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Association between occupations and selected noncommunicable diseases: A matched case-control among Thai informal workers

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Abstract

Objectives: We conducted a matched case-control study of informal workers to determine the association between occupational classification and selected types of noncommunicable diseases (NCDs).

Method: We extracted data of patients aged ≥18 years from the Thai National Health Security Office database (NHSO) during 2011-2014. Cases were patients who had a primary diagnosis of: diabetes mellitus (E10-E14), hypertension (I10-I15), ischemic heart disease (I20-I25) or stroke (I60-69), or thyroid gland disorder (E00-E07). Controls were patients who had a primary diagnosis of intestinal or parasitic infections (A00-A09 and B25-B99), and were randomly matched 1:1 with cases of the same age and residential area. The four-digit occupation codes recorded in the NHSO were grouped and recoded based on the submajor groups of International Standard Classification of Occupations (ISCO-08) as follows: agricultural workers, unskilled workers, service, and sales workers. Analysis was performed using multivariable conditional logistic regression.

Results: Occupation and sex inequalities were present among all the selected NCDs. Higher risk for the four selected NCDs was found among unskilled workers. Stronger risk for cardiovascular disease was present among males, while females had a higher risk for metabolic disorders.

Conclusions: There is a need to understand what are the key factors that increase the risk for NCDs among informal sector workers. Health promotion campaigns are needed to raise awareness among economically and social disadvantaged informal workers about the risk for NCDs. This will require collaboration between public health and the workforce, and allocation of government budgets to address the needs of these workers.

KEYWORDS

health inequality, informal worker, noncommunicable diseases, occupational classification, Thailand

1 | INTRODUCTION

Noncommunicable diseases (NCDs) are a leading cause of mortality worldwide. NCDs accounted for 71% of all deaths, with cardiovascular diseases, such as stroke, ischemic heart disease (IHD), and diabetes mellitus the two leading causes of NCDs deaths.[1] In 2018, global mortality was 41 million, with almost half of them between 30 and 69 years old. About 85% of these premature deaths occurred in low- and middle-income countries (LMICs).[1] The dramatically increased trend of NCDs among LMICs is attributed to the presence of higher NCD risk factors among the socioeconomically disadvantaged.[2,3] In particular, the major risk factors, such as tobacco smoking and alcohol consumption, of NCDs were higher among the low socioeconomic group than other groups.[4]

Social determinants of NCDs are defined as unequal conditions under which people are born, live, and work, as well as inequitable power, resources, and money between the social groups.[5] These unequal conditions are based on socioeconomic status, gender, and race.[3] A large survey in European countries and a systematic review among LMICs emphasized the linkages between social inequality and health,[6–8] with a higher NCD prevalence among lower socioeconomic occupations and females.[6,7] Cardiovascular diseases were found to be more common among low socioeconomic status persons, while diabetes mellitus was common among high socioeconomic status persons.[8] Occupational classification is one of the social determinants that can frame ways of life and social interactions as well as opportunities that would affect health and well-being in later life.[9,10] Occupational classification can be used to identify target populations for health promotion and NCD prevention and control; however, only few of studies have focused on occupational classification and NCDs.[2–4,6–8]

In Thailand, about 37 million people are employed and more than half of them are in informal employment, with almost 90% in the agricultural and service sectors.[11] The informal sector is defined by self-employment or home-based contract labor without social support provided by formal employment such as social security, private health insurance, sick and vacation leave, workers compensation.[10] More than 50% of informal workers have an educational level of high school or lower and have few protections from workplace health hazards.[10,11] To improve equity in health services financing and provide financial risk protection, Thailand has implemented three public insurance schemes: (1) Civil Servant Medical Benefits Scheme (CSMBS) for government employees, pensioners, and their dependents; (2) Social Health Insurance Scheme (SSS) for employee in formal sector workplaces; and (3) Universal Health Coverage Scheme (UHC) for the remaining population, including informal workers.[12] Although Thailand's UHC system provides equitable accessibility to health services,[12,13] the working and living conditions of informal workers may increase their health risks for cardiovascular diseases, hypertension, stroke, and diabetes mellitus.[1,9]

Thyroid disorders are group of the slow-motion disasters that shorten life expectancy[14] and predispose individuals to cardiovascular diseases and diabetes mellitus.[15–17] Sharing key risk factors between thyroid disorder and NCDs encouraged the Advisory Board of the World Thyroid Federation propose the necessary actions to WHO to include thyroid disorders as a member of NCDs.[18] Additionally, recent studies in Thailand reported dysregulation of thyroid hormone levels among agricultural workers exposed to pesticides.[19,20]

Increasing trends in cardiovascular diseases, hypertension, stroke, and diabetes mellitus have created an economic burden in Thailand.[21] In 2009, the economic cost of NCDs was approximately 6617 million USD due to premature deaths and loss of productivity among the workforce.[22] This is a serious issue among informal workers, where long-term illnesses can affect their livelihood and family financial stability.[23] Understanding the relationship between occupational classification and selected types of NCDs including thyroid disorder can provide valuable information in developing NCD surveillance, prevention, and control measures to provide better health for these disadvantaged groups.[3,5–8,22–24] The aim of this study was to identify whether specific types of informal work are associated with an increased risk for the five selected types of NCDs and whether there are also disparities in risk based on gender.

2 | METHODS

2.1 | Study design and settings

We conducted a 1:1 matched case-control study within a cohort from the National Health Security Office (NHSO), Thailand. The NHSO is an autonomous institution and functions as a health service purchaser for members of Thai Universal Health Coverage (UHC) system which covers almost 75% of Thai citizens.[12,13] The UHC is the main provider of health services for informal workers and NHSO data cover all types of illnesses diagnosed and cared for at all levels of the health service system in Thailand. Based on Thailand health service operation, physicians are main health care providers who are responsible for diagnosis and treatment, and nurse practitioners are responsible for diagnosis and treatment of common illnesses at primary care units. All patients with NCDs and critical illnesses are obligatorily referred to secondary or tertiary care facilities for diagnostic confirmation and treatment. All diagnosed patients are recorded in the

NHSO database based on the International Classification of Disease 10th Revision (ICD-10).[25]

Since the agricultural sector has highest numbers of informal workers,[11] we purposively selected four agricultural provinces in Thailand including Kanchanaburi (Western Thailand), Nakhonsawan (Lower-Northern Thailand), Suphanburi (Central Thailand), and Pitsanulok (Northern Thailand). These four provinces grow the main agricultural products such as cassava, sugarcane, rice, and vegetables, and food of the country. Also, these four provinces had higher levels of pesticide exposure ie atrazine, glyphosate, paraquat, and chlorpyrifos,[26] that previous reports have shown impact thyroid hormones (19-10) and metabolic disorders associated with cardiovascular disease.[27,28]

2.2 | Sample selection

During 2011-2014, 2 182 600 patients with diagnoses were recorded in the NHSO database. Of these, we included the 413 084 persons aged ≥18 years. Patients with unavailable occupational codes or irrelevant occupational codes such as unemployed, students, monks, or priests were excluded. Of 333 230 eligible subjects. We included 34 416 of patients who had a primary diagnosis of diabetes mellitus (E10-E14), hypertension (I10-I15), IHD (I20-I25), stroke (I60-69), thyroid gland disorder (E00-E07), or intestinal or parasitic infections (A00-A09 and B25-B99) (Figure 1).

2.3 | Case selection

All patients who were diagnosed with diabetes mellitus (n = 9792), hypertension (n = 3889) IHD (n = 4939), stroke (n = 9101), and thyroid disorders (n = 1043) were randomly selected as cases.

2.4 | Control selection

The eligible patients diagnosed with intestinal or parasitic infections (n = 10 269) were randomly assigned as controls and matched 1:1 with each type of cases of the same age and residential area.

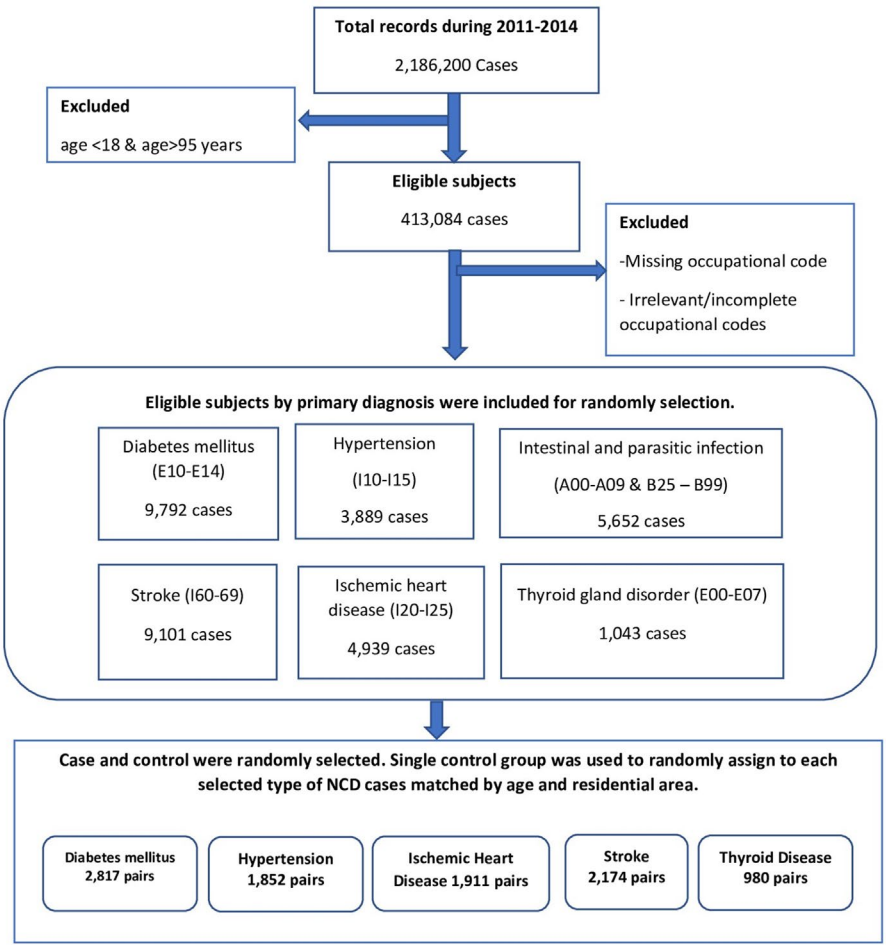

FIGURE 1 Process of data selection and sampling frame

2.4.1 | Occupational classification

The four digits of the occupation codes in the NHSO database were recorded based on the national standard codes developed by the Strategy and Planning Division, Ministry of Public Health.[29] Of 780 occupational codes, only 303 occupational codes were recorded in the NHSO database as UHC members. We recoded the NHSO occupational codes in line with the International Standard Classification of Occupations (ISCO-08).[30] The ISCO-08 classified occupation into 43 submajor groups with two digits. The four-digit NHSO occupation codes were aligned with the two-digit ISCO codes as follows: personal service workers such as waiters, hairdresser, taxi driver, etc; sale workers such as shop salesperson, street food salesperson, shopkeeper, etc; market-oriented skilled agricultural workers; cleaners and helpers such as housekeepers; agricultural laborers; laborers in construction; and refuse workers and other unskilled workers.

Due to small numbers in some occupations, the occupational codes were grouped into three types of occupation based on skill level and risk of pesticide exposure from work: (1) unskilled workers included occupations requiring physical strength and only a primary level of education, with only a small likelihood of pesticide exposure. It included cleaner, refuse worker, and construction laborer groups; (2) service and sales workers included occupations which require an ability to read or manual dexterity, with very little likelihood of pesticide exposure. It included the personal service and sales workers groups; and (3) agricultural workers included the skilled agricultural worker and agricultural laborers groups.[30]

2.4.2 | Education level

The education level was classified into three groups according to the educational system and context in Thailand: (1) lower than primary school, (2) primary school, and (3) high school and higher. Due to large numbers of missing data, we kept the cases and controls without educational level data and assigned them to a not available group (N/A) to ensure the adequacy of sample size.

2.4.3 | Age and residential area

The age of subject was determined on the date of diagnosis with selected illness. Residential area was defined based on province code of the patient reported to the NHSO database.

2.5 | Data analysis

Descriptive analyses were presented as the number and percentage for nominal and ordinal scale variables, mean (SD), and median for interval scale variables. Cases and controls were compared to ensure age and residential area were completely controlled for using matching process.

Multivariable conditional binary logistic regression was used to calculate odds ratio and 95% confidence interval. P-value was calculated using a McNemar test and $P < .05$ was considered as statistically significant. We developed a multivariable model by including a priori-selected variables, sex, and highest education factors. Matched variable, that is, age and residential area did not include in the multivariate model because both the variables presented identical distribution ($P = 1.00$).

3 | RESULTS

3.1 | Selected diseases descriptive analysis

Among the five selected NCDs, diabetes mellitus was the most common (9792 cases), followed by stroke (9101 cases) and IHD (4932 cases) (Table 1). We found a higher percentage of female patients compared to male patients for diabetes mellitus, hypertension, and thyroid disorders, by up to four times. In contrast, IHD and stroke were more common in males than females (Table 1). Among all eligible cases, the most reported only had a primary level of education. The number of cases was distributed unequally across the four provinces, with diabetes mellitus most commonly found in Suphanburi province (32.7%), hypertension most commonly found in Kanchanaburi province (28.1%), IHDs and stroke most commonly found in Nakonsawan (33.7% and 32.4%, respectively), and thyroid disorders most commonly found in Pitsanulok province (33.4%) (Table 1). Among the cases of diabetes, the occupation with the largest percentage of cases was agricultural workers, while for hypertension, IHD, stroke, and thyroid disease, the largest percentage of cases was found among unskilled workers. The age of patients with thyroid disorder (mean = 46.3, SD = 13.2) was younger than the other diseases (Table 1).

3.2 | Characteristics of selected diseases cases and matched control

All five diseases were compared with matched controls who were diagnosed with intestinal or parasitic infections (A00-A09 and B25-B99). Age and residential area were completely matched for all cases ($P = 1.000$). Table 2 presents the distribution of various factors between cases and controls. The distribution of sex was significantly different for all diseases ($P < .001$) but the distribution of educational level ($P < .05$) and occupation type ($P < .001$) were only significantly different for hypertension, IHD, and stroke (Table 2).

TABLE 1 Characteristics of cases by selected diseases

Factors	Diabetes mellitus		Hypertension		Ischemic heart disease		Stroke		Thyroid disease	
	n = 9792	%	n = 3889	%	n = 4932	%	n = 9101	%	n = 1043	%
Sex										
Female	6735	68.8	2352	60.5	2150	43.6	3787	41.6	870	83.4
Male	3057	31.2	1537	39.5	2782	56.4	5314	58.4	173	16.6
Education level										
Lower than primary school	2106	21.5	721	18.5	858	17.4	1568	17.2	177	17.0
Primary school	4000	40.8	1631	41.9	1956	39.7	3697	40.6	367	35.2
High school and higher	687	7.0	395	10.2	369	7.5	723	7.9	178	17.1
N/A	2945	30.1	1142	29.4	1749	35.5	3113	34.2	321	30.8
Occupation										
Agricultural worker	4329	44.2	1472	37.9	1943	39.4	3682	40.5	387	37.1
Service and Sales worker	1676	17.1	719	18.5	958	19.4	1690	18.6	185	17.7
Unskilled worker	3787	38.7	1698	43.7	2031	41.2	3729	41.0	471	45.2
Province										
Kanchanaburi	1991	20.3	1095	28.1	1070	21.7	1530	16.8	160	15.3
Nakonsawan	2891	29.5	955	24.6	1661	33.7	2951	32.4	253	24.3
Pitsanulok	1707	17.4	763	19.6	953	19.3	2061	22.6	348	33.4
Suphanburi	3203	32.7	1076	27.7	1248	25.3	2559	28.1	282	27.0
Age in year										
Mean, SD	61.13,	11.47	59.18,	13.33	63.70,	12.49	62.63,	12.85	46.33,	13.19
Median	61		59		64		62		46	
Min-Max	18-94		18-94		19-94		18-95		18-88	

TABLE 2 Characteristics comparison, number (percentage), between selected diseases case and matched control

Factors	Diabetes Mellitus 2817 pairs		Hypertension 1852 pairs		Ischemic Heart Disease 1911 pairs		Stroke 2174 pairs		Thyroid Disease 980 pairs	
	Case	Control	Case	Control	Case	Control	Case	Control	Case	Control
Age (Years)										
<35 years	159(5.6)	159(5.6)	95(5.1)	95(5.1)	39(2.0)	39(2.0)	58(2.7)	58(2.7)	172(17.6)	172(17.6)
35-44	521(18.5)	521(18.5)	331(17.9)	331(17.9)	159(8.3)	159(8.3)	251(11.5)	251(11.5)	247(25.2)	247(25.2)
45-54	860(30.5)	860(30.5)	660(35.6)	660(35.6)	384(20.1)	384(20.1)	540(24.8)	540(24.8)	305(31.1)	305(31.1)
55-64	660(23.4)	660(23.4)	427(23.1)	427(23.1)	595(31.1)	595(31.1)	655(30.1)	655(30.1)	173(17.7)	173(17.7)
>65	617(21.9)	617(21.9)	339(18.3)	339(18.3)	734(38.4)	734(38.4)	670(30.8)	670(30.8)	83(8.5)	83(8.5)
P-value	1.000		1.000		1.000		1.000		1.000	
Sex										
Female	1865(66.2)	1720(61.1)	1095(59.1)	1163(62.8)	644(33.7)	1185(62.0)	757(34.8)	1354(62.3)	821(83.8)	598(61.0)
Male	952(33.8)	1097(38.9)	757(40.9)	689(37.2)	1267(66.3)	726 (38.0)	1417(65.2)	820(37.7)	159(16.2)	382(39.0)
P-value	<.001		.022		<.001		<.001		<.001	
Education level										
Below elementary	578(20.5)	538(19.1)	334(18.0)	378(20.4)	310(16.2)	375(19.6)	346(16.1)	463(21.3)	172(17.6)	176(18.0)
Elementary	1081(38.4)	1138(40.4)	761(41.1)	740(40.0)	774(40.5)	778(40.7)	893(41.1)	885(40.7)	344(35.1)	374(38.2)
Above elementary	297(10.5)	299(10.6)	228(12.3)	177(9.6)	147(7.7)	150(7.8)	191(8.8)	176(8.1)	160(16.3)	136(13.9)
N/A	*861(30.6)*	*842(29.9)*	*529(28.6)*	*557(30.1)*	*680(35.6)*	*608(31.8)*	*741(34.1)*	*650(29.9)*	*304(31.0)*	*294(30.0)*
P-value	.374		.017		.017		<.001		.332	
Occupation										
Agricultural worker	1186(42.1)	1214(43.1)	702(37.9)	790(42.7)	769(40.2)	917(48.0)	889(40.9)	1402(47.9)	386(39.4)	438(44.7)
Service and Sales worker	1247(44.3)	1173(41.6)	898(48.5)	782(42.2)	864(45.2)	718(37.6)	997(45.9)	838(38.5)	450(45.9)	412(42.0)
Unskilled worker	384(13.6)	430(15.3)	252(13.6)	280(15.1)	278(14.5)	276(14.4)	288(13.2)	294(13.5)	144(14.7)	130(13.3)
P-value	.075		.001		<.001		<.001		.059	
Province										
Kanchanaburi	707(25.1)	707(25.1)	495(26.7)	495(26.7)	380(19.9)	380(19.9)	423(19.5)	423(19.5)	146(14.9)	146(14.9)
Nakonsawan	834(29.6)	834(29.6)	424(22.9)	424(22.9)	713(37.3)	713(37.3)	661(30.4)	661(30.4)	238(24.3)	238(24.3)
Pitsanulok	493(17.5)	493(17.5)	428(23.1)	428(23.1)	366(19.2)	366(19.2)	534(24.6)	534(24.6)	336(34.3)	336(34.3)
Suphanburi	783(27.8)	783(27.8)	505(27.3)	505(27.3)	452(23.7)	452(23.7)	556(25.6)	556(25.6)	260(26.5)	260(26.5)
P-value	1.000		1.000		1.000		1.000		1.000	

Note: *P*-value for Mc Memar test; *P*-value < .05 is considered statistically significant.

3.3 | Multivariable conditional logistic regression analysis

Multivariable conditional logistic regression was used to estimate the odds ratio of each illness adjusted for sex and education. Agricultural work was used as the reference group for all diseases, except diabetes. The results were presented separately as follows:

3.4 | Diabetes mellitus

We found that males were significantly less likely to develop diabetes than females by 20% (adjusted odds ratio 0.802; 95% CI 0.720-0.894). Unskilled workers presented a higher risk for diabetes mellitus compared to agricultural workers (adjusted odds ratio 1.197; 95% CI 1.018-1.407). However, educational level was not associated with diabetes mellitus ($P > .05$). (Table 3).

3.5 | Hypertension

Males had a slightly higher risk for hypertension compared to females (adjusted odds ratio 1.102; 95% CI 1.015-1.329). Those subjects whose educational level was high school and higher had a significantly greater risk for hypertension compared to those with lower education (adjusted odds ratio 1.396; 95% CI 1.088-1.792). The unskilled worker group had a significantly higher risk for hypertension compared to agricultural workers (adjusted odds ratio 1.345; 95% CI 1.152-1.571).

3.6 | Ischemic heart disease

The multivariable conditional binary logistic regression showed that males had about three times higher risk for IHD than females (adjusted odds ratio 3.255; 95% CI 2.813-3.766). Unskilled workers and service workers had a significantly higher risk for IHD compared to agricultural workers (adjusted odds ratio 1.496; 95% CI 1.273-1.757 and 1.369; 95% CI 1.104-1.698, respectively).

3.7 | Stroke

Similar to IHD, males had a higher risk for stroke than females (adjusted odds ratio 3.118, 95% CI 2.725-3.567). Education level was significantly associated with stroke, with those whose educational level was primary school (adjusted odds ratio 1.382, 95% CI 1.146-1.668) or above primary school (adjusted odds ratio 1.381, 95% CI 1.046-1.825) was at higher risk for stroke compared to those whose

TABLE 3 Conditional logistic regression analysis to estimate the adjusted odds ratio and 95% Confidence interval (CI)

	Diabetes Mellitus		Hypertension		Ischemic Heart Disease		Stroke		Thyroid Disorders	
Factors	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Sex										
Female	1		1		1		1		1	
Male	0.802*	0.720-0.894	1.102*	1.015-1.329	3.255*	2.813-3.766	3.118*	2.725-3.567	0.310*	0.247-0.388
Education level										
Below elementary	1		1		1				1	
Elementary	0.884	0.762-1.026	1.177	0.976-1.419	1.185	0.967-1.452	1.382*	1.146-1.668	0.942	0.718-1.238
Above elementary	0.926	0.755-1.136	1.396*	1.088-1.792	1.115	0.828-1.502	1.381*	1.046-1.825	1.178	0.841-1.649
N/A	0.960	0.820-1.124	1.057	0.870-1.285	1.266*	1.025-1.564	1.452*	1.191-1.769	1.060	0.797-1.410
Occupation										
Agricultural worker	1.114	0.942-1.318	1		1		1		1	
Service and Sales worker	1.197*	1.018-1.407	1.345*	1.152-1.571	1.496*	1.273-1.757	1.552*	1.337-1.802	1.270*	1.015-1.589
Unskilled worker	1		1.057	0.855-1.305	1.369*	1.104-1.698	1.302*	1.052-1.611	1.219	0.895-1.661

Note: OR is Odds ratio adjusted for sex and highest education.

*P-value < .05.

educational level was below primary school. Unskilled workers and service workers had significantly higher risk for stroke compared to agricultural workers (adjusted odds ratio 1.302; 95% CI 1.052-1.611 and 1.552; 95% CI 1.337-1.802, respectively).

3.8 | Thyroid gland disorder

Females had a higher risk for thyroid disorders than males (adjusted odds ratio 0.310, 95% CI 0.247-0.388) and those in the unskilled worker group had a higher risk compared to agricultural workers (adjusted odds ratio 1.270; 95% CI 1.015-1.589).

4 | DISCUSSION

Based on our knowledge, this study is one of the few studies that focused on NCDs among informal workers. After controlled for age, residential area, sex, and education, we found that among these informal workers, unskilled workers were at the highest risk of all five NCDs: diabetes mellitus, IHDs, hypertension, stroke, and thyroid disorders. However, service workers were also at significantly elevated risk of cardiovascular diseases, that is,. IHD and stroke compared to agricultural workers.

The demographics of reported cases to NHSO emphasized the benefits of the universal health coverage (UHC) to the poor.[12,13] Almost half of the reported cases had only elementary education and were unskilled workers. The number of cases reported to the NHSO likely reflected the real burden of diabetes mellitus, IHD, hypertension, stroke, and thyroid disorders in Thailand, because the database covers 75% of Thai citizens.[12,13] Routinely analyzing NHSO data would assist in identifying health risks in this population and help in targeting needed health interventions.

Our study underlined the health inequities found across occupational classifications and aligns with studies in other countries.[6–8] We confirmed higher risks of cardiovascular diseases and hypertension in people with low socioeconomic status, such as unskilled laborers, after controlling for age, sex, education, and residential area. The present findings were consistent with other studies in Asia and LMICs.[8,27,31–34] In Thailand, unskilled worker is in the lowest quintile of monthly income and commonly hold only elementary education.[11] Such condition may likely result in adverse living, working, and social conditions among unskilled labors, as well as more health risky behaviors such as smoking, alcohol consumption, and poor diet.[3–5,9,23] In addition, a national survey in Thailand revealed that only 17% of unskilled labors reported adequate physical activity.[33] Previous studies reported higher risk of diabetes mellitus in high-income groups [6–8,32,33] which contrasted with our findings. This is likely because our study population was from the UHC health care system and was in informal sector jobs that was mostly in low socioeconomic group.[11]

Besides occupation, sex inequalities were confirmed for all selected NCDs. Males are at higher risk of cardiovascular diseases and hypertension. These results are similar to previous studies,[8,31,34] but differ from a cohort study in Japan.[32] The higher risk of cardiovascular diseases and hypertension among males is likely linked to a higher prevalence of smoking and alcohol consumption in males versus females in Thailand.[33] Also, physical inactivity among males is higher than females in Thailand.[33] Interestingly, females had a higher risk of diabetes mellitus than males, by 20%, which is consistent with the Thai national health examination survey.[33] One possible explanation of this higher risk for diabetes in females is obesity, since the latest Thai national survey found a higher prevalence of obesity in females compared to males.[33] The possible explanation linkages between obesity and diabetes mellitus are the dysfunction of adipose tissue and insulin resistance among obese persons.[35] Also, nutritional changes during pregnancies can alter glucose metabolism in mothers and offspring in later life.[36] We found a higher risk of thyroid disorders among females and unskilled laborers. Previous studies in Thailand found elevated thyroid hormones among pesticide using farmers compared to organic farmers,[19,20] but our study did not find an elevated risk among agricultural workers. However, the higher prevalence of thyroid disorders among females is consistent with previous studies.[37,38] Our finding addresses necessary action to against thyroid disorders in this population. The disease can compromise work performance and productivity that will affect informal workers' livelihood. Also, the diseases can induce risk of cardiovascular diseases, diabetes mellitus, and even shorten life expectancy.[14]

This study revealed lower risk for agricultural workers than fir unskilled workers that likely relates with the surveillance of chemical residual in blood in agricultural workers. In Thailand, all primary care units have been sponsored by the Community Health Funds to proactively assess chemical residual in blood in agricultural workers and that also simultaneously screen for hypertension and diabetes mellitus. Agricultural workers who have screening result higher than the normal value have been sequentially offered health promotion programs and behavioral change programs.[39]

Although our study confirmed the need for NCD prevention and control among a disadvantaged occupational group such as unskilled laborers, it should be noted that this study had some limitations. First, our assignment of occupational group was based on the self-report at the time of diagnosis and may have changed over the working life of the patient. Second, we used the NHSO database which does not collect data on the major risk factors (smoking, alcohol consumption,

physical inactivity and unhealthy diet) for NCDs which may affect our interpretation. Due to such limitation, we used sex as a proxy variable for different distribution of these risk factors between male and female.[33] Third, our study focused on in informal workers who were the UHC members and so is unlikely to cover high-income employment. Fourth, the category of unknown educational level revealed a significant association with IHD, thus further investigation is needed. Finally, our study was limited to four provinces in Thailand that were mainly agricultural areas, thus the results may not generalize to the whole population of Thailand.

5 | CONCLUSION

Elevated risk for NCDs among unskilled workers emphasizes the need for health education among the economic and socially disadvantaged groups. Although the Universal Health Care system in Thailand can reduce health inequity in term of accessibility to care, additional focus and budgetary allotment is needed along with a collaboration between public health practitioners and the workforce population to develop relevant health promotion campaigns.

6 | DATA AVAILABILITY STATEMENT

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

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AUTHOR CONTRIBUTIONS

MT initiated the idea, conducted the study, analyzed the data, and drafted the manuscript; PK guided the occupational health concept; SW guided the concepts of occupational classification, commented and edited the manuscript.

DISCLOSURE

Approval of research protocol: Formal ethical approval was not required as we obtained de-identified data for research purposes.

Informed consent: N/A.

Registry and the registration no. of the study/trial: N/A.

Animal studies: N/A.

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