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Internet Addiction Disorder and its Associated Factors and Educational Intervention for its Prevention among 15-19 year Old Adolescents in Colombo District, Sri Lanka

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Keywords: Internet addiction, adolescents, associated factors, prevention of Internet addiction, school-based

ABSTRACT

Introduction

The internet has conceptually transformed the earth into a high-dimensional information network village. It has improved many aspects of people's lives and has become an unseparated part of everyday routine. Internet addiction disorder is growing as a potentially problematic condition parallel to existing behavioral disorders, especially among adolescents.

Objectives

The objective of this study was to to determine its prevalence and associated factors among 15-19-year-old adolescents in Colombo district, Sri Lanka.

Methods

The study had three components with three different study designs. Internet Addiction Test (IAT) developed by Young (1998) was adapted, translated, and validated to both Sinhala and Tamil languages resulting IAT-Sinhala and IAT-Tamil versions by conducting two descriptive cross-sectional validation studies. The second component of the study was a school-based descriptive cross-sectional study including an analytical component conducted among 15-19-year-old adolescents in Colombo district. Initial bivariate analysis was followed up with Multivariate Logistic Regression analysis to determine the associated factors of Internet addiction disorder. Component three was a quasi-experimental study to determine the effectiveness of an educational intervention for the prevention of Internet addiction disorder. The educational package was developed on Social Cognitive Theory. The contents were designed following a literature review, expertise from a multidisciplinary panel, and using the preliminary results of the descriptive cross-sectional study. Adolescents of two educational zones in Colombo district were purposefully selected for the Intervention group (n=280) and control group (n=290).

Results

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). 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 nonacademic activities, higher duration of internet use in years, and no excessive internet use by the parents were the statistically significant associated factors of Internet addiction disorder among 15-19-year-old adolescents in Colombo district. Following the intervention, the proportion of adolescents with the Internet addiction disorder in the intervention group was less in comparison with the control group and the difference was statistically significant ($\chi2=9.026$, df=1, p=0.003). There was a statistically significant difference between the mean differences of pretest and post-test IAT scores (t=-0.412, df=279, p=0.001) with the reduction of mean IAT scores among the intervention group. The proportion of study participants engaged in social media ($\chi2=10.6$,df=1, p=0.001) and excessive engagement of internet gaming ($\chi2=5.514$, df=1, p=0.019) among the intervention and the control groups revealed a statistically significant difference in favour of the intervention group.

Conclusions and Recommendations

Both IAT-Sinhala and Tamil versions were valid and reliable tools to assess Internet addiction disorder among 15-19-year-old school-going adolescents in Sri Lanka. The prevalence of Internet addiction disorder among 15- to 19-year-old adolescents in Colombo district is within the range of regional levels. Future studies of qualitative methodology Both versions of validated IAT and the developed educational package are recommended to use in future prevention programs and to aid the policymakers and the administrators in the prevention, diagnosis, and management of Internet addiction disorder among this age group.

Introduction

Internet is an amazing invention. Across the globe, it is an integral part of modern life for many people. It has become a significant component of contemporary life for all age groups. People have increasingly adopted and used the internet for entertainment, socia-

lization, 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).

The term “addiction” has derived from Latin “addictus”. It means, being excessively devoted to something with a loss of ability to choose freely. Internet addiction disorder is often referred to as excessive or poorly controlled preoccupations, urges, or behaviors regarding internet-related device use that leads to impairment or distress. The term is having many contenders such as “Pathological internet use”, “Problematic internet use”, “Compulsive internet use”, “Internet use disorder”, “Internet addiction syndrome” and “Pathological use of electronic media”. Internet penetration among the world population by 2020 has been estimated as 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, 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 the 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. A major challenge to analyzing these different prevalence rates is the availability of different instruments to assess this addictive behavior. Thus, prevalence data on Internet addiction disorder are limited by methodological difficulties considering the diagnosis and the heterogeneity of diagnostic tools. World Health Organization (WHO) defines adolescents as “Individuals in 10-19 years age group”. Adolescents experience rapid physical, cognitive and psychosocial growth. It is a unique stage of human development and an important time for establishing the foundations of good health (WHO n.d.).

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 during 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 data on Internet addiction disorder among adolescents. In Europe and the United States of America, rates ranged from 7.9 to 25.2% while the Middle East and Africa had 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). Adolescence is a developmental period during which dependent children grow into independent adults. During adolescence, children undergo striking physical, intellectual, and emotional growth. Major changes in the structure and functioning of the brain occur during this period which results in significant cognitive and behavioral development (Steinberg 2008). Adolescents move toward their peers as their primary social support system. Their mobile phones provide a constant connection to their friends as well as access to popular media. Therefore, it is not surprising that adolescents spend more time engaged in internet-related activities during the day. Once new media are becoming daily routine, Internet addiction disorder appears as a potential problem among young people. Adolescents, who have grown up in the digital technology era, are very much familiar with telecommunication devices and the internet from an early age.

The internet has certain particular characteristics that make it particularly attractive to the adolescent population, such as being infinite, offering services, leisure and social interactions at any time, low cost, and anonymity, which can encourage uninhibited actions (Avila et al. 2020). Avila et al. (2020) reported excessive use of the internet has been a problem for adolescents for so many years. Association of young age and Internet addiction disorder has been a proven fact since adolescents begin to psychologically separate from their parental figures and seek new social connections outside their families (Avila et al. 2020). Studies have shown that human brains continue to mature and develop throughout their childhood, adolescence, and well into early adulthood. Structural neuroimaging studies of the brain among adolescents have found that individuals with Internet addiction disorder had structural abnormalities in their gray matter, such as decreased gray matter volume or gray-matter density in multiple cortical and subcortical areas. The findings were further demonstrated that Internet addiction disorder is associated with dysfunction in the dopaminergic brain system. The results further suggested that Internet addiction disorder shares similar neurobiological abnormalities with substance use disorders (Tereshchenko and Kasparov 2019).

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 performances, lack of motivation, social withdrawal, and loneliness (Chung, Lee, and Lee 2019). Adolescents who have addicted to the internet are reported to have an increased risk of psychological disorders such as depression, social problems, loneliness, and academic issues. Internet-addicted adolescents spend less time with their families than their peers without Internet-related addiction also been reported (Malinauskas and Malinauskiene 2019). Scholars have also warned that Internet addiction disorder could bring substantial loss of productivity in schools and academic institutions where no internet governance policies are implemented (Shek and Yu 2012).

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, higher exposure to internet gaming were 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. As a result, a trustworthy assessment of Internet addiction disorder in this age group is limited in the local context. Therefore, it is unclear which associated factors increase the risk of internet addiction disorder due to the lack of data. There is a growing importance of prevention of Internet Addiction disorder among adolescents due to the presence and severity of addictive use of the Internet and its impact on personal, academic, and social life. Lack of preventive strategies can be also enhanced the negative outcomes of the addiction among the youth. Studies revealed that young people seem greatly susceptible to Internet addiction disorder compared to adults and preventive strategies are very much needed since it is preventable (Avila et al. 2020).

Out of the scientific studies on Internet addiction disorder at the global level, only a few have been available in the literature on the preventive aspects. The majority of the researchers agreed that preventive interventions on Internet addiction disorder should be focused mainly on adolescents in their school environments since they have the highest prevalence (Vondrackova and Gabrhelik 2016). Malinauskas and Malinauskiene (2019) showed significant effects in all randomized controlled trials with educational programs and emphasized the importance of preventive education on Internet addiction disorder in a meta-analysis. Investigators have found that cognitive-behavioral therapy-based treatment approaches are effective on addicted adolescents in terms of secondary prevention (Ruano et al. 2016). Some antidepressant drugs have been also tried for the treatment of Internet addiction disorder and revealed that both psychological and pharmacological interventions as combined therapy proved beneficial in severe addicts (Przepiorka et al. 2014). Lindenberg et al. (2017) revealed, Internet addiction disorder is a significant mental health issue among adolescents and the prevention of Internet addiction disorder needs to be supported by effective preventive strategies with a knowledge-based educational approach. Over the years, information technology has become a crucial part of the day-to-day activities of modern human lives. Therefore, completely discontinuing the use of technology is not a practical approach since it has proven its use in all aspects of human life. Meanwhile, there is a rising concern regarding those who are excessively using technology which can lead to addiction. This may eventually result in marked distress and functional impairments of the general life of youth such as academic performance, social interaction, future occupational interest, and behavioral problems.

The addiction threatens the physical, mental, and social well-being of an adolescent leading to many life adversities. Such individuals are often inactive, getting fatter, lacking physical fitness, and having sleepless nights contributing to mental issues such as stress, anxiety, depression, problems in later marriage life, poor performances in education, missing job responsibilities, and having a troublesome social life. There will be many social and cultural issues in the future life of adolescents since the researchers have shown that addicted individuals spend less time with their families resulting in unfaithfulness, isolation, sleep disorders, loneliness, and forgetting responsibilities (Musai and Darkesh 2014). The economic and social implications of Internet addiction have also been researched and revealed many more young addicts cannot acquire the skills and capabilities that are necessary for employment in modern workplaces in their future lives. They will be socially isolated and less employable since they lack skills than their non-addicted mates (Ramesh and Igor 2016). Due to the Covid 19 pandemic, the government of Sri Lanka took emergency responses to slow down the spread of the disease and the Ministry of Education issued notices to close all schools in the country with immediate effect. Students were asked to stay at home and learn via online courses. That triggered more and more adolescents to spend time on the internet to study, play online games, watch movies, use social media, and chat and become addicted. Therefore, this study has provided an excellent and timely opportunity to develop evidence-driven information to identify associated factors and develop strategies to reduce adverse effects of Internet addiction disorder among adolescents.

Methods

This study intended to adapt, translate, and validate the Internet Addiction Test (IAT) to assess Internet addiction disorder and to determine its prevalence and the associated factors among 15-19-year-old adolescents in Colombo district, Sri Lanka.The study also expected to develop an educational package to prevent Internet addiction disorder and to determine the effectiveness of the developed package among the 15-19-year-old adolescents in Colombo district. The present study consisted of three components.

The cultural appropriateness of the Internet Addiction Test (IAT) was determined, and the process ensured the concepts in the instrument were comparable between the original and the target language. The items in the instrument were assessed in terms of relevance and acceptability in the target population. It was conducted following a literature review and findings were discussed with a multidisciplinary panel of experts including two consultant community physicians, a consultant paediatrician, a consultant psychiatrist, and a psychologist. During the process, the original English version of the IAT was presented to the multidisciplinary panel of experts to assess its appropriateness to the local setting. The experts were requested to assess each item of the questionnaire.
Expert opinion on the relevance of cultural suitability of each item was obtained through a modified Delphi technique. The cultural appropriateness of concepts and words was indicated in a five-point ordinal scale. If the panel of experts had any suggestions to improve an item, a separate column was introduced to mention the additional comments. Following the first modified Delphi round, the responses from the experts were assessed by the principal investigator with the guidance of the supervisor. All the experts were agreed upon all original items in the IAT. The sentences pattern of questions number two, three, and eight were altered according to the Sri Lankan culture and adolescent population. With the alterations of these items, the questionnaire was finalized. Two modified Delphi rounds were completed to prepare the final set of items in the questionnaire. Gjersing, Caplehorn, and Clausen (2010) provided a set of standardized guidelines on the methodology of cross-cultural adaptation of study instruments and steps of the cross-cultural adaptation process. This was aimed to obtain semantic, idiomatic, experiential, and conceptual equivalence in the translation process. In this study, forward and backward translation methods were used to translate the study instruments. Accordingly, the Internet addiction test (IAT) was translated to both Sinhala and Tamil languages.

The English version of the Internet Addiction Test (IAT) following the alteration of the sentences pattern was forward translated to Sinhala by four different experts independently. The selected professionals were a psychiatrist, a consultant community physician, an English teacher, and a professional translator. All the translators selected were fluent in both languages. Two of them were very much familiar with medical terminology and construct of the adapted tool while the other two were non-medical experts having acceptable cultural understanding. All four forward-translated versions were compared and synthesized into one version by another consultant community physician who is having excellent bilingual and bicultural expertise. Discrepancies were discussed with forward translators and consensus was achieved. Several individual translations were provided to enhance the quality, which allowed divergent interpretations of ambiguous items in the original tool. The qualifications and characteristics of the translators were considered as they should culturally be representative of the target population. All the translators were made aware of the objectives of the study and the concepts. The mother tongue of all these translators is Sinhala. Simple wording, preservation of the original meanings of the statements, and cultural suitability were ensured during the translation process.

Once the individual experts agreed upon the translations, the items of the tool were produced for backward translation. Gjersing, Caplehorn, and Clausen (2010) reported backward translation improves the quality of the final version of the tool. The synthesized translated version to Sinhala after the forward translation was sent to two consultant community physicians for the backward translation independently. Both the backward translators were proficient in English and Sinhala languages. Following the individual backward translations, a synthesized single backward translated version was created by another consultant community physician. Synthesized backward translated version was compared with the original version in terms of wording, grammatical errors, and sentences. The consensus was achieved through the committee approach. When there was an agreement between the backward translation and the original, those items of the forward translation were considered as acceptable. Discrepancies found were sorted out through discussions with the expert panel. Eventually, all the items in the translated Sinhala version of the Internet Addiction Test (IAT) were forwarded for pretesting of the questionnaire. Assessment of judgmental validity includes face validity, content validity, and consensual validity. A multi-disciplinary panel of experts consisting of consultant community physicians, psychiatrists, psychologists, and paediatricians was involved in this process. Face validity, similarly, called logical validity, is the simplest form of validity where you apply a superficial and subjective assessment of whether your study or test measures what it is supposed to measure (Bartlett 1951). Face validity of the IAT-Sinhala version was determined by the panel of experts by evaluating the components of the instrument with the appropriateness of its original purpose. The ambiguity of the statements, consistency of the style of questions, formatting of questions, clarity of the language used, and readability of questions were further discussed.

Content validity refers to the extent to which the items on the instrument are representative of the entire domain the tool seeks to measure (Michaels 1989). It is appraised to describe whether the components of each scale have covered all the attributes that needed to be measured by the particular concept (Abramson 1999). The translated Sinhala version of IAT was tested for content validity by the multi-disciplinary panel of experts.

They ensured the tool comprises all the conceptual domains related to Internet addiction disorder. The consensual validity was determined through the process of the modified Delphi technique by a multidisciplinary panel of experts, who were not involved in the assessment of initial cultural appropriateness and translation process. Each item of the tool was assessed, and the consensus was generated on its relevance. Appropriateness of words, acceptability in the local setting were also determined. Consensual validity was carried out as an interactive process involving experts and based on a group consensus. An expert panel of nine multidisciplinary experts was selected from the fields of Community medicine (Three), Psychiatry (Three), and Psychology (Three). Selected experts were fluent in both English and Sinhala languages.

All the panel members were kept anonymous to each other. The opinion of the multidisciplinary panel of experts was collected and compiled. A file containing the English version which was subjected to cultural appropriateness and the Sinhala translation of the IAT was distributed among the panel members with a covering letter. All the relevant details and the objectives of the study were provided with written instructions to the experts. The members of the panel reviewed all the items of the questionnaire during the first round and indicated whether each item should be retained in the tool. Relevance of the items on diagnosing Internet addiction disorder, appropriateness of wording, and the acceptability of the concept in the local context has been considered. A rating scales (1-9) was also provided to the panel members, and they were requested to rate each item of the scale. The items were rated according to a nine-point ordinal scale, “one” indicating strongly disagree and “nine” indicating strongly agree. There was a separate column to include additional comments for the experts. All the ratings and comments were summarized after the first and second rounds by the principal investigator. Based on the responses provided at each round, the items of the instrument were improved accordingly for the next round. Sumathipala and Murray (2000) provided a guideline for the process, and it was followed throughout.

Construct validity refers to the extent to which a particular variable is related to other specified variables that are consistent with theoretically derived hypotheses, concerning the concepts or constructs that are being measured (Abramson 1999). Construct validity of the Internet Addiction Test(IAT) was carried out since the original version has been modified during the translation and cultural adaptation process. Exploratory and Confirmatory factor analysis were carried out to assess the construct validity. Exploratory factor analysis (EFA) is a family of multivariate statistical methods that attempts to identify the smallest number of hypothetical constructs that can explain the covariation observed among a set of measured variables (Cattell 1966). Therefore, EFA was carried out to assess the underlying factor structure of the translated and judgmentally validated IAT-Sinhala version.Confirmatory Factor Analysis (CFA) was carried out to determine whether the underlying factor structure was replicable in the data by confirming the goodness of fit. There are different fit statistics were used and they have their own cut-offs that indicate a good fit.

Data entry was done by the principal investigator. The datasheet was rechecked for missing values and other inconsistencies. Exploratory Factor Analysis (EFA) was conducted to identify the latent factor structure using the SPSS version 21. Inter-correlation matrices of the items and anti-image correlation matrix were determined to assess the factorability of data. Bartlett's test of sphericity (Bartlett 1951) was conducted to determine whether the matrix is significantly different from an identity matrix. The factor analysis is appropriate once Bartlett’s test shows a significant result. The Kaiser-Meyer-Olkin (KMO) test was performed to determine the sampling adequacy for each variable in the model and the complete model (Kaiser 1974). Eigenvalues and Cattell's scree test were examined to determine the number of factors. Factors that had Eigenvalues more than one were selected. The scree plot was used to determine the number of factors to be retained by inspecting the shape of the resulting curve to detect the point at which the curve changes drastically (elbow) indicating the appropriate number of factors to select (Cattell 1966). Exploratory Factor Analysis (EFA) was carried out to assess the size of factor loadings (correlations between the variables being tested and the factor). Identified factors have been rotated to optimize the interpretability of the scale. There were four main factors were identified in the tool following the analysis. Confirmatory Factor Analysis was carried out by using Linear Structural Relations (LISREL-8.8) statistical software package to identify the extent to which the four-factor model was replicable in data. Normality and multicollinearity of the data were studied to assess the compatibility of data for Confirmatory Factor Analysis. Assessment of the appropriateness of the model was determined based on several fit indices. The different fit indices and the cut-off values for a good fit between the hypothesized model and the observed data used in this study for each index to evaluate the model fit are summarized (Hu and Bentler 1999). A similar process has been followed in the process of judgmental validity and construct validity in the Tamil version.

Component two was a descriptive cross-sectional study including an analytical component. This component was to determine the prevalence of Internet addiction disorder by using the validated Internet Addiction Test (IAT) and describe the associated factors of Internet addiction disorder among 15-19-year-old adolescents in Colombo district. This school-based descriptive cross-sectional study was conducted in Colombo district, Western Province of Sri Lanka. The district has the highest population density (3300 per square kilometer) in Sri Lanka. It comprises 13 divisional Secretariat areas and 566 grama niladari 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 grade 10 to grade 13 in Colombo district. There are four types of government school categories in Sri Lanka (Samita and Thattil 2002). Out of four categories, type 1AB, 1C, and type 2 were included in the present study. The type 3 category was excluded since they are only having classes up to grades 1-5 or 1-8. The data collection was completed at the respective selected school premises. The study has excluded the paying schools. This descriptive cross-sectional study was carried out from October 2019 to July 2021. The data collection was completed in February and March 2021. The study unit has been defined as an adolescent who completed his or her 15th birthday and has not reached the 20th. School-going adolescents, both males, and females were selected from government schools in Colombo district.

Multi-stage stratified cluster sampling method with probability proportionate to the size was carried out to obtain the required sample size. During probability proportional to size (PPS) sampling larger clusters have a higher probability of being sampled and individ-

uals in smaller clusters have a smaller probability of being sampled. At the end of the process, each individual in the population has the same probability of being sampled. The contribution of the sample size for each stratum was calculated according to their student population. Schools and classes of each stratum were listed separately with their student populations in a table format for each stratum. Cumulative populations were calculated for each stratum by adding the total number of students in classes. The number of clusters to be selected from each stratum was calculated according to their respective populations. The sampling interval was calculated to select clusters in each stratum.

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. Total Internet Addiction Test(IAT) scores of an individual exceeding one standard deviation above the mean score were considered as the cut-off for having Internet addiction disorder. Although there were several methods used to assess the cut-off for IAT, the current methodology provides a more scientific approach considering the cultural differences and variety of sociodemographic profiles of the study samples. Perera (2017) and Kormas et al. (2011) used the same methodology to determine the cutoff in their studies. Pretesting of this self-administered questionnaire was completed in Galle district among 32 adolescents aged 15 to 19 years of age. Galle district belongs to the Southern province and is outside the study setting. However, the district shares the majority of the socio-demographic, economic, environmental, and geographic characteristics of the study setting. The process was carried out by the principal investigator to assess the clarity of the questionnaire, suitability of the instruments to the participants, presence of any misinterpretation of questions, and accuracy of wordings of the questions. It was also helped to determine the average time needed to fill out the questionnaire and possible obstacles that could arise during the data collection. Required modifications were made with the necessary reconstructions to the questionnaire based on the findings of the pre-test.

Data entry was done by the principal investigator and a team. 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. The total score of an individual exceeding one Standard Deviation (SD) was considered as the cut-off value as discussed in the cross-sectional validation study. The statistical analysis was performed by summarizing the selected variables to determine the associated factors of Internet addiction disorder. The associated factors were analyzed using bivariate cross-tabulations. Individual odds ratios were calculated with 95% confidence intervals for selected associated factors and statistical significance of the associated factors determined. Chi-square test was used to calculate the strengths of association between the associated factors and the Internet addiction disorder. A p-value of ≤ 0.05 was considered statistically significant and the results presented with Odds Ratios(OR) and 95% confidence intervals. 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 the 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 the p-value less than 0.1 in univariate analysis were included in the multivariate analysis and 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. It has been widely accepted that adolescence itself is a risk factor for Internet addiction disorder due to their developing brains and internal curiosity. Teenagers have been found to use the internet more than adults for addictive acts (Beard 2005).

With the advent of broadband and mobile access and wider availability, young people are having the opportunity to connect to the internet at any place and at any time. Therefore, adolescents can become so immersed in their online activities leading to affect their psychological functioning, mental health, and general well-being. Since the addicted adolescents were reported to have an increased risk of psychological disorders such as depression, social problems, loneliness, academic issues, and suicidal tendencies, the outcome will be disastrous if they are not properly managed. The preliminary analysis of the current study showed that Internet addiction disorder is a considerable issue, and the interventions should be aimed to prevent the Internet addiction disorder and improve the academic, social, and mental state of the adolescents. Due to the Covid-19 pandemic school children were requested to be at home and study online, which triggered more and more adolescents to spend time on the internet to study, play online games, watch movies, use social media, and chat. Therefore, the current study provided an excellent opportunity to design evidence-based strategies to reduce the incidence and adversities of Internet addiction disorder.

Social Cognitive Theory (SCT) emphasizes the influence of individual experiences, the actions of others, and environmental factors on individual health behaviors (Bandura A 1986). The application of this theory supposed that the addictive behavior can be interpreted through identifying the individual's organizational mechanisms which are influenced by behavior-based outcomes and the individual's self-efficacy. The theory further describes the impact of self-efficacy on ambition, performance, and learning levels, being an important basis to define an individual's motivation level, psychological health, and personal performance. Therefore, this theory has been applied as a basis for interventional strategies to prevent Internet addiction disorder (Alrekebat 2016). The researchers were also explored that the human learning capacity allows individuals to use their capacity to plan actions, set goals, and anticipate potential behavioral consequences. Therefore, extensive evaluation of personal experiences, self-assessments, self-reflective capability can be used to alleviate behavioral addiction (Larose, Mastro, and Eastin 2001). Social cognitive theory has influenced many areas of education, health sciences, social policy, and psychotherapy. Therefore, researchers designed their educational interventions based on the concepts in the theory which assist the behavior change process (Nadeeka 2020). This educational intervention for the prevention of Internet addiction disorder has been designed based on this health promotional concept to prevent addiction among 15–19-year-old adolescents.

Charles Tatum (2019) described a system for the development and evaluation of educational programs. The model was used as a guide in the development of the educational intervention to prevent Internet addiction disorder among 15–19-year-old adolescents in the current study. As per the guideline, five steps have been followed in the development of the educational package according to the model. The steps were planning design, development, implementation, and evaluation (Charles Tatum 2019). Pilot testing of the intervention was completed in a school that was not included in the main study. It allowed the principal investigator to test the research approach with a small number of study participants and provided an excellent opportunity to detect the understandability of the contents of training materials among adolescents. The feasibility of the main study, exact timing, and resource allocation were also assessed. A quasi-experimental study was conducted considering the practicability and feasibility of a school-based study. It intended to determine the effectiveness of developed educational package for the prevention of Internet addiction disorder among 15-19-year-old adolescents in Colombo district. The educational package was developed based on Social Cognitive Theory (SCT). Quasi-experimental studies have been extensively used to assess the effectiveness of educational interventions in school settings. Many public health interventions found in the literature have been quasi-experimental and researchers argued that quasi-experimental studies were more practicable than true experiments since they provide beneficial and generalizable information (Abramson 1999).

Three schools were randomly selected out of all the eligible schools in Piliyandala educational zone following a baseline survey. The list of schools in the Piliyandala educational zone was obtained from the Ministry of Education and was screened for the selection criteria mentioned above. Four classes were randomly selected in each school for the intervention. All the eligible students of the selected classes were recruited for the intervention group. Three schools were randomly selected out of all the eligible schools in Homagama educational zone following a baseline survey for the assessment of eligibility of schools. The list of schools in the Homagama educational zone was obtained from the Ministry of Education and was screened for the selection criteria mentioned above. Four classes were randomly selected in each school for the control arm. All the eligible students of the selected classes were recruited for the control group. All the authorities in the educational and health sectors were advocated sufficiently before the intervention mentioning the importance and possible beneficial outcomes of the study. When the approval for the study has been granted from the selected school authorities, the principal investigator sent the information sheets and consent forms to the parents with the assistance of teachers of selected classes before the implementation process of the study. Students were informed that they needed to bring back the documents signed with the decision by one of their parents/guardians. Information sheets, consent forms, and assent forms were provided to the adolescents in selected classes and informed written consent was obtained. Following several discussions with the school principals and teachers, time slots were selected to conduct the program at chosen school premises. The intervention package has been implemented as three modules during the implementation phase. The pre-intervention assessment was carried out in selected schools in both intervention and control groups simultaneously.

Adolescents who consented to the study were enrolled. The validated IAT-Sinhala version with outcome assessment questionnaire was administered to both intervention and control groups. All the measures were taken to maximize the participation of study participants such as minimal disturbances to the routine educational activities, choosing convenient time slots, and avoiding exam periods. The study was implemented in two different educational zones in Colombo district. The intervention was completed in three schools in Piliyandala educational zone, and the control arm was conducted in three schools in Homagama educational zone.

Implementation of the educational package was carried out as three modules. the intervention group of students was provided with the educational package for the prevention of Internet addiction disorder. Three sessions of the intervention modules were completed for the intervention group at fixed time intervals for 1 week apart. The post-test analysis was completed after 12 weeks from the pre-test. Each session was completed within two hours. Module one consisted of the Introduction of Internet addiction disorder and why adolescents are at higher risk. The module included one hour lecture, video presentation with a question-and-answer session. The second module was completed after one week. Students were required to memorize the information provided during module one at the beginning. Module two was mainly on the different types of Internet addiction disorder and the clinical characteristics of these types. The session was included a PowerPoint presentation and brainstorming session with the involvement of the participants. During module three, preventive strategies of Internet addiction disorder were discussed in-depth and ways of estab-

lishing a culture for responsible use of the internet were reinforced. The time slots for the implementation of the educational package were allocated following the discussions with school principals and class teachers. Three study periods were selected considering the feasibility. A separate hall was chosen for the intervention to minimize the disturbances to the routine academic activities of the other classes. Teaching materials were provided for the students.

Powerpoint presentations, video presentations, and interactive discussions were included in all the modules. Modules were fully completed as planned one week apart by the principal investigator. The intervention was implemented during the period of the Covid 19 pandemic, and all the activities were established according to the protective guidelines. There were no financial incentives for the study participants. The study was completed at the school premises and conducted during academic hours. All the participants of the interventional study were so much enthusiastic and happy about the learning materials and methods used. Post-intervention data collection was conducted following 12 weeks of the pre-test. Validated IAT-Sinhala version was re-administered, and primary and secondary outcomes were assessed. At the same time, post-assessment of the control group was similarly completed. The study was conducted from February 2021 to May 2021. Pretest and post-test data were collected 12 weeks apart. Primary and secondary outcome measures were defined. Measuring a change in outcomes provides information as to whether the intervention has made a difference.

There was no randomization of the study groups and blinding was not applied considering the feasibility and the study setting. An equal number of study participants for the intervention and control groups were selected. The schools in the control group and the intervention group were included in two different educational zones of the district and more than five kilometers away from each other. No cross-contamination of the two study groups was assumed. Data entry was done by the principal investigator. All the gathered data were manually cleaned and checked before entering the statistical package of social sciences (SPSS-version 21).

Pre-interventional basic socio-demographic characteristics of the intervention and the control groups were compared. The primary outcome was assessed by comparing the proportion of adolescents with Internet addiction disorder at pre-intervention and post-intervention stages of the study groups by using the chi-square test. The Chi-square test was used to assess the secondary outcomes between two groups except for the mean difference of total IAT score of the intervention group between pre-intervention and the post-intervention stages, which was assessed by using paired t-test. Evaluation of the interventional study was completed in terms of outcome evaluation and process evaluation. Outcome evaluation assesses the results and determines whether the intended outcomes of the intervention were achieved or not. Measuring a change in outcomes provides information as to whether the intervention has made a difference. Primary outcome and secondary outcomes were evaluated. Process evaluation determines whether the intervention has been implemented as intended. It provides additional information on the implementation process, how different structures and resources were utilized.

All the modules were conducted as planned. Selected students have participated in both the intervention and control groups with minimum loss to follow-up rates. All the modules were conducted by the principal investigator and assisted by the group which was adequately trained. Feedback forms were provided to adolescents to get the feedback at the end of the training sessions. The permission was obtained in writing to carry out the present study from the Ministry of Health and Ministry of Education. Prior approval was obtained from the Provincial Director of Health Services(PDHS) of Western province and Southern province, Provincial Director of Education of Western province and Southern province, Regional Director of Health Services(RDHS) of Colombo and Galle, zonal education offices, and principals of the selected schools. Informed written consent was obtained from the parents and the adolescents who were involved in the present study for all the components. Informed verbal consent was taken from all the principals and teachers in relevant schools before data collection. The objectives and aims were explained with information sheets in simple language.
Contact details of the principal investigator were provided to all the participants and parents for any clarification regarding the study. Confidentiality was assured throughout.

A self-administered questionnaire was given without any identification detail. Withdrawal from the study was able to be done by directly informing the principal investigator at any instance during the study period. The participants were allowed to seek clarifications before filling out forms. If they were not given consent, they were asked to refrain from filling out forms. Parents of eligible participants were informed that they have the right to decide whether to participate in their child or not and that is not losing any benefit to the child in terms of education or health care in the future. Since the intervention was successful, the principal investigator was intended to conduct it for the control group in the future. Awareness programme on the prevention of Internet addiction disorder has been already completed for the control group. Following answering the questionnaires all participants were made aware of the risks of the Internet addiction disorder and the benefits of responsible use of the internet.

Study participants who have been identified to have the addiction by the principal investigator using the validated tool and if they were willing to seek support have planned to be referred for counseling to a child psychiatrist with their parental consent. The electronic database was password protected by the principal investigator who was having the only access. Datasheets were kept under lock and key. The collected data sheets were planned to destroy after 2 years of completion of the study. Individual data were not included in any form of dissemination of data. Individual participants were not personally identified in any form of presentation or

publication. Dissemination of the results of the study has been planned as a thesis submitting for MD part 2 examination in Community Medicine. Findings of the study were planned to be communicated through a report to Family Health Bureau(FHB), Provincial Directorate of Health Services(PDHS)-Western province, Regional Directorate of Health Services(RDHS)- Colombo, and Provincial Ministry of Education-Western province. Results will be planned to present at scientific sessions and journal article publications. There were no potential risks that have been identified in this research or similar research during the past. There was no conflict of interest. Ethical clearance for the study was by the Ethics review committee of the Faculty of Medicine, Colombo.

Results

The IAT-Sinhala version demonstrated a four-factor model consisting of 20 items with the model indices of RMSEA= 0.06, CFI= 0.93, NNFI= 0.91, SRMR= 0.063, and GFI=0.77. It had an acceptable internal consistency with a Cronbach alpha value of 0.782. The IAT-Tamil version had a three-factor model with 20 items and the model indices were RMSEA=0.07, CFI=0.91, NNFI=0.87, and SRMR=0.066. It was also demonstrated excellent levels of reliability with a Cronbach alpha value of 0.948.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).

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**	

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Table1. Levels of Internet addiction disorder among 15–19-year-old adolescents in Colombo district

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 of 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)**
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

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
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 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

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Table 2. Multivariate logistic regression model with selected associated factors for Internet addiction disorder among 15–19-year-old adolescents in Colombo district

Following the intervention, the proportion of adolescents with the Internet addiction disorder in the intervention group was less in comparison with the control group and the difference was statistically significant ($\chi2=9.026$, df=1, p=0.003). There was a statistically significant difference between the mean differences of pretest and post-test IAT scores (t=-0.412, df=279, p=0.001) with the reduction of mean IAT scores among the intervention group. The proportion of study participants engaged in social media ($\chi2=10.6$,df=1, p=0.001) and excessive engagement of internet gaming ($\chi2=5.514$, df=1, p=0.019) among the intervention and the control groups revealed a statistically significant difference in favour of the intervention group.

Discussion

Internet addiction disorder is called "Electronic heroin"(Williamsle 2014). The use of the Internet has brought a variety of conveniences to people's modern life. Nevertheless, the negative impact is also created by addictive behaviors to the Internet pervasively on individuals' academic and working performance, family life, social relationships, physical health, and psychological well-being. Even though there are different views on the term, Internet addiction disorder usually refers to a phenomenon that an individual is unable to control his or her use of the internet and eventually causes marked distress and functional impairment in daily life. For the present study, the condition has been operationally defined as "A consistent and potentially pathological behavioral pattern characterized by salience (preoccupation with online activities), tolerance (pursuing increasing time to achieve satisfaction), withdrawal symptoms (when unable to use the internet), using online activities to modify mood, conflict (within oneself, in relationships, or academic/occupational activities because of online engagement), and relapse (unsuccessful attempts to control the behaviors)"(Griffiths

et al. 2016a).
Following the appearance of the Internet, the explosion of its use soon drew attention to this addictive phenomenon and with the increasing number of internet users, it has become a serious concern, especially for adolescents. Adolescents, who have grown up in the digital technology era, are very much familiar with telecommunication devices and the internet from an early age. In this developing stage of the individual's life, Internet addiction disorder can negatively affect academic performance, family relationships, and psychosocial development among the youth.

The prevalence data on Internet addiction disorder are limited by methodological difficulties related to the diagnosis and the lack of cross-culturally adapted diagnostic instruments. And there are no existing studies in the local context that have focused on the prevention of Internet addiction disorder among adolescents. In the absence of a validated instrument to detect Internet addiction disorder among the adolescent population in Sri Lanka, IAT original English version was adapted, translated, and validated. Internet Addiction Test (IAT) is one of the most utilized diagnostic instruments to assess Internet addiction disorder all over the world and has been translated into many languages including English, Chinese, French, Italian, Turkish, and Korean (Young 2009). It assesses the status of Internet addiction disorder based on 20 self-reported items with a six-point Likert scale and measures the severity of the addiction of an individual. The other study instruments which were commonly used in previous studies to detect Internet addiction disorder have been carefully examined in terms of their advantages and disadvantages before selecting the IAT as the most suitable tool.

The factor structure of the Internet Addiction Test(IAT) is consistent with the operational definition of Internet addiction disorder used in the present study. The validated tool is a self-administered study instrument that usually takes less than 10 minutes for the completion of the questionnaire by an individual. The individual statements were simple and easily be understood by the study population. Since the tool is a self-administered questionnaire (SAQ), that assured the confidentiality of responses to the participants. It has been also identified as effective in collecting honest and accurate information and interviewer bias was eliminated. Considering these factors IAT was very much suitable for the assessment of Internet addiction disorder among 15–19-year-old adolescents. The routine practice was to translate the validated Sinhala version to Tamil and use it to assess the prevalence. However present study conducts a separate validation study for Tamil, considering the linguistic and cultural differences of two populations.

The study design was a descriptive cross-sectional validation study design for both Sinhala and Tamil versions. The study settings were Sinhala and Tamil medium schools in Galle district for Sinhala and Tamil versions respectively. Galle district belongs to Southern province which is adjacent to the Western province where the main study component was conducted. Therefore, the scale validity was tested in a different sample but from a comparable study population with varying perceptions, different social and geographical conditions. Convenience sampling method was used where the sample was taken from six Sinhala medium schools for the Sinhala version and six Tamil medium schools in Galle education zone, Galle district. These schools were selected purposively from the school list of Sinhala and Tamil medium government schools of type 1AB, type 1C, and type 2 categories. The main advantage of this purposive selection of schools was the logistic feasibility and selecting samples from all types of school categories with both the sexes. Out of the selected schools, three of them were selected for the data collection for Exploratory Factor Analysis and the other three for Confirmatory Factor Analysis in each version. Rather than translating the validated Sinhala version to Tamil as the routine practice, the principal investigator was focused to conduct a separate validation study for the Tamil language has been a strength for the present study. The study population was 15-19-year-old adolescents in Sinhala and Tamil medium schools in Galle district.
All three school categories (Type 1AB, Type 1C, Type 2) were represented in the final sample. In each selected school, four classes were randomly selected to cover all the grades.

A scientifically determined number of study units were enlisted conferring the standard sample size calculations. The recommendations were typically based on a ratio of the number of variables to the number of factors such as 5:1 or 10:1 (Cattell 1966). Since the IAT includes 20 items, the 10:1 ratio has been exceeded ensuring an adequate sample size for both versions. All the questionnaires were inspected to obtain completely answered questionnaires. Different data sets for Exploratory Factor Analysis and Confirmatory Factor Analysis were used. The routine practice in the validation process is to compare the tool with a gold standard method, namely criterion validation. The major issue in criterion validity testing, for the Internet Addiction Test(IAT), was the lack of gold standards. Therefore, only judgmental validity (face, content, consensual validity) and the construct validity were used for the validation process which was a limitation in the current study. It has to be emphasized that there have been very limited efforts were taken to measure Internet addiction disorder in Sri Lanka with a reliable and validated tool among adolescents. Thus, the Internet Addiction Test did not have a version for the adolescents in the local context and its psychometric properties are not known in this population. The present study provides a valid and culturally sensitive tool to detect Internet addiction disorder among 15-19-year-old adolescents and to determine its prevalence. It can be helpful to assess future trends, identification of associated factors, and implementation of preventive strategies. Thus, it will benefit adolescents, students, teachers, parents, and future researchers who have an interest in this field.

The descriptive component of the present study was carried out to determine the prevalence of Internet addiction disorder by using the validated Internet Addiction Test (IAT) and to describe the associated factors of Internet addiction disorder among 15–19-year-old school-going adolescents in Colombo district. The cross-sectional nature of the study has enabled to quantifying and categorizing

the study population in terms of the presence or absence of a disease in an existing situation at a given point in time (Abramson 1999). This was the most suitable study design to determine the prevalence of Internet addiction disorder and to describe its associated factors since this design permitted the principal investigator to carry out the study in an efficient manner without compromising the validity of data within the given time frame of the academic activity period. In addition, the cross-sectional study design provided the platform to compare the study groups with different levels of associated factors of Internet addiction disorder. The data collection for determining the prevalence and the associated factors were completed concurrently aiming to improve the effectiveness of the study. Since the study design is cross-sectional, the temporal relationship has not been assessed and was a limitation in this study design. The study participants were 15- to 19-year-old adolescents in government schools in Colombo district.

It has been highlighted that the study has not assessed the Internet addiction disorder among non-school-going adolescents and adolescents in private and international schools which is a limitation in this study. Thalagala & Rajapakse (2004) reported that non-school-going adolescents' socioeconomic status and family backgrounds were different in terms of their behaviors. As a result, the prevalence of Internet addiction disorder among non-school-going adolescents could be different from that of schooling adolescents. Adolescents in paying schools were also not included in the present study. Therefore, the results cannot be generalized to the whole 15-19-year-old adolescent population which is a limitation. The study was conducted in Colombo district where the principal investigator was familiar with the original administrative structure which facilitated the logistic arrangements. However, the data collection was carried out under the strict health guidelines due to the COVID – 19 pandemic situation which led to altering the data collection process with a minimum number of data collectors keeping the minimum distance among the participants. The study was conducted in both Sinhala and Tamil medium schools since the validated tool of IAT was available in both languages. It has enabled the assessment of different ethnicities with different cultural groups ensuring principles of ethics and enhanced the internal validity of the study. The sample size was determined according to the scientifically estimated sample size calculations using locally relevant estimates. The calculation accounted for the effect of the design effect and non-response. The prevalence of Internet addiction disorder was varying since different diagnostic criteria, different cut-off values, different epidemiological backgrounds, and different samples. Considering these circumstances and varying rates, the estimated prevalence of Internet addiction disorder was considered as 50% to achieve the maximum sample size. There are studies that the sample size was calculated for an assumed prevalence of 50% since there were no studies on a similar scale (Krishnamurthy and Chetlapalli 2015). Two other different sample sizes were also estimated by using standard formulae to determine the strength of association between associated factors and Internet addiction disorder.

A multi-stage stratified cluster sampling method was used. To minimize the effect of clustering, the correction was made with the design effect. For the calculation of the design effect, the rate of homogeneity(δ) was estimated based on previous school-based studies with a similar design (Silva 2020). Usually, the rate of homogeneity ranges from 0.1 to 0.4 (Bennet et al., 1991). Rho (δ) value was taken as 0.1 for the present study since it has been usually selected to determine socio-demographic factors in school-based studies in Sri Lanka. Furthermore, the roh value recommended is lower and closer to zero. Therefore, the minimum roh value of 0.1 was considered (Farber 1990). Probability proportionate to the size of the adolescent population of the age group of 15 to 19 years in each school category was considered during the sampling process. To address the differences in functional categories in schools, all the schools in the district were stratified. The sampling process of probability proportionate to the size and the stratification contributed to enhancing the precision of estimates for predetermined sample size.
It also ensured the sufficient representation of study participants from all functional types of schools. In the current study, a cluster sampling method was carried out. A class (cluster) in any grade (10,11,12,13) which 15–19-year-old adolescents are studying was considered as a cluster. Cluster size was determined by considering the median number of students in a class according to the school statistics obtained. In many school-based studies conducted in Sri Lanka using the cluster sampling method, the cluster size was considered as the median number of students in a class due to the skewed distribution of the number of students in a class (Nadeeka 2020). The minimum possible cluster size has been considered for the internally heterogeneous groupings and maximum cluster numbers. This low value of the cluster size was facilitated to increase the number of clusters and the variation in subjects and schools. This probability sampling method has been contributed to minimizing the selection bias and facilitated the study findings to be generalized. In addition, the selection of study participants and the comparison groups recruited for the cross-sectional analytical study were carefully designed to avoid differential or nondifferential misclassification bias.

The adapted, translated, and validated IAT in the cross-sectional validation study was used in this component to detect the Internet addiction disorder among 15–19-year-old adolescents, and validity and the reliability of IAT have also been established. The data collection for the descriptive cross-sectional study with an analytical component was carried out using a self-administered questionnaire. The individual questions in the self-administered questionnaire have been decided based on a comprehensive literature review and the opinion of a multidisciplinary panel of experts. Since the cross-sectional study was focused on attributes related to the subjective perceptions of adolescents and their behavior it was justified that a self-administered questionnaire would yield more valid information rather than using an interviewer-administered questionnaire and eliminated possible interviewer bias as well.
While constructing all the sections of this questionnaire maximum effort was carried out to make the questions clear, concise, non-controversial, and non-ambiguous. The validity of the study instrument was ensured by assessing the judgmental validity that includes face, content, and consensual validity by a multidisciplinary panel of experts. Face validity is appraising the likelihood of the measurements to obtain information of real relevance to what the researcher wants to measure (Abramson 1999). It was ensured by the panel of experts in terms to which the instrument has subjectively viewed as measuring what it has supposed to measure. The

content validity of the tool was assured by the expert panel emphasizing that the items of the tool have fairly representative of the entire domain the test seeks to measure. Consensual validity has been assured as the agreement of several experts that the measure is valid (Abramson 1999). It was determined by assessing the agreement of the expert panel, to ensure the conceptual definition has been selected appropriately in the instrument and that was carried out using the modified Delphi technique.

Several methods were adopted to ensure the quality of data in terms of validity and reliability throughout the study. The reliability and validity of the results were aimed at by creating a strong research design, choosing appropriate samples and methodology. 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 in Gampaha district, Sri Lanka(16.1%) (Perera, 2017). The later study has 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, 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 the Middle East and Africa had rates from 17.3 to 23.6% among adolescents during 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 that 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). A cross-sectional study among college students in Bengaluru, India on Internet addiction disorder reported higher prevalence rates of mild Internet addiction of 34% (95% CI:29.91%-38.09%) and moderate levels of addiction of 8% (95% CI: 5.97%-10.63%) (Krishnamurthy and Chetlapalli 2015). However, Different cut-off values have been used for the categorization (normal range:0-30,mild:31-49 points, moderate: 50-79 points, and severe: 80-100). Since the study was used the cut-off value of 30 may be attributed to the higher prevalence of addiction compared to the current study. Furthermore, Bengaluru has been considered as an Information technology hub in India and excessive internet use among adolescents is an emerging public health issue with higher prevalence rates compared to the Sri Lankan context.
It has to be justified that the prevalence of Internet addiction disorder varied across different sociodemographic and internet use-related variables in different locations. Comparing the prevalence reported in the present study with the previous research, it is possible to conclude that the current prevalence of Internet addiction disorder among the 15-to 19-year-old adolescents in Colombo district is within the range of regional levels considering Sri Lankan and South Asian figures.

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 the 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.

Among the associated factors of Internet addiction disorder, 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 regarding 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 the 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 the 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 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 among the users. Behavioral 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 of Internet addiction disorder and social media use has not been reported as Odds ratios comparative to the present study where the odds ratio was computed to quantify the strength of association. This alarming statistic of the current study sheds light on policy implications. Programme 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 an 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 army medical college, Rawalpindi during 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 of 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 outdoor 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 contradicting 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 the 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 supervising the use of the Internet of their children, may lead to overuse and addiction.

Excessive engagement of internet gaming was reported to have higher levels of Internet addiction disorder among the 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 during 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 nonacademic 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 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 ($\chi 2$=43.940, p=0.001) among students in professional courses in central India during 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 the Internet addiction disorder ($\chi 2$ =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 the parents has a positive association with Internet addiction disorder (AOR=3.256, p=0.002). Adolescents who have more time to spend with 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.

A quasi-experimental study was conducted considering the practicability and feasibility of a school-based study. There was no randomization of the study groups and blinding was not applied considering the study setting which was a limitation in this study. Schools in two selected educational zones were purposefully selected for the intervention and control groups. Quasi-experimental studies have been extensively used to assess the effectiveness of educational interventions at school settings globally as well as locally. Many public health interventions found in the literature have been quasi-experimental and researchers argued that quasi-experimental studies were more practicable than true experiments since they provide beneficial and generalizable information (Abramson 1999).

The schools in the intervention group and the control group were included in two different educational zones of the district and more than five kilometers away assuming no cross-contamination of the intervention. The intervention was completed in the schools of Piliyandala educational zone, and the control arm was conducted in Homagama educational zone. These zones were expected to be relatively homogeneous in terms of sociodemographic, environmental, and educational characteristics.
Both the areas have similar education systems and almost similar information sources. The sample size for the interventional study was calculated using a standard formula for a dichotomous response. The effect size selected for the calculation was 0.45 and the design effect was 2.1. A school-based intervention was carried out in Sri Lanka on the prevalence of emotional and behavioral problems with an educational module to improve behaviors among school children reported the effect size of 0.45 and that figure was used as the effect size (Nadeeka 2020). Since there were no similar studies in the local context on Internet addiction disorder, the design effect used for the school-based intervention in Sri Lanka on the prevalence of emotional and behavioral problems among adolescents was chosen which was 2.1 (Nadeeka 2020). A total of 570 participants were included in the quasi-experimental study for both groups.

During the past decade, the amount of school-based research on preventive health especially on behaviors in children and youth has risen dramatically. Therefore, the school-based interventions were required to be planned very carefully with the minimum disturbances to the routine education of the children. As a result, authorities in the educational and health sectors were advocated sufficiently regarding the intervention and encouraged them by mentioning the possible beneficial outcomes of the study. Recruitment of the study participant in selected schools for the study began with a series of advocacy meetings with school principals and teachers.

The intervention package has been implemented as three modules during the implementation phase. All the measures were taken to maximize the participation of study participants such as minimal disturbances to the routine educational activities, choosing convenient time slots. The intervention group of students was provided with the educational package for the prevention of Internet addiction disorder while the control group received usual routine care. All three modules were fully completed as planned one week apart. The intervention was implemented during the period of the Covid 19 pandemic, and all the activities were established according to the protective guidelines. The primary outcome of the intervention was the post-intervention proportion of adolescents with Internet addiction disorder and secondary outcomes were the proportion of adolescents used more than 3 hours per day for non-academic use of the internet at the post-intervention stage, the proportion of adolescents engaged excessively in social media at the post-intervention stage, and the proportion of adolescents excessively engaged in internet gaming at the post-intervention stage.
All the participants of the intervention study were so much enthusiastic about the learning materials and methods used. They were very well appreciated while conducting the educational sessions.

Post-intervention data collection was conducted following 12 weeks of the commencement of module one using the Internet Addiction Test (IAT), which was a self-administered questionnaire, and outcomes were assessed. At the same time, post-assessment of the

control group was similarly completed by the same questionnaire.These outcomes have been used for the evaluation of interventions on the prevention of Internet addiction disorder in the previous school-based studies among adolescents (Throuvala et al. 2019). It should be emphasized that Internet addiction disorder needs urgent attention among policymakers and program planners before it becomes an uncontrollable behavioral issue among adolescents. Few obstacles were encountered while implementing the educational package. Due to the Covid 19 pandemic, strict guidelines had to be taken while conducting the workshops. The principal investigator had to alter some life skill development activities in the modules to keep the minimum distance among the participants. Many academic hours have been lost due to the school closure during the pandemic situation.

Allocation of time slots for the intervention had also been a challenge since the school authorities had to maximally use the available periods to cover the routine curriculum. However, considering the importance and the time appropriateness of the topic, school principals and teachers provided their fullest support to implement the package. The response rate of the intervention group was 97.2% and in the control group, it was 96.3%. The response rates reflect the minimum loss of follow-up rates indicating high validity of the results of the study. There was no statistically significant difference between the intervention and control groups in terms of age ($\chi2=1.72$,df=1,p=0.678), sex ($\chi2=1.43$,df=1,p=0.231) and school grade ($\chi2=0.172$, df=1, p=0.678). Therefore, no significant difference in baseline characteristics was observed between the two groups. Comparison of the proportion of study participants with Internet addiction disorder among the intervention and the control groups at the postintervention stage revealed that there was a statistically significant difference between the proportions of the two groups($\chi2=9.026$, df=1,p=0.003) with the reduced proportions of adolescents with internet addiction disorder in the intervention group. Out of a large number of scientific studies on Internet addiction disorder, only a few have been available in the literature on the preventive aspects.

Ruggieri (2016) conducted a school-based intervention on the prevention of Internet addiction disorder among adolescents in 2016 in Italy showed a significant reduction of the levels of Internet addiction disorder between pre-test and post-test values for both males and females (p=0.038). Throuvala et al. (2019) compared post-test scores between intervention and control groups following a peer training programme on secure internet use among adolescents and reported a significant difference in favor of the intervention group (U=40350.5, $p<0.05$). Since the study groups were small, nonparametric tests have been used for the analysis. Preintervention comparison revealed there was no statistically significant difference observed between intervention and control groups in terms of the proportion of time used on the internet for non-academic activities ($\chi2=0.029$ df=1,p=0.865), social media use ($\chi2=2.005$, df=1, p=0.157), and engagement in internet gaming ($\chi2=0.702$, df=1, p=0.402).
Therefore, no statistically significant difference was observed between the intervention and control groups at the baseline. This result was expected since the two educational zones of the study groups were relatively homogeneous in terms of sociodemographic, environmental, and educational characteristics. Both the areas have similar education systems and almost similar information sources. Relevant post-intervention outcomes were also determined accordingly between two groups and assessed the effectiveness of the intervention.

Post-intervention comparison of the proportion of adolescents who used more than 3 hours per day for non-academic use among the intervention and the control groups revealed that there was no statistically significant difference between the two groups even after the intervention ($\chi2=0.560$,df=1,p=0.454). This was an unexpected result since the intervention modules were largely focused on the reduction of screen time among the intervention group. The proportion of study participants engaged in social media ($\chi2=10.6$, df=1, p=0.001) and the extent of engagement in Internet gaming($\chi2=5.514$, df=1, p=0.019) among the intervention and the control groups at the postintervention stage reported that there was a statistically significant difference in favor of the intervention group.Comparison of the mean difference of total IAT scores at the pre and post-intervention of the intervention group using paired t-test revealed a statistically significant difference between mean differences of pretest and post-test IAT scores (t=-0.412, df=279, p=0.001). A similar result was observed in a school-based study conducted in 2016 in Italy that reported a significant difference following the intervention among the study participants. However, the outcome assessment was carried out for males and females separately and reported mean difference between pre-and post-test IAT scores among males were 7.29 (SD=16.36, 95% CI:2.38-12.2, $p<0.001$) and for females 5.33 (SD:16.76, 95% CI:0.29-10.37,p=0.038) (Ruggieri 2016). There are limited studies available in the literature on the preventive aspects of Internet addiction disorder. Different outcome assessment methods, different instruments used, and different methodologies were the major challenges to compare and contrast the different interventional studies. Considering the results of primary and secondary outcome assessment of the Quasi-experimental study it can be concluded that the educational package for the prevention of Internet addiction disorder is being effective.

Conclusions

1. It is recommended to use both versions of Internet Addiction Test (IAT-Sinhala version and IAT-Tamil version) for assessment of Internet addiction disorder among 15-19-year-old school-going adolescents, provided they are valid and reliable.

2. Use of both versions of IAT-Sinhala and IAT-Tamil is recommended in future observational studies among different adolescent populations owing to the acceptable psychometric properties of these validated tools to explore the concept of Internet addiction disorder further.

3. Future studies with the qualitative assessment of Internet Addiction disorder are recommended. This would assess the implications which could provide more valid information to minimize the risk behaviors in terms of internet use.

4. Since the causal effects between the Internet addiction disorder and the associated factors could not be confirmed due to the cross-sectional nature of the study design, longitudinal studies are recommended to establish the temporal associations.

5. Since there are significant associations between the Internet addiction disorder and the excessive engagement of internet gaming, excessive internet usage time per day for nonacademic activities, and parental use of the internet, it is recommended to make parents aware of the risk behaviors in terms of internet use.

6. Parents and teachers need to explain that adolescents should be educated regarding the responsible use of the internet and balancing the time between internet surfing, academic activities, and outdoor physical activities.

7. The quasi-experimental study showed that developed educational package for the prevention of Internet addiction disorder is effective. Similar interventions should be implemented at different settings to prevent and control Internet Addiction Disorder

8. Both versions of validated IAT and the developed educational package are recommended to use in future prevention programs and to advocate policymakers and administrators to implement programs for prevention, diagnosis, and management of Internet addiction disorder.

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