ORIGINAL ARTICLE

Development and Psychometric Evaluation of the 15-item Bilingual (Malay/English) Cervical Cancer Awareness Scale (Cx-CAS) for Young Women

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ABSTRACT

Introduction: The success of cervical cancer preventive measures partly relies on the awareness of the high-risk group (including young girls or women who are vulnerable to many risk factors of getting HPV infection which may lead to cervical cancer at a later age) on the importance of screening and basic characteristic of cervical cancer for it to be able to translate into positive behavior in preventing the disease. Hence, this study aimed to develop and evaluate the psychometric properties of the bilingual (English/Malay) Cervical Cancer Awareness Scale (Cx-CAS) among young women aged less than 40 years. **Materials and methods:** This study evaluates the content validity, face validity, reliability, and construct validity of the newly developed Cx-CAS awareness scale. Two cross-sectional pilot studies were conducted to explore the usefulness of the measuring items and assessed the dimensionality of the construct using Exploratory Factor Analysis (EFA) (n= 322) and Confirmatory Factor Analysis (CFA) (n=275). **Results:** Content validity index item level (I-CVI) and universal agreement (UA) were 0.99 and 0.94, respectively. The final Cx-CAS model with four constructs was appropriate (KMO=0.815), with multicollinearity below 0.85, with Cronbach's alpha reliability of more than 0.70 for all four constructs. The CFA results showed that the Cx-CAS final model has excellent fitness indicated by the Chi-square p-value >0.05, GFI > 0.90, TLI >0.95, CFI >0.96, RMSEA <0.08. **Conclusion:** The 15-item cervical cancer awareness scale (Cx-CAS) has shown to have excellent psychometric properties and has the potential to be used in cervical cancer awareness surveys among young women with similar cultures, languages, and backgrounds.
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Keywords: Cervical cancer, Knowledge, Awareness, Young women, Questionnaires

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INTRODUCTION

The GLOBOCAN 2020 report designates cervical cancer as the fourth most significant cause of cancer-related mortality among women, following breast, colorectal, and lung cancer. The report estimates a global incidence of 604,000 new cases of cervical cancer, resulting in 342,000 deaths attributed to the disease (1). These figures represent the annual statistics for the specific year according to the GLOBOCON 2020 report. The incidence of cervical cancer is mostly found in developing countries in the region of sub-Saharan Africa, Melanesia, South America, and Southeast Asia (1). Knowing the fact that it is a preventable and curable disease, a global initiative has been proposed by the World Health Organization to highlight the vital public health needs to prevent and eliminate cervical cancer by the year 2030 through increased vaccination coverage among girls, high screening uptake by 35 years of age among women and early treatment (2-3).

Infection with human papillomavirus (HPV) is the main culprit of cervical cancer. Extensive literature has linked exposure to HPV infections and the sexual lifestyle of young women. Having sexual activity at an early age, having multiple sexual partners, and having a history of other sexually transmitted infections, genital warts, or cervical or penile cancer increase the risk of being infected with HPV (4-5). Infection of HPV was most commonly found among sexually active young women aged between 18 and 30 years (6-7). Even though incidence and mortality due to cervical cancer were mostly observed among older women aged 35 years

and above, preventive measures in eliminating cervical cancer should start early targeting those at-risk young women through the efforts of advocating to them about the slowly progressive disease, the risk factors, and importance of screening.

Over the past decade, researchers, exemplified by Romli et al. (2019) and Seng et al. (2018), have predominantly employed the Knowledge, Attitude, and Practice (KAP) framework to probe into cervical cancer awareness. Utilizing KAP instruments, these studies aimed to evaluate the multifaceted dimensions of cervical cancer awareness, including knowledge, attitude, and practice, encompassing elements such as risk factors, warning signs, causes, and Pap smear testing. This thorough exploration of these facets is imperative for appraising cognitive and behavioral shifts among women in the face of the consistently escalating prevalence of cervical cancer. Despite noteworthy strides in awareness and comprehension, a discernible gap persists in existing instruments, compelling the refinement of assessment tools. A preliminary version of a questionnaire was utilized, revealing the need for improvement in evaluation methods. Recognizing the significance of resolving this omission, the questionnaire was substantially improved in the current study. This modification entailed increasing the item count to 52, a rigorously planned strategic attempt designed to improve both the psychometric qualities and general comprehensiveness of the instrument. The emphasis was on correcting the earlier neglect of constructs in the practice area.

Low knowledge or awareness of cervical cancer has been reported among local women in Malaysia (8-9). In the context of this study, the term "awareness" is utilized to encapsulate a multidimensional assessment that goes beyond a mere cognitive understanding of cervical cancer-related information. It encompasses an individual's knowledge, attitudes, and practices regarding cervical cancer, its risk factors, warning signs, causes, and preventive measures such as Pap smear screening tests. This holistic approach aims to gauge not only factual knowledge but also the attitudes individuals hold toward cervical health and their corresponding practices. Integrating knowledge, attitude, and practice dimensions offers a comprehensive view of cervical cancer awareness, encompassing cognitive, behavioral, and attitudinal aspects. This conceptualization was elucidated in the introduction to lay the groundwork for the subsequent utilization of the term throughout the study.

A study among young women in Malaysia also revealed that 48.8% of young university female students do not know that HPV is related to cervical cancer (10) and a systematic review among studies in Southeast Asia also highlights low knowledge of cervical cancer screening as one of the significant barriers to Pap Smear screening among women (11). Despite the alarming data shown, there is a paucity of information on the development and validation of knowledge, attitude, and practice scales used in the studies (8,10,12). Assessment of the true burden of poor cervical cancer literacy among women requires a validated and reliable tool that is developed and tailored to the local culture. Hence, the objective of this study was to develop and determine the psychometric properties (reliability, content validity, and construct validity) of an instrument known as the Cervical Cancer Awareness Scale (Cx-CAS) among young women. The findings of the current study may benefit future studies by providing reliable and validated tools for assessing the awareness of cervical cancer among young women locally.

MATERIALS AND METHODS

Item development

Items for Cx-CAS were developed to measure awareness of cervical cancer among young women using the technique of adopting and adapting from the previous scales used in the literature which assess awareness, knowledge, attitude, or practice towards cervical cancer among women (8-9, 12). A total of 52 items were developed and the items are hypothesized to reflect three initial aspects of cervical cancer awareness: Knowledge of cervical cancer (33 items), Attitude towards Pap smear screening (12 items), and Practice of Pap smear (7 items). Items for knowledge offered three options (Yes/No/Do not know). One mark will be given for every correct answer. Meanwhile, items for attitude and practice aspects offered five ordered Likert scale response options. Each of the items was developed in Malay language and followed by an English translation by one independent translator who was well versed in both languages. Next, back translations were carried out by two experts to check for the validity of language accuracy for the bilingual scale.

Content Validation and Content Validity Index Calculation

Content validity is the extensive measurement tool to represent the measured constructs (13-14). We performed the content validation procedure using the six steps suggested by Yusoff (2019): preparing the content validation form, selecting a review panel of experts, conducting content validation, reviewing domain and items, providing a score on each item, and calculating the content validity index (CVI) value. Six experts consisting of a gynaecologist, medical educationalist, and survey experts reviewed the Cx-CAS content. Criteria for grading scales for content validity index guidelines are divided into relevance, clarity, simplicity, and ambiguity. The acceptable cut-off score of CVI was one (13-15). Amendments was made based on expert comments and results of I-CVI, S-CVI/Ave and S-CVI/UA.

All the data was entered into Microsoft Excel and calculated for the item-level content validity index (I-CVI), scale-level content validity index (S-CVI), scale-level content validity index, universal agreement calculation method (S-CVI/UA), and scale-level content validity index, averaging calculation method (S-CVI/Ave). Each item rated 3 or 4 would be converted to valid ('1'), and items rated 0, 1, or 2 would be converted to non-valid ('0') (13). Face validity was assessed using participants' direct comments and suggestions regarding the feasibility, readability, and clarity of the language (17–18). The acceptable cut-off score of CVI was set at least 0.83 based on the total number of six experts involved (13–15).

Three essential indices are used to evaluate content validity: Item-level Content Validity Index (I-CVI), Scale-level Content Validity Index using the Average method (S-CVI/Ave), and Scale-level Content Validity Index using the Universal Agreement method (S-CVI/UA). I-CVI is calculated as the proportion of content experts who give a relevance rating of 3 or 4 to a given item. The formula is I-CVI = (agreed item) / (number of experts). S-CVI/Ave is computed as the average I-CVI across all items on the scale. The formula is S-CVI/Ave = (sum of I-CVI scores) / (number of items). S-CVI/UA is computed as the Universal Agreement method, evaluates the proportion of item achieving universal agreement among experts. The formula is S-CVI/UA = (sum of UA scores) / (number of items).

Face validity with Pre-testing

The choice of ten participants for face validity and pre-testing follows known principles in psychometric instrument development (19). This sample size is widely recommended for first evaluations since it allows for a diverse variety of perspectives while remaining manageable for quantitative analysis (20).

In our study, pre-test participants were chosen from the target population–young women in educational settings. This is to ensure that the feedback received was relevant to the intended user group of Cervical Cancer Awareness Scare (Cx-CAS). The selection aimed to capture a representative range of backgrounds, education levels, and experiences within the target demographic to enhance the scale's applicability and cultural relevance. The demographic characteristics of the participants were to ensure transparency, highlight sample diversity, and support the validity of face validity and pre-testing.

The scale was pre-tested using a quantitative technique with ten young women under the age of 40, as described in the study (16–18). This quantitative pre-testing aimed to elicit structured input and ideas on the feasibility, readability, and clarity of the terminology used in the Cervical Cancer Awareness Scale (CxCAS). Participants' replies were rigorously evaluated, and modest changes were made to improve the scale's suitability based on the quantitative insights gleaned from their comments.

This iterative process of quantitative pre-testing, coupled with a sample size of 10 participants, ensured that the scale's content and presentation were refined before proceeding to the subsequent pilot study. The pilot study included quantitative steps for validating the scale, such as exploring and confirming its factors through analysis. We also assessed the reliability of the Cervical Cancer Awareness Scale (Cx-CAS).

Pilot Study for Construct Validity

Exploratory Factor Analysis (EFA)

A cross-sectional study was conducted with 320 Malaysian young women, aged between 18 to 40 years old. The 320 participants for the Exploratory Factor Analysis (EFA) were chosen through a randomized approach to provide a representative and impartial sample. Participants were selected for the study based on established criteria related to the research objectives. The recruitment method followed established sample size calculation guidelines, as detailed by Zainuddin (2018), and used acknowledged rules of thumb for pilot research. The participants met the inclusion criteria and came from a variety of backgrounds within the target demographic. This approach aims to collect a diverse range of opinions, thereby improving the robustness and generalizability of the EFA findings.

The 320 participants were recruited using convenience sampling based on sample size determination using the ratio of participants to the measured variables (five participants per item) (19-20). The Cx-CAS with an initial 52 items were distributed via Google Forms through social media platforms (Facebook posting), and instant message sharing through messaging platforms (WhatApps and Telegram). Data obtained in this survey was used to measure construct validity using exploratory factor analysis (EFA) to examine the inter-correlations between large variables in psychometric scales and to reduce the data into a smaller number of factors (12,21-22).

Confirmatory Factor Analysis (CFA)

Participants were chosen for the Confirmatory Factor Analysis (CFA) in educational settings employing a simple random sampling method, ensuring a representative sample that met the predetermined inclusion criteria. Based on these criteria, 275 participants in total were selected following established standards for determining sample size. By taking participants from a variety of educational backgrounds and circumstances, this systematic method sought to improve the study's external validity. This improved the study's robustness and generalizability of the results obtained from the CFA.

CFA is used for validating the factor loading and

measurement of the model. Any item that does not fit the measurement model due to low factor loading (<0.5) will be removed from the model. In CFA, the assessment involved the unidimensionality, validity, and reliability of the constructs in the measurement model (21). One concern about these approaches is that two folds are called factor loadings and fitness indexes. For this reason, this is often approximated to make sure factor loading is adequate to be accepted together with the fitness indexes (22). As a result, the researchers must guarantee that both folds meet the requirements. These are made to fulfill the needs of fitness indexes, which are divided into three categories: parsimonious fit, absolute fit, and increment fit. Furthermore, the application of CFA allows researchers to determine to what extent the strength of indicators and measurement models are related to the features of the cervical cancer awareness scale. As a result, a reliable measurement model can assist researchers in accurately interpreting their findings.

Ethical Consideration

Ethical approval was obtained from the Medical Research and Ethics Committee, Ministry of Health Malaysia (NMRR-19-4080-52413 (IIIR)) and the Human Research Ethics Committee of Sains Malaysia (USM/JEPeM/20050285). Informed consent was obtained from each participant before they started answering the Cx-CAS in Google Forms. Participation was voluntary. Each participant was given the full autonomy to withdraw from the study at any time. Information and data obtained were kept confidential and only used for this current study.

Data Analysis

Face validity was assessed through participants' direct comments regarding feasibility, readability, and language clarity. The acceptable cut-off score for CVI was set at a minimum of 0.83, based on the involvement of six experts.

Socio-demographic characteristics of study participants were described either as mean and standard deviation for continuous data or frequency and percentage for categorical data. Data management and statistical analysis for EFA and reliability tests were conducted using IBM Statistical Package for Social Science (SPSS) statistical 26.0 (IBM Corp Chicago, IL). Meanwhile, the AMOS (Analysis of Moment Structures) IBM SPSS version 23 (IBM Corp., Armonk, NY, USA) was used for confirmatory factor analysis (CFA). A visual scan of the correlation matrix, Bartlett's test of sphericity, and Kaiser-Meyer-Olkin (KMO) measures were used to indicate the appropriateness of EFA. The reliability of items was determined using the Cronbach's alpha (CA) coefficient. The item-to-total correlation was used to determine the internal consistency among items, whereby values of more than 0.70 were considered acceptable. The chi-square test was supplemented with the root mean square error of approximation (RMSEA), comparative fit (CFI), and the Tucker–Lewis (TLI) indices. RMSEA values less than 0.06–0.08 with a 95% confidence interval were deemed as an acceptable fit. The general cut-off criterion for CFI and TLI was 0.90 for acceptance, respectively (23-24). The p-value was set at 0.05. The flow chart of the methodology used in the validation is shown in Figure 1.

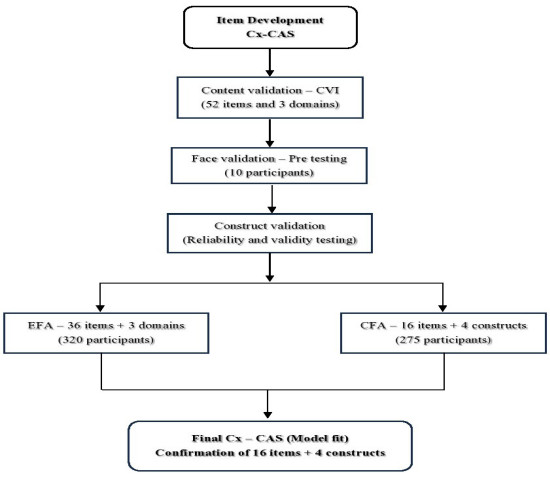

Figure 1: Study flowchart of methodology used in validation.

RESULTS

Content Validity

The content validity was conducted in two rounds with three experts at a time (13,15,25). I-CVI scores for knowledge construct with 33 items had good scored 0.92 (S-CVI/AVE) in respect of relevance, clarity, simplicity, and ambiguity. However, the desired UA was not achieved when expert number 2 average calculation scored 0.77. On the other hand, the attitude construct with 12 items had perfect scores on I-CVI and UA (1.00) for both S-CVI/AVE and S-CVI/UA. Meanwhile, the practice construct with 7 items scored 0.93 (S-CVI/AVE) for relevance, clarity, simplicity, and ambiguity. However, UA scored low by expert 3 at 0.71.

After minimal language clarity modifications to few items in construct knowledge and practice, the second round of measurement of content validity was conducted and resulted in identical findings of good scored I-CVI = 1.00 (S-CVI/Ave). Hence, we conclude that the Cx-CAS has achieved a satisfactory level of content validity across fifty-two items on knowledge, attitude, and practice constructs, with I-CVI scoring at an impressive 0.99 and UA at 0.94.

Face validity

To assess the face validity of the Cervical Cancer Awareness Scale (Cx-CAS), a cohort of ten young women was purposefully recruited. The participants provided valuable insights into the clarity and understandability of the scale's items and response scale. Participants affirmed that all items were easily comprehensible, and

the response scale was clear for an effective rating.

During this evaluation, participants specifically highlighted the need for improvement in seven items featuring negative statements (B3, B4.1, B4.2, B4.3, B4.4, B9.1, and D1). Items B represent knowledge statements, while items D represent practice statements. Modifications were made based on their comments. Their suggestion was to enhance the clarity of these statements by incorporating examples, thereby increasing their overall understandability. In response to this constructive feedback, thoughtful amendments were made to the identified items, aligning them with participants' recommendations.

The face validity assessment was conducted through direct interactions with the participants, where they were encouraged to share their feedback on the instrument's clarity and user-friendliness. The iterative process of gathering and incorporating participant feedback demonstrates our commitment to refining the Cx-CAS and ensuring its appropriateness for the target demographic. These adjustments were made to enhance not only linguistic clarity but also cognitive accessibility, contributing to the overall robustness of the instrument for subsequent psychometric evaluations.

Pilot Study for Construct Validity

Exploratory Factor Analysis (EFA)
The Mean (SD) age for participants involved in the cross-sectional survey for EFA and reliability testing was 24.28±3.59 years old. The majority of them (57.5%) were Malay ethnicity and unmarried (81.6%). Assessment of the correlation matrix revealed numerous coefficients ≥0.30 but none exceeded 0.90 (26). Bartlett's Test of Sphericity (1950) statistically rejected the hypothesis that the correlation matrix was an identity matrix (Chi-square = 4240.686, $p < 0.0001$). The sampling adequacy was achieved indicated by the Kaiser-Meyer-Olkin (KMO) value of 0.815 (20,27). These measures indicate that further analysis with EFA is appropriate.

The EFA procedures were analyzed using the Principal Axis Factor (PFA) to measure the factor extraction in the measurement model. The eigenvalue elaborated three stages: before extraction, after extraction, and after rotation. Before extraction, 52 items were included in the EFA measurement. The initial analysis proposed to extract eleven factors based on the initial eigenvalues. Initial findings indicated the first factor explained a relatively large amount of variance under Extraction Sums of Squared Loadings = 19.761 and the percentage cumulative of Extraction Sums of Squared Loading = 51.680. However, the value cumulative on Extraction Sums of Squared Loadings shown value factor 13 failed to achieve 60%. Therefore, EFA analysis was performed by fixing the number of factors extracted 11 which rotated by Promax in factor analysis rotation.

Item quality based on factor loading and commonalities value with an acceptable communalities limit of 0.4 to 0.7 (26,28-29). Items with factor loading >0.5 were retained for further EFA final analysis (26,28,30). This is, after the item removal procedure based on Rotated Factor Matrix and commonalities extraction.

Out of 52 items included in the initial EFA analysis, 36 items were removed due to low factor loading, low commonalities, and unreliable factors. Factors seven to eleven are unreliable and were removed from the model because they contain items fewer than two items each (26) (Table I).

Table I: Problematic Items removed with explanation

No.	Item	Problem	Total items removed
1	K8a, K8g, P6	Communalities less than 0.3	3
2	K3, K6, K8b, K8c, K8d, K8g, K8h, K8i, K9a, K9b, K9c, K11a, K11b, K11c, K13, A5, A6, P1, P4, P5, P7	Cross loading factors and low factor loading less than 0.5	20
3	K8l, K8m, K8f, K8e, K10b, K10a, P2, P3, K7, K5, K8j, K8k, A8	Factors are not reliable. (Factors with less than three items each)	13
		Total items removed after final EFA	**36**
		Total items retained for CFA	**16**

The final Cx-Cas model with the four factors structure with a total of 16 items was found to be most appropriate (KMO=0.815, multicollinearity below 0.85, Cronbach's alpha more than 0.70) (31-32). The values for an item-total correlation (point-biserial) help indicate the discriminant in the psychometric items. Value-corrected item-total correlation (CITC) of more than 0.4 indicates very good discriminant (33-34) (Table II). Thus, the four factors Cx-CAS model were fit for further construct validity analysis using confirmatory factor analysis (CFA).

Table II: The reliability and discriminant analysis of four-factors Cx-CAS model after EFA

Factor	Initial Domain	Final Constructs	Item Statement	Item Label	Total Items	Cronbach's alpha	Corrected Item-Total Correlation (CITC)	Mean	Variance	Std. Deviation
1	Attitute (A1)	Disease and Screening awareness	*Saya tidak tahu had umur yang sesuai untuk melakukan pemeriksaan saringan kanser serviks (Pap smears). (I don't know the appropriate age limit to perform a Pap smear test)*	A7	5	0.865	0.572	16.126	21.071	4.59
			Saya tidak mempunyai maklumat dan kesedaran berkaitan pemeriksaan saringan kanser serviks (Pap smears). (I have no information and awareness regarding Pap smear screening tests)	A9			0.664			
			Maklumat kurang diberikan oleh personel kesihatan mengenai kanser serviks. (Less information is provided by health personnel about cervical cancer)	A10			0.787			
			Maklumat kurang diberikan oleh personel kesihatan mengenai pemeriksaan saringan kanser serviks (Pap smears). (Less information is provided by health personnel about Pap smear test)	A11			0.769			
			Saya tidak tahu sela masa untuk pemeriksaan saringan kanser serviks (Pap smears). (I don't know the interval of Pap smear screening test)	A12			0.635			
2	Attitude (A2)	Behavioral barriers	*Saya berasa segan sebelum menjalani pemeriksaan saringan kanser serviks (Pap smears). (I felt embarrassed before having a Pap smear test)*	A1	4	0.840	0.706	13.675	13.844	3.721
			Saya berasa malu semasa menjalani pemeriksaan saringan kanser serviks (Pap smears). (I felt embarrassed while undergoing a Pap smear test)	A2			0.736			
			Saya berasa keberatan untuk menjalani pemeriksaan saringan kanser serviks (Pap smears). (I am reluctant to have a Pap smear test)	A3			0.637			
			Pemeriksaan saringan kanser serviks (Pap smears) merupakan sesuatu yang janggal pada saya. (The Pap smear test is an awkward thing for me)	A4			0.611			
3	Knowledge (K1)	Cervical cancer sign and symptoms	*Apakah tanda dan gejala kanser serviks? (What are the signs and symptom of cervical cancer?)*							
			Masalah (lelehan) keputihan. (Vaginal discharge)	K4a	4	0.797	0.551	1.910	6.123	2.474
			Lelehan faraj (kemaluan) berbau busuk. (Unpleasant odour vaginal discharge)	K4b			0.658			

CONTINUE

Table II: The reliability and discriminant analysis of four-factors Cx-CAS model after EFA (CONT.)

Factor	Initial Domain	Final Constructs	Item Statement	Item Label	Total Items	Cronbach's alpha	Corrected Item-Total Correlation (CITC)	Mean	Variance	Std. Deviation
3	Knowledge (K1)	Cervical cancer sign and symptoms	*Pendarahan faraj tidak normal/ selain daripada haid biasa. (Abnormal vaginal bleeding between periods)*	K4c			0.639			
			Sakit ketika mengadakan hubungan seks. (Discomfort or pain during sex)	K4d			0.577			
4	Knowledge (K2)	Awareness on screening practice	*Bilakah sepatutnya pemeriksaan saringan kanser serviks (Pap smears) dilakukan? (When is the best time for Pap smear screening?)*							
			Semasa mengalami haid. (During menstrual)	K12a	3	0.832	0.631	3.930	3.472	1.863
			Sehari (1) hari selepas haid. (A day after menstrual)	K12b			0.743			
			Sepuluh (10) hari selepas haid. (10 days after menstrual)	K12c			0.701			
			Total Items:		**16**					

Confirmatory Factor Analysis (CFA)

Next, a total of 275 young women were recruited to test for the construct validity using CFA. The Mean (SD) age for participants involved in the cross-sectional survey for CFA and reliability testing was 20.51± 0.56 years old. The majority of them (75.6%) were Malay and unmarried (83.6%). The proposed model which contained measurement of fitness indexes presented in Table III.

Table III: The assessment of construct validity

Model	Removed items	Problem	Fitness indices							Comment
			Chi Sq	df	Chi sq/ df	GFI	CFI	TLI	RMSEA	
Model A (Initial CxCas 16 items)	None	Model not fit	262.639	98	2.68	0.891	0.93	0.914	0.078	Not achieved
Model B (16 items)	None	MI > 15 (e1 ↔ e2)	197.435	97	2.035	0.920	0.957	0.947	0.061	Achieved
Model C (15 items)	A7	Factor loading < 0.6	170.146	84	2.026	0.925	0.961	0.951	0.061	Achieved
Model D (Final CxCas 15 items)	None	MI > 15 (e1 ↔ e4)	154.149	83	1.857	0.931	0.968	0.959	0.056	Achieved

The fitness indexes for Model D as the final Cx-CAS have achieved the requirement of construct validity (19, 24). In terms of the convergent validity and composite reliability (CR), results indicated that the convergent validity and composite reliability for the Cx-CAS construct has been achieved with all values for CR greater than 0.5 and average variance extracted (AVE) were greater than 0.6 (21, 35-36) (Table IV).

Table IV: The Cx-CAS Composite Reliability and Convergent Validity

Construct	Items	Domains	Factor Loading	Cronbach's Alpha (above 0.70)	CR (above 0.60)	AVE (above 0.50)	Convergent Validity
Disease and Screening awareness (DSA)	A9	ATTITUDE (A1)	0.670	0.855	0.864	0.621	Yes
	A10		0.860				
	A11		0.960				
	A12		0.610				
Behavioral barriers (BB)	A1	ATTITUDE (A1)	0.670	0.899	0.900	0.696	Yes
	A2		0.940				

CONTINUE

Table IV: The Cx-CAS Composite Reliability and Convergent Validity

Construct	Items	Domains	Factor Loading	Cronbach's Alpha (above 0.70)	CR (above 0.60)	AVE (above 0.50)	Convergent Validity
Behavioral barriers (BB)	A3		0.910				
	A4		0.790				
Cervical cancer sign and symptoms (SS)	K4a	KNOWLEDGE (K1)	0.830	0.825	0.829	0.533	Yes
	K4b		0.830				
	K4c		0.670				
	K4d		0.620				
Awareness of screening practice (SP)	K12a	KNOWLEDGE (K2)	0.700	0.826	0.828	0.617	Yes
	K12b		0.810				
	K12c		0.840				

The discriminant validity for all constructs was achieved by inter-factor correlation and diagonal values of the square root of AVE higher than all other values (21, 36). Figure 2 shows the final psychometric properties for 15-item Cx-CAS with four identified constructs: Disease and screening awareness (DSA), Behavioural barriers (BB), Signs and symptoms (SS), and Awareness of screening practice (SP). The Cx-CAS final model shows to have a good fit indicated by the Chi-square p-value >0.05, GFI > 0.90, TLI >0.95, CFI >0.96, and RMSEA <0.08.

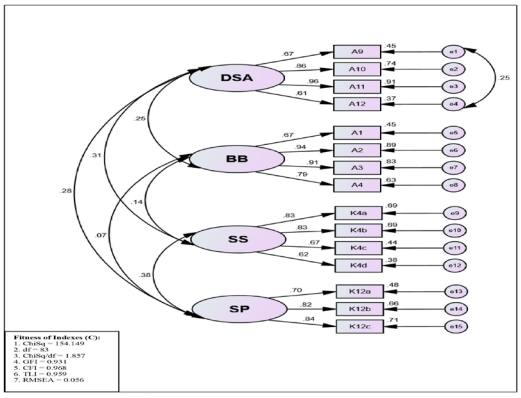

Figure 2: The psychometric properties of Cx-CAS

DISCUSSION

Cervical cancer remains one of the top five female cancers in Asia and has imposed a significant impact on the public health burden, especially in low- and middle-income countries worldwide. In Malaysia, cervical cancer contributes 6.8% of total new cancer cases reported among women in the year 2020, regardless of their age (1). Most of cervical cancer patients were asymptomatic (37). In reaction to this, several public health preventive strategies are actively taken by the Ministry of Health Malaysia under the WHO global strategies to accelerate the elimination of cervical cancer worldwide (2-3).

Among the public health strategies are to increase cervical cancer detection rate, increase screening uptake, and early treatment, and encourage prevention through vaccination. These include free HPV DNA-based testing and Pap smear screening, outreach health educational campaigns, and implementation of a national school-based HPV immunization program targeting Malaysian girls aged 13-15 years old. However, the success and benefit of these preventive measures rely greatly on the awareness of the high-risk group (including young girls or women who are vulnerable to many risk factors of getting HPV infection which may lead to cervical cancer at a later age) on the importance of screening and basic characteristic of cervical cancer for it to be able to translate into positive behavior and continuous practice in preventing the disease.

In response to that, this study aimed to develop a validated and reliable bilingual instrument (Malay and English versions) Cervical Cancer Awareness Scale (Cx-CAS) that could be used to assess cervical cancer awareness among young women in Malaysia. The results of the 15-item Cx-CAS showed that the questionnaire had excellent psychometric properties and was acceptable to be used in populations with similar socio-demographic backgrounds.

The Cx-CAS 15-item scored good for reliability, content validity, and construct validity. These parameters are seen to be comparable to another cervical cancer knowledge or awareness questionnaires called the Knowledge in Cervical Cancer and Prevention Methods 55-items (KCCPM-55) developed for Oman population (38), Turkish Cervical Cancer and Human Papilloma Virus Awareness Questionnaire (39), Cervical Cancer Knowledge and Beliefs of Appalachian Women Questionnaire (40) and Knowledge in Cervical Cancer-61 items developed for Chilean adolescents (41). However, the psychometric qualities in this study could not be compared to existing local tools used in assessing knowledge, attitude, or practice of cervical cancer due to the unclearly detailed development and validation procedures conducted in the previous studies (8-9).

The exploratory factor analysis (EFA) was used to examine the Cx-CAS factor sampling adequacy, factor correlation, and dimension identification (21,42). After factor analysis using the extraction method on Principal Axis Factoring, the Kaiser-Meyer Olkin (KMO) index had a significant value in this study. Removal of problematic items based on commonalities less than 0.3, cross-loading, factor loading less than 0.5, and unreliable factors. Factor analysis is a useful assessment approach for examining troublesome items and grouping all things to examine the relationship between components (43).

Relevant concepts from health behavioral theories were used during the initial development of Cx-CAS domains and to support the final constructs (Disease and Screening Awareness, Behavioral barriers, Signs and Symptoms, and Awareness of Screening Practice) which was extrapolated from the total variance. To support our four constructs developed, we chose three elements from the Theory of Planned Behavior (TPB) which are the behavioral intention, attitude, subjective norms, and Health Belief Model (HBM). According to Roncancio et al. (2015), it is critical to include the TPB concept as a factor in predicting and encouraging cervical cancer screening to explain the participant's behavioral decision to uptake a Pap smear test. The previous study also proposed a verified model, indicating that the application of TPB and HBM theory was reliable in explaining the behavior (44-45). In addition, the main purpose of using health behavior theory such Theory of Planned Behaviour and Health Belief Model is to assist in the design of behavioral change intervention (46).

The strength of the newly developed tool in assessing awareness of cervical cancer among young women relies on its excellent psychometric properties and the length of the items. A short-form questionnaire is very favorable in conducting assessments in clinical settings and surveys involving the younger generation (47). However, this study is not without limitations. The Cx-CAS questionnaire was only tested among young women in one state in northern Malaysia. Multicentre testing of Cx-CAS involving multiple states in Malaysia with more sample heterogeneity and bigger samples will help in further confirming the psychometric properties of the newly developed tool. The English version questionnaire, on the other hand, requires additional future cross-cultural validation research with adequate sample size in other countries or regions to further confirm the psychometric properties of Cx-CAS to be used in other settings.

The questionnaire distinguishes itself in several critical aspects that merit emphasis. Firstly, the contents are meticulously designed to encapsulate not only cognitive aspects of cervical cancer awareness but also behavioral and attitudinal dimensions. This comprehensive approach aligns with the evolving understanding that effective health interventions demand an assessment beyond mere knowledge.

Moreover, the refinement process, including face validity and pre-testing involves a diverse range of group young women. To ensure the tool's cultural relevance and appropriateness for the target demographic. The incorporation of participant feedback, particularly the enhancement of items with negative statements based on user suggestions, speaks to the questionnaire's dynamic and responsive nature.

Additionally, expanding the questionnaire to 52 items and conducting a thorough psychometric evaluation affirm our commitment to robust measurement, setting the tool apart. Employing both EFA and CFA further ensures its construct validity and reliability.

CONCLUSION

The 15-item cervical cancer awareness scale (Cx-CAS) has shown to have excellent psychometric properties and has the potential to be used in cervical cancer awareness surveys among young women population with similar cultures, languages, and ethnic backgrounds.

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