

# Work Ability of Thai Ageing Workers in Southern Thailand: A Comparison of Formal and Informal Sectors

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## Research Article

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# Abstract

## Background

Thai society has been moving towards an ageing society. The independent elderly persons needed to continue decent work after retirement. This study analyses the association of work ability, individual and work-related factors with Work Ability Index (WAI) of the formal and informal sectors in a southern Thailand community.

## Methods

This cross-sectional study with multi-stage sampling employs in 324 Thai elderly workers, aged between 45 and 70, working in Nakhon Si Thammarat province. Data collection of socio-demographic status, health history, work-related factors questionnaires were done with anthropometric data and WAI instrument between March and September 2019. The descriptive and logistic regression analysis were used for the association analysis.

## Results

Participants were predominantly general labour (23.8%), female (70.7%). Smoking and alcohol consumption was more than 70% and obesity was more than 60%. Nearly half of them were NCDs patient (48.2%). Total average WAI at 40.6 (S.D. = 4.6) and 37.5 (S.D. = 5.0) for formal and informal sectors, respectively. Nearly Fifty-two per cent (51.9%) of the participants had received sometimes occupational health services and frequently accessed to health promotion 78.1%. There was no association of work sector and WAI. The workers of age 55 years and above (OR = 1.45; 95% CI [1.21, 1.74]), the presence of NCDs (OR = 2.85; 95% CI [1.69, 4.80]), and unsafe working practice (OR = 2.11; 95% CI [1.26, 3.55]) have a higher risk of low to moderate WAI.

## Conclusions

The age group, presence of NCDs and safety practices, associated with work ability of the Thai's ageing workers. It suggested that promoting healthy behaviour and work environment may be an important strategy to improve ageing worker's work ability and health. The ageing health services should cooperate with occupational health programmes in order to improve work ability and productivity of ageing workers for life-long working.

## Background

Thai society has been moving towards an ageing society. The number of elderly aged 60 years and over has seen a slow but sure increase. In 2019, the number of older people reached 17.5 percent of the

nations' population, which is considered to be part of 'ageing society', as defined by the United Nations (UN). The Thai society will become a complete ageing society when its proportion increases to approximately 20 percent in the year 2022 [1]. It was found that the number of elderly workers has grown every year—from 3.10 million people in 2010 to 4.70 million in 2020 [2]. Thailand Elderly Plan No.2 (2002–2021) supported that 67 percent of the independent elderly persons needed to continue decent work after retirement [3].

Moreover, formal workers who shift their work after retirement to informal sectors such as agriculture, or are self-employed or home-based workers, increased according to the increasing proportion of older people. The evidence suggests that older people will remain in the workforce for a more extended period in response to several social and economic drivers [4–5]. The vast majority of Japanese workers aged 60 and over remain in the labour force to maintain their standard of living, and for economic reasons. Five factors contribute to the different labour force participation rates of older workers in the United States and Japan: 1) economic need; 2) type of employment; 3) cultural values; 4) policy factors; and 5) health [6]. In Thailand, the informal workers also continue to work in their old age until physical deterioration occurs and their work ability declines.

As defined by the World Health Organization (WHO) or the European countries, the term 'older worker' refers to workers aged 45 years and over [7]. The International Labor Organization (ILO) defines the nature of workers who are beginning to have difficulty in their employment and/or occupation due to their increasing age [8]. Thailand has identified elderly workers as those who are 60 years of age and above, who are still working and able to perform their duties [2]. However, if based on the deterioration of the body or physiological changes affecting the working potential, it is estimated that people enter the category of 'older workers' at the age of 45 years old.

Naturally, physical fitness and health of a population deteriorates according to increasing age—the muscles have less mass, the joints are affected and the body's mobility goes down. However, elders who exercised daily and properly in their younger years, and still continue to, can still be energetic and perform well; their bodies are fitter and mind is alert. Thus, having an active lifestyle and including physical exercise in daily life will increase the potential and opportunities to work efficiently. However, ageing worker's productivity depends on their health and health-related works. The work and ageing conditions are two main factors that threaten their health and work ability—such as disease history, behavioural health, work hazards and health care access—which may cause a decrease in working opportunities, productivity and income stability [9].

Thailand has an integrated Long Term Care (LTC) system to community primary health care. The LTC is the public health and social services that operate to meet dependent people's needs due to chronic illnesses, various disability accidents, and the elderly who cannot help themselves in daily life [10]. However, it mainly focuses on the curative and rehabilitation activities that do not include the community's ageing workers' occupational health and safety services. The increasing trend of the informal ageing workers in the community is then a significant issue for worker's health, which needs

response from community health service. Health needs of ageing workers comprise physical function and fitness, and working ability that will be utilized to perform any job they are engaged with. Work Ability Index (WAI) is an instrument used in clinical occupational health and research to assess working ability during health examinations and workplace surveys. The index comprises demands of the work and the worker's health status and resources, which is an appropriate tool to apply for the ageing worker's health need assessment [11]. Its assessment domain could significantly assist the community occupational health and safety operation to support ageing worker's holistic health.

A number of studies have been conducted among different populations to reveal the relation between individual and work-related factors with WAI, but it has yet to be used among formal and informal ageing workers in Thailand [12–14]. The difference of socio-economic and work-related factors, and the health status and WAI have not been studied yet. Moreover, aging worker's health needs will be critical determinants, which need to be analyzed and quantified by WAI so as to express the readiness of work performance of the ageing workers in both formal and informal sectors. This study explores health needs of ageing workers using working ability dimensions between the formal and informal sectors in a southern Thailand community. We conducted the Nakhon Si Thammarat province survey, which had the highest population among Thailand southern provinces. The study's benefits are for primary healthcare arrangement to provide and meet the needs in occupational health and safety areas for the active ageing workers.

## Methods

### Study Design and Setting

This study employed a cross-sectional design based on quantitative approaches. We conducted surveys in rural and sub-urban areas of the two districts located in Nakhon Si Thammarat province, which had the highest population of ageing workers among the southern provinces of Thailand. Participants consisted of Thai elderly workers in formal (public and private) and informal sectors, aged between 45 and 70, working in Nakhon Si Thammarat province for at least two years.

### Sample Size Determination and Sampling

The data was obtained from the community health survey of each sub-district area. The study population was 112,117, which was calculated by the finite population formula with  $p = 0.28$  (proportion of people aged between 45 and 70 years, of population in Nakhon Si Thammarat Province), and the adjusted extra 5 per cent then yielded the minimum sample size of 324. Community areas and types of occupation employed multistage sampling proportional to size selection. First, the study area was selected; two districts with the highest elderly population were chosen. Second, stratified random sampling by dividing the elderly workers into two strata of formal and informal sectors was carried out. We considered the topography from the sub-districts and villages accordingly, and then allocated the sub-strata's proportional sample size in each stratum. Finally, we used simple random sampling to create organizational name lists for formal workers and community health centre registries for informal workers.

# Data Collection and Measurements

Data was collected through personal, face-to-face interviews by four trained data collectors between March and September 2019. Data quality was controlled in the field by supervisors from the School of Public Health, Walailak University, and investigators.

## Socio-demographic Status, Health History and Work-related Factors Questionnaire

To evaluate study factors, we used a separate questionnaire designed by the researchers. Socio-demographic factors included worker sectors, gender, age, marital status and educational level; health-related factors included non-communicable chronic diseases (NCDs), smoking status, alcohol consumption and regular exercise activity. Work-related factors in this study was divided into two categories: physical work environment and psychosocial work-related factors. In addition, we collected data on working practices, occupational health services experience (health education, occupational health risk and working process assessment, and primary diagnosis), health promotion service experience and utilization of primary care (health education and counselling, primary prevention program and NCDs screening). Two measurements assessed the quality of the overall questionnaire. The index of item objective congruence (IOC) yielded a value of 0.9-1.0 for content validity, and the Cronbach's alpha coefficient was 0.86 for reliability.

## Measurements

The anthropometric data were measured weight, height and waist circumference (WC) using a standardized digital scale (TANITA UM-070, TANITA Corporation, Japan) and a standard measuring tape, to the nearest 0.1 kg and 0.1 cm, respectively. To record body mass, the participants wore light clothing without shoes. WC was taken on bare skin, in a horizontal plane midway between the inferior margin of the last rib and iliac crest [15]. Obesity was determined through calculation of body mass index (BMI) and WC for Asian; value of BMI  $\geq 23$  kg/m<sup>2</sup> was used to define overweight and  $\geq 25$  kg/m<sup>2</sup> was used to define obese and WC levels of  $> 90$  and  $> 80$  cm for men's and women's abdominal obesity, respectively [15–17].

## Work Ability Index (WAI)

The WAI is an instrument developed by the Finnish Institute of Occupational Health Research. This index is aimed at assessing work ability during health examinations and workplace surveys, and avoiding early retirement and work-related disability [18]. The WAI is calculated by summing up the seven items score (range 7–49). Finally, work ability is classified into one of the four categories of poor (7–27), moderate (28–36), good (37–43) and excellent (44–49) [11]. We use WAI questionnaire version translated in Thai by Kaewboonchoo O, 2015 for the assessment [19]. However, to analyze the impact of independent variables on different domains of WAI, we combined seven items of WAI into three domains according to the purpose of WAI, and other research has used these classification [11, 20–21] which took into

consideration the demand of work, as well as the : 1) perception of work ability—including item 1, 2 and 6); 2) workers' health status—including item 3, 4 and 5); and mental resources—including item 7.

## Study Variables

In this article, the dependent variables were WAI and each dimension of work ability: perception of work ability, health status, mental resources. The explanatory variables included socio-demographic factors, health factors and work-related factors.

## Statistical Method

Both descriptive and inferential statistics were carried out using R 3.2.1 for Windows (CRAN, 2016). The proportions of the variable of interest by socio-demographic, health factors and work sectors were calculated. Independent t-test and Pearson's chi-squared were used to examine the different dimensions of work ability, total work ability index score, and the domain according to the purpose of WAI among workers sectors. We categorized WAI into two levels: WAI score lower or equal to 36 is a 'poor and moderate' and above 36 is a 'good and excellent'. Pearson's chi-squared were used for comparing the rates. The potential variables were selected with a p-value less than or equal to 0.2 from bivariate analysis to perform the final model. Simple logistic regression modelling was performed to detect the association between socio-demographic, health and work-related factors with work ability index, and each dimension in a multivariate analysis. Statistical significance level was set at 0.05.

## Results

### Characteristics and Health Factors

Table 1 describes the distribution of individual health status and behaviour, and occupational health variables within this sample. Participants (n = 324) were predominantly general labour (23.8%), female (70.7%), age group 60–70 (37.4%) with average aged 56.2 (S.D. = 7.4), married (74.7%) and primary school (60.8%). Nearly half of them were NCDs patient (48.2%). Smoking and alcohol consumption was more than 70% and 'did not exercise regularly' was 59 %. Current working duration of fewer than 10 years (42.6%) and income was less than 5,000 Thai-Baht (38.9%). Obesity was detected at 63.6% by waist circumference as overweight (65.4%) when detected by BMI. The work environment exposures were an equal proportion (50%) for mild and moderate physical environment groups, and nearly 60% of them fell in the category of good occupational behaviour. Most of the participants had received occupational health services sometimes (51.9%), and received the same frequently for health promotion accessibility (78.1%).

Table 1  
 Characteristics and health factors of aging worker groups (n = 324)

Characteristics	Worker groups: n (%)		
	formal (n = 71)	informal (n = 253)	total
<b>Gender</b>	37 (52.1)	58 (22.9)	95 (29.3)
Male	34 (47.9)	195 (77.1)	229 (70.7)
Female			
<b>Age group (y)</b>	25 (35.2)	49 (19.4)	74 (22.8)
45–49	25 (35.2)	55 (21.7)	80 (24.7)
50–54	17 (23.9)	32 (12.6)	49 (15.1)
55–59	4 (5.6)	117 (46.2)	121 (37.4)
60–70			
<i>Min = 45, Max = 70, mean = 56.2, S.D. = 7.4</i>			
<b>Marital status</b>	5 (7.0)	21 (8.3)	26 (8.0)
Single	61 (85.9)	181 (71.5)	242 (74.7)
Married	5 (7.0)	51 (20.2)	56 (17.3)
Widow/ Separate			
<b>Educational status</b>	1 (1.4)	3 (1.2)	4 (1.2)
Illiteracy	17 (23.9)	180 (71.1)	197 (60.8)
Primary school	28 (39.4)	51 (20.2)	79 (24.4)
Secondary school	25 (35.2)	19 (7.5)	44 (13.6)
Bachelor degree or higher			

Note: 1 USD = 30.1568 Thai-Baht (accessed on 18 January 2021)

Characteristics	Worker groups: n (%)		
	formal (n = 71)	informal (n = 253)	total
<b>NCDs</b>	46 (64.8)	122 (48.2)	168 (51.9)
Absence	25 (35.2)	131 (51.8)	156 (48.2)
Presence (repeated answer)	6 (8.5)	59 (23.3)	65 (20.1)
Hypertension	9 (12.7)	21 (8.3)	30 (9.3)
Dyslipidemia	5 (7.0)	10 (4.0)	15 (4.6)
Diabetes	0 (0)	14 (5.5)	14 (4.3)
Chronic respiratory diseases	5 (7.0)	27 (10.7)	32 (9.9)
others			
<b>Smoking status</b>	42 (59.2)	208 (82.2)	250 (77.2)
Never smokers	10 (14.1)	13 (5.1)	23 (7.1)
Former smokers	19 (26.8)	32 (12.6)	51 (15.7)
Smokers			
<b>Alcohol consumption</b>	40 (56.3)	201 (79.4)	241 (74.4)
Never drinking	0 (0)	10 (4.0)	10 (3.1)
Ever drinking	31 (43.7)	42 (16.6)	73 (22.5)
Drinking			
<b>Occupation</b>	30 (42.3)	0 (0)	30 (9.3)
Government employees	26 (36.6)	0 (0)	26 (8.0)
Company employees	10 (14.1)	67 (26.5)	77 (23.8)
General labors	0 (0)	68 (26.9)	68 (21.0)
Rubber plantation	0 (0)	15 (5.9)	15 (4.6)
Fruit plantation	0 (0)	64 (25.3)	64 (19.8)
Merchant	0 (0)	16 (6.3)	16 (4.9)
Personal business	5 (7.0)	23 (9.1)	28 (8.6)
Others			

Note: 1 USD = 30.1568 Thai-Baht (accessed on 18 January 2021)

Characteristics	Worker groups: n (%)		
	formal (n = 71)	informal (n = 253)	total
<b>Current working duration (y)</b>	32 (45.1)	106 (41.9)	138 (42.6)
< 10	21 (29.6)	65 (25.7)	86 (26.5)
10–20	18 (25.4)	82 (32.4)	100 (30.9)
> 20			
<b>Income per month (Baht)*</b>	9 (12.7)	117 (46.2)	126 (38.9)
< 5,000	18 (25.4)	83 (32.8)	101 (31.2)
5,000–10,000	16 (22.5)	21 (8.3)	37 (11.4)
10,001–15,000	28 (39.4)	32 (12.6)	60 (18.5)
> 15,000			
<b>Regular exercise Activity</b>	33 (46.5)	100 (39.5)	133 (41.0)
Yes	38 (53.5)	153 (60.5)	191 (59.0)
No			
<b>Waist circumference</b>	33 (46.5)	85 (33.6)	118 (36.4)
Normal	38 (53.5)	168 (66.4)	206 (63.6)
Obesity			
<b>BMI</b>	28 (39.4)	84 (33.2)	112 (34.6)
<=22.9 (normal)	43 (60.6)	169 (66.8)	212 (65.4)
>=23.0 (overweight)			
<b>Physical work environment exposure</b>			
Mild	40 (56.3)	122 (48.2)	162 (50.0)
Moderate - high	31 (43.7)	131 (51.8)	162 (50.0)
<b>Psychosocial factors exposure</b>	47 (66.2)	149 (58.9)	196 (60.5)
Mild	24 (33.8)	104 (41.1)	128 (39.5)
Moderate - high			

Note: 1 USD = 30.1568 Thai-Baht (accessed on 18 January 2021)

Characteristics	Worker groups: n (%)		
	formal (n = 71)	informal (n = 253)	total
<b>Working practices</b>	22 (31.0)	108 (42.7)	130 (40.1)
Unsafe	49 (69.0)	145 (57.3)	194 (59.9)
Safe			
<b>Occupational health services Experience</b>			
Sometimes	31 (43.7)	137 (54.2)	168 (51.9)
Frequently	40 (56.3)	116 (45.8)	156 (48.1)
<b>Health promotion accessibility Experience</b>			
Sometimes	13 (18.3)	58 (22.9)	71 (21.9)
Frequently	58 (81.7)	195 (77.1)	253 (78.1)
Note: 1 USD = 30.1568 Thai-Baht (accessed on 18 January 2021)			

## Working Ability of Ageing Workers: Dimension and Class

Table 2 shows participant's total WAI stood on average at 40.6 (S.D. = 4.6) and 37.5 (S.D. = 5.0) for formal and informal sectors. The ageing workers in formal sector tend to have a higher WAI score than informal workers in every dimension. Independence t-test showed a statistically significant difference in the WAI score for each dimension between the formal and informal sectors ( $p < 0.05$ ). We used the Pearson's chi-square examined work ability classes into two categories; poor to moderate and good to excellent WAI. There was a rate difference of WAI classes between formal and informal workers ( $p = 0.002$ ). Most of the workers had a high proportion of good to excellent WAI, which are 81.7% and 62.5% for formal and informal workers. We explored WAI of worker sectors according to three purpose categories. The analysis found rate differences between WAI and workers group in the perception and working ability as well as health status categories ( $p < 0.001$ ). The formal workers had the highest proportion of strong perception of working ability (64.8%) while the informal worker had the highest proportion of bad health status (65.6%). Moreover, the formal worker had higher good health than bad health (56.3% vs 43.7%), which contrasted with the informal worker group (34.4% vs 65.6%). However, there was no difference of WAI for mental resources in both worker groups.

Table 2  
Dimension, score, class and domain of WAI of aging workers

Items	Formal (n = 71)	Informal (n = 253)	p-value
<b>Dimension of work ability: mean (SD)</b>			
1) Current work ability compared with the lifetime best	7.9 (1.4)	7.5 (1.6)	0.016 <sup>a</sup>
2) Work ability in relation to the demands of the job	8.7 (1.4)	7.8 (1.6)	< 0.001 <sup>a</sup>
3) Numbers of current diseases diagnosed by a physician	5.7 (1.7)	5.3 (1.7)	0.028 <sup>a</sup>
4) Estimated work impairment due to diseases	4.5 (1.4)	4.1 (1.8)	0.022 <sup>a</sup>
5) Sick leave during the past year (12 months)	4.6 (0.6)	4.5 (0.8)	0.019 <sup>a</sup>
6) Personal prognosis of work ability 2 years from now	5.6 (1.6)	5.1 (1.6)	0.004 <sup>a</sup>
7) Mental resources	3.4 (0.6)	3.3 (0.7)	0.023 <sup>a</sup>
Total work ability index score: mean (SD)	40.6 (4.6)	37.5 (5.0)	< 0.001 <sup>a</sup>
Class of work ability: n (%)			
Excellent-good	13 (18.3)	95 (37.5)	
Moderate-poor			
Three domains according to the purpose of WAI: n (%)			
Perception of work ability	25 (35.2)	145 (57.3)	< 0.001 <sup>b</sup>
Weak	46 (64.8)	108 (42.7)	
Strong			
Health status	31 (43.7)	166 (65.6)	< 0.001 <sup>b</sup>
Bad	40 (56.3)	87 (34.4)	
good			
Mental resources	35 (49.3)	158 (62.5)	0.228 <sup>b</sup>
Weak	36 (50.7)	195 (37.5)	
Strong			
<sup>a</sup> Independent t test, <sup>b</sup> chi-square test			

## WAI Class by Socio-demographic, Work-related and Health Factors

Table 3 shows the bivariable analyses of the rate presenting a so-called 'poor to moderate' and 'good to excellent' WAI categories based on individual and occupational health factors. The analysis found that statistically significant association of individual factors and WAI categories are workers sector, age group, presence of NCDs, WC, and overall occupational behaviours ( $p < 0.05$ ). However, several other factors did not have an association with WAI: residential area, gender, marital status, smoking status, alcohol consumption, exercise activity, BMI, overall occupational health services, overall health promotion services, and physical and psychosocial work-related factors.

Table 3

The class of WAI according to socio-demographic, health status and work-related factors

	<b>Poor-Moderate (n = 108)</b>	<b>Good-Excellent (n = 216)</b>	<b>p</b>
<b>Worker sector</b>	13 (18.3)	58 (81.7)	0.002
Formal	95 (37.5)	158 (62.5)	
Informal			
<b>Residence</b>	46 (31.9)	98 (68.1)	0.635
Rural	62 (34.4)	118 (65.6)	
Sub-urban			
<b>Gender</b>	32 (33.7)	63 (66.3)	0.931
Male	76 (33.2)	153 (66.8)	
Female			
<b>Age (y)</b>	29 (18.8)	125 (81.2)	< 0.001
<55	79 (46.5)	91 (53.5)	
>=55			
<b>Marital status</b>	29 (35.4)	53 (64.6)	0.651
Single/widow/ separate	79 (32.6)	163 (67.4)	
Married			
<b>NCDs presence</b>	34 (20.2)	134 (79.8)	< 0.001
Absence	74 (47.4)	82 (52.6)	
Presence			
<b>Smoking status</b>	84 (33.6)	166 (66.4)	0.852
Never smokers	24 (32.4)	50 (67.6)	
Former/ Smokers			
<b>Alcohol consumption</b>	81 (33.6)	160 (66.4)	0.857
Never drinking	27 (32.5)	56 (67.5)	
Ever/ Drinking			

	Poor-Moderate (n = 108)	Good-Excellent (n = 216)	p
<b>Exercise Activity</b>	40 (30.1)	93 (69.9)	0.299
Yes	68 (35.6)	123 (64.4)	
No			
<b>Waist circumference</b>	30 (25.4)	88 (74.6)	0.022
Normal	78 (37.9)	128 (62.1)	
Obesity			
<b>BMI</b>	31 (27.7)	81 (72.3)	0.117
Normal	77 (36.3)	135 (63.7)	
Overweight			
<b>Physical work environment exposure</b>	53 (32.7)	109 (67.3)	0.814
Mild	55 (34.0)	107(66.0)	
Moderate-high			
<b>Psychosocial factors exposure</b>	65 (33.2)	131 (66.8)	0.936
Mild	43 (33.6)	85 (66.4)	
Moderate-high			
<b>Working practices</b>	57 (43.8)	73 (56.2)	0.001
Unsafe	51 (26.3)	143 (73.7)	
Safe			
<b>Occupational health services experience</b>	63 (37.5)	105 (62.5)	0.099
Sometimes	45 (28.8)	111 (71.2)	
Frequently			
<b>Health promotion services experience</b>			0.924
Sometimes	24 (33.8)	47 (66.2)	
Frequently	84 (33.2)	169 (66.8)	

## Determinants of WAI and WAI Purposes Categories

Table 4 demonstrates the multivariable analyses among the determinants of WAI and WAI purposes categories. The multivariate analysis highlighted the association of age group, presence of NCDs and working practices with the WAI group. The probability of WAI poor to moderate was higher in age group

55 year and over (OR = 1.45; 95%CI [1.21, 1.74]), and higher in NCDs presence (OR = 2.85; 95%CI [1.69, 4.80]), as well as unsafe working practices (OR = 2.11; 95%CI [1.26, 3.55]). For the perception of work ability dimension, the probability of poor perception was higher in the age group 55 year and over (OR = 1.41; 95%CI [1.21, 1.66]), it was also higher of weak mental resources in age group 55 year and over (OR = 1.32; 95%CI [1.13, 1.55]). Moreover, the higher probabilities of poor health status were found in age group 55 years and above, and especially NCDs presence (OR = 1.21; 95%CI [1.02, 1.45], (OR = 6.42; 95%CI [3.76, 10.96], respectively).

Table 4

The simple logistic regression model of associations between socio-demographic, work-related and health factors with work ability index among ageing workers ('poor to moderate' and 'good to excellent')

	OR (95% CI)			
	WAI	Perception of work ability	Health status	Mental resources
Worker Sector (formal#)	1.69 (0.83, 3.45)	1.72 (0.95, 3.09)	1.76 (0.95, 3.27)	1.25 (0.71, 2.20)
Age (< 55#)	1.45 (1.21, 1.74) <sup>***</sup>	1.41 (1.21, 1.66) <sup>***</sup>	1.21 (1.02, 1.45) <sup>*</sup>	1.32 (1.13, 1.55) <sup>***</sup>
NCDs presence (No#)	2.85 (1.69, 4.80) <sup>***</sup>	1.57 (0.98, 2.53)	6.42 (3.76, 10.96) <sup>***</sup>	1.21 (0.76, 1.95)
WC (Normal#)	1.38 (0.70, 2.72)	0.97 (0.52, 1.79)	1.28 (0.66, 2.49)	1.36 (0.74, 2.50)
BMI (Normal#)	1.10 (0.56, 2.16)	1.17 (0.63, 2.16)	1.34 (0.69, 2.62)	0.87 (0.47, 1.61)
Working practices (Safe#)	2.11 (1.26, 3.55) <sup>**</sup>	1.59 (0.98, 2.57)	1.06 (0.62, 1.79)	1.25 (0.78, 2.01)
Note: <sup>***</sup> p < 0.001, <sup>**</sup> p < 0.01, <sup>*</sup> p < 0.05, # Reference group				

## Discussion

This study has been carried out mainly to explore the difference of WAI between formal and informal sector workers, the relations of socio-demographic, health and work-related factors, and WAI and its dimension. The results show that individual age group, presence of NCDs, occupational health behaviours are significantly associated with the WAI and WAI dimensions; perception of working ability, health status and mental resources of the study sample.

Age group and work ability. This study categorized worker's age into two groups; less than 55 and 55 years and above. The effects of age group associated to the WAI and similar to the three dimensions. The workers of age 55 years and above have a higher risk to 'poor to moderate WAI' class. Age was a significant factor associated to WAI in many studies. Our results' direction of association is consistent

with many studies showing that age is significantly and negatively associated with WAI in various occupational sectors [22–25]. However, the data did not highlight gender and working ability, corresponded to the study of van den Berg et al. in 2009 [26], although there is the probability of low or poor work ability, which was higher in women's WAI measurement [27]. The ageing of workers requires two issues that need consideration [28–29]: the first one involves worker's health, and the second is job productivity and performance. A larger number of older workers implies, for example, an increasing number of people at work with minor and major health problems that occur more frequently after 55 years of age [30]. About 53% of both sectors in the study were ageing workers, and half were NCDs. Age and the presence of NCDs were the predominant factors of ageing workers' productivity. The results show that the presence of NCDs is a strong and positive association among the 'poor to moderate WAI', especially in a 'health status' dimension (OR = 6.42). Our data explored the presence of NCDs (48.2%), with hypertension in the highest proportion. Complex interactions were proposed between ageing of working population and lifestyle risk factors such as low-level of physical activity, known as the risks of cardiovascular disease, and work-related risk factors [31]. Our data showed approximately 60% of workers had overweight or obesity status, in line with other reports [18, 26, 32–34]. However, the rate may not be different between the two sectors. Moreover, more than half of the workers (59%) reported a non-regular exercise group. Physical health, which is one of the intermediate determinants of individual lifestyle, directly affects worker's health status and functional activity, which are base factors for working ability [35–36]. Then the declining of physical capability and increasing of risk to NCDs; obesity was the negative factor influencing working ability of the ageing workers. Other risk factors, including smoking and alcohol consumption, are not associated with WAI. We found the high proportion (more than 70%) of 'non-smoker' and 'non-drinking' workers in this study, especially in the informal sector. This association is not significant in bivariable and multivariable models, this result corresponds to Mehdi El Fassi et al. (2013) [27] stating that workers' smoking habit was reported as significant in a single study only [32].

Working conditions correspond to the fourth floor and consist of work, and all of its dimensions as described by WAI [35–36]. Our study explored working practices in various manners composed of personal hygiene, safety inspection, personal protective equipment (PPE) usage, simple working improvement, resting duration and housekeeping. The study results demonstrate that worker who was 'unsafe' had a higher probability of the 'low to moderate' WAI (OR = 2.11). The univariable analysis of working practices demonstrate the higher proportion (60%) of safety practices. The bivariable analysis also show the significant association of WAI and working practices. We also found that there is a statistically significant association of safety practices in the 'good to excellent' worker in the multivariable analysis. K Tuomi et. al. (2001) have shown that work environment factors, such as poor work postures, distracting work environment, poor physical climate, tool failure and work rooms were strongly associated with poor working ability [18]. On the other hand, improvements in the work and tasks, work environment and tools positively influenced working ability [18].

In Thailand, informal worker's occupational health services were integrated in the primary healthcare system arranged by the Universal Health Coverage scheme (UCS). The formal workers in the public and private sectors utilize healthcare services by their health insurance scheme, which is Civil Servant Benefit

Scheme (CSMBS) and Social Security Scheme (SSS), respectively. Those services promote health, are prevention and cure-based when it comes to general health and diseases, which cannot be separated from occupational problems and diseases, except in the SSS. However, worker's health improvement issue is more complex and requires a holistic approach, especially in the ageing worker. The services have to set in at the early phase of physical and mental deterioration described by the decline of the WAI score. Work ability model is appropriate for an ageing workforce process based on the self-assessment of subjective experiences of personal resources, working context, and work-life interface [35–36]. The structure of work ability changes during a person's life and career, such as the fact that ageing affects the individual's resources [37]. The implementation of work ability assessment in the occupational health and safety program will provide preventive measures and early rehabilitation in the workplace and healthcare centre [38–40].

There are several limitations in this study. Firstly, the cross-sectional design by which exposure and outcome were measured concurrently does not certify the causal relationship model. In epidemiological studies, an association of exposure and outcomes is causal only if the study's plausibility was explored. Secondly, self-reported measurements of the study's variables—including working ability and occupational hazards—may lead to recall and information bias. Workers' awareness of the occupational hazards could affect the measures' correctness. Workers in the formal sector were familiar with their work conditions, and they were able to recognize the occupational hazards in their workplace, while informal workers may not. Lastly, we focused on the working abilities of ageing workers residing in sub-urban and rural communities because of the information access, which may not be representative of workers elsewhere in different settings. Generalization beyond the study population should be used with consideration.

## Conclusions And Recommendations

In conclusion, this study determined the association between working ability and the determinants, health-related factors, socio-demographic and work environment of the formal and informal ageing workers. The results presented that age group, presence of NCDs and safety practices associated with work ability of the Thai ageing worker. There is a strong association of between NCDs and health status of the workers. It suggested that promoting healthy behaviour and work environment may be an important strategy to improve ageing worker's work ability and health. The formal worker's organizational health strategy might consider providing the concept of total worker health at the early ageing stage. Correspondingly, the primary healthcare centre may integrate the concept of worker's holistic health for health promotion and prevention strategy to work well for the informal workers. In addition, the ageing health services should cooperate with occupational health programmes in order to improve work ability and productivity of ageing workers for life-long working. For further study, longitudinal studies in various occupational settings of the ageing worker are required to determine the association better.

## Abbreviations

BMI

Body mass index; NCDs:Non-communicable diseases; OR:Odds ratio; WAI:Work ability index; WC:Waist circumference

## **Declarations**

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### **Availability of data and materials**

The datasets generated and/or analysed during the current study are not publicly available due to concealment of datasets has been identified in the human research ethics request process. Requests for tools and materials should be addressed to the corresponding author.

### **Ethics approval and consent to participate**

This study has been approved by the Human Research Ethics Committee of Walailak University, Thailand (No. WUEC-19-030-1). All methods were carried out in accordance with relevant guidelines and regulations of declaration of Helsinki. Written Informed consent was obtained from all participants at the beginning of the study. The participants were reminded that the study was voluntary, confidential and the results would remain anonymous.

### **Consent for publication**

Not applicable

### **Competing interests**

The authors declare that they have no competing interest.

### **Authors' contributions**

CT and ST were responsible for the concept, development, interview conduct, and supervision of the research. CT analyzed the data and constructed the draft manuscript. All authors contributed to the preparation of the manuscript, reviewing and approving the final manuscript.

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