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Cross-Cultural Validation and Psychometric Properties Test of the Healthy Lifestyle Intention Scale for University Students

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ABSTRACT

Background: University students are internationally recognized as a population at risk due to unhealthy lifestyle behaviors and elevated health risks. Supporting positive behavioral change requires understanding their intentions to adopt healthier habits. This study aimed to psychometrically evaluate and culturally validate the healthy lifestyle intention scale (HLIS) in three countries and regions.

Methods: A cross-sectional methodological study was conducted in 2023 among university students in Finland ($n = 753$), Singapore ($n = 750$), and Hong Kong, China ($n = 767$). The HLIS was developed based on the Adherence to Treatment of Patients with Chronic Disease Instrument. Psychometric evaluation included Spearman's ρ, Cronbach's α, and both exploratory and confirmatory factor analyses.

Results: Findings from all three countries and regions indicated that Spearman's ρ values ranged from weak to high across the dimensions of self-readiness (0.23–0.69), family support (0.42–0.78), peer support (0.48–0.80), and social media influence (0.48–0.80). Cronbach's α values demonstrated acceptable internal consistency (0.41–0.92). Structural validity was supported by confirmatory factor analysis. While the Finnish model suggested a need for further refinement (comparative fit index [CFI] = 0.81, root mean square error of approximation [RMSEA] = 0.11), the models for Singapore (CFI = 0.92, RMSEA = 0.07) and Hong Kong, China (CFI = 0.92, RMSEA = 0.07) showed strong fit indices.

Conclusion: The current version of the HLIS demonstrates promising psychometric properties for assessing health-related behavioral intentions among university students in a cross-cultural context. Further validation with more diverse international samples is recommended.

Summary

- The importance of primary prevention in reducing chronic non-communicable diseases is highlighted, with an emphasis on students' intentions to adopt healthy lifestyles.
- The support of family, peers, and social media is beneficial for university students in their efforts to adopt healthy lifestyles.
- The need for culturally sensitive, valid, and reliable measures for primary prevention is emphasized. The HLIS is identified as a promising tool for assessing and promoting healthy lifestyle intentions in diverse populations, aiding in the development of targeted interventions and policies to effectively address global health challenges.

1 | Introduction

The period of emerging adulthood, defined as the age range from 18 to 30 years, is seen as a culturally constructed developmental phase that coincides with the university years [1]. This period is seen not only as an era of opportunity and freedom but also as a time when behavioral risk factors emerge [2–4]. These factors have the potential to influence the long-term future, thereby increasing the risk of chronic non-communicable diseases (CNCDs) [5, 6]. CNCDs are recognized as the leading cause of morbidity and mortality worldwide. According to the World Health Organization, CNCDs, including cardiovascular diseases, cancers, respiratory diseases, and diabetes, account for more than 70% of all deaths worldwide [7].

Internationally, it is widely recognized that university students tend to have unhealthy lifestyles and high levels of health risk, which is a cause for concern [8, 9]. Evidence suggests that about one-third of the population meets the recommended daily amount of physical activity [3]. Conversely, less than one-tenth of the population consumes the recommended five daily servings of fruits and vegetables. In addition, nearly half of the population is estimated to be overweight or obese, and the college years are often a time of weight gain [3, 10].

The high prevalence of unhealthy lifestyles among university students underscores the need to recognize and support their intention to adopt healthy lifestyles. Given their special status, academic institutions are in an excellent position to facilitate students' healthy lifestyle aspirations. It is therefore recommended that stakeholders develop health-related initiatives aimed at promoting healthy lifestyles within an inclusive and diverse academic environment [11].

The concept of adherence, as described by Kyngäs in the original theory of adherence of patients with chronic diseases, refers to a responsible, active, and intentional self-care process through which individuals strive to maintain their overall health. The development of the theory of adherence of people with chronic diseases was initiated by Kyngäs in 1999 with the primary aim of identifying the factors that influence adherence. The initial focus was on young people with diabetes. The theory highlights that good adherence is significantly associated with factors such as strong motivation, a sense of normality, support from parents, physicians, and nurses, a positive attitude toward the disease and its treatment, and no fear of complications [12].

Subsequent modifications and applications of the theory have been made in relation to different patient demographics, with considerations for specific diseases and patient age groups [13, 14]. These modifications address disease-related and self-care demands as well as support factors. To illustrate this point, the theoretical framework for adolescents with chronic illness includes parental support as an important factor, while in the case of adults, support from spouses or other family members is recognized as important. Empirical evidence has shown that factors such as perceived importance of lifestyle change [13], motivation, sense of normality, outcomes of care, fear of complications, and support from family, friends, and health professionals are associated with improved adherence in patients with long-term conditions [15, 16]. Despite the extensive research on adherence in chronically ill children, adolescents and adults, there is still a paucity of studies examining the appropriateness of existing adherence measures for assessing the intention to adopt healthy lifestyle behaviors as a primary prevention strategy.

Adherence to a healthy lifestyle during the early years of adulthood has been demonstrated to have a positive impact on health in later life, as well as on the establishment of healthy lifestyles that ensure a full life for the next generation [2, 17]. Furthermore, adherence to a healthy lifestyle has also been positively associated with modestly higher grade averages [18]. To promote positive behavioral change among university students regarding their health, it is essential to study and identify their intentions to adopt healthy lifestyles. This could assist health professionals in providing appropriate support for the intention to change [19].

Consequently, there is an urgent need to conduct pertinent cross-cultural research to address various issues in these heterogeneous and multicultural societies. It is imperative that cross-cultural studies among university students employ reliable and validated instruments to ensure accuracy and relevance [20]. Concerns about the need for health behavior change among university students are global [17].

The purpose of this study was to modify and psychometrically validate a healthy lifestyle intention scale (HLIS) in three countries and regions. The validation of this instrument aimed to create a reliable tool for assessing healthy lifestyle intentions across diverse cultural settings. Since cultural values and norms strongly influence individuals' health beliefs, motivation, and behavioral tendencies, an adaptable approach is essential for capturing these variations effectively. In Finland, the strong cultural emphasis on personal responsibility and autonomy in health management fosters a high level of self-care and intention-driven behavior [21]. In contrast, Hong Kong, China's collectivist orientation and deep family involvement in health decisions shape intentions through perceived social expectations and familial support [22]. Meanwhile, in Singapore—a multicultural society that integrates both collectivist and individualist influences—health intentions are shaped by a combination of traditional beliefs, modern health

literacy, and digital health engagement [23]. These cultural factors fundamentally shape how individuals perceive health, illness, and their role in managing chronic conditions. The specific research question was "What is the construct validity and reliability of the modified scale that measures healthy lifestyle intentions among university students in Finland, Singapore, and Hong Kong, China?"

2 | Methods

2.1 | Design

This methodological, cross-sectional study was conducted according to the STROBE statement to ensure methodological quality [24]. This was achieved by modifying the previous Adherence to Treatment of Patients with Chronic Disease (ACDI) [13]. First, the instrument was translated and culturally adapted. Second, item reformulation took place. Third, construct validity and reliability tests were conducted [20].

2.2 | Sample

Students were recruited using convenience sampling [25]. The target population of the study consisted of university students between the ages of 18 and 30 from three countries and regions: Finland, Singapore, and Hong Kong, China. The inclusion criteria were as follows: students enrolled in an undergraduate program at the University of Oulu in Finland, the National University of Singapore, Singapore, and the Chinese University of Hong Kong in Hong Kong, China; students able to understand Finnish or English; and students with access to an electronic device (e.g., mobile phone, tablet, or laptop) that could complete the questionnaire. Individuals with a history of mental disorders or past trauma were excluded from the study.

2.3 | Measures

The original 31-item ACDI-scale [13, 15] has previously been utilized with patients and adolescents suffering from chronic conditions and was subsequently modified for the purpose of health promotion. The original instrument incorporated factors pertaining to adherence, which were scored using a 5-point Likert scale ranging from 1 (*strong agreement*) to 5 (*strong disagreement*). The following factors were included in the scale: intention to adhere to a healthy lifestyle (10 items); meaning of lifestyle change (5 items); motivation (5 items); support from family and friends (4 items); support from doctors at the hospital (4 items); support from nurses at the hospital (4 items). The questionnaire's validity and reliability have been previously assessed, with Cronbach's α values ranging from sufficient ($\alpha = 0.69$) to high ($\alpha = 0.91$). The Cronbach's total α value of the ACDI-scale was 0.78.

Phase I: Instrument Translation and Cultural Adaptation

The cross-cultural adaptation of the instrument was conducted in the following manner. Initially, the original version of the HLIS was dispatched to two translators, who independently translated the scale from Finnish to English, thus yielding two versions of the scale. Subsequently, a meeting was convened between the researchers (A.O. and O.K.) and the two translators with the objective of producing a synthesis version. The two versions were then circulated to the two translators to produce the back-translation versions. These versions were then compared by the translators and researchers (A.O. and O.K.) to correct any potential interpretation errors and to ensure the accurate interpretation of the items and the overall content [20].

Phase II: Item Reformulation

Item reformulation: the instrument underwent modification for application in the primary prevention context, a process that entailed the exclusion of disease-related variables. This adjustment was made in view of its prior utilization with chronically ill children, adolescents, and adults. Consequently, the focus was shifted to a health behavior perspective. The 31-item scale was adopted to assess healthy lifestyle intentions and renamed the HLIS. The item formulation was conducted by a research group comprising researchers from all three regions (J.L., E.W., A.O., and O.K.). Items pertaining to long-term illnesses were removed (seven items) and modified (nine items). Furthermore, items pertaining to the themes of support from doctors (four items) and nurses (four items) at the hospital were removed. Conversely, support from family members (four items), close acquaintances (four items), close friends (four items), and acquaintances from social media (four items) were incorporated into the scale.

The modified version included 25 items (Supporting Information S1: Table 1). The content and face validity of the instrument were evaluated by five university students in each region (master's and doctoral programs) after item formulation [20]. The panel of students was tasked with evaluating each item of the instrument for content validity using the scale: 1 = *not relevant*; 2 = *unable to assess relevance*; 3 = *relevant but needs minor alteration*; 4 = *very relevant and succinct*. Items that received a 1 (*not relevant*) or 2 (*unable to assess relevance*) were to be revised. The process involved face-validity verification and confirmation of the instrument's readability, feasibility, consistency of style, and clarity of language, as perceived by experts in the field [26]. While some sentences were revised to enhance clarity, no items were eliminated.

Phase III: Content and Construct Validity and Reliability Testing

Modified 25-item HLIS statistical testing was conducted on the data collected during the cross-sectional study phase. Each region Finland ($n = 753$), Singapore ($n = 750$), and Hong Kong, China ($n = 750$) collected data from university students within their own region using the same inclusion and exclusion criteria, in accordance with the study protocol and the ethical review of each institution. Due to legal restrictions preventing data transfer between regions, each region conducted its own analyses under the same assumptions, using exploratory factor analysis (EFA), a widely used method for testing the construct validity of the instrument.

Content validity and internal consistency reliability were assessed using Spearman's correlation and Cronbach's a. Content validity was evaluated to ensure that the instrument accurately captured the intended concept. To assess construct validity, an EFA was conducted using principal component analysis (PCA) with orthogonal varimax rotation. The purpose of this analysis was to determine the underlying structure of the instrument by evaluating the relationships among items and assessing how well they aligned with the intended theoretical constructs. A more detailed description of these findings is provided in Section 2.4.

2.4 | Data Analysis

The analysis was conducted using SAS statistical software version 9.4. Descriptive statistics, including frequencies and percentages, were calculated to characterize the demographic and socio-demographic characteristics of the respondents (see Table 1). Given that the HLIS is a modification of the ACDI instrument and has not been utilized in primary prevention, the objective was to establish the measurement properties of the HLIS, including content validity, construct validity, and reliability.

As delineated in the section dedicated to the methodology, content validity was established. In addition to this, Spearman's ρ was determined, with these being calculated based on the correlation between the items and the factors/dimensions to which they relate, in accordance with the original theory of adherence [26].

The construct validity of the HLIS was assessed using EFA with principal components and orthogonal varimax rotation. The number of factors with an eigenvalue greater than one was then examined in greater detail. Factors with factor loadings greater than 0.30 were considered to be significantly relevant and were therefore retained for further analysis [27].

The structural validity of the HLIS was then subjected to a confirmatory factor analysis (CFA), which was independently conducted in every region on each multi-item scale. Concurrently, an evaluation of the factor nomenclature was undertaken, culminating in their enhancement for the purpose of enhancing clarity with respect to their relationship to the content: The factor names were modified to enhance clarity regarding their relationship to the content, and the items were self-readiness (four items), family influence (four items), peer support (four items), and social media impact (four items), with each item loading only on the corresponding scale. The goodness-of-fit statistics of the factor models were estimated using the χ^2 statistic, the comparative fit index (CFI), and the root mean square error of approximation (RMSEA). In evaluating relative fit indices, we follow criteria, where CFI and TLI ≥ 0.90 and RMSEA ≤ 0.06 indicate acceptable fit [28].

Cronbach's alpha (α) calculation was performed to assess the internal consistency of the HLIS. The assessment of internal consistency was conducted by evaluating Cronbach's alpha (α), with a value of $\alpha \geq 0.76$ being considered acceptable [29].

2.5 | Ethics

The present study adhered to the ethical research guidelines for research involving human subjects, as outlined in the "World Medical Association Declaration of Helsinki" (2013 [30]). Research permissions were obtained from the respective university committees. According to the Finnish National Board on Research Integrity (Responsible Conduct of Research, n.d.), ethical approval was not required as the participants were not minors and the research posed no direct or indirect psychological or physical harm [31]. In Singapore, ethical approval was obtained from the National University of Singapore Institutional Review Board (NUS-IRB-2023-5), and in Hong Kong, China, from the Survey and Behavioural Research Ethics

TABLE 1 | Characteristics of the respondents in Finland ($n = 753$), Singapore ($n = 750$), and Hong Kong, China ($n = 767$).

Characteristics	Finland		Singapore		Hong Kong, China	
Demographic and socioeconomic characteristics	**% (*n*)**	**Missing % (*n*)**	**% (*n*)**	**Missing % (*n*)**	**% (*n*)**	**Missing % (*n*)**
Age (mean [SD])	23.6 (2.63)	0 (0)	21.4 (2.16)	0 (0)	22.3 (3.2)	0 (0)
Gender		2.6 (20)				
Male	28.0 (205)		39.3 (295)		38.1 (292)	
Female	72.0 (528)		60.7 (455)		61.9 (475)	
Years of study		0.3 (2)		0 (0)		0 (0)
Year 1	21.0 (158)		37.3 (280)		27.5 (211)	
Year 2	17.9 (135)		19.3 (145)		24.9 (191)	
Year 3	18.4 (139)		24.3 (182)		19.3 (148)	
Year 4 or above	42.7 (322)		19.1 (143)		28.3 (217)	
Faculty		0.5 (4)				0 (0)
Non-STEM	64.0 (479)		36.5 (274)		53.5 (410)	
STEM	36.0 (271)		63.5 (476)		46.5 (357)	

STEM, Science, technology, engineering, and mathematics subjects.

Committee of the Faculty of Medicine at The Chinese University of Hong Kong (Ref: SBRE-22-0651).

The utilization of the HLIS instrument, in conjunction with the adaptation of select items, has been formally endorsed with the instrument's original developer. Participation in the study was voluntary, and anonymity was secured as the data were collected via electronic link through student email lists. Before the initiation of the questionnaire, an information letter outlining the study's details was disseminated, and informed consent was obtained. The collected data were stored in password-protected files, with access strictly limited to the research group members specified in the research permissions. The data will be stored for a period of 10 years and subsequently destroyed with the assistance of the research data support personnel from the authors' organizations, in accordance with the general data protection regulation [32].

3 | Results

3.1 | Participant Characteristics

The study population comprised university students from the University of Oulu in Finland ($n = 753$), the National University of Singapore in Singapore ($n = 750$), and the Chinese University of Hong Kong in Hong Kong, China ($n = 767$). In Finland, the survey was completed by university students, of whom a significant majority were female ($n = 528$, 70.1%). The mean age of the Finnish respondents was 23.6 years (SD 2.63). A considerable proportion of respondents reported being unmarried ($n = 322$, 43.1%), while 213 students (28.5%) reported being married or cohabiting.

In the Singaporean cohort, the mean age of participants was marginally lower at 21.6 years (SD 2.16). The majority of the respondents ($n = 746$, 99.5%) reported being unmarried, with only a small proportion (0.5%) reporting being married or cohabiting.

The demographic data for respondents in Hong Kong, China, showed that their mean age was 22.3 years (SD 3.2). The majority of the respondents identified as female ($n = 475$, 61.9%). A comprehensive overview of the respondents' demographics is provided in Table 1.

3.2 | Content Validity Testing

In this study, statistical content validity was comprehensively assessed through the utilization of Spearman's correlation coefficients (r) to provide insight into the strength of the relationships between the various items and their respective dimensions (Supporting Information S1: Tables 1–3). The interpretation of these coefficients was as follows: a correlation of 0–0.19 was considered to indicate a very weak relationship, 0.20–0.39 a weak relationship, 0.40–0.59 a moderate relationship, 0.60–0.79 a strong relationship, and 0.80–1.0 a very strong relationship [26].

An examination of the dimension of self-readiness revealed that items 1–4 exhibited a range of correlations. In the Finnish data set (Supporting Information S1: Table 1), the correlations ranged from 0.23 to 0.53, indicating a mix of weak to moderate relationships. Conversely, the Singaporean data (Supporting Information S1: Table 2) exhibited a range of correlations from 0.40 to 0.69, signifying a moderate to strong correlation. The Hong Kong, China, data set (Supporting Information S1: Table 3) exhibited correlations ranging from 0.36 to 0.63, suggesting a moderate relationship.

The observed correlations for the motivation dimension (items 5–9; Supporting Information S1: Tables 1–3) demonstrated significant variability across various data sets. In the Finnish data set, the correlation coefficients ranged from 0.19 to 0.52, indicating weak to moderate relationships. Conversely, the Singaporean data set demonstrated a more extensive range of correlation coefficients, varying from 0.14 to 0.69, suggesting a broader spectrum of relationships, ranging from very weak to strong. The Hong Kong, China, data set exhibited a range of correlations from 0.01 to 0.65, indicating a broad spectrum of relationship strength, from very weak to strong.

The assessment of the sense of normality dimension (items 10–13) revealed correlations ranging from 0.32 to 0.50 in the Finnish data, indicating weak to moderate relationships. In the Singaporean data, the correlation coefficients ranged from 0.11 to 0.68, suggesting a similar range of relationships. In Hong Kong, China, the correlations ranged from 0.01 to 0.60, indicating a spectrum of relationships from very weak to moderate.

With regard to the family Influence dimension (items 14–17), the Finnish data correlations demonstrated a range from 0.42 to 0.67, thereby reflecting moderate to strong relationships. The Singaporean data demonstrated a range of 0.52–0.78, suggesting robust relationships. A similar correlation was observed in the Chinese Hong Kong data, exhibiting a range of 0.52–0.78.

The peer support dimension (items 18–21) demonstrated moderate to strong relationships, as evidenced by the correlations in the Finnish data, which ranged from 0.48 to 0.71. The data from Singapore demonstrated strong correlations, with values ranging from 0.52 to 0.80. A similar pattern was observed in the Chinese Hong Kong data, which exhibited strong relationships with correlation coefficients ranging from 0.57 to 0.74.

The impact of social media was evaluated using correlation coefficients ranging from 0.60 to 0.81 in the Finnish data set, from 0.70 to 0.85 in the Singapore data set, and from 0.65 to 0.83 in the Hong Kong, China data set. The aforementioned correlations indicated strong to very strong relationships, with statistical significance at $p < 0.001$.

3.3 | Construct Validity Testing

EFA was conducted to confirm the construct validity of the HLIS using PCA with orthogonal varimax rotation on the 25

completed items to extract the major contributing factors. The results of Phase I indicated that all items with factor loadings of 0.40 or less, that is, items 6, 8, and 9, were removed from the motivation factor. Additionally, the entire sense of normality factor (comprising items 10, 11r, 12r, and 13) was removed since all of its items had factor loadings of less than 0.40. Subsequent to this, a new analysis was conducted in Phase II, utilizing the same assumptions. The results of this analysis indicated that the factor loading of item 5 in the motivation factor was below 0.40, thus leading to its removal. As a result, the decision was made to remove the entire factor, given that only one item remained in this factor.

In Phase III, the EFA yielded a factor solution with statistical values ranging from satisfactory to excellent across all three regions. Following the elimination process, a 16-item HLIS was formulated with four domains for the following items: the factor solution for the four items measuring self-readiness exhibited factor loadings ranging from 0.41 to 0.88 and communalities from 0.30 to 0.78. The factor solution for the family influence scale (four items) yielded factor loadings ranging from 0.67 to 0.90 and communalities from 0.45 to 0.82. With regard to the peer support scale (four items), the factor loadings ranged from 0.49 to 0.90, while the communalities fell between 0.51 and 0.81. A similar pattern was observed in the factor solution for

TABLE 2 | Factor loadings and communalities of healthy lifestyle intention scale in Finland ($n = 753$), Singapore ($n = 750$), and Hong Kong, China ($n = 767$).

	Finland		Singapore		Hong Kong, China	
Items of HLIS	**Factor loadings**	**Communalities**	**Factor loadings**	**Communalities**	**Factor loadings**	**Communalities**
Factor 1: Self-readiness						
1	0.76	0.64	0.78	0.60	0.63	0.39
2	0.50	0.57	0.70	0.48	0.52	0.27
3	0.43	0.60	0.81	0.66	0.79	0.62
4	0.80	0.72	0.88	0.78	0.79	0.62
Factor 2: Motivation						
5	0.63	0.57	0.60	0.36	0.46	0.21
6	0.15	0.40	0.78	0.61	0.70	0.48
7	0.40	0.58	0.78	0.61	0.80	0.64
8r	0.62	0.66	0.46	0.21	0.10	0.01
9r	0.69	0.56	0.60	0.36	0.18	0.03
Factor 3: Sense of normality						
10	0.32	0.57	0.47	0.22	0.81	0.65
11r	0.83	0.77	0.80	0.64	−0.16	0.03
12r	0.86	0.79	0.85	0.72	0.01	0.00
13	0.34	0.62	0.45	0.20	0.75	0.56
Factor 4: Family influence						
14	0.79	0.72	0.79	0.63	0.69	0.48
15	0.79	0.68	0.87	0.75	0.67	0.45
16	0.74	0.71	0.90	0.82	0.80	0.64
17	0.70	0.70	0.86	0.74	0.82	0.67
Factor 5: Peer support						
18	0.51	0.53	0.78	0.61	0.72	0.51
19	0.56	0.50	0.84	0.70	0.75	0.56
20	0.74	0.72	0.90	0.81	0.85	0.72
21	0.70	0.71	0.86	0.75	0.84	0.70
Factor 6: Social media impact						
22	0.76	0.73	0.86	0.74	0.77	0.60
23	0.83	0.76	0.91	0.83	0.80	0.64
24	0.89	0.79	0.92	0.85	0.91	0.82
25	0.88	0.78	0.92	0.84	0.89	0.79

Abbreviation: HLIS, healthy lifestyle intention scale.

TABLE 3 | Descriptive statistics, item-to-total correlations, Cronbach's α of subscales and total scale of healthy lifestyle intention scale in Finland ($n = 753$), Singapore ($n = 750$), and Hong Kong, China ($n = 767$).

	Finland ($n = 753$)					Singapore ($n = 750$)				Hong Kong, China ($n = 767$)			
Domains	**Items**	**Mean**	**SD**	**Cronbach's α if item deleted**	**Cronbach's α of the domains**	**Mean**	**SD**	**Cronbach's α if item deleted**	**Cronbach's α of the domains**	**Mean**	**SD**	**Cronbach's α if item deleted**	**Cronbach's α of the domains**
Self-readiness					0.62				0.79				0.76
	1	4.83	1.17	0.58		4.88	0.97	0.75		4.77	1.03	0.87	
	2	4.29	1.48	0.64		4.82	1.14	0.80		4.63	1.27	0.87	
	3	5.29	0.76	0.60		4.82	1.02	0.74		4.84	1.00	0.87	
	4	4.90	1.01	0.39		4.90	0.94	0.68		4.94	0.94	0.87	
Motivation					0.64				0.62				0.60
	5	3.96	1.14	0.63		4.53	1.24	0.62		4.33	1.23	0.87	
	6	5.51	0.72	0.64		5.26	0.75	0.57		5.03	0.98	0.87	
	7	5.49	0.75	0.59		5.28	0.75	0.57		5.18	0.83	0.87	
	8	3.62	1.45	0.52		3.21	1.43	0.57		3.20	1.32	0.88	
	9	4.22	1.29	0.53		3.57	1.37	0.48		3.31	1.33	0.87	
Sense of normality					0.76				0.58				0.41
	10	5.13	0.80	0.76		5.00	0.83	0.59		4.63	0.90	0.87	
	11	4.96	1.10	0.65		4.04	1.35	0.42		3.63	1.25	0.88	
	12	4.76	1.21	0.66		4.02	1.35	0.32		3.70	1.22	0.88	
	13	4.71	1.07	0.75		4.86	0.87	0.61		4.52	0.95	0.87	
Family intention					0.82				0.88				0.83
	14	4.85	0.99	0.79		4.69	0.98	0.88		4.52	0.96	0.87	
	15	4.99	1.05	0.79		4.69	0.99	0.84		4.30	1.06	0.87	
	16	4.01	1.33	0.74		4.45	1.15	0.81		4.32	1.08	0.87	
	17	3.89	1.29	0.76		4.42	1.16	0.84		4.06	1.10	0.87	
Peer support					0.83				0.87				0.87
	18	4.70	0.98	0.83		4.73	0.89	0.87		4.45	0.94	0.86	
	19	4.67	1.08	0.80		4.71	0.89	0.84		4.13	1.04	0.87	
	20	3.88	1.30	0.76		4.58	0.95	0.80		4.16	1.06	0.87	
	21	3.97	1.22	0.77		4.58	0.97	0.82		4.02	1.07	0.87	
Social media impact					0.91				0.92				0.91

(Continues)

TABLE 3 | (Continued)

Domains	Items	Finland ($n = 753$)				Singapore ($n = 750$)				Hong Kong, China ($n = 767$)			
		Mean	SD	Cronbach's α if item deleted	Cronbach's α of the domains	Mean	SD	Cronbach's α if item deleted	Cronbach's α of the domains	Mean	SD	Cronbach's α if item deleted	Cronbach's α of the domains
	22	4.05	1.22	0.90		4.11	1.14	0.92		3.97	1.11	0.87	
	23	3.72	1.24	0.88		3.92	1.23	0.90		3.68	1.19	0.87	
	24	3.44	1.32	0.87		3.90	1.21	0.89		3.70	1.21	0.87	
	25	3.51	1.29	0.88		3.90	1.22	0.89		3.67	1.20	0.87	
Total					0.76				0.78				0.73

the four items measuring social media impact, which yielded factor loadings ranging from 0.77 to 0.92 and communalities from 0.60 to 0.84. The results of the EFA are presented in Table 2.

3.4 | Internal Consistency of the Scale

The reliability of the HLIS, which measures the internal consistency of its factors, was evaluated using Cronbach's α values as demonstrated in Table 3. These values provide insight into the reliability of the domains across different countries and regions. In the Finnish data, Cronbach's α values ranged from 0.62 to 0.91, with an overall total of 0.75. This range indicates acceptable to excellent internal consistency among the domains. A similar pattern was observed in the Singaporean data, where Cronbach's α values ranged from 0.58 to 0.92, with an overall total of 0.78, reflecting consistent reliability. In Hong Kong, China, Cronbach's α values ranged from 0.41 to 0.83, with an overall total of 0.73, suggesting acceptable internal consistency.

The findings indicate that the HLIS exhibits acceptable internal consistency across Finland, Singapore, and Hong Kong, China. These results provide support for the reliability of the scale in measuring healthy lifestyle intentions among university students in these countries and regions, as referenced by Haig [27]. This consistency underscores the scale's reliability in diverse cultural contexts for assessing students' intentions regarding a healthy lifestyle.

3.5 | Structural Validity

Following the execution of the EFA, a CFA was performed on the factors formed after the removal of the nine items to confirm the structural validity of the HLIS. This assessment was conducted separately for each of the three groups (Figures 1–3) through a comparative analysis of the Finnish, Singaporean, and Hong Kong, China data on factor loadings and model fit.

In the Finnish data set (Figure 1), the first-order factor loadings indicated moderate to high correlations among the constructs. Self-readiness demonstrated the lowest range (0.49–0.71), while family influence and social media impact exhibited stronger loadings (0.65–0.91). Peer support ranged from 0.54 to 0.87. At the second-order level, peer support emerged as the most significant factor ($\lambda = 0.93$), followed by family influence ($\lambda = 0.67$), social media impact ($\lambda = 0.63$), and lastly, self-readiness ($\lambda = 0.47$). The model statistics for the HLIS in the Finnish data demonstrated unsatisfactory fit indices, with CFI at 0.81 and RMSEA at 0.11.

The Singaporean data set (Figure 2) exhibited the following factor loadings at the first-order level: self-readiness ranged from 0.59 to 0.90, family influence from 0.62 to 0.91, peer support from 0.61 to 0.92, and social media impact from 0.76 to 0.92. At the second-order level, peer support retained its dominance ($\lambda = 0.80$), followed by family influence ($\lambda = 0.72$), self-readiness ($\lambda = 0.54$), and social media impact ($\lambda = 0.49$). The Singaporean model exhibited robust fit indices, with a CFI of

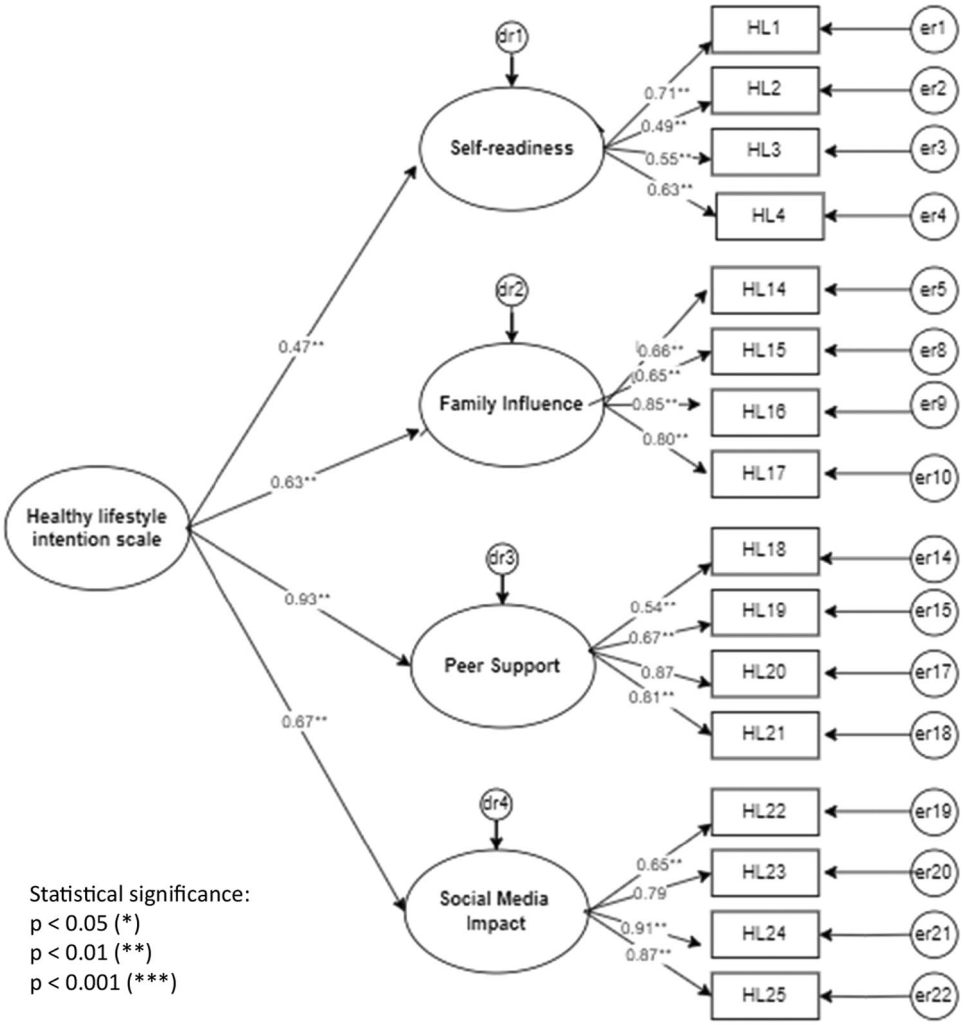

FIGURE 1 | The psychometric characteristics of the healthy lifestyle intention scale among emerging adults in Finland ($n = 753$). dr, residual term; er, error term.

0.92 and an RMSEA of 0.07, suggesting a satisfactory degree of model fit.

As demonstrated in Figure 3, the Hong Kong, China data set exhibited the highest first-order loadings for level indicated self-readiness (0.63–0.96). Family influence (0.74–0.90) and peer support (0.68–0.83) also demonstrated robust ranges, while social media impact (0.57–0.83) exhibited a comparatively diminished effect. At the second-order level, self-readiness ($\lambda = 0.87$) emerged as the most significant factor, followed by peer support ($\lambda = 0.68$) and family influence ($\lambda = 0.60$), with social media impact ($\lambda = 0.56$) ranking last. The model fit statistics for Hong Kong, China were CFI 0.92 and RMSEA 0.07.

4 | Discussion

The purpose of the present study was to modify and psychometrically validate an HLIS measuring healthy lifestyle intention among university students in three countries and regions in versatile cultural contexts. The HLIS is predicated on a measure of adherence to treatment among young people with diabetes [12]. The instrument has been evaluated and refined in diverse patient populations, including those afflicted with stroke [13], coronary heart disease [15], and multimorbidity [16]. This study aims to further develop the HLIS and to test its applicability for assessing healthy lifestyle intentions among young adults in a university setting in a primary prevention context. To the best of our knowledge, the instrument of the intention to adhere to a healthy lifestyle has not been validated culturally.

Following the modification of the instrument, the psychometric properties of the HLIS were examined using Spearman's correlation, reliability analysis (Cronbach's α), and content and construct validity using EFA with acceptable values. Structural validation was examined using CFA, which revealed numerous parameters that estimate the adequacy of the model. In this study, the correspondence between the theoretical model and the observed correlation matrix was assessed using CFI; a sufficiently good model should have a CFI > 0.90 [28] and RMSEA < 0.08 [33]. The model fit indicated that the Singapore (CFI 0.92, RMSEA 0.07) and Hong Kong, China (CFI 0.92, RMSEA 0.07) models were acceptable, while the Finnish data (CFI 0.81, RMSEA

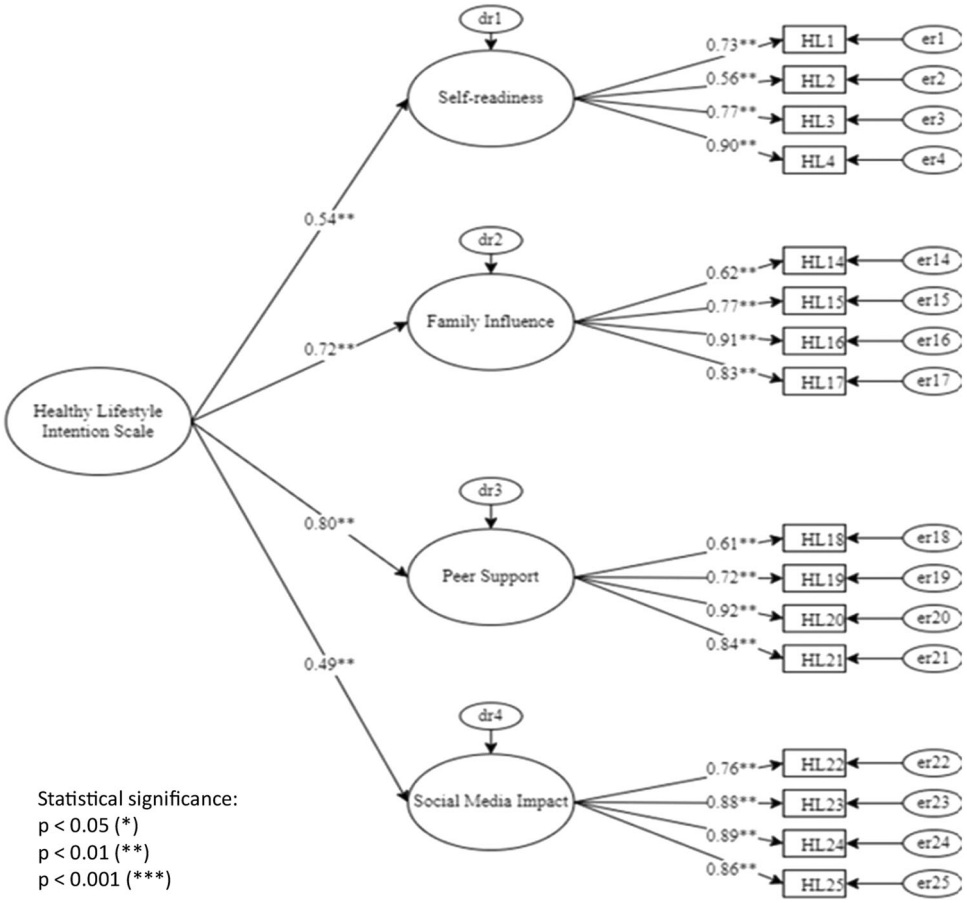

FIGURE 2 | The psychometric characteristics of the healthy lifestyle intention scale among emerging adults in Singapore ($n = 750$). dr, residual term; er, error term.

0.1) did not reach acceptable model fit values. The model fit statistics were unsatisfactory, indicating that the HLIS constructs do not fully align with the hypothesized model in the Finnish cultural context. Moreover, the lack of cross-cultural consistency in structural validity suggests potential issues in the questionnaire's design, particularly in the selection and formulation of items. This highlights the need for further refinement of the model or additional investigation into factors influencing these constructs within the Finnish data [28] (Figure 1).

However, the findings are informative and clinically interesting. The results provide insights into how cultural context influences healthy lifestyle intentions, revealing significant differences in the importance of factors and model performance across cultures in three countries and regions. In the Finnish data set, the strongest correlation was observed between intention to adopt a healthy lifestyle and peer support and social media influence; the weakest correlation was with self-readiness.

Peer support, defined as a form of social support among university students, has been shown to play an important role in behavior change, both in terms of maintenance and initiation [34]. Peer support has been demonstrated to engender a sense of community and to facilitate the comparison of experiences, the discussion of concerns, the management of stressors related to university studies, and the seeking advice and support. The sense of being heard has been demonstrated to increase self-esteem and perceived support, both of which have been shown to mediate loneliness, a phenomenon that is particularly salient among university students [35].

The advent of the internet has had a profound impact on human interaction, learning, and entertainment. The evolution of social media has facilitated the establishment of support networks among friends; however, these networks concomitantly carry potential risks. It is therefore imperative to acknowledge the dual nature of the internet, with its concomitant health-promoting and health-threatening dimensions. A comprehensive understanding of these dual impacts is imperative for optimizing the benefits while mitigating the risks. The impact of these factors on mental, physical, social, and intellectual health is contingent on usage patterns and context, with beneficial and harmful outcomes possible depending on these factors. With respect to physical health, the use of the internet and social media has been demonstrated to enhance sleep quality by providing relaxation resources. However, it can also have a detrimental effect on sleep duration due to prolonged screen time before bedtime. Social media has been shown to facilitate social participation and support, fostering connections and a sense of community. Furthermore, university

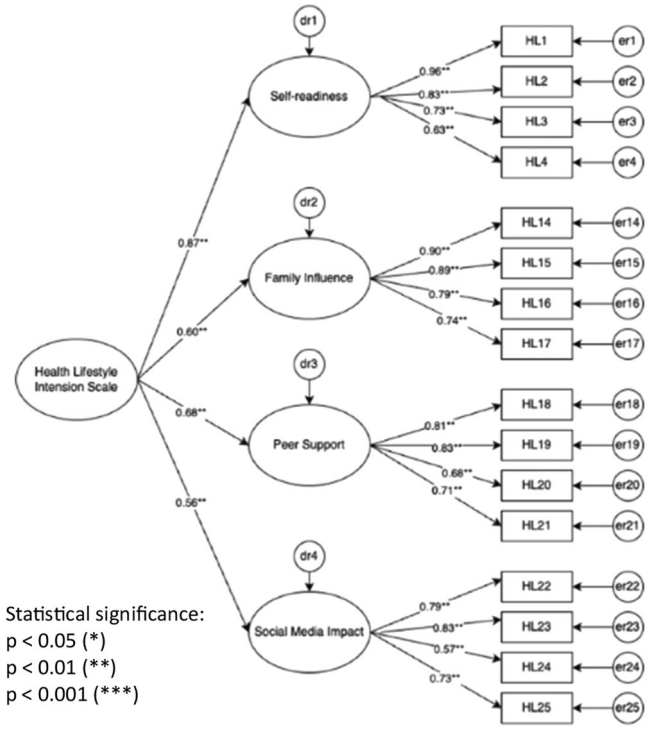

FIGURE 3 | The psychometric characteristics of the healthy lifestyle intention scale among emerging adults in Hong Kong, China ($n = 750$). dr, residual term; er, error term.

students frequently use the internet to access health information and to interact with health professionals, thereby improving their knowledge and decision-making skills [36].

The Singaporean data (Figure 2) demonstrated a more balanced and robust relationship across all constructs in the model of intention to adhere to a healthy lifestyle. The model exhibited strong fit indices, suggesting that the hypothesized model is well aligned with the Singaporean context. This finding suggests that the interaction of these factors is culturally relevant and adequately captured by the model. The significant impact of peer support and family influence on healthy lifestyle intentions is highlighted by the balanced factor loadings and the satisfactory model fit in Singapore. This observation may be indicative of collectivist values, which are known to place significant emphasis on family and human relationships [37].

The Hong Kong, China data (Figure 3) demonstrated significant associations between the constructs of the model, indicating that self-readiness exhibited the strongest association with intention to adopt a healthy lifestyle, and the impact of social media exhibited the weakest association. This finding is in contrast with the data from Finland and Singapore, where peer support exhibited a stronger association with intentions to adopt a healthy lifestyle. The model fit statistics for Hong Kong, China were satisfactory, suggesting that the model effectively captures the relationships between these constructs in the Hong Kong context. This satisfactory fit is indicative of Hong Kong, China's distinctive emphasis on cultural self-efficacy and its significance in achieving outcomes.

These discrepancies imply the necessity for culturally adapted models that consider regional priorities and values when evaluating the suitability of health behaviors. While peer support and family influence are generally important, their relative importance and interaction with other constructs varies across cultures. By recognizing these cultural nuances, future research endeavors can more effectively adapt models to specific cultural contexts, enhancing their explanatory power and relevance.

It is imperative that researchers who aspire to conduct cross-cultural comparisons, particularly in the domain of social support and health, demonstrate an acute awareness of cultural sensitivity. The presence of group disparities on a specific construct may be attributable to instrument bias across cultures, thereby compromising the accuracy of reflection of the latent construct. This potential for bias can lead to premature or erroneous conclusions in cross-cultural research. To ensure the attainment of unbiased measures, it is imperative that research endeavors encompass the consideration of culture-specific expressions. The promotion of measurement sensitivity to cross-cultural issues can be facilitated by increased international academic cooperation and professional exchange among researchers focused on cross-cultural studies [38].

Despite the meticulous nature of the study, it is also necessary to consider its potential limitations. The scale has been utilized for a variety of purposes in the past; consequently, the primary challenge was to adapt and translate the scale and use it in different contexts. This challenge was addressed during the design and translation stages, with the adaptation and validation of the scale conducted in accordance with Sousa and Rojjanasrirat [20]. The purpose of the study was to ascertain the degree to which the translated measure was consistent with the original, that is, to determine whether it functioned in the same manner in different languages and cultures [20]. The inability to merge data between research centers presented its own set of challenges. It is important to acknowledge the possibility of response bias, given that data were collected through a self-report questionnaire. Additionally, the translation of the instrument and data collection in two different languages may have negatively impacted the study's reliability. Moreover, the instrument is not suitable for patients with psychiatric disorders, particularly those experiencing impaired insight or difficulties in reality testing, such as individuals with eating or body image disorders.

5 | Conclusion

The modified and culturally validated version of the HLIS has shown potential in terms of its psychometric properties for measuring healthy lifestyle intentions among university students in a cross-cultural context. Therefore, further testing with a cross-cultural sample is recommended.

Author Contributions

The researchers participated in the study design and collected data from the three regions as follows: Finland—Outi Kähkönen and Anne Oikarinen, Hong Kong, China—Eliza Lai-Yi Wong, Cindy Yue Tian, and Annie Wai-Ling Cheung, Singapore—Ying Lau. Statistical analyses were performed by statistical experts: Finland Janne Engblom and Hong Kong, China and Singapore—Ho Hin Henry Chan. The main responsibility for writing the manuscript was taken by: Outi Kähkönen, with comments on the manuscript provided by other researchers (Anne Oikarinen, Janne Engblom, Ying Lau, Eliza Lai-Yi Wong, Cindy Yue Tian, and Annie Wai-Ling Cheung). The final version of the manuscript was approved by all investigators.

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Ethics Statement

According to the law and Finnish National Board on Research Integrity, ethical approval was not required as the participants were not minors and the research posed no direct or indirect psychological or physical harm. In Singapore, ethical approval was obtained from the National University of Singapore Institutional Review Board (NUS-IRB-2023-5), and in Hong Kong, China, from the Survey and Behavioural Research Ethics Committee of the Faculty of Medicine at The Chinese University of Hong Kong (Ref: SBRE-22-0651).

Consent

All the students gave their informed consent to participate in the study.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Use of Large Language Models, AI, and Machine-Learning Tools

AI tools (Copilot and ChatGPT-4) have been used for language checking and formatting the list of references.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.

Supplementary Table 1: Spearman Correlation Coefficients of subscales of the Healthy Lifestyle Intention Scale (IS) for University Students in Finland (n=753; Note: ***$p < 0.001$). **Supplementary Table 2:** Spearman Correlation Coefficients of subscales of the Healthy Lifestyle Intention Scale (IS) for University Students in Singapore (n=750; Note: ***$p < 0.001$). **Supplementary Table 3:** Spearman Correlation Coefficients of subscales of the Healthy Lifestyle Intention Scale (IS) for University Students in Hong Kong, China (n=767; Note: ***$p < 0.001$).