ORIGINAL ARTICLE

Age, loneliness and time spent online in female explain a high percentage of variability of the Internet Addiction Test

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Abstract

OBJECTIVE: A high percentage of young people show a Problematic Internet Use (PIU). In literature, level and trend of PIU, the network usage and the impact of time spent online are not univocal. Our study aims to assess the level and trend of PIU, investigate the relationship between PIU and some socio-demographic and Internet use related factors and psychological variables among female adolescents and young adults.
DESIGN: The sample involved 135 female students (mean age 17.69 ±2.95), divided in three subgroups according to age (men age 14.87 ±0.5; 17.72 ±0.52; 20.67 ±2.29). Besides socio-demographic and Internet use related factors, data were collected to investigate the level of PIU, loneliness and subclinical autistic traits.
RESULTS: A high proportion of participants have PIU (42.2%; N=57), with a significant reduction in risk with increasing age. Severe Internet addiction was recorded in 0.7% (N=1). Age, loneliness and time spent online are predictors for PIU (R^2=0.65). Subclinical autistic traits result to be correlated with loneliness. Among the participants, 65.92% use Internet for social networking, and 71.9% at risk of PIU use social networks.
CONCLUSION: Females show high level of PIU, and spend much time connected to the Internet, mainly on social networks. Additionally, some personality traits are associated with PIU. Taken together, these findings suggest the importance of guiding young people to a conscious and planned use of the Internet, and organizing interventions aimed at improving cognitive flexibility and socialization.

INTRODUCTION

In the last decades, the Internet has improved many aspects of our lives. Its usability is growing up, without limits of time and space, offering a wide range of diversified services. Asia has more users than all other continents (49% in 2019) while the country with the most users in the world is China with 802 million users (20% of the world users), followed by India with 500 million users (Internetlivestats.com, 2020). European users are progressively growing (about 16% of world users); particularly in Italy the share of Internet usage reached

70,4 % in 2019, with 43,5 millions users (Statista Research Department 2020).

Internet use seems to have a strong attraction to teenagers and young adults (Mullen *et al.* 2018). In adolescents and young people, it was found that in the long term this influence can lead to Internet-related dysfunctional behavior, with negative consequences on several aspects of life, such as: social isolation, withdrawal symptoms, psychological and physical problems (Douglas *et al.* 2008; Machimbarrena *et al.* 2019; Romano *et al.* 2013; Shaw & Black 2008; Younes *et al.* 2016). A study on a large and nationally representative dataset (Twenge *et al.* 2019) showed an increase of indicators of mood disorders, suicide-related outcomes and rates of deaths by suicide between the mid-2000s and 2017, mainly among adolescents and adults aged 18 to 25. The effects were primarily due to cohort. After reasonably excluding some explanations, the authors pointed out that the increased use of digital media might have changed modes of social interaction enough to affect mood disorders and suicide-related outcomes. It should be noted, however, that in a recent analysis of data from three large-scale nationally representative samples of adolescents, there was very little evidence for an increase in the negative associations between technology and mental health over time in the past decade. The research only detected that social media's relations with emotional problems had slightly increased, without differences in the time courses between girls and boys (Vuorre *et al.* 2021). However, authors highlight the self-report nature of their data and that, in general, despite self-report measures of mental health have high face validity, they are consistently biased and not highly correlated with objective data.

Internet Addiction Disorder (IAD) is anyway considered as a new psychiatric disorder even if it is not listed as a clinical entity in the fifth edition of Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association 2013). As behavioral addiction (Cudo & Zabielska-Mendyk 2019; Young 1998), IAD refers to an individual's inability to control Internet use, which may lead to distress and impaired functioning (Douglas *et al.* 2008; Jorgenson *et al.* 2016; Young 1996). Several characteristics associated with IA are similar to those reported for substance use disorders, such as mood changes, distress, tolerance, withdrawal, and functional impairment (Jorgenson *et al.* 2016; Osborne *et al.* 2016; Reed *et al.* 2017; Truzoli *et al.* 2019). The World Health Organization (WHO 2014) encoded the umbrella term "problematic use of Internet", encompassing all problematic Internet-related behaviors.

International prevalence rates of IAD have a great variability which depends on the measurement methods, target population and level of technological development of the society, going from 1% to 36.7% worldwide, with the highest rates reported in Asia (Mok *et al.* 2014; Zhang *et al.* 2008), while in Europe the prevalence ranges from 1.5 to 8 % (Petersen *et al.*

2009). Adolescents are likely to be the most susceptible population: they are particularly vulnerable at the onset of addictive behaviors and they are the subgroup of the population most exposed to the Internet (Grant *et al.* 2010; Huang & Shen 2010; Jorgenson *et al.* 2016; Mullen *et al.* 2018). In Italy, Viganò *et al.* (2020) reported that 53.83% of high school adolescent participants were at risk of developing IAD, while Truzoli *et al.* (2019) showed that 34.4% of university participants fell above the cut-off for mild problems. Other reports found that 1.4% to 17.9% of adolescents have IAD in both Western and Eastern societies (Kaltiala-Heino *et al.* 2004; Mythily *et al.* 2008). A research in Northern Italy, conducted on university students, reported an Internet addiction prevalence estimate of 0.8% (Poli & Agrimi 2012). In Central Italy, Pallanti *et al.* (2006) showed a prevalence of 5.4% in high school students, while Taranto *et al.* (2015) found a prevalence of 4.7% in students aged 14-16. Moreover, Bianchini *et al.* (2017) detected a prevalence of 0.7% in high school students coming from Central-Southern Italy (15-24 years).

Some studies have longitudinally investigated the trend of IAD. A short-term longitudinal study conducted by Li *et al.* (2019) in a sample of Chinese adolescents between 12 and 18 years of age found overall a linear decline in adolescent IAD over the six months. Stavropoulos *et al.* (2018) showed that in adolescents -assessed twice at age 16 and 18 years- IAD symptoms decreased over time. In a meta-analysis, the general Internet use group reported an average weighted persistence of 53% (CI: 47–59%), with inter-study heterogeneity: 79.5%. Subgroup analysis was performed to investigate the heterogeneity between studies' persistence. The average level for persistence was lower for the Western countries: 28% as compared to Asia: 61%. (Dahl & Bergmark 2020).

However, the adolescent age appears to be at relatively high risk for developing IAD (Kuss *et al.* 2014; Van Deursen & Van Dijk 2014). IAD severity is susceptible to age-related effects, because the maturation of the prefrontal cortex and executive functions reach completion in late adolescence; therefore, during preadolescence and early adolescence may lack the inhibitory activity necessary to moderate the addictive Internet use. (Bernheim *et al.* 2013).

However, the results of cross-sectional studies are contradictory. Some detect no significant effects of age (Poli & Agrimi 2012), while others suggest that 15-16 years old adolescents have an increased risk of developing IAD compared to 11-12 years old (Karacic & Oreskovic 2017), and several researches conclude that IAD behaviors tend to decrease during adolescence (Bakken *et al.* 2009; Yen *et al.* 2009).

Consistent with the studies by Koyuncu *et al.* (2014), Wang *et al.* (2011) and Wu *et al.* (2016) gender was not associated with the risk of IAD, while other studies found male gender to be an independent risk factor for IAD (Chang *et al.* 2015; Durkee *et al.* 2012; Kilic *et al.*

2016; Mei *et al.* 2016; Sasmaz *et al.* 2014; Tang *et al.* 2014).

Among online activities, the use of social networks is widespread and a large number of users spend more than 3 h a day on the Internet (Hassan *et al.* 2020). Anyway, with regard to age difference, studies revealed that the risk and frequency of addictive use of social networking sites decrease as age increases (Branley & Covey 2018). There is also evidence that girls use social media more often than boys (Lopez-Fernandez 2018; Peris *et al.* 2020).

In relation to hours spent online, several studies suggest that the IAD is significantly associated with time spent daily on the Internet and length of Internet use (Hassan *et al.* 2020). Tonioni *et al.* (2012) identified a relevance of the number of hours per week spent online (47.8±27.5) in a clinical IAD group. A study (Jang *et al.* 2008) found that the duration of Internet use was a factor differentiating the nondependent from the at-risk group, while the length of time of Internet use per day was an independent predictor distinguishing the at-risk from the dependent group. Thus, some activities performed online may have a greater additive component and time spent online may be one of the signals of Problematic Internet Use (PIU).

Some research has pointed out high comorbidity rates between PIU and neurodevelopmental disorders, like Autism Spectrum Disorder (ASD), both in children and young adults (de Vries *et al.* 2018; So *et al.* 2017). The higher risk for problematic videogame use in individuals with ASD was related to some aspects of the behavioral phenotype of ASD, such as highly restricted interests, preoccupations, and repetitive behavior patterns (Engelhardt *et al.* 2017).

Indeed, some authors have highlighted that autistic children and adolescents have an increased risk for compulsive use of the Internet, due to clinical peculiarity (Hirota *et al.* 2020; Kawabe *et al.* 2020; Restrepo *et al.* 2020; Romano *et al.* 2014, Young & De Abreu 2017), even in comparison with typically developing individuals (MacMullin *et al.* 2016).

Autism is a very complex disorder that impairs many aspects of the individual functioning, with particular attention to the social skills and communication, limited and repetitive behavior, preference for repetitiveness and routines (Stice & Lavner 2019). Currently, there is various evidence supporting the role of genetic factors in the etiology of autism. Indeed, there is a rate of recurrence of 2-8% within families (Muhle *et al.* 2004), and 60% and 21-27% concordance in monozygotic (MZ) and dizygotic (DZ) twins respectively (Hallmayer *et al.* 2011). Several case-control studies on families have subsequently extended these results, documenting a set of cognitive, social and personality characteristics commonly referred to as the "Broad Autism Phenotype " (BAP), or subclinical autistic traits (Goldberg *et al.* 2005; Piven *et al.* 1990). Within a dimensional approach, the BAP implies the existence of a continuum (or spectrum) of characteristics ranging from individuals who show almost no autistic traits to individuals with diagnoses of severely compromised autism (De Groot &Van Strien 2017; Losh *et al.* 2008). The concept of BAP is supported by studies indicating that relatives of individuals diagnosed with ASD are more likely to express mild autistic traits, regardless of diagnosis (Bailey *et al.* 1998). However, there is evidence that subclinical autistic traits are also continuously distributed in the general population (Stewart & Austin 2009).

Currently different scales are available to evaluate the BAP such as the Broad Autism Phenotype Questionnaire (BAPQ) (Hurley *et al.* 2007), the Adult Autism Subthreshold Spectrum (AdAS) (Dell'Osso *et al.* 2017), or Autism Spectrum Quotient (AQ) (Baron-Cohen *et al.* 2001).

Some studies suggest autistic traits as risk factors for mental disorders and highlight their role in shaping psychopathological manifestations (Dell'Osso *et al.* 2018; Takara & Kondo 2014).

Romano *et al.* (2013) reported that PIU was related to autistic traits. In a study (Finkenauer *et al.* 2012) autistic traits were related with PIU among married couples, predicting increased compulsive Internet use overtime among women. De Vries *et al.* (2018), in a study on psychiatric patients, found higher autistic traits among participants with PIU with respect to normal Internet users.

In relation to BAP, Truzoli *et al.* (2019) found that participants with higher numbers of autism traits are just as likely to experience withdrawal-like effects on stopping using the Internet as those with lower AQ scores; thus, the amount of scores did not reduce the possibility of Internet withdrawal effects being displayed. Additionally, it has been found that students with autistic traits were related to a worse emotional regulation linked to reduced social relationships at school and increased addiction to video games (Liu *et al.* 2017; Suzuki *et al.* 2020).

Moreover, among the predictors of IAD, the role of loneliness has been highlighted (Akgün Kostak *et al.* 2019; Ang *et al.* 2018; Costa *et al.* 2019; Favotto *et al.* 2019; Li *et al.* 2016; Shettar *et al.* 2017; Wu *et al.* 2016). According to Zhang *et al.* (2018), loneliness positively predicted compulsive Internet use and withdrawal. There are also data that support the relationship between Internet Gaming Disorder (IGD) and loneliness (Sarda *et al.* 2016). Specifically, both IGD and loneliness are accompanied by left dorsolateral prefrontal cortex dysfunction (Dong *et al.* 2021; Kong *et al.* 2015).

Loneliness is a subjective emotional state defined as the personal perception of being socially isolated, or the feeling of being alone in spite of longing for others (Costello 1983; Younger 1995). Investigating loneliness is important because it is recognized as a very relevant risk factor in various health problems (Loades *et al.*

2020). For example, it is closely related to mental health disease in young people and alcohol dependence in the elderly and adults (Canham *et al.* 2016). Chronic feelings of loneliness are linked to the worsening of mental well-being and to typical symptoms of disorders such as anxiety and depression (Beutel *et al.* 2017; Moeller & Seehuus 2019).

Adolescents may be more susceptible to feelings of loneliness for several reasons. During adolescence, young people tend to become more autonomous towards their parents and involvement in the peer group becomes more important (Laursen & Hartl 2013). Social interactions become more complicated and awareness of self increases. It may be especially difficult for young people with ASD to keep up with their peers and to be engaged and accepted by them. Young people with ASD have fewer social skills and spend less time interacting with others (Macintosh & Dissanayake 2006), thus children and adolescents with ASD might be at greater risk of experiencing feelings of loneliness (Lasgaard *et al.* 2010). Some studies have shown that children and adolescents with ASD actually report higher levels of loneliness than non-clinical control groups (Kalyva 2010; Locke *et al.* 2010). Moreover, the experience of loneliness in young people with ASD may be age-dependent and becomes worsened during adolescence (Deckers *et al.* 2017; Lasgaard *et al.* 2010; Locke *et al.* 2010). Given the above, it is conceivable that loneliness levels are also associated with subthreshold autism traits. In fact, some researchers have found that individuals with subclinical autism-related traits are more likely to experience loneliness (Caruana *et al.* 2021) and that BAP is related to fewer and lower-quality interpersonal relationships, resulting in poorer health outcomes (Diamont & Windholt 1981; Freeth *et al.* 2013; Sandstrom & Zakriski 2004) and low quality of life (Reed *et al.* 2016). Finally, some studies (Jobe & White 2007; Sasson *et al.* 2013; Stice & Lavner 2019) found that individuals with a stronger autism phenotype (e.g., rigidity, preference for sameness, high attention to detail) report more loneliness. Moreover, their findings support the view that these individuals do not necessarily prefer aloneness, but they experience increased levels of loneliness related to lack of social skill.

In summary, numerous data suggest relationships between PIU, BAP and loneliness, and some data are not conclusive (PIU trend and time spent on the Internet). In relation to BAP, as we pointed out above, various tests are widely used in the literature, including the Broad Autism Phenotype Questionnaire (BAPQ) (Hurley *et al.* 2007), and Autism Spectrum Quotient (AQ) (Baron-Cohen *et al.* 2001). However, the tests are not equivalent because they do not investigate the same areas. In this study, we used two scales to assess the BAP. One of these, the Adult Autism Subthreshold Spectrum, has also been validated in Italy and may be more suitable for an Italian sample.

In the light of the above evidences, this cross-sectional study aims a) to assess the level and trend of PIU, b) to evaluate the relationship between PIU, socio-demographic variables, BAP and loneliness, and c) to check the time spent online and the type of Internet use in relation to PIU levels among Italian female adolescents and young adults. A further objective of this study is to assess which of the two scales for BAP is most appropriate for our sample.

In order to compare the variables between the participants in this study, the total sample was divided into three age ranges: from 14 to 16.9 years (first group); from 17 to 18.9 years (second group); and (third group) >19 years.

Materials and methods

Participants
The sample included 135 female adolescents and young adults attending high schools of the province of Monza and Brianza (North Italy) or female students attending a three-year degree bachelor in the area of healthcare professions of the University of Milan.

The participants read and signed a document containing information on the research, data processing, guarantee of anonymity, and informed consent; in the case of high school students (minors), informed consent was given by parents. This study is conforming to the provisions of the Declaration of Helsinki in 1995 (as revised in Edinburgh 2000).

Measures
Socio-demographic (age, gender, type of school) and related to the use of the Internet (type of use and time spent online) questionnaire and four self-assessment scales were administered.

The Internet Addiction Test (IAT) (Young 1998), consisting of 20 items, was used to measure the psycho-pathological risk related to the use of the Internet out of three levels: Normal level (20-39 points): the Internet user could browse some once longer than usual, but he has good self-control on his own behavior; At risk level (40-69 points): the Internet user experiences some problems due to the use of the Internet, with a negative impact on his daily life; Severe level (70-100 points): the person has little or no self-control. Using the Internet causes serious problems and interferes in individual daily life.

For each question, a score on Likert scale is assigned to 5 points with respect to the frequency with which certain behaviors related to the use of the Internet. For the adopted questionnaire, reliability coefficient Cronbach alpha was calculated as 0.90 (Keser *et al.* 2013).

In order to evaluate the subclinical autistic traits, one of the assessment tools used is the Adult Autism Subthreshold Spectrum (AdAS; Dell'Osso *et al.* 2017). It was not created for diagnostic purposes, but to assess the presence (or absence) of a wide variety of events

associated with autism that may be present in individuals who do not reach the diagnostic threshold.

The AdAS is composed of 160 items divided into 7 subgroup areas:
1) The "childhood/adolescence" area investigates the events present during the subject's childhood or adolescence, i.e., having difficulty talking to others, having few friendships or being bullied.
2) The "verbal communication" area refers to the tendency to speak in a very low, too high or monotonous voice and to prefer online communication (e-mail or chat) to that in person or to the telephone conversation, difficulty speaking in public, etc.
3) The "nonverbal communication" area refers to aspects such as difficulty at staring others in the eyes, feeling uncomfortable in embracing, kissing or holding for hand someone, have outbursts of anger for no real reason.
4) The "empathy" area refers to the one's difficulty in understanding other's intentions or thoughts, interpreting facial expressions and understanding the body language.
5) The "routine and inflexibility" area refers to the one's difficulty in changing his way of acting or his methods of working (generally his habits/rituals) even when faced with better systems.
6) The "restricted interests and ruminations" area investigates aspects such as speaking only to people who share the same specific interests, being fascinated by systemic numbers/information, tendency to mull over the same topics or have a strong attention to details.
7) The "hyper/hyporeactivity to stimuli" area refers to how the person reacts to sounds, tactile or sensory stimuli in general (being too or not very sensitive to stimuli such as pain, temperature, sounds, feeling uncomfortable in noise environments, etc.).

Item responses are coded in a dichotomous way (yes/no) and domain scores are obtained by counting the number of positive answers. The reliability of AdAS shows a coefficient of 0.96 (Dell'Osso *et al.* 2017).

To measure the BAP, we also use the Broad Autism Phenotype Questionnaire (BAPQ; Hurley *et al.* 2007). The BAPQ is a self-report questionnaire consisting of 36 items spread across three 12 item subscales. Items are rated along a six-point Likert scale (ranging from "very rarely" to "very often"), which forces ratings to fall above or below a value of neutral on each question. Original internal consistency analysis of the subscales (Hurley et al 2007) supported this three-component model, which is consistent with traditional conceptualizations of domains characterizing autism: social, communication, and restricted and repetitive behaviors. The BAPQ reports a reliability coefficient Cronbach alpha of 0.95 (Hurley *et al.* 2007).

In order to assess the feeling of loneliness subjectively experienced, University of California Loneliness Scale (UCLA) was used. The UCLA is composed of up to 20 items evaluating the subjective feeling of loneliness and social isolation. The person must indicate how much the statements in the test describe him on a 4-point scale ranging from 0 to 3, with score going from 0 to a total of 60. The higher the score, the more severe the feeling of loneliness. The scale has an internal consistency of 0.92 and a test-retest reliability of 0.73 (Reed *et al.* 2015).

Procedure
The exclusion criterion was to be male.

After a short introduction in which the participants were informed of the content of the research and the questionnaires and the importance of completing each item, they were asked to sign the informed consent and to fill all questionnaires. Moreover, a formal authorization was obtained from the degree courses coordinators and the school directors.

Participants completed the socio-demographic and related to the use of the Internet questionnaire and self-assessment scales in the classrooms provided by the School or University and were encouraged to carry out the compilation individually. The time taken was 60 minutes.

Statistical analysis
Means and standard deviations or percentages of the scales' total scores and of subscales' scores were calculated for the total sample and for each age group. In order to compare continuous variables non-normally distributed between age groups, the Kruskal-Wallis test and the Mann-Whitney test were used. We used Bonferroni's correction for multiple comparisons. To compare categorical variables between age groups, the Fisher's Exact Test was used. To evaluate the association between continuous variables non-normally distributed, Spearman correlations were used. Multiple linear regression (stepwise method) was used to determine a ranking of predicting variables based on their respective contributions to the overall variance in IAT total scores. Two-sided significance level was set at $p \leq .05$.

Results

The whole sample included 135 female adolescents and young adults. The age was ranging from 14 to 31 years, with a mean age of 17.69 (±2.95). Adolescents attend a secondary high school of the province of Monza and Brianza and belong to four high school classes: two first classes with ages ranging from 14 to 16.9 years (first group) and two upper fourths classes aged between 17 and 18.9 years (second group). Young adults were students attending the first year of two three-year bachelor's degrees in the area of healthcare professions of the University of Milan with ages ranging from 19 to 31 years (third group).

Tab. 1. Number of participants (and percentages) of each age group and the total sample, along with mean and standard deviation (SD) of age, scales used and time spent online for age groups and the total sample

	First group of age	Second group of age	Third group of age	Total sample
N	54 (40%)	30 (22.2%)	51 (37.8%)	135
Age	14.87 ± 0.5	17.72 ± 0.52	20.67 ± 2.29	17.69 ± 2.95
IAT total scores	49.11 ± 7.49	37.9 ± 1.44	30.84 ± 3.1	39.73 ± 9.61
AdAS	58.04 ± 18.76	49.90 ± 14.69	47.02 ± 17.63	52.07 ± 18.08
BAPQ	93.98 ± 17.1	93.83 ± 16.63	93.71 ± 14.61	93.84 ± 15.97
UCLA	17.15 ± 5.22	16.00 ± 0.0	16.00 ± 0.0	16.46 ± 3.33
1-3 hours	21 (38.9%)	16 (53.3%)	33 (64.7%)	70 (51.9%)
4-7 hours	31 (57.4%)	13 (43.3%)	16 (31.4%)	60 (44.4%)
> 7 hours	2 (3.7%)	1 (3.3%)	2 (3.9%)	5 (3.7%)

Number of participants and age, mean and standard deviation (SD) of the scales used and time spent online for each age group and the total sample are provided in Table 1.

In Table 1, by comparing the IAT total scores between groups, significant differences emerged (Kruskal-Wallis test, $p<0.001$); significant differences also emerged when comparing the AdAS total scores between groups (Kruskal-Wallis test, $p=0.008$). In both cases there is a reduction in scores from the first to the third group. In contrast, no significant difference emerged between groups when comparing BAPQ and UCLA scores.

In addition, for the AdAS scale, we found significant differences between the groups in two sub-scales. Precisely, in the "routine and inflexibility" sub scale (M and SD first group: 16±5.56; second group: 15.2±5.1; third group: 12.5±5.76; total sample: 14.53±5.72; Kruskal-Wallis test, $p=0.004$, with Bonferroni's correction $p=0.007$; by applying the Mann-Whitney test, differences emerged in the "routine and inflexibility" sub scale between the first and the third group and between second and the third group, $p=0.02$) and in the "hyper/hyporeactivity to stimuli" sub scale (M and SD first group: 5.71±2.59; second group: 4.43±2.68; third group: 4.11±2.66; total sample: 4.81±2.72; Kruskal-Wallis test, $p=0.006$, with Bonferroni's correction $p=0.007$; the first group differences both from the second and from the third: Mann-Whitney, $p=0.03$, while in the second and the third no difference emerged, $p=0.58$).

Table 2 shows the values of the three IA cut-offs in the age groups and the total sample.

Within the first age group, almost all participants fall into the category at risk of IAD. The percentages of a normal Internet use increase from the first to the third group (thus, with increasing age), while for participants at risk or with IAD the percentages decrease from the first to the third group. In the total sample, 0.7% showed serious addiction.

By comparing the distribution of IAT scores of each group with the others, significant differences emerged (Mann-Whitney test: first vs second group $p<0.0001$, first vs third $p<0.0001$, second vs third $p<0.0001$; with Bonferroni's correction $p=0.017$). When comparing the frequencies of the three age groups with non-addicted, at-risk and addicted participants (the latter two together, for statistical reasons), using the Fisher's Exact test, significant differences emerged ($p<0.0001$).

As regards to the type of use, we distinguished between searching for information, news, etc. (Use 1); study and formation (Use 2); social network (Use 3); online games (Use 4); online gambling (Use 5); fun - i.e., streaming online services, music, video download, etc. (Use 6); shopping online/banking (Use 7); pornography (Use 8); and dating (Use 9).

Table 3 shows frequencies (and percentages) of the type of Internet use in the total sample and in the three age groups.

The use of the Internet for social networking is the most common mode, both in the total sample and in each age group. This is followed by use of the Internet for fun. Very few participants use the Internet for study and formation.

As regard to the relationship between the IAT scores and the Internet use, it is evident that groups identified on the basis of the cut-offs are directed towards social networks and fun (Table 4).

Tab. 2. Number (and percentage) of IA levels in the age groups and the total sample

	First group of age	Second group of age	Third group of age	Total sample
IAT normal level	0 (0%)	26 (86.7%)	51 (100%)	77 (57%)
IAT at-risk level	53 (98.1%)	4 (13.3%)	0 (0%)	57 (42.2%)
IAT severe level	1 (1.9%)	0 (0%)	0 (0%)	1 (0.7%)

Tab. 3. Frequencies (and percentages) of the type of Internet use in the total sample and in the three age groups

	First group of age	Second group of age	Third group of age	Total sample
Use 1	0 (0%)	1 (3.3%)	0 (0%)	1 (0.74%)
Use 2	0 (0%)	2 (6.7%)	3 (5.9%)	5 (3.70%)
Use 3	37 (68.5%)	18 (60%)	34 (66.7%)	89 (65.92%)
Use 4	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Use 5	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Use 6	16 (29.6%)	9 (30%)	14 (27.5%)	39 (28.9%)
Use 7	1 (1.9%)	0 (0%)	0 (0%)	1 (0.74%)
Use 8	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Use 9	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Afterwards, the number of hours spent online was divided into the following three groups: group 1 (1-3 hours), group 2 (4-7 hours), group 3 (>7 hours). Main results are provided in Table 5.

In the total sample, by comparing time spent online between non-addicted, at risk and addicted individuals (the latter two together, for statistical reasons), using Fisher's Exact Test, significant differences emerge ($p<0.04$).

In the total sample, the majority of non-addicted spend between 1 and 3 hours on the Internet, while the majority of the participants at risk spend from 4 to 7 hours on the Internet. Only a few individuals spend more than 7 hours online, but surprisingly most of them (n=3) show a normal Internet use.

Moreover, with regard to the three age groups, comparing the non-addicted with the at risk group for Time spent online (1-3 hours), with Fisher's Exact test we obtain significant differences ($p<0.0001$). In fact, in the non-addicted level the frequency of the 1-3 hours category increases with increasing age, conversely in the addicted the opposite trend occurs.

In addition, always regarding the three age groups, comparing the non-addicted with the at risk group for Time spent online (4-7 hours), with Fisher's Exact test we obtain significant differences ($p<0.0001$). In

the non-addicted, the frequency of the 4-7 hours category increases with increasing age, while in the at risk level it decreases, although it should be noted that it is almost totally concentrated in the group of the youngest participants.

The analysis of the correlation (Spearman's r) between Internet addiction, loneliness, BAP, age, time spent online and main Internet use is presented in Table 6.

A significant correlation was observed between the Internet addiction and the BAP (Broad Autism Phenotype) as evidenced by the positive association between the IAT total scores and AdAS total scores (contrariwise, no significant correlations between IAT total scores and BAPQ total scores were found). Significant positive correlations were observed between the Internet addiction and loneliness and time spent online, while Internet addiction correlates negatively with age. Age correlates negatively also with BAP and time spent online. The two scales related to Broad Autism Phenotype correlate positively with loneliness.

The multiple linear regression with stepwise method was used to select a set of predictors having the best relationship with the dependent variable. In this case, dependent variable: IAT TOT; predictors: AdAS, UCLA, Time spent online, and Age. We conducted a

Tab. 4. Frequencies and percentages of the type of Internet use in the three IAT cut off subgroups

	IAT <40	IAT 40≤ x ≤69	IAT ≥70
Use 1	1 (1.3%)	0 (0%)	0 (0%)
Use 2	5 (6.5%)	0 (3.3%)	0 (0%)
Use 3	48 (62.3%)	41 (71.9%)	0 (0%)
Use 4	0 (0%)	0 (0%)	0 (0%)
Use 5	0 (0%)	0 (0%)	0 (0%)
Use 6	23 (29.9%)	15 (26.3%)	1 (100%)
Use 7	0 (0%)	1 (1.8%)	0 (0%)
Use 8	0 (0%)	0 (0%)	0 (0%)
Use 9	0 (0%)	0 (0%)	0 (0%)

Tab. 5. Frequencies and percentages of time spent online (Group 1, 2, and 3) in the total sample and in the three age groups

Time spent online	IAT <40	IAT 40≤ x ≤69	IAT ≥70
Total Sample			
1-3 hours	46 (59.7%)	24 (42.1%)	0 (0%)
4-7 hours	28 (36.4%)	32 (56.1%)	0 (0%)
>7 hours	3 (3.9%)	1 (1.8%)	1 (100%)
First group of age			
1-3 hours	0 (0%)	21 (39.6%)	0 (0%)
4-7 hours	0 (0%)	31 (58.5.3%)	0 (0%)
>7 hours	0 (0%)	1 (1.9%)	1 (100%)
Second group of age			
1-3 hours	13 (50%)	3 (75%)	0 (0%)
4-7 hours	12 (46.2%)	1 (25%)	0 (0%)
>7 hours	1 (3.8%)	0 (0%)	0 (0%)
Third group of age			
1-3 hours	33 (64.7%)	0 (0%)	0 (0%)
4-7 hours	16 (31.4%)	0 (0%)	0 (0%)
>7 hours	2 (3.9%)	0 (0%)	0 (0%)

multicollinearity test in the predictor variables. In our study, the lowest Tolerance value is 0.95 and the highest VIF is 1.15. Accordingly, multicollinearity does not appear to be a significant problem in our dataset.

Given the p-value of the F statistic computed with ANOVA ($F_{(4)}=58.80$, $p<0.0001$), the information brought by the explanatory variables is significantly better than what a basic mean would bring. Based on the Type III sum of squares we obtained: $F_{(1)}=157.12$, $p<0.0001$ for Age; $F_{(1)}=25.60$, $p<0.0001$ for UCLA; e $F_{(2)}=5.82$, $p=0.004$ for Time spent online. Thus, three variables have been retained in the model. These three variables bring significant information to explain the variability of the dependent variable IAT TOT: Age ($R^2=0.53$), Age and UCLA ($R^2=0.61$), Age, UCLA and Time spent online ($R^2=0.65$). Given the R^2, 65% of the variability of the dependent variable (IAT TOT) is explained by the three explanatory variables. Among the explanatory variables, Age is the most influential.

Discussion

The main objectives of this study were to verify with a cross-sectional design the level and differences of PIU according to age, to investigate which scale for BAP was more appropriate for Italian participants, to evaluate the type of use and time spent online and to identify the predictors of PIU in a gender-oriented sample.

With regard to level and trend, the IAT overall mean of the total sample was on the borderline of the normal range. However, overall, 42.2% of the participants are classifiable as being at risk for IAD; this percentage is consistent with the data collected in Italy (Truzoli *et al.*

Tab. 6. Correlations between the scales used, time spent online, age and the type of Internet use

Variables	IAT TOT	UCLA TOT	BAPQ TOT	AdAS TOT	Time spent	Age	Type of use
IAT TOT	1						
UCLA TOT	0,20*	1					
BAPQ TOT	-0,03	0,18*	1				
AdAS TOT	0,22**	0,24**	0,54***	1			
Time spent	0,24**	0,07	0,08	0,18*	1		
Age	-0,88***	-0,16	0,06	-0,26**	-0,19*	1	
Type of use	0,15	0,09	0,17	0,16	0,07	0,002	1

Legenda: *<0.05; **<0.01; ***<0.001.
BAPQ: Broad Autism Phenotype Questionnaire; UCLA: University of California Loneliness Scale; AdAS: Adult Autism Subthreshold; IAT: Internet Addiction Test.

2019; Viganò *et al.* 2020). According to previous epidemiological studies on the Italian samples (Bianchini *et al.* 2017; Poli & Agrimi 2012), 0.7% of the sample showed serious addiction.

It should also be noted that the IAT overall mean of the three age groups is different, meaning that the youngest (14-16.9 years) is in the risk range (just over 49), while that of the other two groups decreases with increasing age (from about 38 to about 31).

In addition, a more detailed analysis showed that almost the whole of the youngest group was in the risk group (98.1%) and 1.9% showed serious addiction. Conversely, little less than 15% of the intermediate age group is in the risk range, while all participants belonging to the older age group show a normal level of Internet use. In the latter two age groups, no participants fall into the serious addiction range.

Even with the limitations of a cross-sectional observation, the main finding is the presence of a high risk of developing IAD and a reduction in PIU with increasing age (the importance of age in explaining IAT scores is supported by the results of multiple linear regression). The data on risk reduction with increasing age are consistent with the findings of Bakken *et al.* (2009), Yen *et al.* (2009), and with the results of longitudinal studies (Li *et al.* 2019; Stavropoulos *et al.* 2018).

With respect to the relation between PIU and the other variables surveyed, significant correlations between PIU, subclinical autistic traits, loneliness, age and time spent online have been found in our study.

The correlation between PIU and BAP is in line with previous findings that showed a positive association between problematic Internet use and subclinical autistic traits in children and adolescents (Chen *et al.* 2015; Romano *et al.* 2013; Truzoli *et al.* 2019). However, this correlation was only found for the AdAS scale and not for the BAPQ. In addition, in our study, a negative correlation between age and subclinical autistic traits and a positive correlation between time spent online and subclinical autistic traits emerged, but only if BAP is measured with AdAS. Thus, the scales we used to test subclinical autistic traits, even though they correlate with each other, are not equivalent with respect to the relationship with PIU, age, and time spent online.

However, both BAPQ and AdAS correlate with loneliness, a finding consistent with other evidence (Dell'Osso *et al.* 2018). In addition, PIU also correlates with loneliness, confirming other studies (Costa *et al.* 2019; Nowland *et al.* 2018).

Finally, our study showed that age not only negatively correlates with BAP, but also with PIU and time spent online.

With respect to the main outcome variable (IAT), although a correlation with BAP was shown, the main variables in explaining the variability of scores are age, loneliness and time spent online.

In literature it has been reported that females use the Internet mainly for social networking (Choi *et al.* 2014). In our study, more than half of the sample (65.92%) uses Internet for social networking (i.e., Facebook, Instagram, etc.), and the 28.9% of the participants for fun (i.e. streaming or downloading); only 3.70% to study and carry out educational activities. It appears that females prefer social networks, in accordance with the current scientific literature (Andreassen *et al.* 2012; Choi *et al.* 2014; Muñoz-Rivas *et al.* 2003).

If we compare the type of Internet use for the three cut-offs of the IAT, we see that the use of social networks is also prevalent in the group at risk of IAD, followed by the use for fun. Thus, it seems that not only the use of the Internet for activities with a high additive component (such as online gaming or gambling), but also the use of social networks can promote a risky exposure to the network in females.

Finally, as regards the time spent online by the overall sample, participants at risk of IAD use the Internet more for 4-7 hours (with about 1.8% using it for >7 hours), while non-addicted individuals use it more for 1-3 hours. However, time spent online differed significantly between the three age groups when comparing the IAT cut-offs.

Few individuals spend more than 7 hours online, but most of them show a normal Internet use. Given that time normally spent on the Internet tends to increase with age (Livingstone *et al.* 2011), this result may be worthy of investigation, with a larger sample and with a procedure that makes it possible to test hypotheses capable of taking this result into account. In fact, a) it may be that for certain individuals with particular personality characteristics (i.e., BAP or loneliness) the use of the Internet performs a positive function allowing the satisfaction of the need to socialize and share or to study topics of particular interest, or b) it is used for constructive purposes such as studying, in both cases without important consequences on daily functioning.

In conclusion, in the light of the above, we can draw some final considerations.

A first consideration is the level of PIU in our sample of females only. The percentage of PIU is high and suggests that females may present risk factors that should not be underestimated.

Moreover, our results suggest a higher vulnerability for PIU in adolescent girls in the 14-16 age group, highlighting a tendency for PIU to decrease with increasing age. Our study confirms that young female adolescents are more vulnerable to developing PIU compared to other age groups. In fact, our findings appear in accordance to current literature that reports lower IAD rates among older people (Chakraborty *et al.* 2010; Kuss *et al.* 2013; Kuss & Lopez-Fernandez 2016).

Our data highlight that females spend much time connected to the Internet, mainly on social networks and following for fun. Thus, even the use of the Internet for activities that tend to be less addictive – e.g., than online gaming or gambling - in the presence of other

personality (such as BAP) or socio-anagraphic (such as age) factors can be characterized as a risk factor. In addition, time spent online is a predictor of PIU.

We also found a correlation between PIU and loneliness. There is evidence that people experiencing loneliness have shown problems in the developmental age to build friendships relationships or in starting conversations with other people (Schiltz *et al.* 2021). So, people who experience loneliness may present an increased risk of developing PIU, leading to unhealthy social interactions and relationships and to an increased sense of loneliness (Bonetti *et al.* 2010; Shettar *et al.* 2017). In fact, some studies claimed that IAD could cause negative psychological effects, including loneliness feelings (Erol & Cirak 2019; Mamun *et al.* 2020; Nowland *et al.* 2018), while others reported that loneliness could be a causal factor for PIU, showing that people who experienced this feeling tend to prefer online interactions, perceived as easy and safer than meeting people in real life (Chen *et al.* 2015; Costa *et al.* 2019). In explaining loneliness as a predictor of PIU, it has been proposed that online relationships can likely engender feelings of loneliness because in this type of relationship sensory information are greatly absent as well as bodily feedback present in face-to-face interactions, representing neurophysiological mechanisms produced in the course of human evolution to recognize satisfying social relationships (Costa *et al.* 2019). In any case, although it is not possible to absolutely exclude the hypothesis that there is a two-way relation between the PIU and loneliness, our study confirms loneliness as a predictor of PIU, as found in adolescents (Ang *et al.* 2018; Chen *et al.* 2015; Parashkouh *et al.* 2018) and medical students (Simcharoen *et al.* 2018).

In summary, in our study being young female, feeling loneliness and spending a lot of time online predicted levels of PIU.

The results of this study also report a significant correlation between Internet addiction and BAP. According to literature, our findings highlighted how some personality traits could lead to an increased vulnerability for IAD, as appearing routine and inflexible and hyper or hyporeactive to stimuli. However, although there is evidence in the literature that for some individuals with BAP (especially in the presence of comorbidity with anxiety; Romano *et al.* 2014) Internet use is not problematic because they can express their social interactions virtually in a satisfactory way, in any case some characteristics such as behavioral and/or cognitive inflexibility and reactivity to stimuli (in particular, to Internet-related cues) can trigger a vicious circle, so that an excessive use of the Internet could be harmful, leading to health and time management problems thus negatively affecting daily life activities (Deckers *et al.* 2017; Gao *et al.* 2020).

The relationship between IAD and BAP is therefore complex and the consideration of individual trait characteristics in isolation may not give a full picture of the probability of an IAD developing (Romano *et al.* 2014).

We also found that the AdAS questionnaire was more sensitive in assessing autistic traits in our Italian female sample than the BAPQ.

This might be due to several causes: a) AdAS was developed simultaneously in both Italian and English, in contrast to BAPQ which was originally developed in English; b) AdAS has a dichotomous (Yes/No) response mode for each item, while BAPQ has an ordinal response mode; and c) the two questionnaires are correlated, but not exactly superimposable.

Therefore, taking into account the results, in order to assess the BAP, we point out the opportunity to use the AdAS scale for research with Italian participants.

Preventive and clinical implications
This is, to our knowledge, the first Italian study gender oriented that investigated some predictors of PIU. This study can help clinicians, parents and school staff to prevent a possible PIU a) guiding young adults to a correct and conscious use of the Internet, helping them to recognize the excitatory and additive power of the often very captivating stimuli conveyed by the network and by social networks in particular; b) guiding young people to a planned use (duration of exposure and type of use) of the Internet; c) organizing specific interventions aimed at improving cognitive flexibility; and d) encouraging socialization processes also with specific support in overcoming insecurities and anxiety associated with real-life relationships.

Finally, our data point out the relationship between autistic traits and PIU. Consequently, clinicians should evaluate autistic traits during the assessment of individuals with PIU.

Limitations
This study also shows some limitations. First, we included only female participants; this characteristic could be seen as strength and a limitation at the same time, because it did not allow evaluating any gender differences, but it constitutes a gender-oriented study. Second, it was a cross-sectional study that did not let to analyse the trend of PIU over time. Third, it has not been possible to highlight a cause-effect association between the variables, although the multiple linear regression identified age, loneliness, and time spent online as predictors for IAT scores. Finally, the sample size of the three age groups, although sufficient, can be increased. These limits can be used as directions for the development of new studies in this field.

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