

The Healthy Lifestyle Scale for University Students: development and psychometric testing

Wang Dong^{A,B,C}, Xing Xiao-hui^B and Wu Xian-bo^A

^ASchool of Public Health and Tropical Medicine, Southern Medical University, 1023 Shatai Road, Guangzhou 510515, China.

^BDepartment of Development and Planning, Southern Medical University, 1023 Shatai Road, Guangzhou 510515, China.

^CCorresponding author. Email: dongw96@hotmail.com

Abstract. We report the development and validation of a scale to evaluate the healthy lifestyles of university students. The Delphi technique was used to determine the content validity of the scale with a panel of 33 experts. Psychometric testing was performed and confirmed with 6000 undergraduate students who were randomly selected from 10 universities in China. Three Delphi rounds were required to achieve final consensus for content validity. The split-half correlation coefficient and Cronbach's α coefficient for the total scale were 0.841 and 0.892, respectively. Construct validity was supported by exploratory factor analysis, which yielded an eight-factor instrument that explained 55.02% of the variance in the 38 items. The proposed Healthy Lifestyle Scale for University Students has good construct validity and reliability and can be used as an evaluation tool for health counselling in university health centres.

Additional keywords: reliability, validity.

Received 31 August 2011, accepted 12 December 2011, published online 17 January 2012

Introduction

In recent decades, lifestyle has been recognised as an important determinant of health status and has become a focus of increasing research interest worldwide. The World Health Organization (WHO) has stated that 60% of an individual's health-related quality of life depends on his or her lifestyle (WHO 2004). Numerous publications (Nöthlings *et al.* 2010; Hu *et al.* 2011; Reddy *et al.* 2011) have shown that healthy lifestyle practices reduce disease occurrence and mortality rates. Healthy lifestyles depend on the early adoption of healthy living habits; unhealthy lifestyles among youths are strongly linked to unhealthy habits in adulthood (Lowry *et al.* 2000; Landsberg *et al.* 2010). Although it is difficult to change unhealthy habits that adults have adopted in their youth, many effects of health risk factors among adults are avoidable if these behaviours are identified and changed at an early stage (Megel *et al.* 1994; Lee *et al.* 1997; Gall *et al.* 2009). Thus, young people are the primary target population for education about the importance of healthy lifestyles (Phongsavan *et al.* 2005).

University students typically enter a dynamic transitional period of new independence from their parents that is characterised by rapid, interrelated changes in body, mind and social relationships (Pullman *et al.* 2009). Although the university years are often viewed as a key phase for personal growth and development, they also represent a period of increased risk for injury, morbidity and mortality associated with multiple

health behaviours (Binkowska-Bury and Januszewicz 2010). Moreover, many university students fail to meet recommended nutritional and physical activity guidelines (Lowry *et al.* 2000; Huang *et al.* 2003). In Australia, adolescents are becoming less physically active and have increasingly adopted a sedentary lifestyle centred on computer use and television viewing (Alricsson *et al.* 2008). A national survey of substance use in the United States (Southern Illinois University Carbondale 2006) found that 84.5% of undergraduate students had consumed alcohol in the previous year, 41.0% used tobacco products and 30.1% used marijuana. Extensive evidence has indicated that university students in China engage in health risk behaviours such as smoking, drinking alcohol, lack of exercise, lack of sleep and poor eating habits (Tao *et al.* 1999; Zhang *et al.* 2002; Lin and Xu 2005; Ji 2007; Zhang and Su 2007; Wang *et al.* 2009). The transition from high school to university is a period of increased stress for this age cohort that may increase their engagement in such health risk behaviours (Ross *et al.* 1999; Pullman *et al.* 2009) and lead to a variety of adverse health outcomes, including major morbidities (Sells and Blum 1996; Lynn *et al.* 2004). These behaviour patterns and their consequences typically persist into adulthood, jeopardising individuals' health status in later life (Pender and Barkaskas 1992).

Because university students are in a unique stage of knowledge absorption and personality shaping, health education in the university environment is an ideal and cost-effective means

of developing healthy lifestyles. Thus, the understanding and evaluation of healthy lifestyles among university students are essential for the promotion of their healthy growth.

Physical examinations can be standardised and laboratory testing methods can be quality-controlled to ensure maximum precision. However, lifestyle is an imprecise, difficult to quantify and highly variable factor with many diverse components. Several instruments have been developed to objectively evaluate healthy lifestyles and examine associated factors, including the Health-Promoting Lifestyle Profile (HPLP), the Adolescent Lifestyle Questionnaire (ALQ), the Adolescent Lifestyle Profile (ALP) and the Adolescent Health-Promoting (AHP) scale. The HPLP (Walker *et al.* 1995) was developed to test Pender's health promotion model. This model is a paradigm for explaining health-promoting behaviour, an expression of the human actualising tendency that is directed towards sustaining or increasing the individual's level of well-being, self-actualisation and personal fulfilment (Pender 1987). The HPLP is perhaps the most frequently used measure of personal health management in nursing studies. However, this instrument does not include items related to disease prevention or undesirable health practices, such as smoking. Furthermore, the HPLP was developed for and tested on adult populations, and its developers indicated the need for additional lifestyle assessment tools that are appropriate for children and adolescents.

The ALQ (Gillis 1997) was tested on a sample of 292 students aged 12–19 years from a rural school district in eastern Canada. The ALP (Hendricks *et al.* 2006) was tested using a convenience sample of 207 students aged 10–15 years from five middle schools in a single district in the United States. Because these two instruments were developed and tested on small and relatively young samples of students, they have not been used widely due to their poor applicability and representativeness. The AHP scale (Chen *et al.* 2003), which is based on Pender's health promotion model, was developed to evaluate health-promoting lifestyles among adolescents and is widely used in Taiwan (Yang *et al.* 2006; Chen *et al.* 2007). However, like the HPLP, the AHP scale is limited by its sole focus on health promotion and is not a suitable tool for the assessment or identification of risk behaviours among youths.

Recent economic, scientific and technological developments, such as the rapid spread of the Internet, have markedly increased the emphasis on competition, and lifestyles have changed dramatically in response. The content of the above-mentioned instruments, which were developed in the 20th century, is thus no longer compatible with current lifestyles.

In recent years, the number of individuals enrolled in higher education has increased dramatically worldwide. For example, China had 5.56 million university students in 2000; this number had tripled (to 15.62 million) in 2005 and is expected to increase to 33.5 million by 2015 (Ministry of Education of the People's Republic of China 2010). Increasing numbers of students tend to practise health risk behaviours, such as smoking, drinking alcohol, practising a sedentary lifestyle and irregular breakfasting. Research on the lifestyles of university students has focussed primarily on these health risk behaviours; few studies have quantified healthy lifestyles among these students, and no study to date has developed a standardised scale for the examination of healthy behaviours in this population. In addition,

because healthy behaviours are sensitive to temporal trends, culture, ethnicity and socioeconomic status, the instruments mentioned above cannot represent actual conditions.

Our aim in the present study was to describe the development and psychometric evaluation of the Healthy Lifestyle Scale for University Students (HLSUS), and to propose its use as a research and evaluation tool by health care providers.

Methods

Instrument development

A review of the relevant literature and instruments (Walker *et al.* 1995; Gillis 1997; Chen 1999; Hong Kong Federation of Youth Groups 1999; Chen *et al.* 2003; Hendricks *et al.* 2006; Ji 2007) was performed to identify candidate items for incorporation in the HLSUS. Content experts developed additional items. The initial HLSUS consisted of 157 items in 15 categories: nutrition, exercise, sleeping habits, individual health habits, safety, studying habits, entertainment, sexual practices, environmental protection, social support, health responsibility, stress management, life appreciation, personal morality and health risk behaviours. These 15 categories were considered to represent the dimensions of a healthy lifestyle for university students.

The instrument used a five-point response format to obtain data regarding the frequency of reported behaviours ('never', 'rarely', 'sometimes', 'usually' or 'always'), with scores ranging from 1 to 5. Five adolescent counselling experts employed at a medical university assessed the instrument's content validity. These experts included psychologists, health educators and physicians who worked in the university health centre and/or were members of the epidemiological and nursing faculty. They were asked to rank each item's priority, to delete or add comments and to score their agreement with the inclusion of each item in the instrument. The five content experts rated more than 60% of the 157 items as 'appropriate'. Editorial changes were made on the basis of feedback from the content experts; some items were deleted and others were added to the HLSUS.

The revised HLSUS consisted of 128 items in 15 categories and was administered to 30 university students (15 men and 15 women) in a pilot study. They were asked to review the questionnaire and assess the clarity, meaning and wording of items. All participants agreed that most HLSUS items were appropriate measurements of their lifestyle, but that 11 items did not reflect their habits or behaviours. An examination of the frequency distribution of responses indicated that the full range of response scores was used for the majority of items. Items were added, deleted or modified based on the recommendations of the panel of multidisciplinary experts and the university students who participated in the pilot testing. The resulting instrument contained 117 items.

The Delphi technique was used to develop and determine the content validity of the HLSUS. This method uses an expert panel to reach consensus for a specific purpose and is a widely used approach in the development of research scales and questionnaires (Duffield 1988; Fisher *et al.* 2001). The expert panel for this study consisted of 33 experts drawn from universities, research institutes and hospitals in China based on their professional reputations and research domains: seven

scholars specialising in school health education, six nutritionists, five hygienists working with adolescents, five physicians working in school infirmaries, four nurses, three psychologists and three epidemiologists. The questionnaire was mailed to each panel member, who was asked to read each question and evaluate the degree to which he or she thought that the item reflected healthy lifestyles for university students. The panel members were then asked to rank their agreement or disagreement with each item's inclusion in the HLSUS on a five-point Likert scale. If they disagreed with the inclusion of an item, they were asked to indicate whether they thought the item should be modified and then included. The panel members were given the opportunity to provide any modifications and/or comments. Their responses were returned to the researchers in a self-addressed, stamped envelope and the data were collated, coded and analysed using SPSS software (ver. 17.0; SPSS Inc., Chicago, IL, USA). Items were retained if the panel indicated $\geq 80\%$ agreement, or provisionally retained for subsequent testing rounds if the panel did not achieve consensus but $< 20\%$ of panel members disagreed (i.e. $\geq 80\%$ of panel members agreed, strongly agreed or were unsure). Items were further modified or deleted as appropriate based on comments provided by the expert panel.

Three Delphi rounds were required to reach final consensus on all items in the HLSUS. Following the first round, 47 items were deleted due to $< 80\%$ agreement and 21 items were modified. Ten of the deleted items were in the personal morality domain, which the expert panel found to have little relevance for healthy lifestyles from a medical perspective. Twenty-two items in the dimensions of sleeping habits, individual health habits, safety, sexual practices, environmental protection and health risk behaviours were integrated into two dimensions: regular behaviours and health risk behaviours. Ten other items were deleted due to duplicate content.

In the second Delphi round, the experts showed strong agreement with the inclusion of most items. However, comments from the expert panel led to the deletion of 26 items and the modification of nine items. The deleted items were in the dimensions of social support, health responsibility, stress management and life appreciation; the panel considered these items to be inadequately worded and commented that the same information was addressed in other items.

The modified instrument was submitted to a third Delphi round to gain final consensus. The modifications were generally minor, and aimed to simplify or clarify items. For example, 'drink alcohol' was revised to 'drink alcohol excessively', 'sleep 8 h daily' was revised to 'get enough sleep daily' and 'wash hands before and after meals' was revised to 'wash hands before meals'. The resulting instrument contained 38 items in eight dimensions.

Testing the HLSUS

Participants

This study used a two-stage, stratified sampling method. First, we applied a proportionate allocation strategy to sample 10 universities, which were selected randomly according to geographic location to provide a representative nationwide sample. Next, a random sample of 600 student numbers was drawn from all student numbers in each selected university. A total of 6000 university students in years 1–5 of 10 universities

located throughout China were recruited for participation; 5523 (92.05% response rate) of these students agreed to participate in this study. To evaluate the reliability of the results, 100 respondents attending Southern Medical University were randomly selected to participate in a retest performed 7 days after the baseline test. Prior to conducting this study, ethical approval was obtained from the Area Health Service Ethics Committee and the Human Ethics Committee of Southern Medical University. All respondents provided written informed consent before participation, and each respondent was free to discontinue participation at any time.

Fieldwork

Because the study was intended to identify the usual pattern of university students' health practices and to avoid the confounding effects of seasonal holidays and the stressful examination period, the survey was conducted mid-semester from November to December 2008 using a self-administered questionnaire. To maximise the response rate and avoid researchers' influence on the respondents, all questionnaires were delivered and collected face-to-face by students whom the researchers had trained as interviewers. The respondents completed the questionnaires individually, and the interviewers were on site to explain any unclear items without inducement.

Data management

All valid questionnaires were entered in duplicate into the database by two independent postgraduate students using EpiData software (ver. 3.1; EpiData Association, Odense, Denmark). Any discrepancy between the two operators was resolved by cross-checking the duplicate data manually and by computer. Data from 615 subjects were excluded due to missing responses to more than five questions or to evidence that the respondent had not taken the questionnaire seriously (e.g. a score outside the normal variation or a majority of 'always' or 'never' responses). Thus, data from 4908 valid questionnaires were analysed in this study. Thirteen of the 100 retest questionnaires were rejected because they were not completed in accord with the study protocol, resulting in a sample of 87 questionnaires for the retest analysis. Missing values were replaced by mean item values. We obtained high response rates to the survey; the average response rates were 93.21% for general information and 99.17% (range: 98.45–99.94%) for all HLSUS items.

The reliability and validity of the HLSUS questionnaire were evaluated. Split-half reliability was computed by correlating the scores of the odd half with those of the even half for each dimension of the HLSUS. Test-retest reliability was assessed by examining differences between test and retest scores using a paired-sample *t*-test and by calculating an intraclass correlation coefficient (ICC). The internal consistency of the HLSUS items was assessed by Cronbach's α coefficient. The construct validity of the HLSUS was assessed by Spearman correlation and factor analyses using principal components analysis (Fang 2001). The Kaiser–Meyer–Olkin (KMO) and Bartlett's sphericity tests were used to measure sampling adequacy before the principal components analysis was performed using varimax rotation with Kaiser normalisation. Analysis of variance and the least significant differences (l.s.d.) method were used to compare the

HLSUS scores of university students with different reported frequencies of illness. All statistical analyses were conducted using SPSS software (ver. 17.0; SPSS).

Results

Subject characteristics

The subjects in this study were 16–25 years (mean: 21.7 years) of age. Of the 4908 students who completed the questionnaire, 2636 (53.71%) were men and 2272 (46.29%) were women. Most ($n = 3641$; 74.19%) participants were junior students (years 1–2) and the remainder ($n = 1267$; 25.81%) were senior students (years 3–5); 2194 (44.70%) came from rural areas and 2714 (55.30%) from urban areas; 227 (4.63%) felt ill frequently, 1924 (39.20%) felt ill occasionally and 2743 (55.89%) rarely felt ill.

Reliability

Split-half reliability test

The split-half correlation coefficient for the total scale was 0.841. This coefficient was >0.70 for 4/8 dimensions (social support, life appreciation, stress management and health responsibility) and ranged from 0.557 to 0.659 for the other four dimensions (nutrition behaviour, regular behaviour, exercise behaviour and health risk behaviour). The health risk behaviour dimension yielded the lowest split-half reliability coefficient (0.557; Table 1).

Test–retest reliability

The absolute mean differences between the test and retest scores for each dimension (0.01–0.34) were not found to be significant by paired-sample *t*-tests ($P > 0.05$). The 1-week ICCs ranged from 0.703 to 0.843 for 6/8 dimensions, excepting the health risk behaviour (ICC=0.612) and stress management (ICC=0.696) dimensions (Table 1).

Internal reliability

The HLSUS instrument showed high internal reliability ($\alpha = 0.892$) overall. Cronbach’s α coefficients >0.70 were obtained for 6/8 HLSUS dimensions (nutrition behaviour, regular behaviour, social support, life appreciation, health responsibility and stress management), excepting the exercise behaviour ($\alpha = 0.619$) and health risk behaviour (0.608) dimensions (Table 1).

Validity

Factor analysis

The KMO value for the HLSUS was 0.929 and the significance of Bartlett’s sphericity was 0.000 ($\chi^2 = 54913.12$, $P < 0.001$), indicating that the samples met the criteria for factor analysis. Factor analysis yielded an eight-factor solution that explained 55.02% of variance, with eigenvalues >1.00. The factor load values of all 38 questionnaire items exceeded 0.35, indicating communality (Table 2). Communality estimates were <0.5 for 10/38 items and 0.502–0.724 for the remaining 28 items, indicating that most items were explained by their respective common factor. The load values of all but three items exceeded the minimum criterion (0.4) of the construct validity test.

Correlation analysis

As shown by Spearman correlation analysis, items within a single dimension correlated more highly with the total score of the dimension (to which they were conceptually related) than with the dimensions to which they were conceptually unrelated (Table 1).

Comparison of HLSUS scores among respondents with different reported frequencies of illness

Analysis of variance revealed significant differences in total HLSUS scores and in scores for each of the eight dimensions according to respondents’ reported frequency of illness. In the pairwise comparison performed using the l.s.d. method, students who rarely felt ill obtained the highest total and dimension scores, and students who frequently felt ill obtained the lowest scores; these differences were significant ($P < 0.05$; Table 3).

Discussion

The examination of healthy lifestyles among adolescents has become a research focus worldwide. University life is a transitional period that provides good opportunities for the establishment of health-promoting lifestyles. Most research on healthy lifestyles has been undertaken in the United States and Europe, where many university students are minimally engaged in health-promoting behaviours, especially healthy diets and physical activity (Steptoe et al. 2002; American College Health Association 2007; Laska et al. 2009). However, the lack of a standardised scale has limited the collection and analysis of data on healthy lifestyles among university students.

Table 1. Reliability and correlation of the dimensions of the Healthy Lifestyle Scale for University Students
ICC, intraclass correlation coefficient

Dimension	No. of items	Reliability				Correlation	
		Split-half reliability	Test–retest mean difference	ICC	Cronbach’s α	Correlation between items and home dimension	Correlation between items and other dimensions
Exercise behaviour	4	0.608	0.28	0.802	0.619	0.078–0.797	0.013–0.221
Regular behaviour	4	0.627	0.19	0.797	0.703	0.578–0.740	0.061–0.359
Nutrition behaviour	4	0.659	–0.34	0.843	0.711	0.677–0.737	0.016–0.348
Health risk behaviour	4	0.557	–0.06	0.612	0.608	0.476–0.727	0.000–0.208
Health responsibility	6	0.714	–0.11	0.724	0.722	0.602–0.665	0.007–0.407
Social support	6	0.736	–0.14	0.774	0.791	0.640–0.763	0.002–0.462
Stress management	5	0.703	–0.09	0.696	0.740	0.655–0.714	0.020–0.506
Life appreciation	5	0.767	–0.01	0.703	0.830	0.712–0.817	0.037–0.504

Table 2. Factor loadings and factor structure of the Healthy Lifestyle Scale for University Students

Dimension/Item	F1	F2	F3	F4	F5	F6	F7	F8	Communality
Exercise behaviour									
Exercise vigorously 30 min (excluding warm up) at least 3 times per week					0.828				0.724
Warm up before vigorous exercise					0.778				0.655
Take part in light-moderate physical activity (brisk walking, bicycling, aerobic dancing, stair climbing) 30-60 min at least 3 times per week					0.778				0.650
Exercise vigorously within 30 min after meals					-0.269			0.482	0.359
Regular behaviour									
Eat breakfast daily							0.717		0.615
Eat three meals daily at regular intervals							0.743		0.660
Keep regular study and resting times							0.607		0.541
Get enough sleep daily	0.348						0.358		0.460
Nutrition behaviour									
Pay attention to replenishing fluids during exercise						0.606			0.485
Drink at least 800 mL (~5 disposable paper cups) of water daily						0.721			0.579
Eat foods rich in dietary fibre (e.g. fruit, vegetables)						0.641			0.545
Consciously choose a diet low in fat, saturated fat, salt and cholesterol						0.629			0.462
Health risk behaviour									
Drink alcohol excessively								0.735	0.581
Smoke or consume tobacco or marijuana								0.760	0.619
Listen continuously to headphones for more than 30 min								0.495	0.669
Read or use the computer continuously for more than 1 h								0.433	0.598
Health responsibility									
Go to a doctor promptly when any unusual sign or symptom appears			0.369						0.381
Comply with doctor's advice and treatment			0.570						0.459
Brush teeth or use dental floss after meals			0.664						0.497
Wash hands before meals			0.692						0.562
Cover mouth and nose when sneezing or coughing			0.618						0.472
Keep public environments (e.g. classroom, library, laboratory) clean			0.554						0.502
Social support									
Actively help classmates in trouble				0.496					0.494
Enjoy keeping in touch with relatives				0.688					0.597
Take part in group activities with classmates				0.696					0.642
Talk about my troubles with others				0.711					0.576
Pay attention to others' feelings when handling affairs		0.547		0.385					0.543
Express my own feelings in a inoffensive manner		0.569		0.319					0.480
Stress management									
Take time for relaxation daily		0.589							0.489
Accept unchangeable things in life		0.700							0.566
Make an effort to monitor my emotional changes		0.629							0.496
Schedule study and leisure activities	0.354	0.384							0.419
Remain unruffled and respond calmly to frustrations	0.484	0.489							0.520
Life appreciation									
Accept new experiences and challenges with pleasure	0.649								0.558
Feel content	0.727								0.635
Make an effort to take interest and be challenged in daily studies and life	0.746								0.673
Make an effort to feel growth in a positive direction	0.726								0.669
Clarify my own learning purpose	0.635								0.476

The HLSUS was intentionally designed to have a broader construct than previously introduced healthy lifestyle scales for adolescents. In contrast to the HPLP (Walker *et al.* 1995), the HLSUS was found to accurately measure both health-promoting and health risk behaviours. Our study also provides support for five additional dimensions identified by Gillis (Gillis 1997), who developed the ALQ for Canadian adolescents and defined a healthy lifestyle to include health-promoting and health-protecting behaviours.

Content validity is usually established deductively by defining a universe of items and sampling systematically within this universe; the acceptance of the universe of content as defining the variable to be measured is thus essential. The initial development of the HLSUS was based on a literature review and student interviews, and its content validity was established following its assessment by a panel of experts using the Delphi technique. This method ensured the identification and inclusion of appropriate items in this instrument. The representation and authority

Table 3. Comparison of Healthy Lifestyle Scale for University Students scores among respondents with different reported frequencies of illness
I.s.d., least significant differences

Dimension	Feel ill frequently (n = 227)	Feel ill occasionally (n = 1924)	Feel ill rarely (n = 2743)	F	P	I.s.d. pairwise comparison
Exercise behaviour	10.89 ± 2.61	11.16 ± 2.62	12.24 ± 3.18	86.105	0.000	1 < 2 < 3
Regular behaviour	13.83 ± 2.95	14.42 ± 2.77	15.00 ± 2.96	33.580	0.000	1 < 2 < 3
Nutrition behaviour	13.19 ± 3.30	13.73 ± 3.16	14.02 ± 3.18	10.449	0.000	1 < 2 < 3
Health risk behaviour	13.37 ± 2.78	14.19 ± 2.26	14.35 ± 2.40	18.796	0.000	1 < 2 < 3
Health responsibility	23.65 ± 3.87	24.58 ± 3.49	25.07 ± 3.68	22.847	0.000	1 < 2 < 3
Social support	21.81 ± 4.37	22.51 ± 3.95	23.02 ± 4.04	15.750	0.000	1 < 2 < 3
Stress management	17.67 ± 3.37	17.99 ± 3.23	18.73 ± 3.33	33.669	0.000	1 < 2 < 3
Life appreciation	18.09 ± 4.24	18.67 ± 3.61	19.83 ± 3.68	68.909	0.000	1 < 2 < 3
Total	132.51 ± 17.30	137.24 ± 15.94	142.26 ± 17.37	72.856	0.000	1 < 2 < 3

provided by the panel of experts ensured the scientific relevance of the items. Few questionnaires contained missing responses, indicating that the instrument was meaningful.

A Cronbach's α value of ≥ 0.7 is generally considered a sufficient demonstration of internal consistency (Liu 2004). The present study found α values of >0.7 for all dimensions of the HLSUS except exercise behaviour and health risk behaviour, indicating satisfactory internal consistency. The exercise behaviour and health risk behaviour dimensions had relatively low Cronbach's α coefficients (0.619 and 0.608, respectively) as well as low ICCs and split-half reliability values, suggesting that the conceptualisation and wording of items in these two dimensions may be problematic. Undergraduate students may have difficulty identifying behaviours that are contrary to good health.

Factor analysis is a common approach to exploring whether the predicted factor structure of a questionnaire is supported, and factor loadings >0.4 are usually considered to support the factor construction of a particular dimension (Liu 2004). Judged by this criterion, our factor analysis results indicated that the HLSUS was in general accord with the theoretical construction. Correlation analysis indicated that each of the 38 items was highly correlated with the hypothesised dimension, whereas relatively low correlations were observed between each item and other dimensions. In addition, consistent with previous studies (Huang and Chiou 1997; Binkowska-Bury and Januszewicz 2010), we found significant differences in healthy lifestyle scores among respondents with different reported frequencies of illness, reflecting the reality that healthy lifestyles promote health and unhealthy lifestyles have poor effects on health. This finding also indicates the good responsiveness of the HLSUS, as it distinguished among subgroups as expected. Therefore, we conclude that the HLSUS is acceptable and applicable for evaluating the healthy lifestyles of university students.

Nevertheless, the present study has at least three limitations. First, no detailed information about non-responders was collected. However, the high response rate limited the effect of any bias due to missing information on non-respondents. Second, although the interviewers received uniform training, their explanations of questionnaire items may have influenced the results. Third, this study did not investigate the influence of associated factors on healthy lifestyles among university students. Thus, further studies should be conducted in multiple global settings to revise the HLSUS and evaluate university

students' healthy lifestyles and associated factors more fully, before the findings are applied widely to the establishment of health-promoting interventions.

Conclusion

The HLSUS covers a broad scope of lifestyle variables, including health-promoting and health-protecting behaviours. It is a valid and reliable instrument that can be used by school health professionals as a practical guide for the assessment of university students' health and the identification of unhealthy behaviours. However, further large-scale investigations are necessary in multiple regions of the world to evaluate the validity of the HLSUS more fully, before it can be used to guide the future development of specific interventions.

Conflicts of interest

None declared.

Acknowledgements

We thank the National Natural Science Foundation of China (81102199) and the Guangdong Natural Science Foundation (S2011040003676) for financial support. We also thank all participants who gave their time to make this project a reality.

References

- Alricsson M, Domalewski D, Romild U, Asplund R (2008) Physical activity, health, body mass index, sleeping habits and body complaints in Australian senior high school students. *International Journal of Adolescent Medicine and Health* **20**(4), 501–512. doi:10.1515/IJAMH.2008.20.4.501
- American College Health Association (2007) National College Health Assessment Spring 2006 Reference Group data report. *Journal of American College Health* **55**, 195–206. doi:10.3200/JACH.55.4.195-206
- Binkowska-Bury M, Januszewicz P (2010) Sense of coherence and health-related behaviour among university students – a questionnaire survey. *Central European Journal of Public Health* **18**(3), 145–150.
- Chen MY (1999) The effectiveness of health promotion counseling to family caregivers. *Public Health Nursing (Boston, Mass.)* **16**(2), 125–132. doi:10.1046/j.1525-1446.1999.00125.x
- Chen MY, Wang EK, Yang RJ, Liou YM (2003) Adolescent health promotion scale: development and psychometric testing. *Public Health Nursing (Boston, Mass.)* **20**(2), 104–110. doi:10.1046/j.1525-1446.2003.20204.x
- Chen MY, Hsiao YC, Gau YM (2007) Comparison of adolescent's health-related behavior in different family structure. *The Journal of Nursing Research* **15**, 1–10. doi:10.1097/01.JNR.0000387594.86790.f0

- Duffell C (1988) The Delphi technique. *The Australian Journal of Advanced Nursing* **6**, 41–45.
- Fang JQ (2001) 'Medical statistics and computer experiments.' (Shanghai Scientific and Technical Publishers: Shanghai) [In Chinese]
- Fisher M, King J, Tague G (2001) Development of a self-directed learning readiness scale for nurses. *Nurse Education Today* **21**, 516–525. doi:10.1054/nedt.2001.0589
- Gall SL, Jamrozik K, Blizzard L, Dwyer T, Venn A (2009) Healthy lifestyles and cardiovascular risk profiles in young Australian adults: the Childhood Determinants of Adult Health Study. *European Journal of Cardiovascular Prevention and Rehabilitation* **16**(6), 684–689. doi:10.1097/HJR.0b013e3283315888
- Gillis AJ (1997) The Adolescent Lifestyle Questionnaire: development and psychometric testing. *Canadian Journal of Nursing Research* **29**(1), 29–46.
- Hendricks C, Murdaugh C, Pender N (2006) The Adolescent Lifestyle Profile: development and psychometric characteristics. *Journal of National Black Nurses' Association* **17**(2), 1–5.
- Hong Kong Federation of Youth Groups (1999) Youth's views of healthy living. *Hong Kong: Youth Poll Series* **68**, 19–38.
- Hu FB, Liu Y, Willett WC (2011) Preventing chronic diseases by promoting healthy diet and lifestyle: public policy implications for China. *Obesity Reviews* **12**, 552–559. doi:10.1111/j.1467-789X.2011.00863.x
- Huang YH, Chiou CJ (1997) Predictors contributing to health-promoting lifestyles among college students in Kaohsiung area. *Zhong Hua Gong Gong Wei Sheng Za Zhi* **16**(1), 24–36. [In Chinese]
- Huang TT, Harris KJ, Lee RE, Nazir N, Born W, Kaur H (2003) Assessing overweight, obesity, diet, and physical activity in college students. *Journal of American College Health* **52**, 83–86. doi:10.1080/07448480309595728
- Ji CY (2007) Report on the survey for the adolescent health risk behaviors of Chinese city (2005 year). (Peking University Medical Press: Beijing) [In Chinese]
- Landsberg B, Plachta-Danielzik S, Lange D, Johannsen M, Seiberl J, Müller MJ (2010) Clustering of lifestyle factors and association with overweight in adolescents of the Kiel Obesity Prevention Study. *Public Health Nutrition* **13**, 1708–1715. doi:10.1017/S1368980010002260
- Laska MN, Pasch KE, Lust K, Story M, Ehlinger E (2009) Latent class analysis of lifestyle characteristics and health risk behaviors among college youth. *Prevention Science* **10**(4), 376–386. doi:10.1007/s11121-009-0140-2
- Lee A, Wun Y, Chan K (1997) Changing family medicine/general practice morbidity patterns in Hong Kong adults. *Hong Kong Practitioner* **19**(10), 508–517.
- Lin Q, Xu Y (2005) An epidemiological characteristic of health risk behaviors survey of undergraduates. *Su Zhou Da Xue Xue Bao* **25**, 432–436. [In Chinese]
- Liu Q (2004) Assessment of quality of life. In 'Statistics of medicine'. 1st edn. (Ed. ZQ Sun) pp. 404–406. (People's Medical Publishing House: Beijing) [In Chinese]
- Lowry R, Galuska DA, Fulton JE, Wechsler H, Kann L, Collins JL (2000) Physical activity, food choice, and weight management goals and practices among US college students. *American Journal of Preventive Medicine* **18**, 18–27.
- Rew L, Johnson RJ, Jenkins SK, Torres R (2004) Developing holistic nursing interventions to improve adolescent health. *Journal of Holistic Nursing* **22**(4), 303–319.
- Megel M, Wade F, Hawkins P (1994) Health promotion, self-esteem, and weight among female college freshmen. *Health Values* **18**, 10–19.
- Ministry of Education of the People's Republic of China (2010) The outline of China's national plan for medium and long-term education reform and development. Available at http://www.moe.gov.cn/publicfiles/business/htmlfiles/moe/moe_177/201008/93785.html [Verified 26 June 2010]
- Nöthlings U, Ford E, Kröger J, Boeing H (2010) Lifestyle factors and mortality among adults with diabetes: findings from the European Prospective Investigation into Cancer and Nutrition–Potsdam study. *Journal of Diabetes* **2**(2), 112–117. doi:10.1111/j.1753-0407.2010.00069.x
- Pender NJ (1987) 'Health promotion in nursing practice.' 2nd edn. (Appleton & Lange: Norwalk, CT)
- Pender NJ, Barkaskas VH (1992) Health promotion and disease prevention: toward excellence in nursing practice and education. *Nursing Outlook* **40**(3), 106–112.
- Phongsavan P, Olatunbosun-Alakija A, Havea D, Bauman A, Smith B, Galea G, Chen J (2005) Health behaviour and lifestyle of Pacific youth surveys: a resource for capacity building. *Health Promotion International* **20**(3), 238–248. doi:10.1093/heapro/dah612
- Pullman AW, Masters RC, Zalot LC, Carde LE, Saraiva MM, Dam YY, Randall Simpson JA, Duncan AM (2009) Effect of the transition from high school to university on anthropometric and lifestyle variables in males. *Applied Physiology, Nutrition, and Metabolism* **34**(2), 162–171. doi:10.1139/H09-007
- Reddy P, Rankins D, Timoshanko A, Dunbar J (2011) *Life!* in Australia: translating prevention research into a large-scale intervention. *The British Journal of Diabetes & Vascular Disease* **11**(4), 193–197. doi:10.1177/1474651411410724
- Ross SE, Niebling BC, Heckert TM (1999) Sources of stress among college students. *College Student Journal* **33**, 312–317.
- Sells CW, Blum RW (1996) Morbidity and mortality among U.S. adolescents: an overview of data and trends. *American Journal of Public Health* **86**(4), 513–519. doi:10.2105/AJPH.86.4.513
- Southern Illinois University Carbondale (2006) Results of the Core Alcohol and Drug Survey. Available at http://www.siu.edu/departments/coreinst/public_html/ [Verified 27 November 2007]
- Steptoe A, Wardle J, Cui W, Bellisle F, Zotti AM, Baranyai R, Sanderman R (2002) Trends in smoking, diet, physical exercise and attitudes toward health in European university students from 13 countries. *Preventive Medicine* **35**(2), 97–104. doi:10.1006/pmed.2002.1048
- Tao FB, Zhang HB, Xu SJ, Zeng GY (1999) An epidemiological study on Health Risk Behaviors of College Students. *Zhongguo Xuexiao Weisheng* **20**, 249–250. [In Chinese]
- Walker S, Sechrist K, Pender N (1995) 'The Health-Promoting Lifestyle Profile II.' (University of Nebraska Medical Center, College of Nursing: Omaha, NE)
- Wang D, Ou CQ, Chen MY, Duan N (2009) Health-promoting lifestyles of university students in mainland China. *BMC Public Health* **9**, 379. doi:10.1186/1471-2458-9-379
- WHO (2004) The WHO cross-national study of health behavior in school-aged children from 35 countries: findings from 2001–2002. *The Journal of School Health* **74**, 204–206. doi:10.1111/j.1746-1561.2004.tb07933.x
- Yang RJ, Wang EK, Hsieh YS, Chen MY (2006) Irregular breakfast eating and health status among adolescents in Taiwan. *BMC Public Health* **6**, 295. doi:10.1186/1471-2458-6-295
- Zhang C, Su W (2007) Survey of health risk behaviors in college students. *Modern Preventive Medicine* **34**, 1110–1115. [In Chinese]
- Zhang HL, Li GY, Zhang BR, Dai GS, Wu CH, Fan L (2002) Descriptive study on the health-harmed behaviors of the college students. *Journal of Langfang Teachers College* **18**, 92–94. [In Chinese]