

Research Paper



Investigating the Role of the Broad Autism Phenotype, Social Cognition, and Sense of Loneliness on Internet Addiction in College Students

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ABSTRACT

Objective: Today, the Internet is a crucial part of life, especially the life of young people. Several factors may cause young people to have internet addiction (IA). This study aims to investigate the role of the broad autism phenotype (BAP), social cognition, and loneliness in creating IA among Iranian college students.

Methods: The research method of this research was correlation and convenience sampling. The sample consisted of 218 students of Imam Khomeini International University studying at this university in 2022-2023. Research data were collected using questionnaires of IA, loneliness, theory of mind, and BAP and analyzed using correlation method and simultaneous multiple regression analyses.

Results: The coefficient of correlation showed that loneliness, social cognition, and BAP have a significant relationship with IA at the ($P=0.01$) level. Also, this analysis showed that social cognition and BAP are more predictive of IA among technical students than social science students. The results showed a significant relationship between loneliness, social cognition, and BAP with IA.

Conclusion: In this regard, the officials of educational centers should take extensive measures to reduce the impact of the factors that cause IA in students.

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Highlights

- The coefficient of correlation showed that loneliness, social cognition, and broad autism phenotype (BAP) have a significant relationship with Internet addiction (IA). Social cognition and BAP among technical students are more predictive of IA than social science students.
- Loneliness plays a greater role in causing IA among these three variables for both groups of students.

Plain Language Summary

In today's world, Internet addiction (IA), especially among college students, has become a global problem. IA has negative consequences such as academic performance inhibition and increase in psychological problems for college students. Therefore, in this study, an attempt was made to investigate the role of important factors influencing IA, such as broad autism phenotype (BAP), Sense of Loneliness, and social cognition in college students. The results of this study showed that BAP, social cognition and Sense of Loneliness are related to IA. This means that with the increase in Sense of Loneliness, the amount of IA in student's increases. Also, with the increase in the BAP and problems in social cognition, the amount of IA in student's increases. Also, the results of the study showed that it is possible to predict IA in students through the state of Sense of Loneliness, BAP and social cognition. It is suggested to design and implement appropriate interventions based on the management and treatment of BAP, social cognition and Sense of Loneliness in order to control IA in college student's.

Introduction

Internet addiction (IA) is not recognized as a disorder by the [American Psychological Association \(APA\)](#) or [World Health Organization \(WHO\)](#), but it is a serious pathology that disrupts various aspects of people's lives ([Young, 1997](#)). For the first time, IA was described as a type of impulse control disorder characterized by impaired control ([Young, 1997](#); [Wang et al., 2020](#)). Meta-analysis has shown that IA has increased in recent years ([Lozano-Blasco et al., 2022](#)). The samples of this meta-analysis were from Europe, America, Asia, and the Pacific. According to the results, IA in the new generation has consequences, such as reduced socialization, acculturation, and increased individualism ([Lozano-Blasco et al., 2022](#)). During the COVID-19 pandemic, the amount of IA was assumed to increase due to the quarantine and stress caused by the pandemic. A study conducted in China reported that the prevalence of IA among the population was 36.7% during the COVID-19 pandemic ([Li et al., 2021](#)). Among students, the Internet is a popular tool, and in a study conducted by [Zhang et al., \(2018\)](#), the results show that the prevalence of IA among medical students is five times higher than the population and requires preventive measures.

Despite the many positive aspects of the Internet, it may hurt many aspects of human life. IA is related to several mental disorders, such as bipolar, major depression, dysthymia, social anxiety ([Cerniglia et al., 2017](#)), substance

use disorders ([Bisen & Deshpande, 2018](#)), physical problems ([Kim & Chun, 2005](#)), problems in sleep cycles ([Choi et al., 2009](#)), and problems in interpersonal relationships ([Bisen & Deshpande, 2018](#)). In a study conducted on students addicted to the Internet, reports showed that 58% of the students experienced decreased grades, absenteeism, and probation due to excessive Internet use ([Young, 1998](#); [Bisen & Deshpande, 2018](#)).

Research has shown that people who report a degree of depression, anxiety, and hyperactivity use the Internet in a more problematic way ([Bickham, 2021](#)), therefore considering the characteristics of the broad autism phenotype (BAP), it is better to pay attention to it as a crucial variable. Recently, similar research has been conducted on the population, whose results show that BAP criteria are observed not only in parents of children with autism spectrum disorder (ASD) but also in those in the population who do not even have children yet ([Camodeca, 2019](#)). Since the deficiency in social interactions is a characteristic of BAP people, these people are likely to use online methods to communicate and prefer them to face-to-face communication. Also, assuming that BAP is more visible in science and mathematics, it can be assumed that the IA is also more in these fields [Liu et al., \(2017\)](#). In a study conducted by [Liu et al., \(2017\)](#) on students, they described that autistic characteristics are related to increased Internet gaming addiction.

Social media usually have the same features; in other words, they are individually personalized for children with ASD or sub-clinical ASD and offer limited topics according to their interests (Lane & Radesky, 2019). The convincing evidence shows that the patterns and reasons for using social media differ between adolescents with and without autism. Teens with ASD prefer to use YouTube, while teens without ASD prefer Snapchat. Also, about 92% of adolescents without ASD stated that they use social media for social interactions. At the same time, 59% of people with ASD stated that they use social media for entertainment purposes (Alhujaili et al., 2022). In a study that analyzed the text of tweets of people with ASD, the results showed that the text of their tweets had significantly more obsessive-compulsive features, such as fixation and worry than those of the control group. Emotional expressions related to fear, paranoia, and anxiety were tweeted more in these people (Hswen et al., 2019). Another study showed that autism disorder, hyperactivity disorder, and impulsivity are predictors of IA. These two disorders alone and together can play a crucial role in causing IA (So et al., 2017). The use of social media may affect the mental health of people who exhibit autistic traits (Ward et al., 2018). Most of the previous research was about children or adolescents with ASD, and nothing was said about adults with BAP and how they use the Internet and their presence on social media. However, the evidence indicates that a deficiency in social interactions can be the underlying factor of IA, and this may be due to the understanding and recognition of people without spending much time and energy on social media.

Understanding other people's feelings and perspectives is equivalent to the social cognition. Sullivan describes a two-component view of the social cognition. Cognitive theory means conceptually understanding the views or intentions of others, and emotional mind theory means understanding the feelings of others or recognizing emotions (Tager-Flusberg & Sullivan, 2000). Social cognition and understanding the feelings and intentions of others can have a relationship with IA. In a study conducted by Gentina et al., (2021), the results showed that adolescents' use of online social networks improves their social cognition, which enables them to separate and interpret information. A study found a convincing negative correlation between low scores on mind reading through the eyes and high scores on IA. The results showed that compared to their peers, adolescents with IA have behavioral problems, hyperactivity and inattention, communication with peers, and emotional problems (Akdeniz et al., 2020). However, since the results were contradictory in the field of social cognition and IA, in the current research, we tried to predict the relationship between these two variables.

People may do anything to escape the feeling of loneliness, and the most accessible thing is to surf the Internet for entertainment or communication with people around the world. Loneliness is a negative and unpleasant feeling related to many psychological problems (Deckers et al., 2017). In the research conducted by Tras, (2019), the results explain that IA and loneliness are two predictors of Internet gaming disorder. Loneliness also plays a significant role in causing IA. Despite the importance of the loneliness variable, research on loneliness and IA is limited. For this purpose, the relationship between these two variables was investigated in the present study.

Considering the conflicting evidence in this field, the current research investigates the role of BAP, loneliness, and social cognition in virtual space addiction. Based on the research background, since people with BAP benefit from little self-expression in the real world and also find it difficult to understand the goals, intentions, and emotions of others, they are more likely to turn and engage heavily in cyberspace and object-based communication. Also, addiction to virtual space and defects in social communication can cause mental health problems, particularly feelings of loneliness. For this reason, the research in this field is significant and can open perspectives for further understanding of BAP, loneliness, and social cognition in the prevention of chronic mental health problems in the population with IA.

The present study was conducted to investigate the role of BAP, social cognition, and feelings of loneliness in the development of IA in students. It is also tried to carefully examine the mentioned psychological problems in this population and to predict based on the samples as much as possible. Specifically, several questions are raised in this research. The first question is the relationship between social cognition and IA. The second question is the relationship between loneliness and IA. The third question is, if a significant relationship is observed, how much is the contribution of BAP in creating internet addiction? Also, the next question is whether the BAP, social cognition, loneliness, and IA are different in technical and social science students.

Materials and Methods

This research's statistical population included all students of Imam Khomeini International University in Qazvin Province, Iran in 2022-2023. The total number of members of the population is equal to 9000 people; using the convenience sampling method, 260 people were considered samples. However, according to the inclusion and exclusion criteria of the study, 43 people

were excluded and, 218 people were selected as a sample. Among the study sample, 142 people (65.1%) were female and 71 (32.6%) were males and 5 (2.3%) were other gender. Their Mean±SD age was 21±3.85 years (range 18-51 years). The students attended in various academic degree courses identified as follows: 108 students (49.5%) in the social science area, and 110 students (50.5%) in the technical area. Among these students, 187 people (85.5%) were undergraduate students, 29 (13.3%) were master's students, and 2 (0.9%) were doctoral students. The inclusion criteria included being a student of an international university, mastering the Persian language, the subject's consent, and the exclusion criteria included the subject's non-participation in the middle of the questionnaire, and being a graduate of Imam Khomeini International University.

The research participants were selected from the university campuses for almost two months, from May to July.

Since our research was conducted in a university environment and the university is a platform for research, we did not take an ethical code to conduct the research and we obtained the subjects' consent.

Procedure

Students were invited to participate in the study voluntarily and with the right to withdraw from the study at any time, via mobile phone. The data collection method was a questionnaire, and due to the coronavirus restrictions, cyberspace has been used for its implementation; in other words, the data were collected through an online questionnaire. At the beginning of the questionnaire, the participants registered their written informed consent to participate in the study, data analysis, and data publication, and completed a structured questionnaire that took about 30 minutes. Specifically, 4 standardized scales were used to test social cognition, loneliness, BAP, and IA, which respectively include reading the mind in the eyes test (RMET), loneliness questionnaire (UCLA) 3rd edition, autism-spectrum quotient (AQ), Internet addiction test (IAT).

Measures

Reading the mind in the eyes test (RMET)

RMET is a neuropsychological test to measure the ability to read minds through the eyes, which was designed by Baron-Cohen et al (2001 a). The revised form of this test includes 36 questions that contain black-and-white images of the eyes of male and female artists in different

states. This questionnaire is a self-report questionnaire. Each question provides four mental state descriptions of the corresponding images, a target, and three deviant states with the same emotional value. The respondent must select the option that best describes the person's mental state in the image from among the options through the visual information in the image. The scores of this test vary from 0 to 36. The lower the score, the more autistic characteristics a person has. Since this test has been used in the framework of studies conducted to measure the ability to read the minds of healthy and sick people, it is considered an indicator and representative of the validity of this test in studies of mental perception. Several linguists' guidance and supervision were used to translate this questionnaire's words into Persian. Acceptable reliability was reported in the original version of this questionnaire. The validity and reliability of the Persian version of this questionnaire were confirmed with Cronbach's α of 0.73 (Aliloo et al., 2011). In this study, the reliability coefficient was 0.62.

Loneliness questionnaire (UCLA) 3rd edition

This scale was the first loneliness measurement scale made by Russell et al., (1978) at the University of California. Despite its validity and reliability, this questionnaire was revised twice to eliminate some deficiencies. It was revised once by Russell et al., (1980) and its third edition by Russell (1996). In the third version of this questionnaire, Russell (1996) simplified the expressions and how to answer the test questions and changed the fourth article from negative to positive. This tool includes 20 questions with a 4-point Likert scale (never, rarely, sometimes, and always). Its scoring method includes never 1 point, rarely 2 points, sometimes 3 points, and always 4 points, but some questions have reverse scoring. Its range of scores is between 20 and 80, and its average is 50. The minimum score indicates no loneliness and a higher score than the average indicates greater loneliness. The α coefficient was reported between 0.89 and 0.94 in its revised version. In research conducted on the Persian version of this questionnaire, the reliability of the questionnaire was obtained with Cronbach's α of 0.89 (Morovati & Yadegari, 2019). In another research conducted by (Garavand et al., 2021), Cronbach's α coefficient was obtained for all questionnaire scales at 0.97. It can be said that the reliability of this test is confirmed. The tool's reliability was obtained in the present study with Cronbach's α of 0.76.

Internet addiction test (IAT)

IAT is a 20-question IA measuring tool invented by Young. This tool is based on a 5-point Likert scale (always, most of the time, often, sometimes, and rarely), and its scoring method is from (1 never) to (5 always). If the subject gets a score equal to or less than 49 on this scale, he is considered a normal internet user, and if he gets a score higher than that, he is considered one of the people who are addicted to using the internet. In the research conducted by Lee et al., (2001) and Kim et al., (2006) in Korea, the reliability of this test was reported with Cronbach's α of 0.90 and 0.92, respectively. In Iran, the reliability of this test was confirmed by Nastiezaie with Cronbach's α of 0.81 and Qasimzadeh with Cronbach's α of 0.88. The present study obtained the reliability coefficient with Cronbach's α of 0.90.

Autism-spectrum quotient (AQ)

AQ was prepared by Baron-Cohen et al (2001 b) at the Center for Autism Studies in Cambridge to examine the subthreshold of ASD in normal adults. This questionnaire has 50 questions; out of these 50 questions, every 10 examines one of the cognitive areas. This test is based on a 4-point Likert scale (completely agree, slightly agree, slightly disagree, and completely disagree). The scoring method is that answers that agree or slightly agree with several questions get 1 point, and answers that disagree or slightly disagree with the rest also get 1 point. This scoring method is intended to avoid bias. A high score on this test indicates having ASD, and a low score indicates the absence of this disorder. The original version of this questionnaire has reported acceptable reliability, and the reliability of its Persian version with Cronbach's α for the internal consistency of all parts with each other was 0.76 and, with a total score of 0.79 (Nejati et al., 2003). This study obtained the reliability coefficient with Cronbach's α of 0.63.

Data analysis

The research method of the current study is descriptive and correlational and these data were analyzed through a simultaneous regression method using SPSS software, version 24. According to the primary analysis of data distribution (based on the Kolmogorov-Smirnov test, skewness, and kurtosis), most of the data of the studied variables are normally distributed. Therefore, parametric analysis was used. Based on the analysis, the variables of loneliness, social cognition, and BAP are predictors of IA variables in students of Imam Khomeini International University, Qazvin, Iran.

Results

All the subjects of this research were undergraduate, master's, and doctoral students of the technical and social sciences faculties of Imam Khomeini International University of Qazvin Province.

Table 1 presents descriptive statistics and descriptive results, including Mean \pm SD and number of subjects of IA, BAP, social cognition, and loneliness variables.

According to the results of Table 2, the correlation between BAP and IA is significant ($P<0.01$). Also, the relationship between BAP and the social cognition is negative and significant ($P<0.05$). According to the report in Table 2, the relationship between BAP and loneliness is significant ($P<0.01$). Also, IA and the social cognition have an inverse and significant relationship. The relationship between IA and loneliness is significant ($P<0.01$). Also, the relationship between the social cognition and loneliness is negative and significant.

According to Table 3, the changes in the model are predicted with a coefficient of determination of 0.17. Durbin Watson's statistic is reported to be 0.33, which can be said to be between 1.5 and 2.5, and the assumption of correlation in the model's residuals is not established.

Table 1. Means scores for IA, BAP, theory of mind, and loneliness

Variables	Mean \pm SD	No.
IA	43.32 \pm 13.798	218
BAP	21.71 \pm 4.522	218
Theory of mind	17.78 \pm 4.034	218
Loneliness	47.82 \pm 8.100	218

IA: Internet addiction; BAP: Broad autism phenotype.

Table 2. Pearson correlations between IA, BAP, theory of mind, and loneliness

Variables	IA	BAP	Theory of Mind	Loneliness
IA	1.000	0.157**	-0.262*	0.271**
BAP	0.157**	1.000	-0.146*	0.356**
Social cognition	-0.262*	-0.146*	1.000	-0.139*
Loneliness	0.271**	0.356**	-0.139*	1.000

IA: Internet addiction; BAP: Broad autism phenotype.

*P<0.05, **P<0.01.

Table 3. Predicting IA based on BAP, social cognition, and loneliness

Model	R	R ²	Adjusted R ²	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df ₁	df ₂	Sig. F Change	
1	0.419 ^a	0.176	0.164	10.737	0.176	15.186	3	214	0.000	0.336

IA: Internet addiction; BAP: Broad autism phenotype.

^aPredictors: Constant, loneliness, social cognition, BAP, ^bDependent variable: IA.

Table 4. Regression analysis predicting IA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	5251.889	3	1750.630	15.186*	0.000 ^b
Residual	24669.107	215	115.276		
Total	29920.995	218			

IA: Internet addiction; BAP: Broad autism phenotype.

*P<0.05.

^aDependent variable: IA, ^bPredictors: (Constant), loneliness, social cognition, BAP.

Table 5. Standard and non-standard regression coefficients and VIF and tolerance coefficients^a

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
Constant	24.217	6.626		3.655	0.000		
BAP	0.372	0.185	0.132	2.011	0.046	0.892	1.121
Social cognition	-0.583	0.180	-0.204	-3.241	0.001	0.969	1.032
Loneliness	0.390	0.095	0.268	4.091	0.000	0.897	1.114

IA: Internet addiction; BAP: Broad autism phenotype; VIF: Variance inflation factor.

Dependent variable: IA.

Table 6. Collinearity diagnostics in model 1

Dimension	Eigenvalue	Condition Index	Variance Proportions			
			Constant	BAP	Social Cognition	Loneliness
1	3.916	1.000	0.00	0.00	0.00	0.00
2	0.054	8.509	0.00	0.11	0.61	0.05
3	0.021	13.740	0.00	0.70	0.02	0.58
4	0.009	20.921	1.00	0.19	0.37	0.37

IA: Internet addiction; BAP: Broad autism phenotype.

Dependent variable: IA.

According to the sig reported in the Table 4, the regression analysis is significant, and it can be said that the variables of BAP, social cognition, and loneliness predict the variable of IA ($F=15.18$; $P<0.05$). The role of the mentioned independent variables in creating IA has become significant.

According to the results of Table 5, the tolerance coefficient should be more than 0.1, which is established in all three variables. Also, the variance inflation factor (VIF) coefficient should be <5 , and the Table report indicates that this assumption has been met in all three variables. Beta coefficients showed that loneliness plays a greater role in causing IA ($B=0.26$; $P<0.01$). After that, the social cognition with an inverse relationship has the second prominent role in creating IA ($B=-0.20$; $P<0.01$), and finally, the BAP has a significant role in creating IA ($B=0.13$; $P<0.05$).

According to the report of Table 6, the condition of collinearity is established, and this assumption has been met.

After the results showed that BAP, social cognition, and loneliness predict IA, we are going to the last research hypothesis.

One of the hypotheses of this research was that BAP, IA, social cognition, and loneliness are different in technical and social science students. According to the results of Table 7, regarding this hypothesis, a significant difference can be observed in IA ($Z=-2.5$; $P<0.05$), BAP ($Z=-1.9$; $P<0.05$) and social cognition ($Z=-2.0$; $P<0.05$) among technical and social science students, but no significant difference has been reported regarding loneliness ($Z=-1.2$; $P<0.05$).

Table 8 presents the higher mean scores of BAP, IA, and loneliness in technical students than in social science students. Also, the mean score of the theory of mind in social science students is higher than in technical students.

As a result, it can be said that all the hypotheses raised in this research have become meaningful according to the regression analysis.

Discussion

Nowadays, using the Internet is one of the most critical topics in students' lives. The Internet's attractiveness has made many young people prefer to use smartphones instead of communicating with family and friends. In the meantime, several factors may also cause people's tendency to use the Internet.

Table 7. Mann-Whitney U test for IA, BAP, social cognition, loneliness based on field of students

Statistics	BAP	IA	Social Cognition	Loneliness
Mann-Whitney U	5047.000	4747.000	7234.500	7703.500
Wilcoxon W	10933.000	10633.000	15490.500	16481.500
Z	-1.924	-2.563	-2.010	-1.229
Asymp. Sig. (2-tailed)	0.054	0.010	0.044	0.219

^aGrouping variable: Field.

Table 8. Description of the differences between IA, BAP, social cognition, and loneliness between technical and social science students

Variables	Field	Mean Rank	Sum of Ranks
BAP	Social science	101.23	10933.00
	Technical	117.62	12938.00
IA	Social science	98.45	10633.00
	Technical	120.35	13238.00
Social cognition	Social science	139.69	18439.50
	Technical	121.02	15490.50
Loneliness	Social science	124.86	16481.50
	Technical	136.32	17448.50

IA: Internet addiction; BAP: Broad autism phenotype.

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The present study was conducted to investigate the role of BAP, social cognition, and loneliness in students' IA. The statistical analysis results showed that all three variables, i.e. BAP, theory of mind, and feeling of loneliness, have a significant role in IA. Loneliness plays a greater role in causing IA among these three variables. In other words, with the increase in feelings of loneliness, the possibility of increasing IA in students increases. However, according to one of the research hypotheses, no difference was observed between technical and social science students in this regard. It can be said that students of both fields are equally drawn towards using the Internet due to the feeling of loneliness. The results of this research were consistent with the results of Saralioğlu et al., (2022), Akgün Kostak et al., (2019), Hou et al., (2019), Costa et al., (2019), and Zoghi et al., (2020). Another study was conducted during the coronavirus epidemic about the feeling of loneliness and the level of IA, which concluded that although certain variables affected the average level of loneliness and the tendency to use the Internet, the results showed that teenagers' IA increases with the increase of their loneliness (Saralioğlu et al., 2022). Another research showed that those students who spent more time using the Internet had problematic Internet use (PIU) and showed more signs of depression and loneliness (Akgün Kostak et al., 2019). These results also apply to the research conducted by Hou et al., (2019). They investigated intimate interpersonal interactions and loneliness among Internet addicts. The result was that people with IA may maintain poor interpersonal relationships and eventually feel lonelier. Also, Costa et al., (2019), by investigating the relationship between PIU with feelings of loneliness and lack of social support, determined that online commu-

nication leads to feelings of loneliness, independent of social support and people's age. This predictability was also confirmed in a study on the relationship between loneliness, sleep quality, and emotional regulation with IA (Zoghi et al., 2020).

Also, the current study is inconsistent with the research of Alqahtani et al., (2020). This study investigated the relationship between IA, loneliness, and life satisfaction, the results showed no relationship between IA, loneliness, and life satisfaction. This significance, which was also observed in most of the previous research, could be because students experience the feeling of loneliness upon entering a new phase of life, and then, turn to using the Internet to eliminate the feeling of loneliness.

The research showed that students' social cognition effectively increases the possibility of IA after feeling lonely. Social cognition has a significant negative relationship with IA, and it can be said that IA increases with a decrease in the level of social cognition. Based on the statistical data, a significant difference is observed between technical and social science students. In other words, technical students use the Internet more than social science students with less social cognition. This result obtained from the research is consistent with the research of Raiisi et al., (2020), Akdeniz et al., (2020), Ruben et al., (2021), Buyanova et al., (2018), and Venter (2019). Raiisi et al., (2020) concluded that a relationship is observed between social skills and psychological security with IA, and as the level of social skills and psychological security increases, IA decreases. In research that sought to investigate the role of levels of maternal attachment and paternal attachment as well as the ef-

fect of mind-reading skills through the eyes on IA, the results showed that both paternal and maternal insecure attachment styles and poor mind-reading skills affect the tendency of adolescents to use the Internet excessively. In addition, adolescents who are addicted to the Internet show a higher degree of inattention, hyperactivity, and emotional problems (Akdeniz et al., 2020). Another study found that using social media may not be bad in itself, but how it is used can have harmful results. People's active and passive communication on the Internet can affect their ability to understand non-verbal information. People who are passively present on the Internet and only read and look at other people's posts show the ability to understand more non-verbal content. These people use their passive presence on the Internet to strengthen skills for face-to-face interactions. On the other hand, people who are actively present on the Internet, i.e. create and post their content, have a weakness in understanding non-verbal information, and their ability to read and respond to others in face-to-face communication is negatively affected (Ruben et al., 2021). In the research conducted by Buyanova et al., (2018), it was concluded that virtual communication and Internet use significantly impact face-to-face interpersonal communication and real life. Adolescents who prefer virtual interaction to face-to-face interaction have a lower level of sociability and have insufficient communication ability, and this interaction method hurts their personality development and interpersonal communication. In addition, computer-mediated communication (CMC) may reduce people's skills to establish face-to-face interactions. If people prefer computer-mediated communication (CMC) to face-to-face communication, they may experience a crisis in knowing themselves and others. It is better to pay attention to face-to-face interactions than use the Internet, where understanding people's emotions and attitudes are more crucial than their words and writings (Venter, 2019).

On the other hand, these results contradict the research of Gentian et al., (2021) and Candrasari (2020). A study showed that online social networks (OSN) can create an interactive environment for teenagers. These online network environments allow teenagers to improve their social cognition ability, and in this way, they can have better control against the adverse effects of online social networks (OSN) (Gentina et al., 2021). Other results showed that social media provides managed social connections with acquaintances, and these social interactions on Facebook are not different from face-to-face interactions with people (Candrasari, 2020).

Establishing face-to-face communication requires social abilities, such as social cognition and reading minds. According to the current research, a significant negative relationship was observed between social cognition and IA, possibly because it is easier to communicate on the Internet than face-to-face interactions. Students prefer IA to face-to-face interactions, and this preference is much more in technical students than in social science students, which could be because social science students are more exposed to social interactions.

Another research result is a significant positive relationship between BAP and IA. This relationship points to the fact that the higher the BAP in people, the higher the probability of becoming addicted to the Internet. This significant positive relationship was also observed among students of technical and social sciences. According to the present study's results, technical students with more BAP are more likely to experience IA than social science students. According to the results, the BAP is less effective in IA after loneliness and social cognition. These results are consistent with the studies of Normand et al., (2021), Kawabe et al., (2019), and (Kawabe et al., 2022). Normand et al., (2021) investigated the prevalence of PIU in people with and without ASD in a systematic review. Out of the ten studies reviewed, eight showed a high score of PIU in people with ASD compared to the comparison group. Also, this research shows that PIU in adults with ASD and its relationship with factors related to PIU in ASD need more studies. Another study was conducted to investigate the prevalence of IA in adolescents with ASD and compare the characteristics of groups with IA disorder and non-afflicted groups in adolescents with ASD, and the results showed that symptoms of attention deficit hyperactivity disorder (ADHD) with high intensity are related to IA disorder in adolescents with ASD. It is necessary to take stronger prevention and intervention to control and treat IA disorder, especially in ASD teenagers with ADHD symptoms (Kawabe et al., 2019). Research conducted on people with BAP showed differences in IA between people with autistic and those without autistic traits. However, more research is required to better understand ASD and its association with IA (Kawabe et al., 2022).

Also, these results were inconsistent with the studies of So, et al., (??), Kawabe et al., (2020) and Dogan and Villanti (2021). In the research conducted by So, et al., (??) given that IA has been reported at a high rate in ASD and ADHD groups. The researchers sought to further investigate this report, and the study result showed that the rate of IA in the ASD and ADHD groups may be similar to previous reports with the population of ado-

lescents. In a study that compared the use of the Internet during the coronavirus epidemic between children with ASD and children without ASD, the results showed that after the spread of the coronavirus, both groups of children turned to excessive use of the Internet and were not different from each other. It is better to apply strategies to monitor and control Internet use for both groups (Kawabe et al., 2020). In one of the studies indirectly contrary to the present research, Dovgan and Villanti (2021) investigated the effect of genetic relationship, gender, and field of study. The results obtained from the research showed no relationship between the BAP, the level of common ASD genes, and gender or field of study, which is types of demographic information.

Despite the conflicting results, in the present study, this significant positive relationship between students of social sciences and students of technical fields was also true, which may be because students of technical fields are more in touch with tools than humans and maybe even because they are more interested in tools, which is one of the symptoms of autism, they have chosen such fields.

To prevent and treat IA in students, it is necessary to study these variables more so that we can provide suitable solutions to reduce IA based on these studies. Also, considering the relationship between the variables, to control students' internet addiction, their loneliness should be reduced, their social awareness should be strengthened, and their autistic traits should be identified and taken into consideration. For this purpose, the best solutions are methods that help more social interactions, such as holding workshops to increase self-confidence, expression techniques, communication, membership in healthy social groups, such as membership in a sports group, and performing activities. In a group, it is also essential to provide various support, including emotional support, because many people who feel lonely may have suffered from this problem due to not receiving such support.

Conclusion

The research results showed a significant relationship between loneliness, social cognition, BAP, and IA. It is recommended to provide students with programs for face-to-face social interaction and a controlled program for using the Internet. Due to the existence of conflicting studies, it is suggested to conduct more research in this regard, especially regarding demographic information, such as gender differences, different occupational groups, and other fields of study and their relationship with research variables. Also, due to the importance of using the Internet in daily life and, on the other hand, the

dangers and disadvantages that excessive use of the Internet has on people, it is better to conduct more specialized studies about other behavioral and personality disorders, such as ADHD and the impact of these behaviors on the tendency to use the Internet. It is also necessary to examine the different levels of internet usage in a more detailed manner based on mass media and how people follow the internet, such as active and passive communication, which may have positive and negative effects. People specializing in cognitive science and neuroscience can measure research factors with brain imaging tools, which record more precise data.

Limitations

Among the limitations of the present study is the limited statistical population of the students of Imam Khomeini International University, which reduces the scope of generalization of the research results. Another limitation of the measurement tool was that few standardized questionnaires are related to BAP.

Ethical Considerations

Compliance with ethical guidelines

All ethical principles are considered in this article. This study was approved by the Ethics Committee of the Imam Khomeini International University, Qazvin, Iran (Code: IR.QUMS.REC.1402.351).

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Authors' contributions

Conceptualization and Supervision: Esmail Shiri; Investigation and Analysis: Ghazal Goudarzi; Methodology and Resources: Fatemeh Feyzi; Review and Editing: Mehrnaz Khodaverdian.

Conflict of interest

The authors declared no conflict of interest.

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