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## Adaptation, Translation, and Validation of Internet Addiction Test (IAT) to Detect Internet Addiction Disorder among 15-19-Year-Old Adolescents in Colombo District, Sri Lanka

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### ABSTRACT

Over the years, the Internet and information technology have become a crucial part of the day-to-day activities of modern human lives. Meanwhile, there is a rising concern regarding those who are excessively using technology which can lead to Internet 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. Nonetheless, the condition is widespread and problematic, limited scientific evidence is available on the diagnosis of Internet Addiction Disorder globally as well as locally. The objective of this study was to adapt, translate and validate an instrument (Internet Addiction Test) to assess Internet addiction disorder to the Tamil Language among 15-19-year-old adolescents in Colombo district. Internet Addiction Test (IAT) developed by Young (1998) was adapted, translated, and validated into Tamil language resulting IAT-Tamil version by conducting a descriptive cross-sectional validation study. The developed tool was intended to assess Internet addiction disorder among 15-19-year-old adolescents in Colombo district. Statistical analysis was carried out to test the construct validity with a sample of 225 and a sample of 240 for the Confirmatory Factor Analysis. The statistical analysis was carried out by using SPSS-21 (Principal Component Analysis) and LISREL 8.8 (Confirmatory Factor Analysis). The reliability was assessed by internal consistency and test-retest reliability methods. The IAT-Tamil version demonstrated 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 also demonstrated excellent levels of reliability with a Cronbach alpha value of 0.948. The IAT-Tamil version was a valid and reliable tool to assess Internet addiction disorder among 15-19-year-old school-going adolescents in Sri Lanka. The validated IAT-Tamil version is recommended to use in future local studies and to aid the policymakers and the administrators in the prevention, diagnosis, and management of Internet addiction disorder among this age group.

### INTRODUCTION

The modern world has been following a vast technological evolution during the past few decades witnessing enhanced accessibility to information through Internet use. In 1996 Dr. Ivan Goldberg, a New York psychiatrist, suggested one of the first diagnostic tests for Internet addiction disorder. He posted a note in an online psychiatric bulletin named “creating a fictitious disorder called Internet addiction disorder”. He also thought that people might have problems if they were online for longer periods than was intended, or if they made unsuccessful efforts to cut down or control Internet use (Dalal & Basu, 2016).

The initial published work on Internet addiction disorder was a case history in 1996 by Dr. Kimberly Young. The concept of Internet addiction disorder began in her mind as a pet project. After the millennium Internet addiction disorder became a significant public health threat. Few countries have started to support education, research, and treatment with this excess caseload (Cash *et al.*, 2012). In the year 2006, the first inpatient health center to treat Internet addiction disorder has been opened in Beijing, China. The Asian countries seemingly had significant issues dealing with the disorder compared to the rest of

the world (Young, 2017). After 2010 researchers have witnessed great developments in internet infrastructure, that have led to increased internet usage and addiction levels among people of various age groups. Several tools were developed and validated in many countries and prevalence rates were assessed (Young, 2017).

Newer treatment modalities and preventive strategies were also developed since the knowledge about effective treatment for Internet addiction disorder is limited. Many individuals are engaging in online activities for professional requirements, academic pursuits as well as recreation. However, all of them will not end up being addicted to the internet. Researchers suggest that genetic factors can be a part of an Internet addiction disorder and biological and environmental vulnerability is considered to contribute to the etiology.

The psychological component of personality traits can also be attributed to the condition. Furthermore, many social factors such as the nature of the education system, parental attitudes, affordability, and availability of the devices and networks are being considered (Ruano *et al.*, 2016). Internet addiction disorder is a broad term that covers a range of behaviors and impulse-control problems. Researchers have identified five subcategories

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of specific types of Internet addiction disorder namely cyber sexual addiction, cyber relationship addiction, social network addiction, internet gaming addiction, and information overload addiction (Salicetia, 2015).

Like most other psychological disorders, there is no exact cause for Internet addiction disorder, and it is characteristic of having multiple contributing factors. Studies suggest that if an individual is suffering from Internet addiction disorder, his or her brain makeup is similar to those that suffer from a chemical dependency, such as drugs or alcohol (Young, 1998). Researchers emphasize the disorder can physically change the brain structure specifically affecting the amount of gray and white matter in regions of the prefrontal brain. This area of the brain is associated with remembering details, attention, planning, and prioritizing tasks (Li *et al.*, 2020). Furthermore, the disorder seems to affect the pleasure center of the brain. The addictive behavior triggers a release of dopamine to promote the pleasurable experience activating the release of this chemical. Over time, more and more of the activity is needed to induce the same response, creating a dependency (Salicetia, 2015).

If an individual is suffering from the disorder, it can affect his or her relationships, work life, finances, or academic life. They may be isolating themselves from others, spending a long time in social isolation, and negatively impacting their relationships. Distrust and dishonesty issues may also arise since they hide or deny the amount of time spent online. One of the basic attractions of the internet is the ability of an individual to remain anonymous. With this anonymity, unlike face-to-face communication, internet users can take on different personalities when online. He or she may create different internet profiles with information about himself or herself (Beard, 2005).

Researchers found that some users chose identities, which represented the opposite of what the person is in their real life to fulfill their unmet needs. Serious financial troubles could result from avoidance of work, continued online shopping, online gaming, or online gambling. Addicts may also have trouble developing new relationships. They withdraw socially as they feel more comfortable in an online environment than in the real world (Beard, 2005). Tsitsika *et al.* (2014) suggested that future studies should be focused to consider cross-cultural differences with adequate psychometric properties. Sri Lanka has a very small number of figures with scientific evidence on Internet addiction disorder.

Therefore, scientific literature on Internet addiction disorder, prevalence data, risk factors, and preventive strategies are also lacking. The unavailability of valid and standardized assessment instruments is possibly the reason for this scarcity of knowledge. Evidence does not exist regarding the availability of a reliable and validated tool to measure Internet Addiction disorder among adolescents in Sri Lanka. Therefore, developing a suitable and consistent tool with acceptable psychometric

properties for examining Internet addiction disorder was much needed. The current study intended to culturally adapt, translate, and validate an instrument to assess Internet addiction disorder among 15–19-year-old adolescents in Colombo district, Sri Lanka. Therefore, the present study can be helpful to detect future trends, identification of associated factors, and implement preventive strategies for Internet addiction Disorder. Thus, it will benefit adolescents, students, teachers, parents, and future researchers who have an interest in this field.

## LITERATURE REVIEW

The growing attention to Internet addiction disorder has urged researchers to develop an instrument to measure internet addiction levels among different populations. Therefore, many experts have attempted to develop tools to diagnose and identify the level of Internet addiction disorder. Young (1998) proposed a set of diagnostic criteria as an initial attempt to detect Internet addiction disorder. According to that, an Individual who fulfills any five of the eight criteria during the last 6 months is regarded as an internet addict. This tool was very simple and easy to use. It was based on the criteria for the diagnosis of pathological gambling in the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM-4). In employing these criteria, only non-essential computer or internet usage has been considered (Shaw & Black, 2008).

Although this questionnaire has been used in several research studies, it has never been subjected to systematic psychometric testing. Researchers were often questioned about the objectivity and reliability of self-reported answers by the participants (Demetrovics *et al.*, 2008). Later the tool has been further modified, and which first five criteria need to be present and at least one of the last three criteria should be required in diagnosing Internet addiction disorder (Vondrackova & Smahel, 2012). Chen's Internet Addiction Scale is a self-reported instrument for the diagnosis of Internet addiction disorder and provides a comprehensive diagnostic profile. The scale is assessing the dimensions of core symptoms of Internet addiction disorder including tolerance, compulsiveness, withdrawal, neglect of family, neglect of social life, compromised work and study, concealment of the use, and physiological discomforts. Higher scores on the scale indicate increased severity of addiction to the disorder (Ko *et al.*, 2005).

The problematic Internet Use Questionnaire (PIUQ) was a three-factor model for the diagnosis of Internet addiction disorder. It was initially developed as a 30-item tool based on previous studies on Internet addiction disorder. Factor analysis and reliability analysis have completed with 1037 participants. As a result of the study, an 18-item instrument has been finalized with 3 subscales namely obsession, neglect, and control disorder. Cronbach's alpha of the scale was 0.87 and in subscales 0.85, 0.74, and 0.76, respectively. The test-retest correlation coefficient was 0.90. Therefore, the scale



proved to be a reliable measurement to assess Internet addiction disorder (Demetrovics *et al.*, 2008).

### Internet Addiction Test (IAT)

Internet Addiction Test (IAT) has been considered as the first validated measure of Internet addiction disorder and can be utilized within both outpatient and inpatient settings. It was proposed as an extension of Young's Internet Addiction Diagnostic Questionnaire (Young, 1998). IAT is one of the most utilized diagnostic instruments to detect Internet addiction disorder all over the world. The instrument has been constructed to capture the Internet addiction disorder associated with the compulsive use of technology. Compulsive use includes watching online videos, internet gambling, online gaming, and engaging in social media. Internet Addiction Test (IAT) comprises 20 items rated on a six-point Likert scale (from zero- not at all, to five - always).

The tool was used as a self-report instrument for adolescents and adults. It measures the extent of a client's involvement with the computer and classifies the addictive behavior in terms of mild, moderate, or severe impairment. The tool has been translated into many languages including English, Chinese, French, Italian, Turkish, and Korean (Young, 2009). The original version of IAT has been developed to help respondents in three ways. First, for those who have already identified as internet addicts, the questionnaire helps to assess in which areas the problem has impacted the person's life. Second, for those who are not sure if they are internet-addicted, the questionnaire will help them to determine whether they meet the criteria for Internet addiction disorder and assesses the impact. Furthermore, this tool assists those who know somebody who is a possible addict, by allowing that person to identify and rate the particular internet user (Young, 2009).

Developing a suitable and consistent tool for examining Internet addiction disorder was much needed. Although several instruments have been developed, none have emerged as the "gold standard". Young (1998) evaluated the existence and intensity of Internet addiction disorder among a North American population sample. It was a 20-item tool with the statement scored on a Likert scale ranging from zero to five. Each item on the questionnaire is equally valued on a six-point scale, with the total maximum score being 100. A higher score signifies a higher level of intensity in Internet addiction disorder (Young, 2009). Various factor models were proposed in past studies which were possibly influenced by the varying cultures and different samples.

The Internet Addiction Test has initially developed as a unidimensional instrument, but different validation studies have shown a factor structure with two, three, four, or six dimensions in many languages (English, Chinese, French, Finnish, German, Italian, Greek, Arabic, and Portuguese (Fernández-Villa *et al.*, 2015). Widyanto & McMurrin (2004) assessed the psychometric properties of the IAT during 2004 and revealed six factors (salience, excessive

use, neglect of work, anticipation, lack of control, and neglect of social life) from the 20-item questionnaire. These scales have shown good to moderate internal consistency. There were 86 eligible participants recruited as volunteers. It was not a random sample, and the sample size was also relatively small for a validation study.

Fernandez-Villa *et al.* (2015) developed a Spanish version of the IAT and analyzed its psychometric properties among college students. The results showed good reliability and psychometric properties of the tool with a two-dimensional solution. The IAT has been adapted using the translation and back-translation method to Spanish. Two factors have been identified by the psychometric assessment which explained 55% of the variance with a total internal consistency of 0.91. The identified factors were emotional investment and performance with time management. Confirmatory factor analysis was conducted to test the fit of the factor structure and showed acceptable goodness of fit. The test-retest scores were analyzed for the reliability assessment. The correlation of the total scores of both tests was good ( $r = 0.899$ ) (Fernández-Villa *et al.*, 2015). Therefore, this Spanish version of IAT demonstrated good evidence of reliability and acceptable psychometric properties for use in the diagnosis of Internet addiction disorder among college students. Dhir, Chen, and Nieminen (2015) validated the IAT among Indian adolescents. There were 1914 high school students aged 12 to 18 years. The Kaiser-Meyer-Olkin test value was 0.97 and confirmed the suitability of data for the analysis. The results showed a single-factor model. The model demonstrated good psychometric properties and was explaining 41.4% of the variance. The data showed high internal consistency and reliability for the tool with Cronbach's alpha value of 0.88. The study revealed IAT is a valid and reliable self-reporting instrument for the assessment of Internet addiction disorder among Indian adolescents (Dhir *et al.*, 2015).

A Croatian preliminary study, conducted in 2016 for the validation of IAT obtained a three-factor structure. The factors obtained were emotional and cognitive internet preoccupation, neglecting work and lack of self-control, and social problems. Randomly selected 352 high school students aged between 15 and 20 years were recruited for the study. All the components explained 51.64% of the total variance. The results of the confirmatory factor analysis indicated that the three-factor model has been well suited to the data and confirmed the obtained structure (Černja *et al.*, 2019).

Samaha *et al.* (2018) assessed the psychometric properties of IAT among Lebanese college students in 2017 has resulted in a four-factor solution. There were 256 medical students included from a private university in Lebanon. These four factors were lack of control, social withdrawal with emotional conflict, time management problems, and concealing problematic behavior. These factors have explained 56.5% of the total variance. Confirmatory factor analysis was conducted in another

sample and the construct has been considered acceptable. All the factor loadings were found to have a statistically significant result ( $p < 0.05$ ). Cronbach's alpha coefficient was estimated for the reliability of the measurement. The internal reliability score of the scale was 0.914. The study concluded that the Internet Addiction Test is a proper tool for evaluating Internet addiction disorder among Lebanese university students. However, the study has been only concerned with university students as its target population.

Therefore, generalizing the findings of this study to other teenage or young adult populations has not been recommended. There have been limited efforts were taken to measure Internet addiction disorder with a reliable and validated tool among adolescents in Sri Lanka. Thus, IAT did not have a version in Sri Lanka for this population. Its psychometric properties are also not known. A descriptive cross-sectional study was conducted on modern information technology behavior among the young working population in Gampaha district, Sri Lanka, in 2017 (Perera, 2017).

The study assessed the psychometric properties of the Internet Addiction Test in 320 study participants. The development and the cultural adaptation of the tool were carried out by the experts with the modified Delphi technique. The validity of the Internet Addiction Test was assessed using face, consensual, content, and construct validity. Good model fit was demonstrated for the Internet Addiction Test with the Root Mean Square Error of Approximation (RMSEA) of 0.07, Comparative Fit Index (CFI) of 0.96, Non-Normed Fit Index (NNFI) of 0.95, Standardized Root Mean Square Residual (SRMR) of 0.06 and Goodness of Fit (GFI) of 0.86.

The study concluded that the Internet Addiction Test can be considered a valid and reliable tool to be used among young working adults in Sri Lanka (Perera, 2017). Since the study populations and the cultural contexts are different between the two studies, the validated tool of IAT for the young working population cannot be applied to the adolescents in the present study.

## MATERIALS AND METHODS

This component is a descriptive cross-sectional validation study that includes adaptation, translation, and validation of the Internet Addiction Test (IAT). The definition of Internet addiction disorder has been operationalized following an extensive literature search. All the available definitions found in the literature have been listed and the following definition was selected as the operational case definition for Internet addiction disorder with the consensus of the experts.

“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.*, 2016). 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 pediatrician, 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 on 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 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.

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 into the Tamil language. The English version of the Internet Addiction Test (IAT) following the alteration of the sentence pattern was forward translated to Tamil by four different experts independently. The synthesized translated version to Tamil after the forward translation was sent to two consultant community physicians for the backward translation independently. Following the individual backward translations, a synthesized single backward-translated version was created.

The 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 acceptable. Discrepancies found were sorted out through discussions with the expert panel. Eventually, all the items in the translated Tamil version of the Internet Addiction Test (IAT) were forwarded for pretesting of the questionnaire. During pretesting, a few

modifications in sentences were made to understand the questions better. However, no items in the questionnaire were found to be difficult to understand. The average time taken to complete the questionnaire by the student was less than 10 minutes.

The instrument was further examined by the principal investigator following the pretesting process to finalize the tool for the judgmental and construct validation process. Unclear words and items that have been identified were further discussed with the members of the expert committee and final adjustments were made based on subjective judgment. The validity of a questionnaire is determined by analyzing whether the questionnaire measures what it is intended to measure. The translated Tamil version was subjected to the judgmental and construct validation process.

The routine practice was to compare the tool to be validated with a gold standard method (criterion validation). The major issue in criterion validity testing for the IAT was the lack of gold standards. Therefore, only judgmental validity (face, content, consensual validity) and construct validity were carried out. 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 analyses 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-Tamil 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 cut-offs that indicate a good fit.

This is a descriptive cross-sectional validation study the data collection was completed in January 2021. Two separate samples were taken for Exploratory Factor Analysis and Confirmatory Factor Analysis and the study setting for the IAT-Tamil version was conducted in six Tamil medium schools in Galle district. The study population was 15-19-year-old school-going adolescents in Tamil medium schools in Galle district. Adolescents aged 15-19 years who were intellectually impaired have excluded from the study.

The final sample was 446, and half of the collected data was used to perform Exploratory Factor Analysis and the rest for the Confirmatory Factor Analysis. The required number of participants was recruited by the Convenience

sampling method where the sample was taken from six Tamil medium schools in Galle district. Confirmatory Factor Analysis was carried out by using Linear Structural Relations (LISREL-8.8) statistical software package to identify the extent to which the model was replicable in the data. Normality and multicollinearity of the data were studied to assess the compatibility of data for Confirmatory Factor Analysis. Assessment of reliability was done by Internal consistency and Test-Retest reliability.

## RESULTS AND DISCUSSION

### Exploratory factor analysis of IAT-Tamil version

There were 225 adolescents in the age group of 15 to 19 years recruited for the Exploratory Factor Analysis. All the responses of the participants were individually checked to ensure that they were all within the range on the Likert scale (minimum of 0 and a maximum of 5) and the completeness of data. The response rate was 99%. Sampling adequacy for Principal Component Analysis (PCA) in terms of Bartlett's Test of Sphericity and a Kaiser-Meyer-Olkin Measure for the IAT-Tamil version. Sampling adequacy was assessed by the statistics of Bartlett's Test of Sphericity and a Kaiser-Meyer-Olkin Measure.

**Table 1:** KMO and Bartlett's Test for IAT-Tamil version

KMO measure of sampling adequacy		0.885
Bartlett's Test of Sphericity	$\chi^2$	4892.6
	df	190
	Sig	0.001

KMO-Kaiser-Meyer-Olkin Measure,  $\chi^2$ -Chi-square statistic, df-degree of freedom, sig-significance

Bartlett's test of sphericity reported significant results with  $\chi^2 = 4892.6$ ,  $df=190$ , and  $p<0.001$ . Kaiser-Meyer-Olkin Measure (KMO) measure was reported as 0.885 and it is above the required value of 0.6. The literature emphasized that KMO value of 0.5 or more has been used as the cut-off for adequate factorability (Osborne & Costello, 2004). Bartlett's test of sphericity was conducted to determine whether the matrix is significantly different from an identity matrix. The test reported significant results and the null hypothesis was rejected and concluded factor analysis is appropriate.

### Assessment of the factor structure of the instrument -IAT-Tamil version

Exploratory Factor Analysis was carried out to assess the underlying factor structure of the Internet Addiction Test (IAT). Factor eigenvalues were used to determine the number of factors to be rotated and an eigenvalue of 1.0 or greater has been retained for the analysis.

### Total variance explained in Principal Component Analysis (PCA) of IAT-Tamil version

The IAT-Tamil version demonstrated three factors which

**Table 2:** Pattern matrix of Principal Component Analysis (PCA) for the factor solution IAT-Tamil version

Item	Component		
	1	2	3
Item2	.966		
Item 7	.877		
Item 6	.857		
Item 4	.827		
Item 13	.804		
Item 11	.802		
Item 10	.747		
Item 19	.680		
Item 15	.666		
Item 20	.499		
Item 8		.907	
Item 1		.902	
Item 14		.902	
Item 5		.874	
Item 18		.831	
Item 16		.792	
Item 17		.750	
Item 12			.848
Item 3			.673
Item 9			.645

are having eigenvalues more than one. The Eigenvalues ranged from 1.025 to 10.807. The three factors extracted were able to explain a total of 74.07 % of the variance. The scree plot has also been examined to identify potential meaningful factors and the Cattell's scree test supported the appropriateness of factors extracted. Pattern matrix demonstrates factor loading of each item onto the factors and shows whether the items are labeled together. The level of factor loading was set as 0.40 and factor loadings with more than 0.40 were shown in the pattern matrix.

Items in the Internet Addiction Test(IAT)-Tamil version loaded well with a factor loading of more than 0.4 into three factors from the re-rotation. Three factors identified coincided with the original scale of the Internet addiction test (IAT) with the inclusion of all 20 items.

#### Identified factors and included items for each factor

Identified factors were salience, excessive use, and lack of control. The relevant items included in each factor were demonstrated. Among the identified factors ten items

**Table 3:** Identified factors and respective items included in the IAT-Tamil version

Identified factor	Number of items	Included items
Salience	10	2,7,6,4,13,11,10,19,15,20
Excessive use	7	8,1,14,5,18,16,17
Lack of control	3	12,3,9

were included in salience, seven factors in excessive use, and three factors in lack of control.

#### Pattern matrix with factors and included items for each factor

All 20 items in the IAT-original English version were included. The pattern matrix of principal component analysis demonstrates the identified factors and includes items. Accordingly, all the items included in the original scale were included for the Confirmatory Factor Analysis.

#### Confirmatory Factor Analysis of IAT-Tamil version

Confirmatory Factor Analysis was carried out to determine the goodness of fit of the factor structure obtained from Exploratory Factor Analysis. A total of 240 study participants were recruited for the Confirmatory Factor Analysis of the IAT-Tamil version. Assessment of the data set has been assessed for the comparability for confirmatory Factor Analysis(CFA) to determine any violations of assumptions demanded by the analytical techniques. Researchers recommend a minimum subject-



to-item ratio of at least 5:1(Cattell, 1966). However, the present study is having a total of 240 study participants for the 20 items. The normality was determined by computing item histogram and the data showed a non-normal distribution the linearity of the data set was assessed through inspection of the bivariate scatter plots and showed a linear relationship. Multicollinearity has been assessed. The matrix of correlations between the individual variables (bivariate correlations between items)

was analyzed since the items in the model must not be correlated and none of them were highly correlated.

#### Assessing the comparability of the factor structure

Confirmatory Factor Analysis (CFA) was carried out to determine the comparability of the factor structure obtained following Principal Component Analysis by using a different sample to find the best-fitting model of the data.

**Table 4:** Cut-off values for a good fit in different fit indices and measures of the IAT-Tamil version

Fit Index	IAT-Tamil version	Cut-off values for good Fit
1.Absolute fit indices		
Standardized Root Mean squared Residual (SRMR)	0.066	<0.08
2.Comparative fit indices		
Non-Normed Fit Index (NNFI)	0.87	>0.90
Comparative Fit Index (CFI)	0.91	>0.90
3.Parsimony fit indices		
Root Mean Squared Error of Approximation (RMSEA)	0.07	<0.06

The model indices of the IAT-Tamil version were RMSEA=0.07, CFI=0.91, NNFI=0.87, and SRMR=0.066. These model fit indices values were compared with the desired values.

**Table 5:** Comparison of Goodness of fit indices of IAT-Tamil version and other IAT factor structures

Model	Current study	(Kaya et al., 2016)	(Cernja et al., 2019)
Number of Items	20	18	20
Number of Factors	03	03	03
CFI	0.91	0.88	0.882
NNFI	0.87	0.87	-
SRMR	0.066	0.07	-
RMSEA	0.07	0.06	0.075

IAT-Internet Addiction Test, CFI- Comparative Fit Index, NNFI-Non-Normal Fit Index, SRMR-Standardized Root Mean Square Residual, RMSEA-Root Mean Square Error of Approximation. The comparison of the Goodness of fit indices of the IAT-Tamil version in the present study and other IAT factor structures was demonstrated with the relevant values. The model indices of the IAT-Tamil version were RMSEA=0.07, CFI=0.91, NNFI=0.87, and SRMR=0.066. Similar factor models were demonstrated by Kaya *et al.* (2016) and Cernja *et al.* (2019).

#### Assessment of reliability of the IAT-Tamil version

The reliability of the IAT-Tamil version was assessed by calculating the internal consistency and assessing the Test-retest reliability

#### Calculating the internal consistency

Cronbach alpha ( $\alpha$ ) coefficient for each subscale of Internet Addiction Test(IAT) was calculated to determine Internal consistency. The sample obtained for CFA was used for the analysis.

**Table 6:** Cronbach's alpha values for the total scale and three subscales of the IAT-Tamil version

Scale	Cronbach's Alpha values	Number of items
1	0.948	10
2	0.921	07
3	0.824	03
Total	0.948	20

The items of the IAT-Tamil version were found to have good internal consistency with Cronbach's alpha of 0.948 for the total scale. High internal consistency was demonstrated within all the subscales.

#### Test-Retest reliability

Reliability was also assessed by Test-Retest reliability. It was assessed by re-administration of the instrument to

a subsample of 32 adolescents following two weeks with Pearson's correlation coefficient.



**Table 7:** Correlation coefficient of three subscales of IAT-Tamil version

Scale	Correlation coefficient
1	0.763
2	0.943
3	0.908s
<b>Total</b>	<b>0.912</b>

**Table 8:** Factors and Items of the final IAT-Tamil version

Item	Component		
	1	2	3
Salience 1	.966		
Salience 2	.877		
Salience 3	.857		
Salience 4	.827		
Salience 5	.804		
Salience 6	.802		
Salience 7	.747		
Salience 8	.680		
Salience 9	.666		
Salience 10	.499		
Excessive use 1		.907	
Excessive use 2		.902	
Excessive use 3		.902	
Excessive use 4		.874	
Excessive use 5		.831	
Excessive use 6		.792	
Excessive use 7		.750	
Loss of control 1			.848
Loss of control 2			.673
Loss of control 3			.645

**Table 9:** Final IAT 20 Items in IAT-Tamil version

No	Statement	0	1	2	3	4	5
1	How often do you find that you stay online longer than you intended?	0	1	2	3	4	5
2	How often do you neglect household routine activities/your educational activities to spend more time on Internet?	0	1	2	3	4	5
3	How often do you prefer the joy through the Internet rather than enjoying it with your family members?	0	1	2	3	4	5
4	How often do you form new relationships with fellow online users?	0	1	2	3	4	5
5	How often do others in your life complain to you about the excessive amount of time you spend online?	0	1	2	3	4	5
6	How often do your grades or schoolwork do suffers because of the amount of time you spend online?	0	1	2	3	4	5
7	How often do you check your email before something else that you need to do?	0	1	2	3	4	5
8	How often does your educational performance or productivity suffer because of the Internet?	0	1	2	3	4	5
9	How often do you become defensive or secretive when anyone asks you what you do online?	0	1	2	3	4	5
10	How often do you deviate from disturbing thoughts in your life by using the Internet?	0	1	2	3	4	5

11	How often do you find yourself anticipating when you will go online again?	0	1	2	3	4	5
12	How often do you fear that life without the Internet would be boring, empty, and joyless?	0	1	2	3	4	5
13	How often do you snap, yell, or act annoyed if someone bothers you while you are online?	0	1	2	3	4	5
14	How often do you lose sleep due to being online?	0	1	2	3	4	5
15	How often do you feel preoccupied with the Internet when off-line, or fantasize about being online?	0	1	2	3	4	5
16	How often do you find yourself saying "just a few more minutes" when online?	0	1	2	3	4	5
17	How often do you try to cut down the amount of time you spend online and fail?	0	1	2	3	4	5
18	How often do you try to hide how long you have been online?	0	1	2	3	4	5
19	How often do you choose to spend more time online over going out with others?	0	1	2	3	4	5
20	How often do you feel depressed, moody, or nervous when you are off-line, which goes away once you are back online?	0	1	2	3	4	5

Three subscales were demonstrated to have strong positive correlations. The Correlation Coefficient of the total IAT-Tamil version was 0.912 and demonstrated good inter-rater reliability. All the correlation coefficients were statistically significant with a p-value of  $< 0.001$ . 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 completion by an individual.

The individual statements were simple and easily 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. Psychometrics has an immense role in measuring health outcomes across the globe. To use the scales in a different culture, there is a need to adapt the instrument appropriately.

The cultural adaptation process requires standard adaptation procedures and assessment of reliability and validity. The IAT original English version was cross-culturally adapted. This process has reduced the risk of introducing bias into the study and ensured the concepts within the instrument were equal between the original and target language, time, and context. This was conducted with the modified Delphi method, which enabled obtaining the views of important stakeholders. All the experts agreed upon all original items in the IAT-English version are relevant in the assessment of Internet addiction disorder.

The sentence pattern of questions number 2,3 and 8 was altered according to the Sri Lankan culture and to suit adolescents. However, the original structure of the IAT has not been changed. The translation process of the questionnaires was carried out according to the proposed guidelines provided for the validation of cross-cultural

assessment instruments to obtain semantic, idiomatic, experiential, and conceptual equivalence in the translation. The IAT-Tamil version is a three-factor model, and the identified factors were salience (ten items), excessive use (seven items), and lack of control (three items).

The model indices of the IAT-Tamil version were RMSEA=0.07, CFI=0.91, NNFI=0.87, and SRMR=0.066. The IAT-Tamil version also demonstrated excellent reliability and psychometric properties with a Cronbach alpha of 0.948. Although many structural variations have been identified in other three-factor models, the IAT-Tamil version shares some similarities with previous research. Cernja, Vejmelka, and Rajter (2019) obtained a three-factor model that explained 51.64% of the total variance and the fit indices were RMSEA = 0.075, CFI = 0.882, SRMR = 0.056.

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

During the validation of the Internet Addiction Test (IAT), only judgemental validity and construct validity were carried out and criterion validity was not conducted. The routine practice was to compare the tool to be validated with a gold standard method (criterion validation). The major issue in criterion validity testing for the IAT was the lack of gold standards. Therefore, only judgmental validity (face, content, consensual validity) and construct validity were carried out and it was a limitation in this study.

The study was conducted on 15-19-year-old school-going adolescents in Colombo district, Sri Lanka. The study population does not include non-school-going adolescents and adolescents in paying schools. Therefore, the study findings are not possible to generalize to the whole adolescent population.

### REFERENCES

- Abramson, J. H. Abramson and Z. H. (1999). Research Methods in Community Medicine: Surveys, Epidemiological Research, Programme Evaluation, Clinical Trials.

- Beard, Keith W. (2005). Techniques and Potential Assessment Questions. *CyberPsychology & Behavior* 8(1), 7–15.
- Cash, Hilarie, Cosette D. Rae, Ann H. Steel, and Alexander Winkler. (2012a). Internet Addiction A Brief Summary of Research and Practice-Cash et Al(2012).Pdf. *Current Psychiatry*, 800, 292–98.
- Cattell. (1966). Exploratory Factor Analysis: A Guide to Best Practice.
- Černja, Iva, Lucija Vejmelka, and Miroslav Rajter. (2019). Internet Addiction Test: Croatian Preliminary Study. *BMC Psychiatry* 19(1), 1–11.
- Dalal, P. K., and Debasish Basu. (2016). Twenty Years of Internet Addiction...Quo Vadis? *Indian Journal of Psychiatry*, 58(1), 6–11.
- Demetrovics, Zsolt, Beatrix Szeredi, and Sándor Rózsa. (2008). The Three-Factor Model of Internet Addiction: The Development of the Problematic Internet Use Questionnaire. *Behavior Research Methods* 40(2), 563–74.
- Dhir, Amandeep, Sufen Chen, and Marko Nieminen. (2015). Psychometric Validation of Internet Addiction Test with Indian Adolescents. *Journal of Educational Computing Research*, 53(1), 15–31.
- Fernández-Villa, Tania, Antonio J. Molina, Miguel García-Martín, Javier Llorca, Miguel Delgado-Rodríguez, and Vicente Martín. (2015). Validation and Psychometric Analysis of the Internet Addiction Test in Spanish among College Students. *BMC Public Health* 15(1), 1–9.
- Fernando, K. D. Nathalia. (2015). A study of face book addiction level among teenage school students in Sri Lanka(in Negambo educational Zone).
- Griffiths, M. D., Daria, J. K., Joël, B., & Halley, M. P. (2016). The Evolution of Internet Addiction: A Global Perspective. *Addictive Behaviors*, 53, 193–195.
- Kaya, Fatih, Erhan Delen, and Kimberly S. Young. (2016). Psychometric Properties of the Internet Addiction Test in Turkish. *Journal of Behavioral Addictions* 5(1), 130–34.
- Ko, Chih Hung, Ju Yu Yen, Cheng Fang Yen, Cheng Chung Chen, Chia Nan Yen, and Sue Huei Chen. (2005). Screening for Internet Addiction: An Empirical Study on Cut-off Points for the Chen Internet Addiction Scale. *Kaohsiung Journal of Medical Sciences* 21(12), 545–51.
- Li, Shanshan, Qianjin Wu, Cheng Tang, Zichao Chen, and Li Liu. (2020, June 11). *Exercise-Based Interventions for Internet Addiction: Neurobiological and Neuropsychological Evidence*. Frontiers in Psychology.
- Osborne, Jason W., and Anna B. Costello. (2004). Sample Size and Subject to Item Ratio in Principal Components Analysis. *Practical Assessment, Research and Evaluation* 9(11).
- Perera. (2017). Modern Information and Communication Technology Behaviour among Young Information and Communication Technology Users in Gampaha District.
- Ruano, Paula, Lismet Lazo Delgado, Sergio Picco, Liliana Villegas, Franco Tonelli, Mario Merlo, Javier Rigau, Dario Diaz, and Martin Masuelli. (2016). We Are IntechOpen , the World's Leading Publisher of Open Access Books Built by Scientists , for Scientists TOP 1%. Intech (tourism), 13.
- Salicetia, Francesca. (2015). Internet Addiction Disorder (IAD). *Procedia-Social and Behavioral Sciences* 191, 1372–76.
- Shaw, M., & Donald, W. B. (2008). Internet Addiction and Clinical Management. *CNS Drugs*, 22(5), 353–366.
- Tsitsika, A., Mari, J., Tim, M. S., Eleni, C. T., Kjartan, Ó., Szymon, W., George, F. M., Chara, T., & Clive R. (2014). Internet Addictive Behavior in Adolescence: A Cross-Sectional Study in Seven European Countries. *Cyberpsychology, Behavior, and Social Networking*, 17(8), 528–535.
- Vondráčková, Petra, and Roman Gabrhelík. (2016). Prevention of Internet Addiction: A Systematic Review. *Journal of Behavioral Addictions* 5(4), 568-79.
- Widyanto, Laura, and Mary McMurran. (2004). The Psychometric Properties of the Internet Addiction Test. *Cyberpsychology and Behavior*, 7(4), 443–50.
- Young, K. S. (1998). Internet Addiction: The Emergence of a New Clinical Disorder. *Cyberpsychology and Behavior*, 1(3), 237–244.
- Young, K. S. (2009). Internet Addiction Test Online. Stoelting, 4–11.
- Young, K. S. (2017). The Evolution of Internet Addiction. *Addictive Behaviors*, 64, 229–230.