

Psychometric Properties for the Malay Version of the Assessment of Criteria for Specific Internet-use Disorders among Young Adults in Malaysia

Abstract

Introduction: Problematic internet use (PIU) can present itself in a variety of online activities. Given the increasing prevalence of PIU among young adults, there is a dearth of comprehensive assessment tools to characterize various PIU in Malaysia. The 11-item Assessment of Criteria for Specific Internet-use Disorders (ACSID-11) assesses specific PIU including online gaming, online buying-shopping, online pornography use, social networking use, and online gambling. The present study investigated the psychometric properties of the Malay ACSID-11. **Methods:** A cross-sectional study using an online survey was used for the data collection. The sample comprised 610 young adults aged 22.55 years (standard deviation ± 3.49). Participants were recruited from July 2023 to September 2023 using convenience sampling. **Results:** The confirmatory factor analysis findings supported the four-factor structure of the Malay ACSID-11 across gender, ethnicity, and academic achievement with good fit statistics: comparative fit index (CFI) ≥ 0.968 , Tucker-Lewis index (TLI) ≥ 0.949 , root mean square error of approximation (RMSEA) ≥ 0.057 , standardized root mean square residual (SRMR) ≥ 0.028 (frequency response); CFI ≥ 0.968 , TLI ≥ 0.958 , RMSEA ≥ 0.079 , SRMR ≥ 0.033 (intensity response). The different online subscales (except for some of the ACSID-11 online gambling subscales) showed good internal consistency (Cronbach's α and McDonald's ω between 0.58 and 0.90 for frequency responses; Cronbach's α and McDonald's ω between 0.61 and 0.93 for intensity responses). **Conclusion:** The Malay ACSID-11 is a valid and reliable instrument for assessing various specific PIU among Malaysian young adults. However, caution is required using the ACSID-11 to assess online gambling because some of its subscales had low internal consistency.

Keywords: Assessment of Criteria For Specific Internet-Use Disorders, behavioral addiction, factor analysis, online addictions, psychometric validation

Introduction

Internet use has become an everyday activity for communication and networking and has rapidly expanded among both individual users and work organizations, particularly in the aftermath of the COVID-19 pandemic.^[1] The global COVID-19 pandemic forced most individuals to stay at home, leading to significant changes in social dynamics.^[2-4] As a result, the use of online services increased significantly, ranging from 40% to 100%.^[5,6] This may have led to some individuals experiencing problematic internet use (PIU).

PIU refers to impulse control and behavioral problems relating to an individual's internet use. Asia has a higher prevalence of PIU, particularly among adolescents and emerging adults.^[7] Young adults typically spend more

than 3 h per day online and are attracted to and preoccupied with various online activities.^[8-10] PIU is an emerging global issue. Engaging in problematic online activity can affect an individual's time management, energy, and attention during the day, as well as alter sleep patterns or facilitate insomnia at night.^[11]

Concerns have been raised about the consequence of PIU, such as physical and mental health problems.^[12-14] It has been reported that PIU is associated with mental health disorders such as anxiety and depression among university students.^[15,16] The prevalence of PIU among adolescents in Malaysia (where the present study was carried out) has been reported to be between 2.4% and 16%.^[17] PIU has also been associated with mental health problems among Malaysian adolescents.^[17]

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In addition, the National Health and Morbidity Survey in Malaysia^[18] reported that more than 30% of Malaysian children and adults experienced mental health problems, among which depression and anxiety were the most observed. Therefore, it is conceivable that some of these mental health problems may be attributable to problematic use of the internet.^[19]

Recently, problematic internet-related behaviors have gained considerable attention. The fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5) recognized internet gaming disorder (IGD) as a potential behavioral addiction.^[20] Moreover, the World Health Organization formally included gaming disorder (GD) as a mental health disorder in the eleventh revision of the *International Classification of Diseases* (ICD-11).^[21,22] Although IGD has been recognized in the DSM-5 and ICD-11, other specific and generalized PIUs have not formally classified. There is no consensus on the classification and definition of specific and generalized types of PIU,^[23] highlighting the need to identify different types through standardized diagnostic criteria, while acknowledging the complex interactions between different forms of problematic online behaviors.

In the multi-dimensional digital realm, PIU can manifest across various online activities, including social networking, online shopping, online gaming, online gambling, and online pornography use.^[23] Media multitasking is a prevalent behavior among young adults and has been inversely associated with both poor academic performance and socioemotional functioning.^[24] Moreover, it may contribute to the rising burden of mental distress, self-harm or suicidal behavior among youth.^[25] Therefore, acquiring screening instruments which can assess different types of PIU is important for their prevention, especially for individuals with poor impulse control. Research has indicated that individuals with poor impulse control may be more susceptible to detrimental effects of media

multitasking.^[26] Therefore, an appropriate screening assessment approach to screen for all types of PIU is crucially needed.

In Malaysia, there is a lack of a comprehensive assessment tool to assess and delineate different types of PIU. The Assessment of Criteria for Specific Internet-use Disorders (ACSID-11),^[23] an instrument assessing various online behaviors based on the ICD-11 diagnostic criteria for GD, has been developed. It is a comprehensive instrument known for its high reliability and validity, designed to assess specific types of PIU, including GD, online gambling disorder, online buying-shopping disorder, online pornography use disorder, and social networking use disorder.^[12]

The original developers of the ACSID-11 encouraged future research to examine psychometric invariance of the scale across different population groups,^[23] although evaluation is needed to establish measurement invariance to examine how diverse groups interpret the meaning of separate items in a psychometric scale.^[27] Therefore, the present study examined psychometric properties of the Malay ACSID-11 given that there is no comprehensive PIU assessment instrument validated in the Malaysian language. The objectives of the present study were to (i) translate the ACSID-11 into Malay, (ii) evaluate the psychometric properties of the Malay ACSID-11, including measurement invariance, and (iii) provide further evidence of the ACSID-11's capacity to assess major types of specific PIU.

Methods

Study design

A cross-sectional study was conducted among university students to establish the validity and the reliability of the ACSID-11. An anonymous online survey (via *Google Forms*) was used for data collection. The data were collected from July 2023 to September 2023 in Malaysia.

Participants and sampling procedure

A total of 610 university students (425 females and 185 males) from Malaysia participated in the study. Participants were recruited using convenience sampling. Potential participants were invited to participate in the study through a link to the online survey, which was disseminated through social media platforms and online forums of Malaysian universities. To be eligible, participants had to meet the following criteria: (i) be aged over 18 years, and (ii) be enrolled at a university in Malaysia. Participants were provided with relevant information about the study, including its purpose and the confidentiality of personal data.

Measures

Assessment of Criteria for Specific Internet-use Disorders

The ACSID-11 assesses five specific types of PIU (i.e., gaming, online shopping, online pornography use, social networking use, and online gambling).^[23] The scale consists of 11 items representing ICD-11 disorder criteria for addictive behavior, comprising three domains (with three items each): impaired control (IC); increased priority given to the online activity (IP); and continuation/escalation (CE) of internet use despite negative consequences.^[23] Additionally, the scale also contains two items for assessing functional impairment in daily life (FI) and marked distress due to the online activity.^[23] Participants were required to report their experiences of online activities (i.e., gaming, online shopping, online pornography use, social networking use, online gambling, and other) in the past year by answering “yes” or “no.”^[23] Subsequently, participants can answer the ACSID-11 items for each of their online activities. Each item of the ACSID-11 is answered in relation to both frequency and intensity. Frequency responses range from 0 (*never*) to 4 (*often*), and intensity responses range from 0 (*not at all intense*) to 4 (*intense*). For each online activity of the ACSID-11, a total score is calculated by adding item scores in each independent domain (i.e., IC, IP, CE, and FI). A higher score indicates greater PIU risk for that particular online activity. The ACSID-11 possesses reliable and valid psychometric properties in various language versions.^[23,28]

Translation procedure

Permission was obtained from Professor Matthias Brand to translate and validate the English version of ACSID-11 into the Malay language. The translation of the Malay version of ACSID-11 followed a standardized process, including forward translation, backward translation, and reconciliation.^[29] In the first step, two bilingual native Malay speakers, proficient in both Malay and English languages, independently translated ACSID-11 from English to Malay, resulting in two different forward translations. The two forward translations were then consolidated and synthesized into a single forward translation. This synthesized forward translation was then independently translated back into

English by two Malaysian translators, resulting in two backward translations. In order to finalize the Malay version of ACSID-11, expert committees specializing in educational psychology, social science, and language literacy thoroughly reviewed and deliberated on all translation versions, including the two forward translations, the consolidated forward translation, and the two backward translations. This meticulous process was designed to ensure linguistic equivalence and cultural adaptations, and to lay the groundwork for subsequent formal psychometric testing.

Ethical considerations

The present study was approved by the Universiti Malaya Research Ethics Committee (UMREC) (UM.TNC2/UMREC_2785) before data collection. Participants were provided with relevant information about the study, including its purpose and the confidentiality of personal data. Participants were asked to provide their informed consent before they could complete the online survey.

Statistical analysis

All statistical analyses were conducted using the JASP^[30] (from University of Amsterdam; Netherlands). Item distribution (i.e., skewness and kurtosis) of the ACSID-11 was performed. For item analyses, factor loadings were evaluated, derived by standardized coefficients in the confirmatory factor analysis (CFA) and the corrected item-total correlation. Both factor loadings and the corrected item-total correlation values had to be more than 0.40.^[31] For assessing internal consistency, Cronbach's α and McDonald's ω coefficients were calculated, considering values ≥ 0.7 indicative of good internal consistency.^[32]

Confirmatory factor analysis and measurement invariance

CFA was performed to examine construct validity (one-factor structure vs. four-factor structure) of the ACSID-11 to verify its factor structure. CFA was computed using a maximum likelihood estimation. In addition, χ^2 statistics, comparative fit index (CFI), Tucker-Lewis index (TLI), standardized root mean square residual (SRMR), and root mean square error of approximation (RMSEA) were used to evaluate for goodness of fit statistics, with nonsignificant χ^2 , CFI > 0.9, TLI > 0.9, RMSEA < 0.08, and SRMR < 0.08 indicating robust fit indices.

For the analysis of measurement invariance, the confirmed factor structure of the ACSID-11 (either the one-factor or the four-factor structure) was assessed using multi-group CFA (MGCFA) across subgroups based on gender (female vs. male), ethnicity (Malay vs. nonMalay), and Cumulative Grade Point Average (CPGA) (<3.50 vs. 3.50 and above). Three nested models were performed in the following steps: (i) configural invariance (investigating if the factor structure was similar between groups); (ii) metric invariance (investigating if the factor loadings of the ACSID-11 items were similar between groups);

and (iii) scalar invariance (investigating if the intercepts of the items were similar between groups). To determine if invariance was supported, every two nested models should not be significantly different from each other, indicated by the nonsignificant χ^2 difference test, and cutoff values of Δ CFI, Δ RMSEA, and Δ SRMR below 0.01.

Results

Table 1 shows that 610 total individuals participated (females = 425), mean age of the participants was 22.55 years (standard deviation [SD] = 3.49). Most participants had no condition or disease during the survey period (93%), and most participants were studying an undergraduate major (87.5%). The mean CGPA was 3.64 (SD = 0.33), with 452 participants having a CGPA 3.50 and above (74.1%). There were similar numbers of participants for ethnicity (301 Malay [49.3%] and 309 non-Malay [50.7%]). In terms of ACSID-11 behaviors, 55.7% engaged in gaming ($n = 370$), 92.1% engaged in online shopping ($n = 562$), 18.5% used online pornography ($n = 113$), 98.5% engaged in social networking ($n = 601$), and 4.8% engaged in online gambling ($n = 29$).

The majority of the ACSID-11 items showed strong factor loadings and corrected item-total correlation for both frequency and intensity responses. However, Item 1 of social networking use behavior (frequency response) presented slightly lower factor loadings (0.34) and

corrected item-total correlation (0.30). Moreover, Item 1 of online gambling (both frequency and intensity responses) presented low factor loadings and corrected item-total correlation, and Item 4 of online gambling (frequency response) presented a low corrected item-total correlation. In terms of item distribution, most skewness and kurtosis values were low for both frequency and intensity responses. However, items related to online pornography use and online gambling presented high values for both skewness and kurtosis for both frequency and intensity responses.

Table 2 shows that all the online activities in the ACSID-11 subscales presented excellent internal consistency reliability, except for online gambling activity. Specifically, only part of the subscales in the ACSID-11 online gambling presented poor internal consistency. Moreover,

Table 2: Internal consistency of the Assessment of Criteria for Specific Internet-use Disorders-11

	Frequency		Intensity	
	α^b	ω^c	α^b	ω^c
Gaming				
AC-IC	0.74	0.74	0.82	0.83
AC-IP	0.82	0.83	0.87	0.88
AC-CE	0.89	0.89	0.91	0.91
AC-FI	0.87	0.87	0.89	0.89
Online shopping				
AC-IC	0.73	0.75	0.79	0.80
AC-IP	0.82	0.83	0.86	0.87
AC-CE	0.90	0.90	0.92	0.93
AC-FI	0.88	0.88	0.91	0.91
Online pornography				
AC-IC	0.75	0.77	0.75	0.77
AC-IP	0.77	0.79	0.85	0.85
AC-CE	0.88	0.88	0.93	0.93
AC-FI	0.86	0.86	0.92	0.92
Social networking use				
AC-IC	0.66	0.69	0.76	0.77
AC-IP	0.79	0.81	0.84	0.85
AC-CE	0.84	0.84	0.88	0.88
AC-FI	0.84	0.84	0.87	0.87
Online gambling				
AC-IC	0.58	0.61	0.61	0.65
AC-IP	0.70	0.73	0.83	0.84
AC-CE	0.88	0.88	0.93	0.93
AC-FI	0.83	0.84	0.91	0.91

^b α and ^c ω reliability analysis for each domain. ACSID-11: 11-item Assessment of Criteria for Specific Internet-use Disorders, AC-IC: Assessment of Criteria for Specific Internet-use Disorders (IC domain score), AC-IP: Assessment of Criteria for Specific Internet-use Disorders (increased priority given to the online activity domain score), AC-CE: Assessment of Criteria for Specific Internet-use Disorders (CE domain score), AC-FI: Assessment of Criteria for Specific Internet-use Disorders (FI domain in daily life and MD score), α : Cronbach alpha coefficient, ω : McDonald omega coefficient, IC: Impaired control, CE: Continuation/escalation, FI: Functional impairment, MD: Marked distress

Table 1: The characteristics of participants ($n=610$)

	n (%)
Age (years), mean $\pm$ SD	22.55 $\pm$ 3.49
Gender	
Male	185 (30.3)
Female	425 (69.7)
Any condition or disease	
Yes	43 (7)
No	567 (93)
Student status	
Undergraduate	534 (87.5)
Postgraduate	76 (12.5)
CGPA, mean $\pm$ SD	3.64 $\pm$ 0.33
<3.50	158 (25.9)
$\geq$ 3.50	452 (74.1)
Ethnicity	
Malay	301 (49.3)
Non-Malay	309 (50.7)
ACSID-11 (behaviors)	
Gaming	370 (55.7)
Online shopping	562 (92.1)
Online pornography use	113 (18.5)
Social networking use	601 (98.5)
Online gambling	29 (4.8)

SD: Standard deviation, BMI: Body mass index, CGPA: Cumulative grade point average, ACSID-11: 11-item assessment of criteria for specific internet-use disorder

Table 3: Index of fit in the confirmatory factor analysis of the Assessment of Criteria for Specific Internet-use Disorders-11

Structure Domain	Frequency rating					Intensity rating				
	χ^2 (df)	CFI	TLI	RMSEA (90% CI)	SRMR	χ^2 (df)	CFI	TLI	RMSEA (90% CI)	SRMR
One-factor										
Gaming	680.69 (44)	0.854	0.818	0.154 (0.144–0.164)	0.064	936.37 (44)	0.839	0.799	0.182 (0.172–0.193)	0.075
Online shopping	558.74 (44)	0.884	0.855	0.138 (0.128–0.149)	0.063	900.95 (44)	0.847	0.809	0.179 (0.169–0.189)	0.083
Online pornography use	744.22 (44)	0.832	0.790	0.162 (0.151–0.172)	0.070	865.01 (44)	0.855	0.818	0.175 (0.165–0.185)	0.068
Social networking use	504.30 (44)	0.868	0.835	0.131 (0.121–0.141)	0.060	722.83 (44)	0.848	0.810	0.159 (0.149–0.169)	0.076
Online gambling	575.98 (44)	0.840	0.801	0.141 (0.131–0.151)	0.069	741.70 (44)	0.867	0.834	0.161 (0.151–0.172)	0.063
Four-factor										
Gaming	160.81 (36) ^a	0.971	0.956	0.075 (0.064–0.087)	0.033	189.34 (36) ^b	0.972	0.958	0.084 (0.072–0.095)	0.033
Online shopping	162.06 (38)	0.972	0.960	0.073 (0.062–0.085)	0.034	179.64 (36) ^c	0.974	0.961	0.081 (0.069–0.093)	0.036
Online pornography use	107.15 (36) ^d	0.983	0.974	0.057 (0.045–0.070)	0.028	185.27 (35) ^e	0.973	0.958	0.084 (0.072–0.096)	0.037
Social networking use	127.18 (38)	0.974	0.963	0.062 (0.050–0.074)	0.035	182.30 (38)	0.968	0.953	0.079 (0.068–0.091)	0.038
Online gambling	142.34 (35) ^f	0.968	0.949	0.071 (0.059–0.083)	0.038	163.41 (34) ^g	0.975	0.960	0.079 (0.067–0.091)	0.037

^aModification indices: Item1~item4; item5~item6, ^bModification indices: Item1~item4; item5~item6, ^cModification indices: Item1~item4; item9~item11, ^dModification indices: Item1~item4; item4~item5, ^eModification indices: Item4~item6; item8~item9; item9~item10, ^fModification indices: Item4~item5; item1~item4; item5~item6, ^gModification indices: Item8~item10; item6~item7; item8~item9; item4~item6, ^aAssessment of Criteria for Specific Internet-use Disorders (one-factor structure), ^bAssessment of Criteria for Specific Internet-use Disorders (four-factor structure). All $P < 0.001$. CFI: Comparative fit index, TLI: Tucker-Lewis index, RMSEA: Root mean square error of approximation, SRMR: Standardized root mean square residual, CI: Confidence interval

Table 3 shows the model fit indices, with the results of CFA indicating that the four-factor structure of ACSID-11 outperformed the one-factor structure. Regarding the item-level statistics, all were satisfactory in factor loading and corrected item-total correlation.

Table 4 shows that the MGCFA results showed that measurement invariance was supported for the majority of ACSID-11 behaviors across gender (female vs. male), ethnicity (Malay vs. non-Malay) and CGPA (<3.50 vs. ≥ 3.50) for both frequency and intensity responses. However, measurement invariance was not supported across ethnicity for online gambling (frequency response). Nevertheless, after the factor loading constraints were relaxed for four items (i.e., Items 3, 5, 6, and 9) of online gambling (frequency response), partial invariance was supported.

Discussion

The ACSID-11 is an established diagnostic instrument designed to assess five types of PIU (i.e., online gaming, online shopping, online pornography use, social networking use, and online gambling).^[23] Findings of the present study generally supported that the Malay version of ACSID-11 had good levels of reliability and validity among young adults in Malaysia. The scale had strong factor loadings and corrected item-total correlation in both frequency and intensity responses. In addition, most of the online activities reported good to excellent internal consistency reliability. Moreover, the four-factor structure of the ACSID-11 showed favorable fit statistics in the CFA. These findings confirmed that the Malay version of the ACSID-11 is a satisfactory instrument for assessing specific internet-use

disorders. The invariance analysis conducted also showed that most of ACSID-11 behaviors were comparable across gender, ethnicity, and CGPA groups in both frequency and intensity responses among young Malaysian adults.

The ACSID-11 is an established tool in screening major types of specific internet-use disorders based on the ICD-11 criteria.^[23,28] This was confirmed by the findings in the present study. In addition, the study found that in the five online behaviors assessed by the ACSID-11, participants were most engaged in social networking, followed by online shopping and online gaming. These findings are consistent with the current online use landscape, in which more than 4.76 billion individuals worldwide used social media in 2023, with youth being the most active users.^[33]

In general, the problematic use of both online social networks and online shopping platforms are recognized as a problematic internet-related behavior according to Fineberg *et al.*^[34] Online behavioral addictions have become a public concern in the context of online gaming, particularly among children and young adults.^[35] In recent years, online gaming has experienced a surge in popularity, with a significant increase in the number of players worldwide.^[36] With over 55% of participants in the present study reporting they engaged in online gaming, the rise and popularity of online gaming among Malaysian young adults cannot be understated.

In the present study, CFA was used to assess the construct validity of the ACSID-11 and validate its factor structure by comparing the one-factor structure model and the four-factor structure model. Results showed that the

Table 4: Measurement invariance of Assessment of Criteria for Specific Internet-use Disorders-11 across gender (females and males)

Gaming	Frequency					Intensity				
	M1 (df=72)	M2 (df=79)	M3 (df=86)	M2-M1 (Δdf=7)	M3-M2 (Δdf=7)	M1 (df=72)	M2 (df=79)	M3 (df=86)	M2-M1 (Δdf=7)	M3-M2 (Δdf=7)
χ^2 or $\Delta\chi^2$	235.21	243.01	265.19	7.8	22.18	252.50	260.02	286.58	7.52	26.56
<i>P</i>	<0.001	<0.001	<0.001	0.351	0.002	<0.001	<0.001	<0.001	0.377	0.0004
CFI or ΔCFI	0.963	0.962	0.959	-0.001	-0.003	0.967	0.967	0.963	0.000	-0.004
RMSEA or ΔRMSEA	0.086	0.083	0.083	-0.003	0.000	0.091	0.087	0.087	-0.004	0.000
SRMR or ΔSRMR	0.036	0.040	0.042	0.004	0.002	0.035	0.037	0.040	0.002	0.003
Online shopping	M1 (df=76)	M2 (df=83)	M3 (df=90)	M2-M1 (Δdf=7)	M3-M2 (Δdf=7)	M1 (df=72)	M2 (df=79)	M3 (df=86)	M2-M1 (Δdf=7)	M3-M2 (Δdf=7)
χ^2 or $\Delta\chi^2$	233.76	240.95	256.97	7.19	16.02	250.82	262.78	270.60	11.96	7.82
<i>P</i>	<0.001	<0.001	<0.001	0.409	0.025	<0.001	<0.001	<0.001	0.102	0.349
CFI or ΔCFI	0.965	0.965	0.963	0.000	-0.002	0.969	0.968	0.968	-0.001	0.000
RMSEA or ΔRMSEA	0.082	0.079	0.078	-0.003	-0.001	0.090	0.087	0.084	-0.003	-0.003
SRMR or ΔSRMR	0.038	0.042	0.044	0.004	0.002	0.040	0.044	0.044	0.004	0.000
Online pornography use	M1 (df=72)	M2 (df=79)	M3 (df=86)	M2-M1 (Δdf=7)	M3-M2 (Δdf=7)	M1 (df=70)	M2 (df=77)	M3 (df=84)	M2-M1 (Δdf=7)	M3-M2 (Δdf=7)
χ^2 or $\Delta\chi^2$	190.56	204.417	223.53	13.857	19.113	261.63	284.53	309.70	22.9	25.17
<i>P</i>	<0.001	<0.001	<0.001	0.054	0.009	<0.001	<0.001	<0.001	0.002	0.001
CFI or ΔCFI	0.970	0.968	0.965	-0.002	-0.003	0.965	0.962	0.958	-0.003	-0.004
RMSEA or ΔRMSEA	0.073	0.072	0.072	-0.001	0.000	0.095	0.094	0.094	-0.001	0.000
SRMR or ΔSRMR	0.032	0.038	0.041	0.006	0.003	0.043	0.052	0.053	0.009	0.001
Social networking use	M1 (df=76)	M2 (df=83)	M3 (df=90)	M2-M1 (Δdf=7)	M3-M2 (Δdf=7)	M1 (df=76)	M2 (df=83)	M3 (df=90)	M2-M1 (Δdf=7)	M3-M2 (Δdf=7)
χ^2 or $\Delta\chi^2$	183.13	188.42	202.46	5.29	14.04	226.73	232.00	236.59	5.27	4.59
<i>P</i>	<0.001	<0.001	<0.001	0.625	0.051	<0.001	<0.001	<0.001	0.627	0.710
CFI or ΔCFI	0.969	0.970	0.968	0.001	-0.002	0.966	0.967	0.967	0.001	0.000
RMSEA or ΔRMSEA	0.068	0.065	0.064	-0.003	-0.001	0.081	0.077	0.073	-0.004	-0.004
SRMR or ΔSRMR	0.039	0.042	0.043	0.003	0.001	0.041	0.045	0.046	0.004	0.001
Online gambling	M1 (df=70)	M2 (df=77)	M3 (df=84)	M2-M1 (Δdf=7)	M3-M2 (Δdf=7)	M1 (df=68)	M2 (df=75)	M3 (df=82)	M2-M1 (Δdf=7)	M3-M2 (Δdf=7)
χ^2 or $\Delta\chi^2$	272.17	287.69	304.08	15.52	16.39	270.87	281.98	296.54	11.11	14.56
<i>P</i>	<0.001	<0.001	<0.001	0.030	0.022	<0.001	<0.001	<0.001	0.134	0.042
CFI or ΔCFI	0.940	0.937	0.934	-0.003	-0.003	0.962	0.962	0.960	0.000	-0.002
RMSEA or ΔRMSEA	0.097	0.095	0.093	-0.002	-0.002	0.099	0.095	0.093	-0.004	-0.002
SRMR or ΔSRMR	0.050	0.054	0.056	0.004	0.002	0.039	0.046	0.047	0.007	0.001
Measurement invariance of ACSID-11 across ethnicity (Malay and non-Malay)										
Gaming	Frequency					Intensity				
	M1 (df=72)	M2 (df=79)	M3 (df=86)	M2-M1 (Δdf=7)	M3-M2 (Δdf=7)	M1 (df=72)	M2 (df=79)	M3 (df=86)	M2-M1 (Δdf=7)	M3-M2 (Δdf=7)
χ^2 or $\Delta\chi^2$	237.21	248.42	256.99	11.21	8.57	262.59	268.17	275.42	5.58	7.25
<i>P</i>	<0.001	<0.001	<0.001	0.130	0.285	<0.001	<0.001	<0.001	0.590	0.403
CFI or ΔCFI	0.963	0.962	0.962	-0.001	0.000	0.966	0.966	0.966	0.000	0.000
RMSEA or ΔRMSEA	0.087	0.084	0.081	-0.003	-0.003	0.093	0.089	0.085	-0.004	-0.004
SRMR or ΔSRMR	0.038	0.045	0.045	0.007	0.000	0.037	0.043	0.043	0.006	0.000
Online shopping	M1 (df=76)	M2 (df=83)	M3 (df=90)	M2-M1 (Δdf=7)	M3-M2 (Δdf=7)	M1 (df=72)	M2 (df=79)	M3 (df=86)	M2-M1 (Δdf=7)	M3-M2 (Δdf=7)
χ^2 or $\Delta\chi^2$	274.42	280.70	300.91	6.28	20.21	235.94	250.05	271.63	14.11	21.58
<i>P</i>	<0.001	<0.001	<0.001	0.508	0.005	<0.001	<0.001	<0.001	0.050	0.003
CFI or ΔCFI	0.956	0.956	0.954	0.000	-0.002	0.971	0.970	0.967	-0.001	-0.003
RMSEA or ΔRMSEA	0.093	0.088	0.088	-0.005	0.000	0.086	0.084	0.084	-0.002	0.000
SRMR or ΔSRMR	0.038	0.042	0.045	0.004	0.003	0.038	0.044	0.045	0.006	0.001

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Table 4: Contd...

Online pornography use	M1 (df=72)	M2 (df=79)	M3 (df=86)	M2-M1 (Δdf=7)	M3-M2 (Δdf=7)	M1 (df=70)	M2 (df=77)	M3 (df=84)	M2-M1 (Δdf=7)	M3-M2 (Δdf=7)
χ^2 or $\Delta\chi^2$	267.38	281.44	309.75	14.06	28.31	319.136	328.24	343.94	9.104	15.7
<i>P</i>	<0.001	<0.001	<0.001	0.050	0.0001	<0.001	<0.001	<0.001	0.245	0.028
CFI or ΔCFI	0.956	0.954	0.950	-0.002	-0.004	0.958	0.957	0.956	-0.001	-0.001
RMSEA or ΔRMSEA	0.094	0.092	0.092	-0.002	0.000	0.108	0.103	0.101	-0.005	-0.002
SRMR or ΔSRMR	0.037	0.046	0.051	0.009	0.005	0.046	0.049	0.051	0.003	0.002
Social networking use	M1 (df=76)	M2 (df=83)	M3 (df=90)	M2-M1 (Δdf=7)	M3-M2 (Δdf=7)	M1 (df=76)	M2 (df=83)	M3 (df=90)	M2-M1 (Δdf=7)	M3-M2 (Δdf=7)
χ^2 or $\Delta\chi^2$	188.24	192.47	207.24	4.23	14.77	233.46	242.46	261.71	9	19.25
<i>P</i>	<0.001	<0.001	<0.001	0.753	0.039	<0.001	<0.001	<0.001	0.253	0.007
CFI or ΔCFI	0.967	0.968	0.966	0.001	-0.002	0.964	0.964	0.961	0.000	-0.003
RMSEA or ΔRMSEA	0.070	0.066	0.065	-0.004	-0.001	0.082	0.079	0.079	-0.003	0.000
SRMR or ΔSRMR	0.039	0.042	0.043	0.003	0.001	0.042	0.048	0.049	0.006	0.001
Online gambling	M1 (df=70)	M2a (df=73)	M3 (df=80)	M2-M1 (Δdf=3)	M3-M2 (Δdf=7)	M1 (df=68)	M2 (df=75)	M3 (df=82)	M2-M1 (Δdf=7)	M3-M2 (Δdf=7)
χ^2 or $\Delta\chi^2$	375.76	398.05	415.00	22.29	16.95	274.18	279.05	296.52	4.87	17.47
<i>P</i>	<0.001	<0.001	<0.001	<0.001	0.018	<0.001	<0.001	<0.001	0.676	0.015
CFI or ΔCFI	0.920	0.915	0.912	-0.005	-0.003	0.964	0.965	0.963	0.001	-0.002
RMSEA or ΔRMSEA	0.120	0.121	0.117	0.001	-0.004	0.100	0.094	0.093	-0.006	-0.001
SRMR or ΔSRMR	0.053	0.065	0.068	0.012	0.003	0.048	0.049	0.052	0.001	0.003
Measurement invariance of ACSID-11 across CGPA (<3.50 and ≥3.50)										
Gaming	Frequency					Intensity				
	M1 (df=72)	M2 (df=79)	M3 (df=86)	M2-M1 (Δdf=7)	M3-M2 (Δdf=7)	M1 (df=72)	M2 (df=79)	M3 (df=86)	M2-M1 (Δdf=7)	M3-M2 (Δdf=7)
χ^2 or $\Delta\chi^2$	239.44	254.51	263.04	15.07	8.53	335.53	345.32	352.49	9.79	7.17
<i>P</i>	<0.001	<0.001	<0.001	0.035	0.288	<0.001	<0.001	<0.001	0.201	0.411
CFI or ΔCFI	0.962	0.960	0.960	-0.002	0.000	0.953	0.953	0.953	0.000	0.000
RMSEA or ΔRMSEA	0.087	0.085	0.082	-0.002	-0.003	0.110	0.105	0.101	-0.005	-0.004
SRMR or ΔSRMR	0.037	0.043	0.043	0.006	0.000	0.037	0.042	0.043	0.005	0.001
Online shopping	M1 (df=76)	M2 (df=83)	M3 (df=90)	M2-M1 (Δdf=7)	M3-M2 (Δdf=7)	M1 (df=72)	M2 (df=79)	M3 (df=86)	M2-M1 (Δdf=7)	M3-M2 (Δdf=7)
χ^2 or $\Delta\chi^2$	263.72	267.80	277.28	4.08	9.48	264.70	277.74	283.39	13.04	5.65
<i>P</i>	<0.001	<0.001	<0.001	0.771	0.220	<0.001	<0.001	<0.001	0.071	0.581
CFI or ΔCFI	0.958	0.959	0.958	0.001	-0.001	0.966	0.965	0.965	-0.001	0.000
RMSEA or ΔRMSEA	0.090	0.085	0.083	-0.005	-0.002	0.094	0.091	0.087	-0.003	-0.004
SRMR or ΔSRMR	0.038	0.040	0.040	0.002	0.000	0.039	0.043	0.044	0.004	0.001
Online pornography	M1 (df=72)	M2 (df=79)	M3 (df=86)	M2-M1 (Δdf=7)	M3-M2 (Δdf=7)	M1 (df=70)	M2 (df=77)	M3 (df=84)	M2-M1 (Δdf=7)	M3-M2 (Δdf=7)
χ^2 or $\Delta\chi^2$	238.34	249.51	251.96	11.17	2.45	356.13	387.55	397.27	31.42	9.72
<i>P</i>	<0.001	<0.001	<0.001	0.131	0.931	<0.001	<0.001	<0.001	<0.001	0.205
CFI or ΔCFI	0.962	0.961	0.962	-0.001	0.001	0.951	0.947	0.946	-0.004	-0.001
RMSEA or ΔRMSEA	0.087	0.084	0.080	-0.003	-0.004	0.116	0.115	0.111	-0.001	-0.004
SRMR or ΔSRMR	0.038	0.043	0.044	0.005	0.001	0.045	0.055	0.056	0.010	0.001
Social networking use	M1 (df=76)	M2 (df=83)	M3 (df=90)	M2-M1 (Δdf=7)	M3-M2 (Δdf=7)	M1 (df=76)	M2 (df=83)	M3 (df=90)	M2-M1 (Δdf=7)	M3-M2 (Δdf=7)
χ^2 or $\Delta\chi^2$	181.17	184.86	209.39	3.69	24.53	256.27	265.10	277.53	8.83	12.43
<i>P</i>	<0.001	<0.001	<0.001	0.815	0.001	<0.001	<0.001	<0.001	0.265	0.087
CFI or ΔCFI	0.970	0.971	0.966	0.001	-0.005	0.960	0.960	0.959	0.000	-0.001
RMSEA or ΔRMSEA	0.067	0.063	0.066	-0.004	0.003	0.088	0.085	0.083	-0.003	-0.002
SRMR or ΔSRMR	0.037	0.039	0.041	0.002	0.002	0.041	0.043	0.044	0.002	0.001
Online gambling	M1 (df=70)	M2 (df=77)	M3 (df=84)	M2-M1 (Δdf=7)	M3-M2 (Δdf=7)	M1 (df=68)	M2 (df=75)	M3 (df=82)	M2-M1 (Δdf=7)	M3-M2 (Δdf=7)
χ^2 or $\Delta\chi^2$	288.58	307.04	313.26	18.46	6.22	265.23	291.187	303.45	25.96	12.26
<i>P</i>	<0.001	<0.001	<0.001	0.010	0.514	<0.001	<0.001	<0.001	0.0005	0.092

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Table 4: Contd...

Online gambling	M1 (df=70)	M2 (df=77)	M3 (df=84)	M2-M1 (Δ df=7)	M3-M2 (Δ df=7)	M1 (df=68)	M2 (df=75)	M3 (df=82)	M2-M1 (Δ df=7)	M3-M2 (Δ df=7)
CFI or Δ CFI	0.939	0.936	0.936	-0.003	0.000	0.964	0.960	0.959	-0.004	-0.001
RMSEA or Δ RMSEA	0.101	0.099	0.095	-0.002	-0.004	0.098	0.097	0.094	-0.001	-0.003
SRMR or Δ SRMR	0.049	0.059	0.060	0.01	0.001	0.045	0.052	0.053	0.007	0.001

*Relaxed for factor loadings: Item 3, item 5, item 6, item 9. ACSID-11: 11-item Assessment of Criteria for Specific Internet-use Disorders, CGPA: Cumulative grade point average, CFI: Comparative fit index, RMSEA: Root mean square error of approximation, SRMR: Standardized root mean square residual, M1: Configural model, M2: Model with factor loadings constrained equal across groups, M3: Model with both factor loadings and item intercepts constrained to be equal across groups

items were aligned with the ACSID-11's four factors: IC, increased priority, CE, and functional impairment. Therefore, the anticipated multifactorial structure of the ACSID-11 was validated and demonstrated with an improved match compared to the one-factor structure model. In general, multifactor models are more commonly used to compare two or more factors when assessing relationship and performance. This is consistent with the function of the ACSID-11 to comprehensively capture the criteria for online addictive disorders.

In the present study, measurement invariance was used to determine the level of invariance between gender, ethnicity, and academic performance. According to Xin *et al.*,^[37] males and females may approach problem-solving and decision-making differently, and that gender may significantly influence perception, leading to different interpretations of online behaviors. Therefore, an invariance analysis was conducted to ensure that the ACSID-11 remained unbiased across genders. Findings showed that the ACSID-11 can effectively assess PIU among both males and females. Moreover, measurement invariance for the ACSID-11 was found across different levels of academic achievement among Malaysians. These findings suggest that future studies can examine gender differences in PIU using the ACSID-11, particularly among students with different levels of academic achievement.

The present study's findings indicated only partial support for invariance across ethnicity for the ACSID-11 subscale of online gambling. The findings may be due to different interpretation of online gambling among different ethnic groups in Malaysia. Gambling research in Malaysia is limited, and Syariah law prohibits all forms of gambling for Muslims, while non-Muslims are subject to secular legal regulations.^[38] Therefore, the perception and interpretation of online gambling activities may differ between different ethnic and religious groups in Malaysia. However, for other online activities such as online gaming, online shopping, online pornography use, and social networking, measurement invariance was supported across ethnicities.

Limitations

Limitations should be acknowledged in the present study. First, the ACSID-11 relies on a self-report method, which may introduce recall biases and social desirability biases.

Second, participants were recruited using convenience sampling, and as such the results were not obtained from a representative sample. Consequently, the generalizability of the present study might be limited. Third, the present study only examined the internal validity of the ACSID-11, specifically its factor structure, without using other external criterion measures. Therefore, it remains unclear whether the ACSID-11 has good concurrent validity compared to other instruments assessing similar constructs, such as the Bergen Social Media Addiction Scale^[39] and the Internet Gaming Disorder Scale-Short Form.^[40] Fourth, there was no follow-up, so test-retest reliability was not assessed in the present study. Given these limitations, future research should extend the psychometric evaluation of the ACSID-11, with samples from different phases of adult maturity and including longitudinal studies.

Conclusion

The findings of the present study demonstrate that the Malay version of the ACSID-11 is a reliable and valid instrument for assessing specific internet-use disorders among Malaysian young adults. This may be particularly useful for educators, mental health professionals, and policymakers to implement targeted prevention and intervention strategies to promote healthy internet use among young adults and reduce the risks associated with online addictions. It is recommended that future research efforts are needed to further evaluate the validity and reliability of the Malay version of the ACSID-11 to extend its applicability to different demographic groups.

Authors' contributions

Conceptualization: Y-LS, C-YL. Investigation: Y-LS, K-HC, KR, SEHT, WYG, WCP, SRN, IN, SÜ, I-HC, C-YL. Methodology: Y-LS, K-HC, KR, MDG, C-YL. Supervision: C-YL. Writing—original draft: Y-LS, K-HC, KR, C-YL. Writing—review & editing: Y-LS, SEHT, WYG, WCP, SRN, IN, SÜ, I-HC, MDG, C-YL.”.

Data availability statement

The datasets generated or analyzed during the study are available from the corresponding author on reasonable request.

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Conflicts of interest

MDG has received research funding from Norsk Tipping (the gambling operator owned by the Norwegian government). MDG has received funding for a number of research projects in the area of gambling education for young people, social responsibility in gambling and gambling treatment from Gamble Aware (formerly the Responsibility in Gambling Trust), a charitable body which funds its research program based on donations from the gambling industry. MDG undertakes consultancy for various gambling companies in the area of player protection and social responsibility in gambling. Chung-Ying Lin is the co-editor-in-chief of the Asian Journal of Social Health and Behavior. However, he has no roles in the review process of this paper; this paper went through rigorous peer review and revision. All other author (s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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