambresin A, Zimmermann G, Berchtold A. Is internet use unhealthy? A cross-sectional study of adolescent Internet overuse. Swiss Med Wkly. 2014;144:w14061.

13. Samaha AA, Fawaz M, El Yahfoufi N, Gebbawi M, Abdallah H, Baydoun SA, et al. Assessing the psychometric properties of the Internet Addiction Test (IAT) among Lebanese college students. Front Public Heal. 2018;6:365.

14. Young K. Internet Addiction Test (IAT). Schloß Holte-Stukenbrock: Stoelting; 2016.

15. Paruthi S, Brooks LJ, D'Ambrosio C, Hall WA, Kotagal S, Lloyd RM, et al. Recommended amount of sleep for pediatric populations: a consensus statement of the American Academy of Sleep Medicine. J Clin Sleep Med. 2016;12:785-6.

16. Fraley C, Raftery A. Model-based methods of classification: using the Mclust software in chemometrics. J Stat Softw. 2007;18:1-13.

17. Scrucca L, Fop M, Murphy TB, Raftery AE. Mclust 5: clustering, classification and density estimation using Gaussian finite mixture models. RJ. 2016;8:289-317.

18. Rodrigues RG, Ferreira JJ, Felgueira T. Entrepreneurial academics: a taxonomy with latent profile analysis. Manag Decis. 2019;57:3346-63.

19. Pastor DA, Barron KE, Miller BJ, Davis SL. A latent profile analysis of college students' achievement goal orientation. Contemp Educ Psychol. 2007;32:8-47.

20. Ramaswamy V, Desarbo WS, Reibstein DJ, Robinson WT. An empirical pooling approach for estimating marketing mix elasticities with PIMS data. Mark Sci. 1993;12:103-24.

21. Biernacki C, Celeux G, Govaert G. Assessing a mixture model for clustering with the integrated completed likelihood. IEEE Trans Pattern Anal Mach Intell. 2000;22:719-25.

22. Lo Y, Mendell NR, Rubin DB. Testing the number of components in a normal mixture. Biometrika. 2001;88:767-78.

23. Bensmail H, Celeux G. Regularized Gaussian discriminant analysis through Eigenvalue decomposition. J Am Stat Assoc. 1996;91:1743-8.

24. Hair J, Black W, Babin B, Anderson R. Multivariate data analysis. 7th ed.

Hoboken: Prentice Hall; 2009.

25. Morrison DG. On the interpretation of discriminant analysis. J Mark Res. 1969;6:156-63.

26. Fumero A, Marrero RJ, Bethencourt JM, Peñate W. Risk factors of internet gaming disorder symptoms in Spanish adolescents. Comput Human Behav. 2020;111:106416.

27. Huang Y, Xu L, Mei Y, Wei Z, Wen H, Liu D. Problematic Internet use and the risk of suicide ideation in Chinese adolescents: a cross-sectional analysis. Psychiatry Res. 2020;290:112963.

28. Guertler D, Rumpf HJ, Bischof A, Kastirke N, Petersen KU, John U, et al. Assessment of problematic internet use by the compulsive internet use scale and the internet addiction test: A sample of problematic and pathological gamblers. Eur Addict Res. 2014;20:75-81.

29. Lee SY, Lee D, Nam CR, Kim DY, Park S, Kwon JG, et al. Distinct patterns of internet and smartphone-related problems among adolescents by gender: latent class analysis. J Behav Addict.2018;7:454-65.

30. Amendola S, Spensieri V, Biuso GS, Cerutti R. The relationship between maladaptive personality functioning and problematic technology use in adolescence: a cluster analysis approach. Scand J Psychol. 2020;61:809-18.

31. Lukavska K, Vacek J, Gabhelik R. The effects of parental control and warmth on problematic internet use in adolescents: a prospective cohort study. J Behav Addict. 2020;9:664-75.

32. Lin CH, Lin SL, Wu CP. The effects of parental monitoring and leisure. Adolescence. 2009;44:993-1004.

33. Park S, Kang M, Kim E. Social relationship on problematic internet use (PIU) among adolescents in South Korea: a moderated mediation model of self-esteem and self-control. Comput Human Behav. 2014;38:349-57.

34. Cerniglia L, Zoratto F, Cimino S, Laviola G, Ammaniti M, Adriani W. Internet addiction in adolescence: neurobiological, psychosocial and clinical issues. Neurosci Biobehav Rev. 2017;76:174-84.

35. Lin CH, Lin SL, Wu CP. The effects of parental monitoring and leisure boredom on adolescents' internet addiction. Adolescence. 2009;44:993-1004.

36. Van Rooij AJ, Prause N. A critical review of "internet addiction" criteria with suggestions for the future. J Behav Addict. 2014;3:203-13.

37. Tokunaga RS, Rains SA. An evaluation of two characterizations of the relationships between problematic internet use, time spent using the internet, and psychosocial problems. Hum Commun Res. 2010;36:512-45.

38. Li X, Li D, Newman J. Parental behavioral and psychological control and problematic internet use among Chinese adolescents: the mediating role of self-control. Cyberpsychology Behav Soc Netw. 2013;16:442-7.

39. Tanner-Smith EE, Wilson SJ, Lipsey MW. The comparative effectiveness of outpatient treatment for adolescent substance abuse: a meta-analysis. J Subst Abuse Treat. 2013;44:145-58.

40. Liu QX, Fang XY, Yan N, Zhou ZK, Yuan XJ, Lan J, et al. Multi-family group therapy for adolescent Internet addiction: Exploring the underlying mechanisms. Addict Behav. 2015;42:1-8.

41. Shek DT, Yu L. Internet addiction phenomenon in early adolescents in Hong Kong. Sci World J. 2012:104304.

42. Zhong X, Zu S, Sha S, Tao R, Zhao C, Yang F, et al. The effect of a family-based Intervention model on internet-addicted Chinese adolescents. Soc Behav Personal Int J. 2011;39:1021-34.

43. Zajac K, Ginley MK, Chang R, Petry NM. Treatments for internet gaming disorder and internet addiction: a systematic review. Psychol Addict Behav. 2017;31:979-94.