Psychometric properties of the Thai version of the work ability index (Thai WAI)

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Abstract: Psychometric properties of the Thai version of the work ability index (Thai WAI): Orawan Kaewboonchoo, et al. Faculty of Public Health, Mahidol University, Thailand—Objective: The purpose of this research was to develop and test the psychometric properties of the Thai version of the Work Ability Index (WAI). **Methods:** Forward translation and back-translation of the WAI were performed by seven bilingual professionals to ensure that the Thai WAI was culturally relevant and conceptually accurate. To ensure generalizability of the Thai WAI, a sample of 2,744 Thai workers from 19 different enterprises in five regions of Thailand completed the Thai version of the WAI along with the General Health Questionnaire. The 19 enterprises were from the following industries: canned food, snack food, cooking oil, footwear, pharmaceutical, ceramics, toy, steel, petrochemical, and auto parts. **Results:** The results from exploratory factor analysis supported a 3-factor model, accounting for 53.49% of the total variance. The results also provided evidence for adequate test-retest reliability and internal consistency of the Thai WAI. The internal consistency of the Thai WAI was found to be slightly low due to the newness of the concept of work ability, which is not a common term used in the Thai language; therefore, explanation of the meaning of work ability is needed to increase understanding of workers. **Conclusions:** By providing early recognition of workers' health risks as well as risks of early termination, the WAI can help Thai human resources managers respond better to the needs of workers and be proactive in their efforts to retain workers in their organizations. Occupational health professionals could also utilize the WAI to evaluate the work ability of Thai workers in order to help organizations recognize early signs of their workers' health risks and possible early terminations and respond appropriately.

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Since the beginning of the 21st century, there have been significant changes in the global population structure. The number of aging members of the population is increasing all over the world[1] including Thailand[2]. Shortage of young workers is an important issue that many countries across the world are encountering[1]. Thailand is becoming an aging society due to having aging people more than 10% of total population[3]. Ideas and actions are needed on how to keep workers in their workplace longer while maintaining a high work ability. Factors that influence worker longevity include working conditions, social environment, individual competencies, and individual physical and mental health. Previous studies have looked at job satisfaction, stress, and mental health among Thai workers, but there are few published studies that have specifically explored the work ability of workers in Thailand[4–6].

An instrument, the Work Ability Index (WAI), was developed by researchers from the Finnish Institute of Occupational Health[7] to assess an individual's work ability in relation to work requirement, health status, and worker resources. Work ability is an indication of how well a person's health, knowledge, skills, attitudes, and motivation match the demands of their job. The higher the work ability an individual has, the longer the individual can perform his or her current job. With the decrease in the number of younger workers in Thailand, as well as many other countries, more efforts are needed to help prolong the working lives of workers and to help prevent from the decline in work ability with increasing age. One of the first steps to help with this process is to have a tool for assessing current work ability. Having an instrument like the WAI to measure the work ability of workers could help with early detection of potential health impairment, both physical and mental. The results for group or individual work ability can help an organization to develop programs and services to prolong the

working lives of its current workers.

The WAI has been translated into several languages[8–11]. A Thai translation of the WAI has also been done and used on factory workers, but there has not been any validation of the instrument; only the reliability of the instrument has been tested[12]. Therefore, this study aimed to assess psychometric properties of the Thai version of the WAI including internal consistency, test-retest reliability, concurrent validity, and the factorial structure of the scale. Currently, the cost of assessments for occupational health are high, both for the work environment and worker health. Having a valid WAI that can be used to perform direct assessments from a worker's perceptions could help increase the accuracy of assessment and reduce the cost of evaluation. We believe that development and validation of the Thai WAI represents a significant step in the effort to increase occupational health surveillance and promote work ability among workers in Thailand.

This instrument validation work is needed to ensure that the Thai version of the WAI can be utilized appropriately and validly with the Thai working population. The WAI can help Thai human resources managers identify at an early stage the health risks of their workers as well as the risks of early termination in order to counteract them. In addition, Thai occupational health professionals could utilize this validated instrument to evaluate the work ability of Thai workers under their care so that they can help organizations recognize early signs of their worker's health risks and possible early terminations.

Methods

Forward translation and back-translation of the WAI

After obtaining permission from the Finnish Institute of Occupational Health to translate the questionnaire, the forward translation and back-translation processes were performed by five bilingual professionals. The forward translation of the WAI from English to Thai was completed separately by two bilingual (English-Thai) occupational health professionals. The translation was done by using conceptual equivalence translation, not literal translation, to preserve the meaning of the original survey while being culturally relevant to the Thai culture. The first author, who is a bilingual (English-Thai) occupational health professional, reviewed and reconciled differences from the initial forward translation to preserve the conceptual equivalence of the translation. After reconciling the differences in the initial forward translations, two other bilingual (English-Thai) occupational health professionals back-translated the Thai version to English. Again, the first author compared the back-translated English versions with the original English WAI, and differences were reconciled to ensure

that the final Thai WAI was culturally relevant and conceptually accurate.

Participants

To ensure generalizability of the Thai WAI, this research study was conducted with 2,935 Thai workers from 19 different enterprises in 5 different regions of Thailand. The 19 enterprises were from the following industries: canned food, snack food, cooking oil, footwear, pharmaceutical, ceramics, toy, steel, petrochemical, and auto parts. The 5 regions were the northern, northeastern, southern, eastern, and central regions of Thailand. In additional, a separate set of 56 Thai workers volunteered to take the WAI two times with an interval of four weeks in order to assess for the test-retest reliability.

Procedure

Ethics approval for this study was obtained from the Ethics Review Committee of Mahidol University, Bangkok, Thailand. Each participant who volunteered to participate in this study signed an informed consent form. Each participant completed a self-report questionnaire packet including demographic items, the Thai Work Ability Index, and the General Health Questionnaire. The questionnaire packet took approximately 20 minutes.

Measurement

The Thai WAI is a self-report questionnaire designed to measure an individual's work ability[7]. It contains ten questions covering seven dimensions: (i) current work ability compared with lifetime best, one item rated using a 10-point Likert scale from 0 (completely unable to work) to 10 (work ability at its best); (ii) work ability in relation to the demands of the job, two items rated using a 5-point Likert scale from 1 (very poor) to 5 (very good); (iii) number of current diseases diagnosed by a physician, 51 items with two choices (own opinion of diagnosis or physician's diagnosis); (iv) estimated work impairment due to diseases, one item rated using a 6-point Likert scale from 1 (unable to work) to 6 (no hindrance); (v) sick leave during the last 12 months, one item with 5 categories from 1 (100–365 days) to 5 (none at all); (vi) personal prognosis of work ability two years from now, one item with choice options of 1 (unlikely) to 7 (relatively certain); and (vii) mental resources, three items rated using a 5-point Liker scale from 0 (never) to 4 (often). The range of the total WAI score is 7 to 49 and work ability is classified as follow: poor (7–27), moderate (28–36), good (37–43), and excellent (44–49)[13, 14].

The General Health Questionnaire-28 (GHQ-28) is a self-report questionnaire used to assess an individual's

potential mental health issues; there are four subscales with seven questions each: (i) somatic symptoms, (ii) anxiety and insomnia, (iii) social dysfunction, and (iv) severe depression[15]. The sum of all the subscales is used to assess mental health status. A score greater than or equal to 6 indicates poor mental health.

In addition, the overall health status of each participant was assessed with one question using a 5-point rating scale from 1 (poor) to 5 (very good).

Reliability and validity

Test-retest reliability and Cronbach's alpha coefficient were used to evaluate the reliability of the Thai WAI. Exploratory factor analysis (EFA) was used to evaluate structural validity. Sick leave during the past year was used to evaluate discriminant validity; to be consistent with previous studies[8, 9], participants were divided into two groups, high sick leave (more than 9 days per year) and low sick leave (9 days or less per year). Based on previous studies that have used the WAI, the 9-day cutoff criteria was used[8, 9]. Other previous studies have demonstrated strong correlation between the WAI and a single-item question concerning work ability[10–16], including strong relations between sick leave and the WAI[17].

Correlations between WAI scores, GHQ score, and self-reported on health status were used to assess construct validity. Less than 1% of the data was missing for each item. If there was missing data for a particular scale, the relevant participants were not included in the analyses. The sample size of 2,744 was adequate for the study's analyses. Specific hypotheses, expected direction of correlations, and expected magnitude of correlations were not formulated a priori. For convergent validity, a description of the comparator instrument and the measurement properties have been provided. There were no apparent design flaws in this study, and the statistical methods were adequate for hypothesis testing.

Results

Demographic

From 2,935 participants, 191 were excluded due to missing data or incomplete responses; many of these participants did not complete at least one entire scale (WAI or GHQ-28). However, none of the items in these scales had over 1% missing data. Final analyses were done with 2,744 participants. The participants ranged in age from 18 to 64 (M=35.19, SD=8.69). There were 1,574 (57.4%) female participants and 1,169 (42.6%) male participants. The mean WAI score was 40.9 (SD=4.3), with the minimum being 24.0 and the maximum being 49.0. More than half of the participants (52.4%) had a good work ability, and about one-third (30.7%) had an excellent work ability.

Other characteristics of participants are displayed in Table 1.

The distribution of each WAI dimension is shown in Table 2. For "current work ability compared with the lifetime best", 72.8% of workers classified themselves in the three highest scores. For "work ability in relation to the demand of the job", 39.1% of the workers placed themselves in the three highest scores. For "number of current diseases diagnosed by physician", 60.6% of workers reported absence of diseases (7 points), and 0.1% reported five or more diseases (1 point). For "estimated work impairment due to diseases", 72.2% of workers reported no disease affecting their work ability (6 points). For "sick leave during the past year (12 months)", 40.3% of workers reported no absence from work due to diseases in the last 12 months (5 points). For "own prognosis of work ability two years from now", 81.3% of workers considered themselves very likely to be able to perform their current activities in two years' time (7 points). For "mental resources", 59.3% of workers had the highest score in the three mental resources scales (ability to appreciate daily activities, perception of being active and alert, feeling of hope for the future).

Reliability

The four-week test-retest reliability of the Thai WAI was evaluated with a separate test sample. Fifty-six Thai workers volunteered to take the WAI two times with an interval of four weeks. The reliability was found to be 0.71 (n=56). For internal consistency, the Cronbach's alpha coefficient for the Thai WAI was 0.66. Cronbach's alpha for each Thai WAI subscale when a question was excluded are displayed in Table 3.

Validity

Principal component analysis was used to reduce the number of original variables by grouping related variables into a smaller number of artificial variables or principal components. Results of exploratory factor analysis through principal component analysis supported a three-dimensional structure for the Thai WAI. The first factor was illness and work impairment from items 4, 5, and 6 of the questionnaire (25.97% of total variance). The second factor was mental resources from items 7, 8, 9, and 10 (16.12% of variance). However, item 7 had a similar factor loading as the first factor, which was more consistent with its concept. The third factor was work ability perception from items 1, 2, and 3 (11.40% of variance). The cumulative total variance was 53.49% (see Table 4).

Sick leave during the past year (item 6) was used to evaluate discriminant validity[8]. Table 5 shows that

Table 1. Characteristics of the subjects (N=2,744)

Variables		Number	%
Gender	Male	1,169	42.6
	Female	1,575	57.4
Age (yr)	20–29	818	29.8
	30–39	1,062	38.7
	40–49	701	25.5
	50–	163	5.9
	Mean=35.2, SD=8.7, min=18, max=64		
Marital status	Single	711	25.9
	Married	1,784	65.0
	Widowed/divorced	249	9.1
Educational level	Elementary school	681	24.8
	Junior high school	449	16.4
	Senior high school	575	21.0
	Diploma/college	495	18.0
	Bachelor or higher	544	19.9
Position	Administrative	51	1.9
	Supervisor	563	20.5
	Operator	2,130	77.6
Factory size	Large	549	20.0
	Medium	1,097	40.0
	Small	1,098	40.0
Work experience (yr)	1–10	1,841	67.1
	11–20	765	27.9
	>20	138	5.0
	Mean=8.2, SD=7.3, min=1, max=40		
Job type	Physical	601	21.9
	Mental	501	18.3
	Physical and mental	1,642	59.8
WAI	Poor	8	0.3
	Moderate	455	16.6
	Good	1,439	52.4
	Excellent	842	30.7
	Mean=40.9, SD=4.3, min=24.0, max=49.0		

WAI: Work Ability Index.

the mean WAI score was significantly higher ($p<0.001$) among workers with low absenteeism (41.99) than among those with high absenteeism (35.40).

Correlations between the Thai WAI scores and (i) GHQ-28 score and (ii) self-reported health status were used to assess construct validity. Thai WAI score was significantly correlated with the four dimensions of the GHQ-28 (somatic symptom, anxiety, social dysfunction, depression) and health status. The workers with a higher WAI had better mental health and a better health status. Item-total correlation for each question and the total Thai WAI score ranged from 0.23 (item 10), 0.28 (item 8), and 0.29 (item 9) to 0.61 (items 2, 4, 6).

Discussion

The aim of this study was to develop and validate the Thai version of the WAI through a large sample of participants in a variety of industries in all regions of Thailand. Psychometric data from this study provided support for the validity and reliability of the Thai WAI. Test-retest reliability indicated short-term stability. The internal consistency was slightly low, possibly due to the newness of the concept of work ability, which is not a common term in the Thai language. The results from EFA supported three factors for the Thai WAI: (i) illness and work impairment, (ii) mental resources, and (iii) work ability perception. Previous

Table 2. Distribution of scores of the WAI Thai version in each dimension (N=2,744)

WAI dimension	Score n (%)											
	0	1	2	3	4	5	6	7	8	9	10	Total
Current work ability compared with lifetime best	4 (0.1)	1 (0.05)	1 (0.05)	5 (0.2)	16 (0.6)	142 (5.2)	135 (4.9)	441 (16.1)	911 (33.2)	385 (14.0)	703 (25.6)	2,744 (100.0)
Work ability in relation to the demand of the job			2 (0.1)	5 (0.2)	115 (4.2)	158 (5.8)	852 (31.0)	537 (19.6)	741 (27.0)	155 (5.6)	179 (6.5)	2,744 (100.0)
Number of current diseases diagnosed by physician		3 (0.1)	5 (0.2)	19 (0.7)	291 (10.6)	762 (27.8)	1,664 (60.6)					2,744 (100.0)
Estimated work impairment due to diseases		20 (0.7)	20 (0.7)	11 (0.4)	34 (1.2)	679 (24.7)	1,980 (72.2)					2,744 (100.0)
Sick leave during past year		97 (3.5)	196 (7.1)	159 (5.8)	1,186 (43.2)	1,106 (40.3)						2,744 (100.0)
Own prognosis of work ability 2 years from now		58 (2.1)			454 (16.5)			2,232 (81.3)				2,744 (100.0)
Mental resources		13 (0.5)	231 (8.4)	873 (31.8)	1,627 (59.3)							2,744 (100.0)

WAI: Work Ability Index.

Table 3. Cronbach's alpha, mean, and standard deviation of the Thai WAI (N=2,744)

Question	Cronbach's alpha when question is excluded	Mean	SD
Current work ability compared with lifetime best	0.64	8.19	1.49
Work ability in relation to physical demand	0.57	3.47	0.83
Work ability in relation to mental demand	0.58	3.54	0.80
Number of current diseases diagnosed by physician	0.59	6.08	1.19
Estimated work impairment due to diseases	0.60	5.65	0.71
Sick leave during past year	0.58	4.09	1.03
Own prognosis of work ability 2 years from now	0.64	6.37	1.36
Enjoying daily tasks	0.60	3.06	0.85
Activity and life spirit	0.60	3.22	0.94
Optimistic about the future	0.61	3.38	0.94
WAI (all questions)	0.66		

WAI: Work Ability Index.

studies also found three factors[8, 9], while other studies found one to two factors[10, 11]. The similar factor loading for item 7 on components 1 and 2 could be due to that fact that the prognosis for future work ability encompasses both the potential work impairment as well as mental resources. As compared with previous studies, the present study found a factor structure very similar to those of the Brazilian and Iranian versions of the WAI except for one item, item 7 being loaded on 2 components[8, 9].

The results also provide evidence for conceptual equivalence and construct validity for the Thai WAI. The Thai WAI showed discriminatory power between high and low sick leave among workers. Similar to the studies with Iranian and Brazilian workers[8, 9], Thai workers with higher sick leave had lower work ability scores than workers with lower sick leave. In comparison to other countries, the mean score for the

Table 4. Principal component analysis of the Thai WAI (N=2,744)

Question	Component			Cronbach's alpha
	1	2	3	
1. Current work ability compared with lifetime best	−0.074	0.104	**0.570**	0.58
2. Work ability in relation to physical demand	0.263	0.150	**0.733**	
3. Work ability in relation to mental demand	0.278	0.117	**0.731**	
4. Number of current diseases diagnosed by physician	**0.738**	−0.048	0.226	0.50
5. Estimated work impairment due to diseases	**0.731**	0.087	−0.041	
6. Sick leave during past year	**0.659**	−0.081	0.381	
7. Own prognosis of work ability 2 years from now	**0.404**	0.438	−0.305	0.51
8. Enjoying daily tasks	0.014	**0.692**	0.161	
9. Activity and life spirit	−0.003	**0.745**	0.156	
10. Optimistic about the future	−0.021	**0.698**	0.069	
Variance of component (%)	25.97	16.12	11.40	
Total cumulative variance (%)	53.49			

WAI: Work Ability Index.

Table 5. Mean Thai WAI scores of participants with low and high sick leave (N=2,744)

Sick leave group	Mean	SD	*t*-test
Low (n=2,292)	41.99	3.42	32.48***
High (n=452)	35.40	4.03	

***$p<0.001$. WAI: Work Ability Index.

Table 6. Pearson correlation coefficients for the Thai WAI and GHQ-28 and health status (N=2,744)

Item	Coefficient
Somatic symptom	−0.315***
Anxiety	−0.314***
Social dysfunction	−0.163***
Depression	−0.274***
Health status	0.235***

***$p<0.001$. WAI: Work Ability Index.

Thai WAI was 40.9 (SD=4.3), while the mean scores for the Iranian and Brazilian WAIs were 35.9 (SD=6.9) and 41.8 (SD=5.1), respectively[8, 9]. The differences are partly due to the different sample populations. The 2,744 participants in Thailand were from 19 different work sectors, while the 236 participants and 521 participants from Iran and Brazil were only from the health-care and energy sector, respectively[8, 9].

Regarding the construct validity of the Thai WAI, work ability was significantly correlated with the mental health variables of the GHQ-28 (somatic symptoms, anxiety, social dysfunction, and depression). Specifically, individuals with higher work ability were found to have lower mental health symptoms. In addition, work ability was significantly correlated with the self-reported health status. Individuals with higher work ability were found to have a more positive health status.

Some limitations of this study include self-report bias and recall bias. Additionally, cross-cultural instrument translation may not yield the same results as an instrument indigenously developed from the Thai work culture perspective. More research studies are needed with the Thai WAI to further understand its psychometric properties with workers other than those included in this study sample, including health-care workers, informal workers, home-based workers, and Thai government workers.

Conclusion

The results of this study show slightly low internal consistency of the Thai WAI due to the newness of the concept of work ability, which is not a common term in the Thai language; however, if an explanation of work ability is added to increase the understanding of workers, the Thai WAI would be a viable instrument for evaluating the work ability of individual Thai workers and those in organizations. With the decrease in younger workers an important issue in Thailand and many countries around the world, having a valid and reliable instrument to measure workers' work ability is an important step to help prolong the working life of older workers. By providing early recognition of workers' health risks as well as risks of early termination, the Thai WAI can help human resources managers respond better to the needs of workers and

be proactive in their efforts to retain workers in their organizations.

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