

Translation and Psychometric Properties of the Chinese Version of the Perceived Workplace Environment Scale in Taiwanese Information Technology Professionals

Yun-Ping LIN¹, Tsui-Sui Annie KAO¹, Marjorie C. McCULLAGH¹,
Dee W. EDINGTON^{2,3} and Janet L. LARSON¹

¹School of Nursing, University of Michigan, USA, ²School of Kinesiology, University of Michigan, USA and ³Health Management Research Center, University of Michigan, USA

Abstract: Translation and Psychometric Properties of the Chinese Version of the Perceived Workplace Environment Scale in Taiwanese Information Technology Professionals: Yun-Ping LIN, et al. School of Nursing, University of Michigan, USA—Background:

The six-item Perceived Workplace Environment Scale (PWES) is a self-report instrument designed to measure employees' perceptions of the extent to which their workplace environment supports employee physical activity. A Chinese version is needed to facilitate workplace physical activity research in Chinese speaking countries. **Objectives:** This paper describes the translation process and the psychometric properties of the newly translated Chinese version of the PWES (PWES-C). **Methods:** The PWES in English was translated into Chinese using a modified committee approach with the consideration of cross-cultural equivalence. Psychometric properties were examined by a cross-sectional survey of 466 male and 109 female Taiwanese information technology (IT) professionals from three IT companies in northern Taiwan. **Results:** Content validity of the newly translated PWES-C was supported by a panel of experts. Internal consistency reliability was high (Cronbach's alpha=0.88), and no significant ceiling and floor effects were observed for the PWES-C. Construct validity was supported by examining the factor structure of the PWES-C using a confirmatory factor analysis, and the results suggest a single-factor structure. **Conclusions:** The PWES-C is a reliable and valid measure of perceived workplace physical activity environments in Taiwanese IT professionals. The scale could be used by employers to document employees' perception of the workplace environment.

(J Occup Health 2012; 54: 223–231)

Key words: Information technology professionals, Instrument translation, Perceived Workplace Environment Scale, Physical activity, Psychometric properties

Changes to living and working environments have contributed to low levels of physical activity among workers. The contemporary economy requires fewer workers performing hard physical labor, and more workers spend their day sitting and doing light work.

Current approaches to worksite health promotion focus on creating supportive environments to facilitate health behavior change¹. Interventions targeting multiple dimensions of the environment play an important role in enhancing worker physical activity and health as well as business performance^{2,3}. However, progress in this area has been limited by the lack of adequate measures. There are a limited number of instruments that measure workplace environmental support for physical activity, and most are lengthy and reflect environmental support for multiple health-related behaviors.

The recently developed Perceived Workplace Environment Scale (PWES)⁴ is a brief measure that focuses on workplace environmental support for physical activity. The PWES is composed of six items that reflect individual, social, organizational, community, policy and physical environment⁴. It is a practical tool for occupational health professionals and/or program developers and can be easily administered to workers in a few minutes.

The purpose of this paper is to describe the translation and evaluation of the psychometric properties of the newly translated Chinese version of the PWES (PWES-C) in a sample of Taiwanese information technology (IT) professionals. The specific aims of this paper are (a) to describe the translation process of the

Received Oct 26, 2011; Accepted Feb 29, 2012

Published online in J-STAGE Apr 14, 2012

Correspondence to: Y. P. Lin, School of Nursing, University of Michigan, Ann Arbor, MI 48109, USA (e-mail: yunping@umich.edu)

PWES from English into Chinese and (b) to examine psychometric properties of the Chinese version including the distribution of the data, internal consistency reliability and construct validity.

Background

In the research literature on workplace health promotion, well-established instruments have been used to assess workplace environments⁵⁻⁸. All but one (the Worksite Supportive Environments for Active Living Survey)⁵ measures environmental support for multiple health-related behaviors (ranging from two to five), including physical activity. They are lengthy measures (ranging from 100 to 226 items) that require site visits/observations or interviews with key corporate managers. Individual items are rated on a dichotomous scale, indicating the presence or absence of environmental support for specific health-related behaviors. In reality, different degrees of environmental support for specific health-related behaviors are possible, and this is not reflected in these instruments. Although these instruments have been shown to have acceptable reliability and/or validity, the observational measures are not easy to complete, and the raters require substantial training and significant experience to achieve reliable results⁹.

1) Development of the Perceived Workplace Environment Scale

Prodaniuk *et al.*⁴ constructed a measure of PWES based on their original instrument, the Workplace Physical Activity Assessment Tool (WPAAT)¹⁰. The WPAAT was developed based on their conceptual framework of an ecological workplace physical activity model¹⁰. This model was based on the work of McLeroy *et al.*¹¹, who proposed an ecological framework for health promotion, and Sallis and Owen¹², who added the physical environment as a potential important component for physical activity.

The PWES⁴ was modified from a 45-item WPAAT “yes/no” assessment tool¹⁰ to a 6-item “5-point Likert scale” survey instrument. Each PWES item measures perceptions concerning one of the six environmental dimensions of the ecological workplace physical activity model. General instructions direct participants to indicate the extent to which the workplace environment supports physical activity. Responses are quantified on a 5-point Likert scale (1=none and 5=a great amount). The use of a 5-point rating scale allows an assessment of varying degrees of environmental support for physical activity and thus has the potential to yield more accurate information.

2) Scoring

Scores are calculated by averaging the item responses, with a potential range of one to five. A higher score reflects a more supportive workplace

environment for physical activity.

3) Previous reliability and validity

Psychometric properties of the original PWES were tested in a sample of 897 employees. Evidence for construct validity was provided by confirmatory factor analysis supporting a unidimensional factor structure: NFI=0.95, IFI=0.95, CFI=0.95, SRMSR=0.06 and RMSEA=0.11 (90% CI=0.09–0.13). Internal consistency reliability was reported to be acceptable with a Cronbach’s alpha coefficient of 0.83 and test-retest reliability of $r=0.97^4$. In the development stage, item content relevance of the PWES was evaluated by a panel of 15 experts including researchers, workplace physical activity practitioners and workers. Construct validity was also supported by significant ($p=0.01$) positive relationships with leisure-time physical activity and workplace physical activity⁴.

Methods

This study was implemented in four phases: Phase 1 consisted of initial instrument translation, Phase 2 consisted of evaluation of the newly translated instrument to establish content equivalence, Phase 3 consisted of preliminary testing of the instrument with the target audience, and Phase 4 consisted of administration of the survey to a large number of subjects in the target audience.

Phase 1: Initial instrument translation

Permission to begin the translation process was obtained from the author of the PWES⁴. The PWES in English was translated into Chinese using a modified committee approach¹³⁻¹⁵, with the consideration of cross-cultural equivalence¹⁶. The committee included two skilled translators, a referee and the principal investigator; each of them had expertise in cultural and linguistic issues. One translator was an American Translators Association (ATA)-certified translator, and the other was a member of the ATA and a certified PRO member of ProZ.com. Both had over ten years of experience in translation. The bilingual referee was an experienced PhD-prepared nurse researcher with expertise in translation issues.

The two translators independently translated the English language PWES into Chinese. Then the committee met in a teleconference to compare and review both versions of the translated PWES item by item to reconcile discrepancies and to produce a consensus version. While some very minor differences occurred between the two Chinese versions, they were easily resolved by consensus. Through this discursive process, the final Chinese translation reflected the entire committee’s best judgment, and this process produces a more accurate translation than the subjective opinion or interpretation of a single

translator¹⁷).

The modified committee approach does not include the back-translation method—where a second translator translates the Chinese translation of the instrument back into English. If any discrepancies or inconsistencies are noticed, it is difficult to determine whether the problems occurred in the first or second translation¹⁷). Additionally, when the first translator is aware that his or her work will be translated back into English, he or she might use wording to ensure that a second translation would truly reproduce the original version, rather than using the best possible wording in the first translation¹⁴). On the other hand, the lack of back-translation could be a limitation of our approach as our final Chinese translation was not back-translated to check for accuracy and consistency. This would affect the use of the PWES-C in situations which require exact equivalence between versions, such as a dual language sample.

Phase 2: Evaluation of the newly translated instrument to establish content equivalence

Content equivalence¹⁶ was established in two ways. First, the final Chinese version of the PWES (PWES-C) was reviewed for content equivalence by the translation committee. Second, a panel of six Taiwanese experts, who had experience working with IT or white-collar workers, were asked to rate the cultural relevancy and clarity of each item. Each item was rated on a 4-point Likert scale (1=not relevant and 4=very relevant and succinct)¹⁸). The expert panel was asked to suggest revisions for items scored below 4. The content validity index (CVI) was calculated for each item (I-CVI) as the proportion of the experts who rated each item as 3 or 4. The I-CVI was excellent, with a score of 1.0 for all items, except for item 6 (I-CVI=0.83). The CVI for the scale (S-CVI) was calculated by averaging the I-CVIs (S-CVI=0.97)¹⁹). As a result, one revision was made to item 6 (see Appendix). Namely, “during or after working hours” was added in parentheses after “during the workday” to make it clear to the respondents.

Phase 3: Preliminary testing of the instrument with the target audience

To establish semantic and technical equivalence¹⁶, the final version of the PWES-C was pretested with 10 IT professionals. They were asked to identify words, phrases and sentences that seemed strange or unusual in their language and to identify any problems in completing items^{16, 20, 21}). All responded that the items were easily understood. Only one revision was made to item 5 based on the participants' suggestions; we added an example (i.e., subsidies for physical activity groups) because this benefit is commonly

provided by many IT companies in Taiwan (see Appendix).

A second pretesting of the PWES-C was conducted with a battery of instruments to be used in a larger study. The entire survey was pretested with 20 IT professionals. It took approximately 3 min to complete the PWES-C. Following pretesting, individual interviews were conducted with 10 subjects, and all confirmed the clarity of item wording. As a result, no modifications were made to the final version of the PWES-C (see Appendix).

Phase 4: Administration of the survey to a large number of subjects in the target audience

1) Design, settings and sample

A cross-sectional descriptive research design was used. The study was approved by the Institutional Review Board at the University of Michigan. Participants were recruited from three IT companies in northern Taiwan. A systematic sample of 735 Taiwanese IT professionals (245 from each of the three companies) was drawn from a list of potential participants. That is, occupational health professionals from the three companies were guided to use a sampling interval of 4 with a random start between 1 and 10 to select 245 out of approximately 1,000 IT professionals from their respective companies. Eligible participants were those who met the inclusion criteria: (a) full-time IT professionals who perform knowledge work in professional positions; (b) aged 18 yr or older; (c) no physical limitations or medical problems that would prevent physical activity performance; and (d) not currently pregnant.

2) Data collection

A total of 735 survey packages were distributed by the IT department assistants from each of the three companies. Each package included an informed consent letter, a self-administered questionnaire, a \$3 gift card and a return envelope. The letter explained the purpose of the study and invited the IT professional to participate in the study. Return of the completed questionnaire represented the respondent's consent to participate in the study. The completed questionnaire was enclosed in a sealed envelope labeled with the principal investigator's name, returned to the department assistant and then collected by the investigator. The usable response rate was 78.4% (576 out of 735). For purposes of this paper, one case was removed from the dataset because one missing value was found in the PWES-C, resulting in a sample size of 575.

3) Construct validity

Construct validity was examined using confirmatory factor analysis (CFA) to see if the proposed factor structure of the PWES-C was supported. The CFA is based on theory and empirical foundations that allow

researchers *a priori* to specify a hypothesized factor structure and then determine how well the proposed measurement model fits the data²².

4) Reliability

Internal consistency reliability was determined using Cronbach's alpha coefficient; criteria included Cronbach's alpha ≥ 0.70 and a change in alpha of ≤ 0.10 when items were deleted. The corrected item-scale correlation and inter-item correlation had to be ≥ 0.30 ²². The mean of each item had to be close to the center of the range of possible scores²³.

5) Conceptual equivalence

To determine whether the Chinese version assesses a similar theoretical construct as the English version of the PWES¹⁶, we examined the relationship between scores of PWES-C and overall physical activity and leisure-time physical activity as measured by the Taiwan version of the International Physical Activity Questionnaire long form²⁴. We compared our findings with those of Prodaniuk and colleagues⁴ in their development of the PWES.

Measurement of physical activity

The 27-item Taiwan version of the International Physical Activity Questionnaire (IPAQ-Taiwan) self-administered long form²⁴ was used as a measure of leisure-time physical activity and overall physical activity²⁵. Reliability and validity of the questionnaire has been established and supported in previous research²⁶. For purposes of this paper, data were reported as continuous measures. The scores (MET \times min/wk) for physical activity were computed by multiplying the frequency (range: 0–7 days/wk), duration (range: 0–960 min/day) and the corresponding metabolic equivalent value (range: 0–8 METs). Leisure-time and overall physical activity scores were calculated according to IPAQ guidelines²⁷.

Data analysis

Prior to data analyses, missing data were examined as an indicator of the data quality, assuming that items were left blank when participants did not understand a given item. Score distributions were examined for the PWES-C. Ceiling and floor effects were assessed by computing the percentage of participants with the

highest and lowest possible score for the PWES-C. Internal consistency reliability for the PWES-C was assessed by examining Cronbach's alpha, inter-item correlations and corrected item-scale correlations.

SPSS 18.0 for Windows was used for data analyses. *t*-tests were used to determine if there was a significant difference between men and women. One-way analysis of variance (ANOVA) was used to determine if there were any significant differences between the means of the three sites. Conceptual equivalence of the PWES-C was assessed using multiple regression. Potential site effects were controlled for statistically because ANOVA showed differences among sites in terms of scores of the PWES-C ($F [2, 572]=75.2, p<0.001$). The regression analyses were performed in three steps. First, unadjusted models were fitted. Second, models were adjusted for demographic factors (e.g., age, sex, education, marital status and occupational class). Finally, models were adjusted additionally for the data collection site by using two site dummy variables.

The EQS 6.1 program was used to perform structural equation modeling (SEM)²⁸. All analyses were performed on covariance matrices using maximum likelihood estimation, with the Satorra-Bentler (S-B) scaling method used to handle non-normal data (Mardia's normalized estimate=8.82)²⁹. To assess model fit, we used nonnormed fit index (NNFI), comparative fit index (CFI), Bollen's (IFI) fit index and root mean-square error of approximation (RMSEA). Values of ≥ 0.95 and ≤ 0.06 were considered to indicate adequate fit for the fit indices and misfit RMSEA index, respectively^{30, 31}. To compare models, we used calculations based on work by Satorra and Bentler³². The Wald and Lagrange multiplier tests for dropping and adding parameters, respectively, were examined.

Results

Descriptive statistics

The sample of 575 Taiwanese IT professionals ranged in age from 24 to 60 ($M=33.7, SD=6.1$) and included 466 (81%) men and 109 (19%) women. Table 1 presents descriptive statistics and the distribution of data for the PWES-C and IPAQ-Taiwan. Scores on the PWES-C indicated somewhat below

Table 1. Descriptive statistics and distribution of data for the PWES-C and IPAQ-Taiwan (N=575)

| Scale | Men (n=466) M (SD) | Women (n=109) M (SD) | Range | Skewness | Ceiling effect % | Floor effect % |
|--------------------------|--------------------|----------------------|----------|----------|------------------|----------------|
| PWES-C | 2.7 (0.80) | 2.6 (0.88) | 1–5 | 0.03 | 0.3 | 2.6 |
| IPAQ-Taiwan ^a | 2,065 (2,169) | 1,441 (1,476) | 0–12,600 | 1.96 | 0.2 | 8.2 |

PWES-C=Chinese version of the Perceived Workplace Environment Scale and IPAQ-Taiwan=Taiwan version of the International Physical Activity Questionnaire.

^aThe data represent the scores of overall physical activity, and the unit of measure for the scores is MET \times min/wk.

moderate levels of support for physical activity in the workplace environments. The highest scores were reported for a positive social climate that encourages physical activity in the workplace, and the lowest scores were reported for the organization’s ability to use community services or resources to support worker physical activity (data not shown). There was no significant gender difference for the PWES-C. A significant gender difference was noted for the IPAQ-Taiwan, suggesting that men were more physically active than women ($t=3.6, p<0.001$). The IPAQ data were normally distributed as defined by the skew index (an absolute value not exceeding 3.0)³³. Small floor effects were observed for the PWES-C, with 2.6% reporting the lowest possible scores. Potential ceiling effects were not evident, with very few participants reporting the highest possible scores for the PWES-C.

Confirmatory factor analysis

Three different models of the PWES-C were tested. Table 2 summarizes the fit statistics of the three models tested. Model 1 hypothesized a one-factor structure in which the PWES-C was conceptualized as a unidimensional measure. However, the results did not show an acceptable fit for this model; the RMSEA was greater than 0.06.

Model 2 posited a two-factor structure (workplace

culture, items 1, 2 and 3; resources for physical activity, items 4, 5 and 6) based on intercorrelations of items. This model performed significantly better than Model 1, and it fit the data reasonably well, with all the fit indices greater than 0.95, except for the RMSEA, which was greater than 0.06 (Table 2). The correlation between workplace culture (factor 1) and resources for physical activity (factor 2) was 0.84, suggesting a substantial amount of shared variance (a common underlying factor)³⁴. Moreover, the Lagrange multiplier test suggested adding three direct effects to improve the model fit.

The final model, Model 3, hypothesized a global factor of the PWES-C including correlated errors among items 1, 2 and 3, indicating that these three items may tap similar aspects (e.g., workplace culture). This model showed an excellent fit to the data: S-B χ^2 (df=6, N=575)=5.52, $p=0.48$; NNFI=1.00; CFI=1.00; IFI=1.00; and RMSEA=0.00 (90% CI: 0.00–0.05) (Table 2). The final model fit the data significantly better than any of the nested and simpler models ($p<0.001$ for all comparisons). All of the items loaded strongly and significantly onto a single underlying factor. All the factor loadings were above 0.60 (Fig. 1).

Table 2. Fit statistics of the PWES-C from confirmatory factor analysis

| Model | S-B χ^2 | df | p | NNFI | CFI | IFI | RMSEA (90% CI) |
|--|--------------|----|------|------|------|------|------------------|
| 1 (one factor) | 80.11 | 9 | 0.00 | 0.92 | 0.95 | 0.95 | 0.12 (0.09–0.14) |
| 2 (two factors) | 28.13 | 8 | 0.00 | 0.97 | 0.99 | 0.99 | 0.07 (0.04–0.09) |
| 3 (one factor with correlated errors among items 1, 2 and 3) | 5.52 | 6 | 0.48 | 1.00 | 1.00 | 1.00 | 0.00 (0.00–0.05) |

PWES-C=Chinese version of the Perceived Workplace Environment Scale, S-B χ^2 =Satorra-Bentler Scaled χ^2 , NNFI=nonnormed fit index, CFI=comparative fit index, IFI=Bollen’s (IFI) fit index, RMSEA=root mean-square error of approximation and CI=confidence interval.

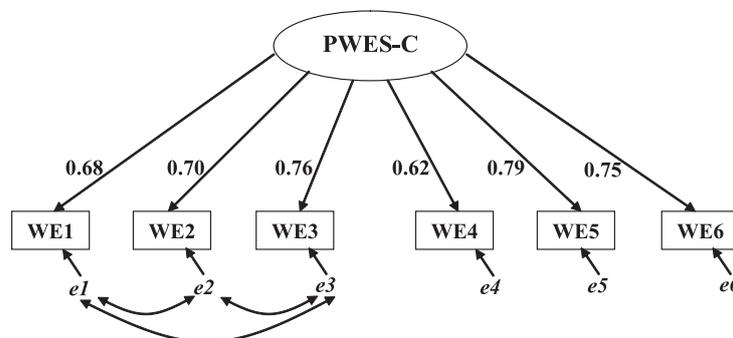


Fig. 1. Factor structure and standardized factor loadings on the Chinese version of the Perceived Workplace Environment Scale items: Satorra-Bentler Scaled χ^2 (df=6, N=575)=5.52, $p=0.48$; NNFI=1.00; CFI=1.00; IFI=1.00; and RMSEA=0.00 (90% CI: 0.00–0.05). All of the solid line paths are statistically significant ($p<0.001$).

Table 3. Unadjusted and adjusted standardized regression coefficients of the PWES-C with overall physical activity and leisure-time physical activity (N=561)

| | Model 1 ^a | Model 2 ^b | Model 3 ^c |
|--------------------------------|----------------------|----------------------|----------------------|
| Overall physical activity | 0.09* | 0.10* | 0.08 [†] |
| Leisure-time physical activity | 0.10* | 0.10* | 0.09* |

[†] $p=0.07$. * $p<0.05$. PWES-C=Chinese version of the Perceived Workplace Environment Scale.

^aUnadjusted standardized coefficient (Beta). ^bAdjusted for age, sex, education, marital status and occupational class. ^cAdjusted for age, sex, education, marital status, occupational class and two site dummy variables.

Reliability

Internal consistency reliability of the PWES-C was good (Cronbach's alpha=0.88). The analysis also suggested that the coefficient alpha for the PWES-C did not improve if items were deleted. The corrected item-scale correlation of each item in the PWES-C was greater than 0.30 (range: 0.56–0.76). The inter-item correlations of the PWES-C were greater than 0.30 and less than 0.80 (range: 0.43–0.76), indicating that redundancy was less of a concern. Finally, the mean of each item (ranging from 2.3 to 2.9) was near the center of the range of possible scores (ranging from 1 to 5) of the PWES-C.

Conceptual equivalence

Conceptual equivalence of the PWES-C was supported by weak, but significant positive correlations with overall physical activity ($\beta=0.10$, $p<0.05$) and leisure-time physical activity ($\beta=0.10$, $p<0.05$) after adjustment for age, sex, education, marital status and occupational class. When further controlling for the effects of site, the beta weight for leisure-time physical activity remained significant ($p<0.05$) but only marginally significant for overall physical activity ($p=0.07$) (Table 3). These results further support the construct validity of the PWES-C.

Discussion

The English version of the PWES was translated into Chinese and validated for cross-cultural equivalence. The results of this study provide strong support for the reliability and validity of the PWES-C when used in a sample of Taiwanese IT professionals. Problems with missing data and potential ceiling and floor effects were very minor. The instrument behaved in a manner consistent with theoretical expectations.

The PWES-C demonstrated very few problems with ceiling and floor effects. This indicates that the instrument would be appropriate for assessing a wide range of workplace environments, including very supportive and not supportive workplace environments.

Results supported the reliability of the PWES-C.

Internal consistency, corrected item-scale correlations and inter-item correlations were acceptable for the PWES-C. Cronbach's alpha coefficient in our study was slightly higher than that reported by Prodaniuk *et al.*⁴⁾.

The results of this study provide evidence for the conceptual equivalence and construct validity of the PWES-C. From a theoretical perspective, the PWES-C was positively related to measures of overall physical activity and leisure-time physical activity. The findings were similar to the work of Prodaniuk *et al.*⁴⁾, who reported weak relationships between the English version of the PWES and workplace physical activity and leisure-time physical activity in a Canadian study. The weak relationships may be due to the fact that multiple factors influence worker physical activity and that the degree of environmental support is only one of the factors. Also, a neutral environment may have no or little impact on worker physical activity⁴⁾. We collected data from only three sites, and one would not expect a strong relationship between workplace environments and physical activity due to the lack of variance in the perceived workplace environment.

The results of this study identified a single factor structure for the PWES-C. However, the inclusion of three correlated errors is necessary to achieve a better model fit. The correlated errors for items 1 to 3 were associated with a common element, the workplace culture. These findings were somewhat different from those reported by Prodaniuk *et al.*⁴⁾, who indicated a unidimensional factor structure for the English version of the PWES. Although fit indices reported in their study were acceptable, their misfit RMSEA index was greater than 0.06, which was similar but somewhat better than our results for the unidimensional measure (RMSEA=0.11 vs. 0.12). Nevertheless, both studies suggested that all six items measured one global PWES factor. This was probably because of the general nature of the items and the overlapping nature of the multiple dimensions of the ecological workplace physical activity model.

The PWES-C makes a unique contribution to the

existing measures of workplace physical activity environments. It is suitable for large-scale studies because it is short. It could potentially be used to monitor changes over time and predict behavior change. It is consistent with contemporary views about the multidimensional nature of health promotion in the workplace context. In terms of its appropriateness in reflecting the environmental support for physical activity, a subjective measure may be more appropriate than an objective measure because workers are less likely to engage in physical activity if workplace environments are not perceived as supportive.

Implications

A short and psychometrically sound measure of the PWES-C provides a means for occupational health professionals to effectively assess and track changes in workers' perceptions of workplace physical activity environments. Data from the PWES-C could be used to make informed policy decisions. For example, government agencies with responsibility for worker health may include this measure in a regular business evaluation associated with safety and health promotion. The scale may also be useful for corporate employers and occupational health professionals who seek to measure workers' perceptions of workplace physical activity environments, perhaps as part of a corporate wellness program.

Future directions

Future research may examine the test-retest reliability, sensitivity to change and criterion-related validity (concurrent validity) of the PWES-C, which have not been evaluated in the current study. Future research may replicate the factor structure of the PWES-C through confirmatory factor analysis. The factor structure of the PWES-C validated in this study is considered tentative until it has been successfully replicated in different samples.

Theories and measures about workplace physical activity environments are still in the early stages of development. More research is needed to further establish consensus on the conceptual and operational definitions and theoretical frameworks to foster empirical examination of the concept of workplace physical activity environments.

Conclusion

The PWES-C is the initial Chinese version of the PWES and a promising instrument for measuring perceived workplace physical activity environments. The results of this study provide strong evidence for its reliability and validity when used in a sample of Taiwanese IT professionals. Each dimension of the workplace environment is measured by a single item,

which may not cover the full scope of the experience operating in the workplace environments that support physical activity. However, the PWES-C has the potential to be a useful and practical tool for employers, program developers and occupational health professionals because it is short and easy to complete.

Acknowledgments: The authors would like to thank Dr. Huey-Ming Tzeng for her expertise and kind assistance in the instrument translation process by serving as a referee, Claire Liu and Shirley Chen for their linguistic competence and translation skills and Laura Klem for her statistical and measurement consultation at the Center for Statistical Consultation and Research, University of Michigan. Our sincere thanks go to the occupational health professionals and IT department assistants from the three IT companies for their kind assistance in the data collection and to all the IT professionals who participated in this research. Finally, this study was supported by grants from (a) the American Association of Occupational Health Nurses Foundation; (b) the Midwest Nursing Research Society; (c) Sigma Theta Tau International, Rho Chapter; and (d) the University of Michigan Rackham Graduate School.

References

- 1) Golaszewski T, Allen J, Edington D. Working together to create supportive environments in worksite health promotion. *Am J Health Promot* 2008; 22: 1–10.
- 2) Pronk NP. Physical activity promotion in business and industry: evidence, context, and recommendations for a national plan. *J Phys Act Health* 2009; 6 (Suppl 2): S220–35.
- 3) Pronk NP, Kottke TE. Physical activity promotion as a strategic corporate priority to improve worker health and business performance. *Prev Med* 2009; 49: 316–21.
- 4) Prodaniuk TR, Plotnikoff RC, Spence JC, Wilson PM. The influence of self-efficacy and outcome expectations on the relationship between perceived environment and physical activity in the workplace. *Int J Behav Nutr Phys Act* 2004; 1: 7.
- 5) Blunt GH, Hallam JS. The worksite supportive environments for active living survey: development and psychometric properties. *Am J Health Promot* 2010; 25: 48–57.
- 6) Golaszewski T, Fisher B. Heart check: the development and evolution of an organizational heart health assessment. *Am J Health Promot* 2002; 17: 132–53.
- 7) Oldenburg B, Sallis JF, Harris D, Owen N. Checklist of Health Promotion Environments at Worksites (CHEW): development and measurement characteristics. *Am J Health Promot* 2002; 16: 288–99.
- 8) Parker KB, DeJoy DM, Wilson MG, Bowen HM,

- Goetzel RZ. Application of the Environmental Assessment Tool (EAT) as a process measure for a worksite weight management intervention. *J Occup Environ Med* 2010; 52 (Suppl 1): S42–51.
- 9) Beresford SA, Bishop SK, Brunner NL, et al. Environmental assessment at worksites after a multi-level intervention to promote activity and changes in eating: the PACE project. *J Occup Environ Med* 2010; 52 (Suppl 1): S22–8.
 - 10) Plotnikoff RC, Prodaniuk TR, Fein AJ, Milton L. Development of an ecological assessment tool for a workplace physical activity program standard. *Health Promot Pract* 2005; 6: 453–63.
 - 11) McLeroy KR, Bibeau D, Steckler A, Glanz K. An ecological perspective on health promotion programs. *Health Educ Quart* 1988; 15: 351–77.
 - 12) Sallis JF, Owen N. Ecological models of health behavior. In: Glanz K, Rimer BK, Lewis FM, editors. *Health behavior and health education: theory, research, and practice*. San Francisco: Jossey-Bass; 2002. p.462–84.
 - 13) Behling O, Law KS. *Translating questionnaires and other research instruments: problems and solutions*. Thousand Oaks (CA): Sage Publications; 2000.
 - 14) Geisinger KF. Cross-cultural normative assessment: translation and adaptation issues influencing the normative interpretation of assessment instruments. *Psychol Assess* 1994; 6: 304–12.
 - 15) Harkness J, Pennell BE, Schoua-Glusberg A. Survey questionnaire translation and assessment. In: Presser S, Rothgeb JM, Couper MP, et al., editors. *Methods for testing and evaluating survey questionnaires*. New York: John Wiley & Sons; 2004. p.453–73.
 - 16) Flaherty JA, Gaviria FM, Pathak D, et al. Developing instruments for cross-cultural psychiatric research. *J Nerv Ment Dis* 1988; 176: 257–63.
 - 17) Martinez G, Marín BV, Schoua-Glusberg A. Translating from English to Spanish: the 2002 National Survey of Family Growth. *Hisp J Behav Sci* 2006; 28: 531–45.
 - 18) Lynn MR. Determination and quantification of content validity. *Nurs Res* 1986; 35: 382–5.
 - 19) Polit DF, Beck CT. The content validity index: are you sure you know what's being reported? Critique and recommendations. *Res Nurs Health* 2006; 29: 489–97.
 - 20) Carlson ED. A case study in translation methodology using the Health-Promotion Lifestyle Profile II. *Public Health Nurs* 2000; 17: 61–70.
 - 21) Wang WL, Lee HL, Fetzer SJ. Challenges and strategies of instrument translation. *West J Nurs Res* 2006; 28: 310–21.
 - 22) Nunnally JC, Bernstein IH. *Psychometric theory*. New York: McGraw-Hill; 1994.
 - 23) DeVellis RF. *Scale development: theory and applications*. Thousand Oaks (CA): Sage Publications; 2003.
 - 24) Taiwan Bureau of Health Promotion, Department of Health. Taiwan Version of the International Physical Activity Questionnaire: Long Form. [Online]. 2007 [cited 2009 Jun 20]; Available from: URL: http://www.bhp.doh.gov.tw/BHPnet/Portal/Them_Show.aspx?Subject=200712250028&Class=2&No=200903250002 (in Chinese)
 - 25) Craig CL, Marshall AL, Sjoström M, et al. International physical activity questionnaire: 12-country reliability and validity. *Med Sci Sports Exerc* 2003; 35: 1381–95.
 - 26) Liou YM. Development and verification of validity and reliability of the Taiwan version of International Physical Activity Questionnaires. Unpublished doctoral dissertation. Taipei: National Taiwan University; 2004 (in Chinese).
 - 27) IPAQ Research Committee. Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire (IPAQ)—Short and Long Forms. [Online]. 2005 [cited 2009 Jun 20]; Available from: URL: <http://www.ipaq.ki.se/scoring.pdf>
 - 28) Bentler PM. *EQS 6 Structural Equations Program Manual*. Encino (CA): Multivariate Software; 2006.
 - 29) Finney SJ, DiStefano C. Non-normal and categorical data in structural equation modeling. In: Hancock GR, Mueller RO, editors. *Structural equation modeling: a second course*. Greenwich (CT): Information Age Publishing; 2006. p.269–314.
 - 30) Hu L-T, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Struct Equ Modeling* 1999; 6: 1–55.
 - 31) Yu C-Y, Muthén B. Evaluation of model fit indices for latent variable models with categorical and continuous outcomes. Paper presented at the annual conference of the American Educational Research Association, April 4, 2002, New Orleans.
 - 32) Satorra A, Bentler PM. A scaled difference chi-square test statistic for the moment structure analysis. *Psychometrika* 2001; 66: 507–14.
 - 33) Kline RB. *Principles and practice of structural equation modeling*. New York: Guilford Press; 2005.
 - 34) Tomas JM, Oliver A. Rosenberg's self-esteem scale: two factors or method effects. *Struct Equ Modeling* 1999; 6: 84–98.

Appendix

English translation of the Chinese version of the Perceived Workplace Environment Scale (PWES-C)

These questions relate to your **perceptions about your workplace environment relative to physical activity**. Please **circle the number** that best describes your response to each statement.

| | <i>None</i> | <i>A little</i> | <i>Some</i> | <i>Quite a lot</i> | <i>A great amount</i> |
|---|-------------|-----------------|-------------|--------------------|-----------------------|
| 1. How much information is provided in your workplace educating and/or encouraging employees about physical activity? | 1 | 2 | 3 | 4 | 5 |
| 2. Is there a positive social climate that encourages physical activity in your workplace? | 1 | 2 | 3 | 4 | 5 |
| 3. How much organizational capacity (i.e. infrastructure, will, and leadership) is there in your workplace that promotes physical activity for employees? | 1 | 2 | 3 | 4 | 5 |
| 4. Has your organization used any services or resources in the community to support the physical activity of employees? (examples: local recreation/activity center, community events) | 1 | 2 | 3 | 4 | 5 |
| 5. Does your workplace have policies that promote the physical activity of employees? (examples: no meetings scheduled over lunch, subsidies for memberships at a local fitness center or physical activity groups) | 1 | 2 | 3 | 4 | 5 |
| 6. Are there convenient and appropriate facilities that you can access in order to do physical activity during the workday (including during or after working hours)? | 1 | 2 | 3 | 4 | 5 |

知覺職場身體活動環境量表中文版

以下問題是關於您對職場環境有關身體活動方面的認知。對於每一句敘述，請圈選一個最能表達您的看法的數字。

| | 無 | 少許 | 有些 | 相當多 | 很多 |
|---|---|----|----|-----|----|
| 1. 您的工作場所提供了多少資訊以宣導及（或）鼓勵員工從事身體活動？ | 1 | 2 | 3 | 4 | 5 |
| 2. 您的工作場所是否具有鼓勵從事身體活動的正面風氣？ | 1 | 2 | 3 | 4 | 5 |
| 3. 在您的工作場所中，有多少促進員工身體活動的組織能力（也就是基礎設施、推動意願和領導力）？ | 1 | 2 | 3 | 4 | 5 |
| 4. 您的組織曾使用社區的任何服務或資源，來支持員工的身體活動嗎？（例如：當地休閒／活動中心、社區活動） | 1 | 2 | 3 | 4 | 5 |
| 5. 您的工作場所是否訂有鼓勵員工從事身體活動的政策？（例如：不在午餐時間開會、補助健身中心會員費或社團活動費用） | 1 | 2 | 3 | 4 | 5 |
| 6. 是否有便利及合適的設施，可以讓您在工作日（包括上班或下班時間）用以從事身體活動？ | 1 | 2 | 3 | 4 | 5 |