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Internet Addiction Disorder and its Associated Factors among 15-19-Year-Old Adolescents in Colombo District, Sri Lanka

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ABSTRACT

Internet addiction disorder is growing as a potentially problematic condition parallel to existing behavioral disorders, especially among adolescents. Nonetheless, the condition is widespread and problematic, limited scientific evidence is available on the prevalence, diagnosis, risk factors, prevention, and efficacy of the treatment globally as well as locally. The objective of this study was to determine the prevalence and associated factors of Internet addiction disorder among 15-19-year-old adolescents in Colombo district. Internet Addiction Test (IAT) developed by Young (1998) was adapted, translated, and validated for this study. A school-based descriptive cross-sectional study was conducted on 1351 school-going adolescents by the multi-stage stratified cluster sampling method. A self-administered questionnaire was used for the data collection and the data analysis was done using the SPSS-21 version. Initial bivariate analysis was followed up with Multivariate Logistic Regression analysis to determine the associated factors of Internet addiction disorder. The prevalence of Internet addiction disorder among adolescents was 17.2% (95% CI: 15.2-19.3). Male sex (AOR=2.27;95% CI:1.27-4.07), excessive use of social media (AOR=4.32; 95% CI:2.12-8.80), lack of engagement in outdoor sports(AOR=5.4; 95% CI:2.49-11.73), unemployed mother (AOR=2.06;95% CI:1.40-3.04), excessive engagement of internet gaming (AOR=1.94;95% CI:1.34-2.82), excessive internet usage time per day for nonacademic activities (AOR=2.59; 95%CI:1.71-3.91), higher duration of internet use in years (AOR=2.64;95% CI:1.80-3.85), and no excessive internet use by the parents (AOR=0.46; 95% CI:0.30-0.70) were the statistically significant associated factors. The prevalence of Internet addiction disorder among was within the range The study findings will aid the policymakers and administrators in the prevention, diagnosis, and management of Internet addiction disorder among this aged group adolescents.

INTRODUCTION

Internet addiction disorder is called "Electronic heroin"(Williamsle 2014). The Internet has become a significant component of contemporary life for all age groups. People have increasingly adopted and used the internet for entertainment, socialization, and information retrieval. Easier access to smartphones and higher utilization of laptops provided people to use the internet freely. Although the positive aspects of the internet have been readily praised, there is a growing amount of literature on the negative side of its excessive and pathological use. Internet addiction disorder is defined as "a psychological dependence on the Internet, regardless of the type of activity once logged on." (Kandell 1998). The condition was also described as an impulse control disorder that results in personal, professional, educational, and financial conflicts with life relationships being affected (Shaw and Black 2008). Internet penetration among the world population by 2020 has been estimated at 63.2%. Asia is having the greatest number of internet users of all continents accounting for 51.8% of all online users. Considering the rest of the world 14.8% is from Europe, 6.8% from North America, and 3.7% from the Middle East (World Internet Users Statistics and 2020 World Population Stats n.d.).Among the Asian countries, China is consisting of the greatest internet-using population. India is the second-largest online market in the world with over 560 million internet users, ranked only behind China by 2020 (Keelery 2020).

The internet penetration in Sri Lanka is 47% with 10.1 million internet users in January 2020. The number of mobile connections in Sri Lanka in January 2020 was equivalent to 149% of the total population (Simon Kemp 2020). Even though Internet addiction disorder has emerged as a universal issue, its international prevalence estimates vary vastly. Cheng and Li (2014) reported a global prevalence of 6.0% (95% CI 5.1–6.9) in a meta-analysis. A descriptive review revealed the worldwide prevalence of the disorder could vary from 0.3% to 38% (Chakraborty, Basu, and Vijaya Kumar 2010).

There were limited estimates on Internet addiction disorder in Sri Lanka. Rodrigo *et al.* (2012) reported a prevalence of 27.6% of Internet addiction disorder among University students and Perera (2017) revealed a prevalence of 16.1% among information and communication technology users in Gampaha district, Sri Lanka. The absolute number of adolescents in the world has been 1.2 billion, representing 16% of the global population. More than half of adolescents live in Asia and nearly 350 million in South Asia (Unicef 2019).

According to the latest population census of Sri Lanka in 2012, 8.1% of the population consisted of 15-19-year-old adolescents (Department of Census and Statistics, 2012). Worldwide, there are variations in prevalence

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data on Internet addiction disorder among adolescents. In Europe and the United States of America, rates ranged from 7.9 to 25.2% while in the Middle East and Africa rates from 17.3 to 23.6% among adolescents by 2014. Studies in Asia have revealed a higher variation in prevalence among young people and adolescents, ranging from 8.1 to 50.9% (Cheng and Li 2014). There are many negative consequences of Internet addiction disorder that have been reported including a variety of detrimental outcomes for adolescents that may require professional intervention. Researchers believe that Internet addiction disorder may manifest the same troubling effects as substance abuse among adolescents. It can be characterized as various physical and psychological problems and mostly manifests in adolescents as low educational performance, lack of motivation, social withdrawal, and loneliness (Chung, Lee, and Lee 2019).

Internet addiction disorder is one of the fast-growing addictive behaviors and is a significant public health problem affecting a large number of adolescents worldwide. Therefore the preventive strategies should be geared towards addressing the associated factors. Anusha *et al.* (2016) reported that male gender, having a personal device, time of internet use, using smartphones, permanent login status, chatting through the internet, making online friends, online shopping, watching films, online gaming, searching information through online and messaging have found to be significantly associated with the Internet addiction disorder. The duration of internet use, having higher levels of depression, compulsivity, aggressiveness, lower family cohesion, higher accessibility to internet cafes, and higher exposure to internet gaming was associated significantly with the disorder (Chung *et al.* 2019), while Goel, Subramanyam, and Kamath (2013) reported social networking, chatting, downloading media files and pornography as associated factors. Despite many countries sharing the public health impact of Internet addiction disorder, much is not known about its associated factors among Sri Lankan adolescents. The objective of this research was to determine the prevalence of Internet addiction disorder and its associated factors among 15-19-year-old adolescents in Colombo district.

LITERATURE REVIEW

Prevalence of Internet Addiction Disorder

Internet addiction disorder appeared as a global phenomenon. Although the disorder has been widely researched over the years, its international estimates of prevalence vary vastly.

A meta-analysis conducted on Internet addiction disorder including 31 nations across seven world regions in 2014 reported the global prevalence as 6% (95% CI 5.1-6.9) with moderate heterogeneity ($I2=44\%$, $p<0.01$). Multiple online search engines were used and traced the articles published from 1996 to 2012. The study examined 164 prevalence figures including 89,281 participants (Cheng and Li 2014). However, this analysis only included the studies that used Young's diagnostic questionnaire and the Internet Addiction Test(IAT). It also excluded the African region since there is no available data. Weinstein and Lejoyeux (2010) reviewed published literature in Medline and PubMed between 2000–2009 in the United States and Europe. Results have indicated the prevalence of Internet addiction disorder is between 1.5% to 8.2%. Tsitsika *et al.* (2014) conducted a study in 2014 including seven European countries involving Greece, Spain, Poland, Germany, Romania, Netherlands, and Iceland. The study reported the prevalence of Internet addiction disorder among 14–17-year-old adolescents as 13.9% (95% CI 13.1–14.7).

This was a school-based study involving 13,284 participants with a mean age of mean age 15.8 years. Internet Addiction Test (IAT) was used for the study to select cases. Since there are variations among prevalence rates, the study suggested that future studies should be needed to consider the cross-cultural differences among the regions (Tsitsika *et al.* 2014). Anusha *et al.* (2016) conducted a cross-sectional study among school-going adolescents in Vadodara, India using the Internet Addiction Test(IAT). A total of 724 study participants were recruited. The prevalence of Internet addiction disorder was 8.7%. However, only English medium schools in Vadodara were selected on a convenience basis and it was a limitation of this study. Martins *et al.* (2020) conduct a descriptive cross-sectional study in public schools in the Portuguese region using the Internet Addiction Test(IAT). The reported prevalence was 16.5%. There were 1916 adolescents were participated in this study and the mean age was 15 ± 1.8 years. This study was reflecting the trend of the prevalence of Internet addiction disorder among adolescents. Profiles and sociodemographic correlates of Internet addiction disorder among early adolescents in southern China highlighted the addiction levels as 15.3%. A total of 2342 adolescents volunteered to participate in the study. The initial age range of the participants for the original study was 11–15 years.

However, 94.7% of the study sample was in the range of 11-13(mean 12.44 ± 0.63) resulting in a selection bias (Chi, Hong, and Chen 2020). Considering the few local studies conducted on prevalence, Rodrigo *et al.* (2012) carried out a cross-sectional study on Internet addiction among university students in Sri Lanka in 2012. This has been reported as one of the initial attempts to identify the addictive behaviors related to online use in Sri Lanka. It revealed that 27.6% of the study sample had addictive behavior. The sample size was 503 with a mean age of 22.7 years. A cross-sectional study was conducted in 2015 among a total of 100 undergraduates at the University of Sri Jayewardenepura to identify the relationship between Internet addiction disorder and academic performance using the Internet Addiction Test(IAT). The study revealed the prevalence of Internet addiction disorder as 41% (Sachitra 2015). Due to the limited sample size, it is difficult to generalize the findings to the reference population.

Associated factors of Internet Addiction Disorder

Internet addiction disorder has been identified as a significant problem for adolescents and many associated factors were described in past studies. Avila *et al.* (2020) found that young age is one of the main risk factors for Internet addiction disorder since they begin to psychologically separate from their parental figures and seek new social connections outside the family.

A systematic review was conducted in 2014 on risk factors of Internet addiction disorder and the health effects among adolescents. It examined nine studies that fulfilled the selection criteria following an extensive literature search of 23 articles. The study revealed, in an adolescent who is not living with his or her mother (OR=1.66, 95% CI=1.03-2.69) and conflict between parent and the child (OR=2.31, 95 % CI=1.28- 4.18) as statistically significant associated factors. This review only selected the publications which were in English language (Lam 2014). Xin *et al.* (2018) conducted a school-based study on online activities, the prevalence of Internet addiction disorder, and its risk factors in China in 2015. A total of 6468 adolescents, aged between 10-18 years participated with a mean age of 13.7 years. The study revealed the disorder was significantly higher in boys than girls ($\chi 2$= 73.74, P< 0.001) and older grade adolescents reported a higher prevalence ($\chi 2$=431.25, P <0.001). The highest odds ratios were also reported for negative relationships between two parents (OR: 1.23, 95% CI: 1.18-1.37), negative relationships with teachers (OR: 1.35, 95% CI: 1.20-1.53), and poor academic performance (OR: 1.22, 95% CI: 1.17-1.35).

Lee *et al.* (2018) conducted a school-based study in South Korea in 2014 on the prevalence and risk factors of Internet addiction disorder among adolescents. The study reported male gender, high academic stress, early exposure to the internet, and depression were significantly associated with Internet addiction disorder in multivariate logistic regression analysis. 1168 adolescents participated with a mean age of 14.5 ± 1.6 (Lee *et al.* 2018). A meta-analysis conducted on Internet addiction disorder among students in South-East Asia in 2018, reviewed existing studies published up to 2016. A total of 38 studies were met the inclusion criteria out of 549 articles searched from PubMed and Google Scholar databases. The study revealed Internet addiction disorder was significantly associated with male gender, social networking, using a smartphone, living in an urban area, lesser age at first internet use, having online relationships, and watching sexually explicit content. Out of 38 studies selected 23 used the Internet Addiction Test for the assessment. However, the study only used articles published in English language and was limited to two electronic databases (Balharao 2018).

In 2019, Internet addiction disorder, prevalence, psychological correlates, and preventive aspects were researched among adolescents in Hong Kong. The study reported male gender, higher school grades, poor academic performance, depression, suicidal ideation, from disorganized family, with family members with Internet addiction disorder, parents with lower education level, and using restrictive parenting style as risk factors for Internet addiction disorder. Teens with self-confidence, higher school performance, positive youth development qualities, with well-educated parents, were found to be protective against it. This meta-analysis reviewed eight papers published on Internet addiction disorder from 2009 to 2018 (Chung *et al.* 2019). Krishnamurthy and Chetlapalli (2015) conducted a cross-sectional study among college students in Bengaluru India 2015 on Internet addiction disorder and its risk factors. Internet addiction disorder has been significantly associated with male gender (AOR=1.69,95% CI=1.081-2.65, P=0.021), engaging online relationships (AOR=2.283, 95% CI=1.424-3.663, P=0.001), continuous availability of the online facility (AOR=1.724, 95% CI=1.018-2.923, P=0.042), and using internet for educational activities (AOR=0.415, 95% CI= 0.263-0.655, P<0.001). In addition, peer influence, preference for virtual interaction with friends, using the internet for chatting, pornography, and online shopping were found to have potential influential factors (P<0.05). Whereas, age, medium of education, place of stay, father's or mother's occupation, years of computer or internet use, an instrument used to connect, and mode of internet access were not found to be significant. A total of 515 study participants were selected by multistage cluster sampling for this study and IAT was used for the data collection. The results of the study highlighted the vulnerability of college students to Internet addiction disorder and the number of possible associated factors (Krishnamurthy and Chetlapalli 2015).

Meanwhile, there are few studies have been conducted in Sri Lanka to examine the associated factors of Internet addiction disorder. These studies have used different criteria to rate the levels of an Internet addiction disorder and most of them applied currently available tools including IAT. Rathnayake and Rathnayake (2018) conducted a study on Facebook usage and the consumption perspective of social media among Sri Lankan consumers in 2018. It was a descriptive cross-sectional study with a sample of 254 Facebook consumers. The study reported that Facebook addiction among males is significantly higher than among females. However, the inadequacy of the sample size and the selection of volunteers were the major drawbacks of the study (Rathnayake and Rathnayake 2018).

A total of 179 adolescents who participated in a preliminary survey on internet use in Central province Sri Lanka reported that 68.7% of the sample used the internet for social media and 55.6% watched films and videos. The opinions of parents and teachers were also obtained and most of them believe the internet is a bad influence on young kids which facilitates them to watch pornography and engage in risky relationships (Ginige P, Kuruwita KAPR, Alahakoon SH 2016). Fernando (2015) reported that a period of internet usage was associated with higher internet addiction levels. The study

considered Facebook addiction levels among 400 teenage school students in Negombo educational zone, Sri Lanka. Students who were using multiple modes(mobiles, laptops, and desktops) for the online connection have shown higher addiction levels rather than those who were using a single instrument. The study also revealed school children with Internet addiction disorder were less engaged in real-life social community participation, had relationship problems, and with poor academic records (Fernando 2015). Rodrigo *et al.* (2012) conducted a cross-sectional survey among university undergraduates of the faculty of medicine, Colombo 2012 on individual problematic internet behaviors. The study revealed addictive behaviors were more common among male students (OR-2.51, 95% CI-1.73-3.64) (Rodrigo *et al.* 2012). A descriptive cross-sectional study conducted in 2017 among the young working population on modern information technology behavior and its underline motives in Gampaha district, Sri Lanka, reported several significant associations for Internet addiction disorder. A total of 1104 working adults aged 18-34 years participated in the study. Young employees who were using the internet for more than 6 months were recruited by the multistage cluster sampling method. Associated factors of Internet addiction disorder were assessed using odds ratios and 95% confidence intervals and logistic regression analysis was carried out.

MATERIALS AND METHODS

This was a descriptive cross-sectional study including an analytical component. This component is to determine the prevalence of Internet addiction disorder by using the validated tool (IAT) and to describe the associated factors of Internet addiction disorder. This study was a school-based descriptive cross-sectional study with an analytical component conducted in Colombo district.

Colombo has the highest population density (3300 per square kilometer) in Sri Lanka. It comprises 13 divisional Secretariat areas and 566 village-level divisions. There were 2,309,809 (11.4% of total country population) people have been enumerated at 2012 population census with 77.6% urban, 22.1% rural, and 0.3% of estate population. According to the census, there were 76.69% Sinhalese, 10.01% Sri Lankan Tamils, 10.51% Sri Lankan Moors, and 1.18% Indian Tamils reported (Department of Census & Statistics 2012).

The study was conducted in government schools having grades 10 to grade 13 in Colombo district. This descriptive cross-sectional study was carried out from October 2019 to July 2021. The data collection was completed in February and March 2021. Multi-stage stratified cluster sampling method was used. The design effect was calculated using the following formula (Bennett, Woods, Liyanage, & Smith, 1991). Cluster size was selected by considering the median number of students in a class according to the school health statistics of Colombo district. The number of students in each class has a skewed distribution. Therefore, the cluster size was considered according to the median number of students in a class. The number of students in each class varied from 10 to 43 in all the schools. The minimum possible cluster size has been considered for the internally heterogeneous groupings and maximum cluster numbers. Therefore, the cluster size was considered as 22. This low value of the cluster size was facilitated to increase the number of clusters. A similar methodology was followed by several school-based studies conducted in Sri Lanka in previous studies (Nadeeka 2020) and (Silva 2020). The final sample size was 1327.

Internet Addiction Test was applied to detect Internet addiction disorder. The scale consists of 20 items with a six-point Likert scale with a range of 0 to 5. The total range of the questionnaire was 0 to 100. The sum of the scores for all the items of an individual was considered as the total score and higher scores indicated higher levels of addiction (Young 2009).

Total Internet Addiction Test scores of an individual exceeding one standard deviation above the mean score were considered as the cut-off for having Internet addiction disorder. The value was calculated using the total IAT scores of the cross-sectional validation study. Data entry was done by the principal investigator. All the questionnaires were inspected for their completeness. The datasheet was rechecked for missing values and other inconsistencies. All the gathered data were manually cleaned and checked before entering the statistical package of social sciences (SPSS-version 21).

The prevalence of Internet addiction disorder among 15-19-year-old adolescents in Colombo district was determined as a probability with a 95% confidence interval. Multivariate analysis was used to investigate the significant variables that have an impact on Internet addiction disorder. It was carried out to identify adjusted odds ratios of associated factors of Internet addiction disorder. Internet addiction disorder (having the disorder/ not having the disorder) was the dichotomous outcome variable (dependent variable).

Associated factors found to have significantly associated with Internet addiction disorder were the covariates(Independent variables). A major use of this technique was to examine the series of associated factors to determine the best model to predict Internet addiction disorder. A confounding factor is an extraneous variable whose presence affects the variables being studied. Therefore, the results do not reflect the actual relationship between the variables under study. Thus, the multiple logistic regression method was used as a mathematical model that can provide an adjusted odds ratio that has controlled for multiple confounders. Variables observed with a p-value less than 0.1 in univariate analysis were included in the multivariate analysis and the backward elimination technique was used. It has been assured that all pertinent and potentially predictive variables were studied and included. The Hosmer-Lemeshow test was used to determine the goodness of fit of the logistic regression model.

RESULTS AND DISCUSSION

Prevalence of Internet addiction disorder among 15-19-year-old adolescents in Colombo district

The sample was collected from 1380 study participants. The response rate was 99% and 15 questionnaires (1.1%) were removed due to incomplete entries. The final sample size was 1351, which exceeded the calculated sample size determined in the methodology (1327). The sociodemographic characteristics of the study population were described using frequency distribution.

The highest proportion of adolescents was in the age group of 16 years (n=573,42.7%) and the lowest proportion was in the 18-year-old age group (n=231,17.2%). The mean age was 16.3 years (SD=0.96). A total of 687 adolescents in the study sample were males (50.9%) and 49.1% were females (n=664).

Table 1: Frequency distribution of the study participants by age and sex

Characteristic	Number	Percentage
Age of the study participants		
15	292	21.8
16	573	42.7
17	246	18.3
18	231	17.2
Total	1342	100
	Mean=16.3 SD=0.96	
Sex of the study participants		
Female	664	49.1
Male	687	50.9
Total	**1351**	**100**

Internet Addiction Test (IAT) scores of the study participants

The level of Internet addiction disorder among the study participants was measured using the validated Internet Addiction Test (IAT).

The mean score value for the Internet Addiction Test (IAT) total score was 27.75 with a median of 24. The skewness was 0.792 and the kurtosis was 0.202 indicating normal distribution.

Assessment of the Prevalence of Internet addiction disorder among 15–19-year-old adolescents in Colombo district

Table 2: Descriptive statistics of Internet Addiction Test(IAT) scores obtained by the study participants

Descriptive statistics	Value
Mean	27.75 (95% CI: 26.73-28.75)
Median	24
Mode	22
Range	83
Skewness	0.792
Kurtosis	0.202

The prevalence of Internet addiction disorder among 15–19-year-old adolescents in the Colombo district was calculated and presented as a proportion with a 95% confidence interval. Cut-off values for the diagnosis of Internet addiction disorder were calculated at the cross-sectional validation study as mean+1SD

There were 17.2% (95% CI: 15.2-19.3) of adolescents with Internet addiction disorder and 82.8% (95% CI: 80.7% - 84.8%) of adolescents without having the disorder.

According to the present study, the prevalence of Internet addiction disorder is 17.2% (95% CI:15.2-19.3) among the 15-19-year-old adolescents in Colombo district. The figure is slightly above the study conducted among young information and communication technology users

Table 3: Levels of Internet addiction disorder among 15–19-year-old adolescents in Colombo district

Level of Internet Addiction Disorder	Frequency	Percentage	95% CI
Adolescents with Internet addiction disorder	233	17.2	15.2-19.3
Adolescents without Internet addiction disorder	1118	82.8	80.7-84.8
Total	**1351**	**100**	

in Gampaha district, Sri Lanka(16.1%) (Perera, 2017). The later study used the same diagnostic criteria with validated 18-item IAT for the study group and a similar methodology. However, the study population has been different.

A cross-sectional survey that was conducted among undergraduates in the faculty of medicine at, the university of Colombo revealed a higher value of Internet addiction disorder of 27.6% among the study population (Rodrigo *et al.* 2012).

Since the present study has used IAT following a proper cultural adaptation and validation process it was difficult to compare the two prevalence values between the two studies. There are very few other local studies conducted on Internet addiction disorder among youth in Sri Lankan context. Nevertheless, the results cannot be compared attributed to variations in the diagnostic criteria and assessment questionnaires used for diagnosis, highly selective samples of online surveys, and inadequate sample sizes. Worldwide, there are huge variations in prevalence data on Internet addiction disorder among adolescents. In Europe and the United States of America, rates ranged from 7.9 to 25.2% while in the Middle East and Africa rates from 17.3 to 23.6% among adolescents in 2012(Cheng and Li 2014). Studies in Asia have revealed a higher variation in prevalence among young people and adolescents, ranging from 8.1 to 50.9% (Cheng and Li 2014). The prevalence of Internet addiction disorder appeared to be higher in a study published in 2018 among 10–18-year-old adolescents in China revealed 26.5% of Internet addiction disorder among the study participants. However, the study used the cut-off value of the conventional 50 marks in the Chinese version of IAT (Xin *et al.* 2018). Variations in the prevalence of Internet Addiction disorder could be

due to differences across investigating sites, sample size, or the time frame of the performed research. However, the overall trend in China appears to be an increase in the rate of addiction, consistent with the dramatic increase in the role of Internet use in adolescents' social life in recent years (Xin *et al.* 2018). The overall figure of young internet subscribers has increased throughout along with the substantial counts of mobile internet connections. It is widely known that young adults are the most active internet users worldwide and early awareness is important for policymakers to examine the problem and implement effective measures to prevent it. With the government's substantial efforts to implement digital technology and revolutionize life on a mass scale, access to the internet is higher than ever. As a result, the number of addicts at an early age will be a problem shortly.

Associated factors of Internet addiction disorder among 15–19-year-old adolescents in Colombo district

This consists of an analytical component to describe the associated factors of Internet addiction disorder among 15-19-year-old adolescents in Colombo district. The data gathered for the assessment of the prevalence has also been utilized as the data source for the determination of associated factors. Associated factors of Internet addiction disorder were determined by conducting cross-sectional analyses between study participants with and without Internet addiction disorder.

These variables were selected according to the conceptual framework of the study. The characteristics of the study participants were described under the topics of sociodemographic, socioeconomic, family and friends

Table 4: Selected variables to determine associated factors according to the conceptual framework

Characteristic	**Selected variables**
sociodemographic	Age
	Sex
	Ethnicity
	Religion
	School grade
Socioeconomic	Monthly income of the family
	Fathers' employment status
	Mothers' employment status
	Father's education level
	Mother's education level
Family and friends related	Family structure
	Excessive use of the internet among parents
	Excessive use of the internet among close friends
Relationship status	Perception about the family in general
	Support from the parents for the educational activities
	Support from the parents for the extracurricular activities
	Perception about the relationship with the teachers
Individual (related to internet use)	Type of device for using the internet
	Mode of internet connectivity
	Having your own device
	The total duration of internet use in years
	Duration of nonacademic internet use in a typical day
	Days in the week of internet usage
	The status of the routine day-to-day activities affected
	The period of the day for using the internet
	Monthly expenditure for internet use
	The extent of using the internet for educational activities
Entertainment related	The extent of engaging in outdoor sports
	The extent of playing Internet/video games
	The extent of reading books for an entertainment/hobby
	The extent of watching movies/videos for an entertainment
	The extent of using the internet for chat/call with others

related, relationship status, individual (related to internet use), and entertainment-related.

Multivariate logistic regression model with selected associated factors for Internet addiction disorder among 15–19-year-old adolescents in Colombo district

The Omnibus test of the model coefficient was significant. There were eight independent variables were retained in the final model. The Hosmer-Lemeshow test statistic indicated that the model adequately fits the data and supported the model ($\chi2=5.309$; df= 07; p=0.724).

Furthermore, 59.4% of the data was correctly predicted by the new model. The independent variables which were included in the final model were presented and the association between each factor the Internet addiction disorder was mentioned as an adjusted Odds Ratio (AOR).

There were eight independent variables were retained in the model. The Hosmer-Lemeshow test indicated that the model adequately fits the data and supported the model ($\chi2=5.309$; df= 07; p=0.724). Furthermore, 59.4% of the data was correctly predicted by the new model. Male sex (AOR=2.27;95% CI:1.27-4.07), excessive use of social media (AOR=4.32; 95% CI:2.12-8.80), lack of engagement in outdoor sports (AOR=5.4; 95% CI:2.49-11.73), unemployed mother (AOR=2.06;95% CI:1.40-3.04), excessive engagement of internet gaming (AOR=1.94; 95% CI:1.34-2.82), Excessive internet usage time per day for non-academic activities (AOR=2.59; 95% CI:1.71-3.91), higher duration of internet use in years (AOR=2.64;95% CI:1.80-3.85), and no excessive use of the internet by the parents (AOR=0.46;95% CI:0.30-0.70) were identified as statistically significant associated factors of Internet addiction disorder in multivariate logistic regression analysis among 15-19-year-old adolescents in Colombo district.

Table 5: Multivariate logistic regression model with selected associated factors for Internet addiction disorder among 15–19-year-old adolescents in Colombo district

Factor	B	SE	Wald	df	Sig	Exp(B)	95% CI for Exp(B)
The extent of attachment to social media (Self-perceived) Often and to some extent	1.465	0.362	16.32	1	0.001	4.32	2.12- 8.80
The extent of engagement in outdoor sports (Self-perceived) Rarely and never	1.688	0.395	18.22	1	0.001	5.40	2.49-11.73
Employment status of the mother Not employed	0.725	0.198	13.37	1	0.001	2.06	1.40-3.04
The extent of internet gaming (Self-perceived) Often and to some extent	0.665	0.189	12.34	1	0.001	1.94	1.34-2.82
Sex of the participant Male	0.823	0.297	7.655	1	0.001	2.27	1.27-4.07
Duration of internet use per day for nonacademic activities Three hours or more	0.959	0.210	20.53	1	0.001	2.59	1.71-3.91
The total duration of internet use in years Three years or more	0.971	0.193	25.29	1	0.001	2.64	1.80-3.85
Excessive use of the Internet by one or both parents(Self-perceived) No excessive use	0.763	0.214	12.75	1	0.001	0.46	0.30-0.70

Among the associated factors of Internet addiction disorder, the male sex emerged as a significant predictor in the multivariable analysis. The findings corroborate with many previous studies stating that addiction is more common in males than in females. According to the present study, being a male (AOR=2.27;95%CI:1.27-4.07) has increased the odds of having Internet addiction disorder. Since this figure has been consistent throughout, the finding may be possibly due to the male adolescents who are generally more passionate about knowing the unknown facts or exploring new inventions or they are usually more attracted to addictive objects such as pornography, cybersex, and online gaming compared with the female. They also have more freedom than the females to engage in online activities. A cross-sectional study conducted among Greek adolescents with a mean age of 14.7 years reported male gender was having higher levels of Internet addiction disorder (OR:2.01,95% CI:1.35-3.00) (Kormas *et al.* 2011) and Krishnamurthy and Chetlapalli (2015) revealed similar results (AOR 1.69, 95% CI:1.081- 2.65, p = 0.021) where the findings were very much consistent with the present study.

Among the local studies, Sachitra (2015) reported that there was a male preponderance to have addiction in undergraduates at the University of Sri Jayawardenepura(<0.05). It has been known that adolescent boys utilize the internet more frequently and extensively than adolescent girls (Krishnamurthy and Chetlapalli 2015). These gender differences observed could be attributed to the potential confounding effect of the differences in the frequency of internet utilization between genders.

Excessive social media can lead to an uncontrollable urge to log on and devote so much time and effort to the users. Behavioural models explain excessive use of social media can be viewed as one form of an Internet addiction disorder, where individuals exhibit a compulsion to use it (Griffiths *et al.* 2016b). According to the current study excessive use of social media has increased the odds of having Internet addiction disorder(AOR=4.32,95% CI:2.12-8.80,p=0.001). This finding of the study has been

persistent throughout. Hassan *et al.* (2020) concluded that spending time on social media websites was the most common online activity among adolescents ($p<0.05$). Guedes *et al.* (2016) and Simsek and Balaban Sali (2020) revealed that the increased prevalence of social media usage has become addictive among the youth($p<0.001$). However, in the above-mentioned studies, an association between Internet addiction disorder and social media use has not been reported as Odds ratios compared to the present study where the odds ratio was computed to quantify the strength of the association. This alarming statistic of the current study sheds light on policy implications. Program planners in the education and health sectors could consider the possibility of students being addicted to social media usage and educate students about the negative consequences of such addictive behavior.

Multivariate logistic regression analysis revealed that lack of engagement in outdoor sports among adolescents was more likely to have Internet addiction disorder (AOR=5.40, 95% CI: 2.49-11.73,$p=0.001$). Li *et al.* (2020) reported exercise and sports can significantly reduce the levels of internet addiction disorder (<0.05). The study also elaborated Internet addiction disorder leads to changes in neural structure, decreases the activity of the dopaminergic system, and limits neurocognitive function which can be reversed by an exercise-based intervention (Li *et al.* 2020). The other possible explanation is that outdoor sports and exercise can substantially reduce the time spent online and make adolescents physically active. A cross-sectional study carried out on the effect of gender and physical Activity on Internet addiction disorder among medical undergraduates in the army medical college, Rawalpindi in 2015 reported that the total score and frequency of Internet addiction disorder diagnosed by IAT were higher in students lacking physical activity as compared to those with regular physical activity ($p=0.01$) (Khan, Shabbir, and Rajput 2017). However, an association between Internet addiction disorder and engagement in outdoor sports among adolescents has not been reported as Odds ratios compared with the present study. Students who take part in any kind of physical activity outdoors tend to stay away from gadgets that use the internet. They are more inclined towards healthy activities instead of spending time on the internet. They tend to sleep early because of physical tiredness, so the chances of internet usage till late at night are rare in these students. On the other hand, students who do not participate in physical activities are lazy and remain stuck with internet devices.Unemployment of the mother was reported to have higher levels of Internet addiction disorder among the 15–19-year-old adolescents in multivariate logistic regression analysis (AOR=2.06,95%CI:1.40-3.04, $p=0.001$). This was an unexpected finding in the present study contradicting the previous research. Ahmadi, Jafarizadeh, and Haghani (2019) reported that the mother's employment level has been positively associated with Internet addiction disorder ($t=1.943$, $df=394$, $p=0.05$).

Despite that, the association between parental depression and adolescent Internet addiction in South Korea has been investigated and found that there are strong positive associations between Internet addiction disorder and high maternal education level ($p<0.05$) which again contradicts the finding of the current study (Choi *et al.* 2018). Studies show that maternal unemployment is associated with low life satisfaction in adolescents (Johansson *et al.* 2019). It is unclear whether this translates to an association between unemployment and Internet addiction disorder among adolescents in the present study.

It is debatable that children and adolescents are wholly mediated by the situation within the family and if the mother is unemployed, she has to be with her children most of the time and Internet addiction disorder among the children should be less. However, Maternal unemployment can also be associated with low-income levels in families, and they may generally have lower educational achievements. Mothers in such families may not be aware of the adverse effects of Internet addiction and possibly not supervise the use of the Internet by their children, which may lead to overuse and addiction. Excessive engagement in internet gaming was reported to have higher levels of Internet addiction disorder among 15–19-year-old adolescents in multivariate logistic regression analysis(AOR=1.94; 95% CI:1.34-2.82). Internet gaming is an emerging issue for adolescents as well as their parents which was increasingly discussed over the last decade. Excessive online video gaming is considered to be associated with addictive behavior that often leads to significant daily, work, and educational disruptions among adolescents. Several studies have similar findings which support the current study result. A cross-sectional study conducted among Greek adolescents using IAT reported that internet gaming has been positively associated with Internet addiction disorder(AOR: 1.85; 95% CI: 1.21-2.82) (Kormas *et al.* 2011).

Association between internet gaming and Internet addiction disorder was further investigated by Tsitsika *et al.* (2014) among 14-17-year-old adolescents in seven European countries and reported to have a positive association between Multiplayer role-playing games and Internet addiction disorder (AOR=1.82 95%CI= 1.63–2.04). Factors associated with Internet addiction among Tunisian adolescents have been investigated in 2019 and reported to have a strong association between Internet gaming frequency and Internet addiction disorder (AOR=3.28, $p=0.002$) (Ben Thabet *et al.* 2019).

The excessive average daily hours spent online for non-academic activities among adolescents were reported to have higher levels of addiction (AOR=2.59,95% CI:1.71-3.91,$p=0.001$). Considering the available literature, similar association patterns have been often identified. A study conducted on the prevalence and associated factors of internet addiction among young adults in Bangladesh reported excessive time spent daily online was having

higher levels of Internet addiction disorder ($p<0.01$) (Hassan *et al.* 2020). Rodgers *et al.* (2013) revealed higher levels of Internet addiction disorder among participants who spent more weekly online hours. Sharma *et al.* (2014) found a significant relationship between hours spent using the internet and the presence of Internet addiction disorder ($\chi2=43.940$, $p=0.001$) among students in professional courses in central India in 2014. The association between the time spent online and the Internet addiction disorder of these studies was similar. However, these were methodologically different from the current study since there are differences in time limits used in the analysis.

The total duration of internet use in years among adolescents was reported to have higher levels of Internet addiction disorder in multivariate logistic regression analysis (AOR=2.64; 95% CI:1.80-3.85). Hassan *et al.* (2020) reported a statistically significant relationship between the duration of internet use and Internet addiction disorder ($\chi2 =7.366$,$p=0.03$), and if the duration was less than 6 months that reduce the level of Internet addiction disorder (AOR=0.622, 95% CI: 0.14–3.21). Therefore, increased online engagement for a longer duration can be significantly associated with Internet addiction disorder. This is also reflecting the early initiation of internet activities in early adolescents which need to be controlled by the parents. Multivariate logistic regression analysis in the present study reported that less use of the internet by the parents has been negatively associated with Internet addiction disorder and considered as a protective factor (AOR=0.46, 95% CI=0.30-0.70).

The supportive evidence has been identified that Ben Thabet *et al.* (2019) revealed excessive use of the Internet by parents has a positive association with Internet addiction disorder (AOR=3.256, $p=0.002$). Adolescents who have more time to spend with their parents have less risk of having internet addiction disorder (Hassan *et al.* 2020). Excessive parental use of the Internet can cause family relationship detachment and can attribute to the higher level of Internet addiction disorder among adolescents due to lack of supervision.

CONCLUSIONS

The prevalence of Internet addiction disorder among 15- to 19-year-old adolescents in Colombo district was 17.2% (95%CI: 15.2-19.3) and the current prevalence of Internet addiction disorder among the 15-to 19-year-old adolescents in Colombo district is comparable with the published local and regional estimates.

The prevalence was assessed in a random and adequate sample of adolescents using the validated IAT with a scientifically determined cut-off point. The multivariate logistic regression model included eight independent variables and the model adequately fits the data ($\chi2=5.309$; df= 07; $p=0.724$) and 59.4% of the data was correctly predicted by the new model. Male sex, excessive use of social media, lack of engagement in outdoor sports, unemployed mother, excessive engagement of internet gaming, excessive internet usage time per day for non-academic activities, higher duration of internet use in years, and no excessive use of internet among parents were identified as statistically significant associated factors of Internet addiction disorder among 15-19-year-old adolescents in Colombo district.

Limitations of the study, Public Health Relevance, and Future Research Implications

The study was conducted on 15-19-year-old school-going adolescents in Colombo district, Sri Lanka. The study population does not include non-school-going adolescents and adolescents in paying schools. Therefore, the study findings are not possible to generalize to the whole adolescent population. Since the study design is cross-sectional, the temporal relationship has not been assessed between Internet addiction disorder and its associated factors. The present study estimated the current prevalence of Internet Addiction Disorder, determined its associated factors, and proposed effective preventive interventions. Thus, it will benefit future researchers who have an interest in this field. The findings will be used to take prompt measures for control and prevention of the disorder for adolescents, parents, teachers, and policymakers. School-based prevention programs can be implemented based on the findings and public awareness of the seriousness of Internet addiction disorder and its effects on adolescents will be enhanced. In the current era where students are more involved in distant learning methods using digital technology, preventive measures for Internet Addiction Disorder need utmost Importance. Understanding the concept of Internet addiction disorder and determining its associated factors are crucial for the planning of preventive strategies.

The present study findings could be used to investigate current knowledge and understanding of Internet addiction disorder for public health program planners to identify the range and extent of the intervention strategies. Public health policies and programs are varying among countries possibly due to cultural differences. Therefore, facts on Internet addiction disorder specific to the local context is needed in establishing planning and implementation of the public health program of the country. Future research on determining the prevalence and associated factors on different study population groups and usage of varied community and school-based interventions are proposed.

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