



Article

The Burden of Work-Related Diseases and Injuries among Agriculturists: A Three-Year Retrospective Study in Thailand

Sunisa Chaiklieng ^{1,*} , Pornnapa Suggaravetsiri ², Worawan Poochada ³ , Wilaiphorn Thinkhamrop ² and Thawatchai Dacherngkhao ⁴

¹ Department of Environmental Health, Occupational Health and Safety, Faculty of Public Health, Khon Kaen University, Khon Kaen 40002, Thailand

² Faculty of Public Health, Khon Kaen University, Khon Kaen 40002, Thailand

³ Doctor of Philosophy in Epidemiology and Biostatistics, Faculty of Public Health, Khon Kaen University, Khon Kaen 40002, Thailand

⁴ Community Public Health Program, Department of Sciences and Technology, Faculty of Liberal Arts and Science, Roi-Et Rajabhat University, Roi-Et 45120, Thailand

* Correspondence: csunis@kku.ac.th; Tel.: +66-93-4629696

Abstract: This study investigated the incidence of work-related diseases and injuries among cultivating farmers in Thailand by conducting a three-year retrospective study with 207,465 farmers from Roi-Et province and 154,478 farmers from Udon Thani province. Health data were collected from the hospital information systems (HIS) of Roi-Et and Udon Thani provinces for a three-year period (2014–2016). We used the ICD-10 classification codes for diseases and injuries to analyse the incidence rates per 100,000 farmers. The number of cases that visited health centres were 53,794 in Udon Thani (34.82%) and 77,438 in Roi-Et (37.32%). The top five morbidity rates in Roi-Et and Udon Thani were work-related musculoskeletal disorders (WMSDs), followed by injuries, infectious disease, skin disease, and lung disease. The incidence of diseases and injuries found in Roi-Et, a more cultivating-agriculture-based province, was higher than that found in Udon Thani province. WMSDs were the greatest health concern in regard to cultivating activities. Infectious and lung diseases might have also been related to the cultivating activities, which warrants further studies. Our findings highlight an urgent need for targeted occupational health services, and health and safety measures among cultivating farmers in both provinces. Regular monitoring and surveillance programmes for cultivating farmers need to be in place, at the provincial level, to mitigate risk and protect the health and well-being of the farmers.

Keywords: agriculturist; occupational disease; musculoskeletal disorders; big data; incidence



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1. Introduction

A five-year (2013–2017) survey of employed persons found that those with neither protection nor social security according to labour law were mainly working in the informal sectors. They had only received universal health coverage from the Thai government for health prevention and control, with no coverage regarding workers' health compensation. In 2018, informal workers comprised 55.3% of the 38.3 million employed persons. They were primarily working in the north-east of Thailand. The majority of this group were farming workers or agriculturists (55.5%) who were mainly farm owners and subsistence farmers [1]. According to the agricultural census, which is conducted every 10 years, most recently in 2013, there were nearly six million registered farmers with holdings nationally. Regarding the agricultural holdings, about 96 percent were cultivating crops, while others involved rearing livestock, freshwater culturing, or sea salt farming. Thailand's main crop is rice, but off-season crops such as cassava, sugarcane, rubber, and corn are grown in rotation, depending on the climate, soil, and water resources. Nearly half of the agricultural holdings can be found in the north-eastern region of Thailand (46.5%). Roi-Et and Udon Thani are

two of the provinces among the top five provinces engaged in cultivating activities in the north-east of Thailand (comprising more than 97.0% of agricultural holdings) [2].

Agriculture is an essential source of livelihood for developing countries. However, it can lead to poor health and is linked to the main causes of death and disease: malnutrition, infection, chronic diseases, and cancer [3]. In Thailand, various research studies have shown that agriculturists have a risk or chance of being exposed to health hazards that affect their health. The highest health risk found among cultivating rice farmers was pesticide toxicity [4], followed by work-related musculoskeletal disorders (WMSDs) [5], heat-related illnesses [6], and skin irritation (71.5%) [7]. The incidence of infectious diseases among cultivating farmers in Chonburi and Kamphaeng Phet provinces has been reported in previous studies as 83 cases of melioidosis [8] and 69 confirmed cases of leptospirosis [9]. During 2012 to 2016, infectious diseases, including leptospirosis and melioidosis, and plant and animal toxicity resulted in high morbidity rates among crop farmers in Nong Bua Lamphu province of Thailand [10]. The highest prevalence of work-related disease among agricultural workers has been WMSDs, followed by heat-related illnesses, i.e., heat or skin rash, heat stroke, sunburn, acne aestivalis, polymorphous light eruption, photo-aggravated dermatoses, and skin cancer from excessive sun exposure, pesticide toxicity, and skin irritation [11]. Some of the diseases are unclear in that they might not have been reported as occupational disease. Some diseases were not reported correctly by the clinic or hospital in relation to ICD-10.

International Statistical Classification of Diseases and Related Health Problems: 10th Revision (ICD-10) codes have been used to specify diseases in Thai health databases. All occupational diseases are specified using Y96 as an additional code of a recorded ICD-10 disease to denote work as the external cause [12,13]. In 2012, the Department of Disease Control assigned specific clinics for agriculturists in primary care units (PCUs) to support health clinics in using the disease surveillance system of farmers in agricultural areas. Up until the time of this study, no reinforcement of the policy had been observed and occupational diseases with external cause coding have been largely ignored [14]. Subsequently, occupational diseases among farmers have rarely been reported, according to the disease surveillance on the Health Data Centre database in Thailand.

A previous study showed that farmers tended not to report their occupation as agriculturists. The number of agriculturists in the health database within the PCUs are not a true representation of the population, as shown in the previous report by Chaiklieng et al. [15]. The Provincial Agriculture Office can provide more accurate data on the actual number of people working in the agricultural sector. These databases include registered farmers so they can access benefits and support from the government. An investigation into the incidence of diseases and occupational injuries among farmers who were actually registered and had morbidity reports in the Health Data Centre (HDC) database found no study findings from 2014–2016 [15] consistent with the ostensible increase in pesticides imported to Thailand in 2013 [16]. The HDC is the central health database system of Thailand that collects and analyses the disease surveillance system data of all healthcare services under the provincial public health office by using 43 files, or standard structured data, classified with ICD-10 codes for diseases and disorders, and records the patient's information every time they receive services from officials. However, previous reports have found a high prevalence of work-related diseases and injuries in a systematic review [11] and included occupational diseases from the HDC [17].

This study investigated the incidence rate of work-related diseases and injuries among farmers who were registered with the Provincial Agriculture Office in two provinces in the north-east of Thailand: Udon Thani and Roi-Et. This study retrospectively retrieved data on incidences of diseases and injuries among farmers between 2014 and 2016. We also looked at other occupational-related diseases that had not previously been reported as occupational diseases within the ICD-10 classification, such as lung disease, skin disease, and infectious disease. We also included diseases that were due to toxicity exposure or chemicals other than pesticides, including solvents, metals and gases, fumes, and vapours.

2. Materials and Methods

2.1. Population and Sample Size

The agriculturists classified as performing cultivating activities, according to the information from the farmers who had registered with the Provincial Agricultural Offices of Roi-Et and Udon Thani provinces, who were working on various agricultural activities, including cultivating rice, cassava, corn, soybean, or sugarcane, were included in this study. A total number of 1,183,377 registered agriculturists met the inclusion criteria regarding the types of farming activities they had been involved in between 2014 and 2016.

The health data structure and standards of 43 files are 43 types of health files which comprise a large dataset collected from the provincial public health offices with the ICD-10 code records of the health data structure and standards of cases visiting primary care units (PCUs) and secondary or tertiary hospitals in Roi-Et and Udon Thani provinces for healthcare services from 2014 to 2016.

Data were extracted from the health records of 43 files based on identifiers of individuals registered as agriculturists with the Provincial Agriculture Office of Roi-Et or Udon Thani, and only if they were registered. Cases were only used if they matched the individuals registered as provincial agriculturists according to the health data structure and standards of the 43 files used to identify each registered case with an ICD-10 code of occupational diseases and injuries.

Coding of occupational diseases and injuries of agriculturist cases with ICD-10 codes can be seen in Table 1. Regarding diagnoses of diseases of agriculturists, data on occupational disease can usually be obtained from file number 19: surveillance which identified diseases under the epidemiological surveillance system according to short- or long-term symptoms at initial service and follow-up service. However, some cases were not reported, or the patients did not return for follow-up. We therefore also accessed other files of diagnosis from the in-patient department (file number 24) and outpatient department (file number 15) which identified ICD-10 codes of all types of service. In the case of patient death during the study year, which was accessed from file number 3, we excluded those patients from this study.

Table 1. Coding of occupational diseases among cultivating farmers.

Occupational Disease	ICD-10 TM	Note
Work-related musculoskeletal disorders (WMSDs)	M00-M99, M542, M545, M548, M60, M624, M653, M792, M796, G560	Considered with additional code Y96 (classified as occupational disease)
Work-related injuries (Injuries)	S00-S99, T00-T29	Considered with an external code (X, W, V, Y), where the 4th digit (place) was 7 (farm) and the 5th digit (activities) was 2 (work in a career) or missing
Infectious disease	A244, A278-A279, A34, A520-A821, A829	
Skin disease	L01, L02, L230-L239, L240-L249, L250-L259, L303, L502, L503, L55, L560-L569, L904	Considered with an external code where the 5th digit (activities) was 2 (work in a career) or missing
Lower respiratory tract disease (Lung diseases)	J62, J630-J638, J660-J679, J68, J40-J47	
Disease from contact with animals and plant poisoning	T610-T619, T620, T621-T628, T630, X20, W57, W59, W60, T631	
Hearing loss	H833, H903-H905	Considered with an external code (X, W) where the 4th digit (place) was 7 (farm) and the 5th digit (activities) was 2 (work in a career) or missing
Heat illness	T670-T679, T68	
Air pressure effects	T70, T700, T708, T71, X30-X39, W85-W99	
Pesticide toxicity	T600, T601, T602, T603, T604, T608, T609	Does not include self-harm or suicide (external code: X68, X4873, and X4809); considered with additional code Y96 or missing
Organic solvent toxicity	T520-T529, T530-T533	
Metal toxicity	T560-T568, T570-T578	
Toxicity of other gases, fumes, and vapours	T58, T590-T598	

2.2. Statistical Analyses

All statistical analyses were performed using Stata, version 14.0 (Stata Corp LP). Categorical data are presented as number and percentage. Continuous data are described with mean and standard deviation, and range (minimum: maximum).

To estimate the three-year morbidity rate of an occupational disease or injury among registered agriculturists from 2014–2016, with a confidence interval (95% confidence interval), the following equation was used:

$$\text{Morbidity rate} = \frac{\text{Number of new cases during 2014 – 2016} \times 100,000}{\text{Number of registered farmers during the three – years period}}$$

This study was approved by the Human Research Ethics Committee of Khon Kaen University (No. HE592154).

3. Results

3.1. Characteristics of Cultivating Farmers

The number of registered farmers between 2014 and 2016, in Roi-Et and Udon Thani provinces, was 207,465 and 154,478 people, respectively. More than 60% were female. The largest proportion of registered agriculturists were working on rice, cassava, and sugar cane plantations. Almost 80% of them worked in relatively small farming areas of less than 4 acres. Most of them produced less than 10 tons (Table 2).

Table 2. Characteristics of cultivating farmers in Roi-Et and Udon Thani provinces, Thailand.

Characteristic	Roi-Et (<i>n</i> = 207,465)		Udon Thani (<i>n</i> = 154,478)	
	Number	%	Number	%
Gender				
male	80,012	38.6	56,599	36.64
female	127,452	61.4	97,879	63.36
Farming activity of the registered agriculturist				
rice	203,623	98.2	137,648	89.11
cassava	2462	1.2	7976	5.16
sugar cane	381	0.2	7313	4.73
rubber	835	0.3	381	0.25
other (soybean corn)	163	0.1	1160	0.75
Planting area (rai)				
<10	155,086	74.76	106,648	69.04
11–20	42,306	20.39	40,905	26.48
21–30	8012	3.86	5646	3.66
31–40	1533	0.74	985	0.64
41–50	430	0.21	226	0.15
>50	78	0.04	54	0.03
mean ± s.d.	8.0 ± 6.1		8.7 ± 5.7	
min: max	0.05: 97		0.1: 133	
Productivity (tons)				
<10	204,352	98.7	141,771	91.84
11–20	1671	0.81	2430	1.57
21–30	392	0.19	1943	1.26
31–40	213	0.10	1493	0.97
41–50	99	0.05	1317	0.85
>50	326	0.16	5405	3.50
mean ± s.d.	1.6 ± 7.4		6.2 ± 30.4	
min: max	0.1: 1300		0.1: 2300	

3.2. Morbidity Rate of Occupational Diseases

Between 2014 and 2016, there were 53,794 (34.82%) and 77,438 (37.32%) reported cases of occupational diseases and injuries registered at the provincial health offices of Udon Thani and Roi-Et provinces, respectively.

The morbidity rates are presented across five diseases in the main occupational disease groupings. The highest morbidity rate was relating to WMSDs, followed by injuries, skin disease, hearing loss, heat-exposure related illnesses, health problems related to air pressure, and pesticide toxicity (Figure 1).

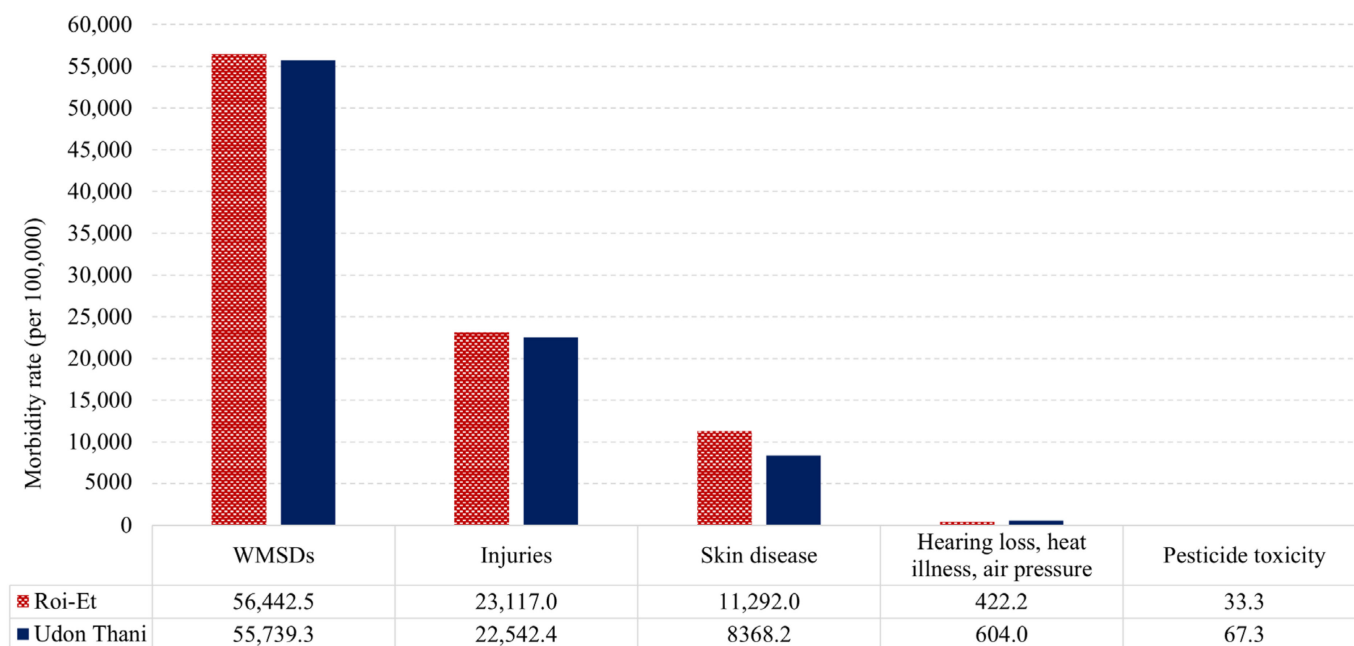


Figure 1. Three-year (2014–2016) morbidity rates (per 100,000) of occupational diseases and injuries among cultivating farmers.

The morbidity rates of diseases in Udon Thani increased from 2014 to 2016, except those of injuries and skin disease, which remained constant during the three-year period (Figure 2). The morbidity rates of diseases in Roi-Et increased from 2014 to 2016, except that of pesticide toxicity, which increased only from 2014 (9.6 per 100,000) to 2015 (14.9 per 100,000) and in 2016, it decreased to a rate lower than that of 2014 (8.7 per 100,000). There was no significant decrease in the morbidity rates of pesticide toxicity between 2014 and 2016 in Roi-Et, but a significant increase was found in Udon Thani from 2014 (13.0 per 100,000) to 2015 (25.3 per 100,000), and 2015 to 2016 (35.6 per 100,000).

At the time of the study, the recording of occupational disease was not mandatory but depended on the decision of hospital management and resources. Work-related disease effects on examination and treatment were not confirmed, for example, in the case of silicosis, it has symptoms similar to tuberculosis (TB), therefore, the report might be missing because it was not confirmed by silica dust exposure in the workplace from stone and sand, or mining or sculpture, or working in the cement industry. Moreover, lung diseases, infectious diseases, and diseases from contact with animals and plant poisoning had not been included in the HDC database of Thailand as types of occupational disease.

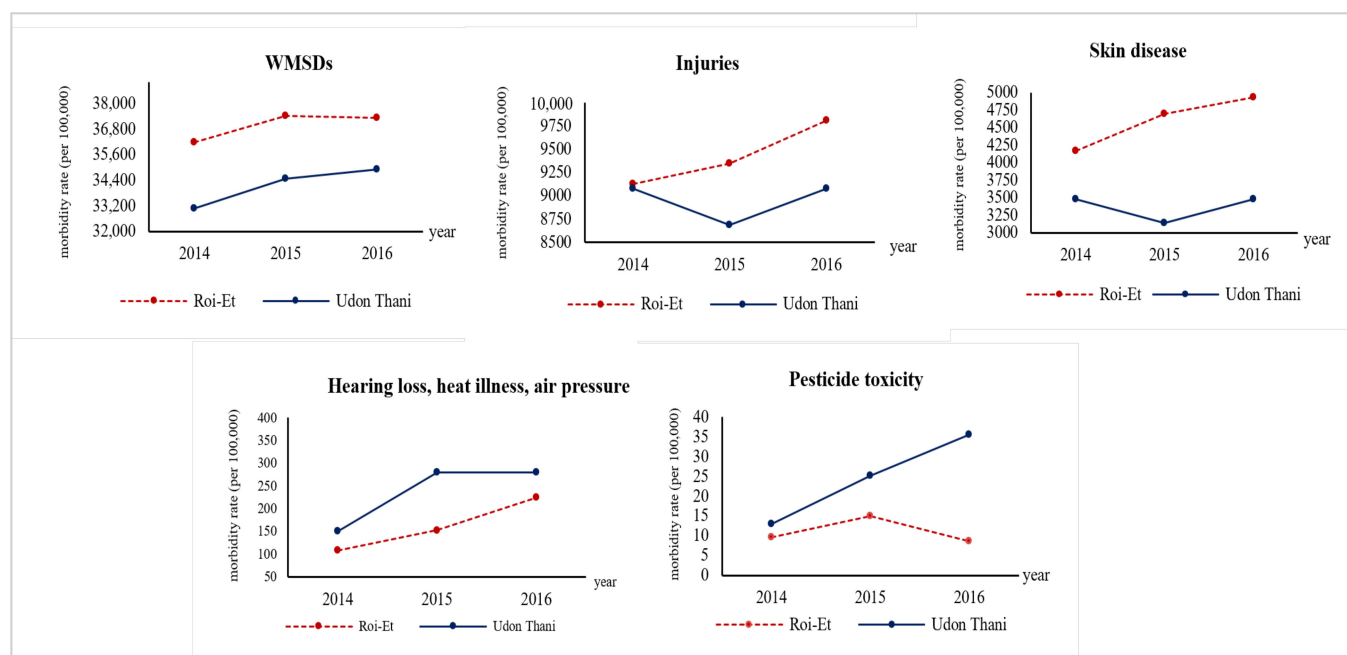


Figure 2. Trends of three-year (2014–2016) morbidity rates (per 100,000) of occupational diseases and injuries among cultivating farmers.

These findings showed a high incidence of occupational diseases in the north-east of Thailand (Figure 3). Morbidity rates of infectious disease and lung disease in Roi-Et were slightly higher than those in Udon Thani. However, the morbidity rate of disease from contact with animals and plant poisoning was lower. The morbidity rates of infectious diseases and lung diseases were the highest of the five main diseases in this group.

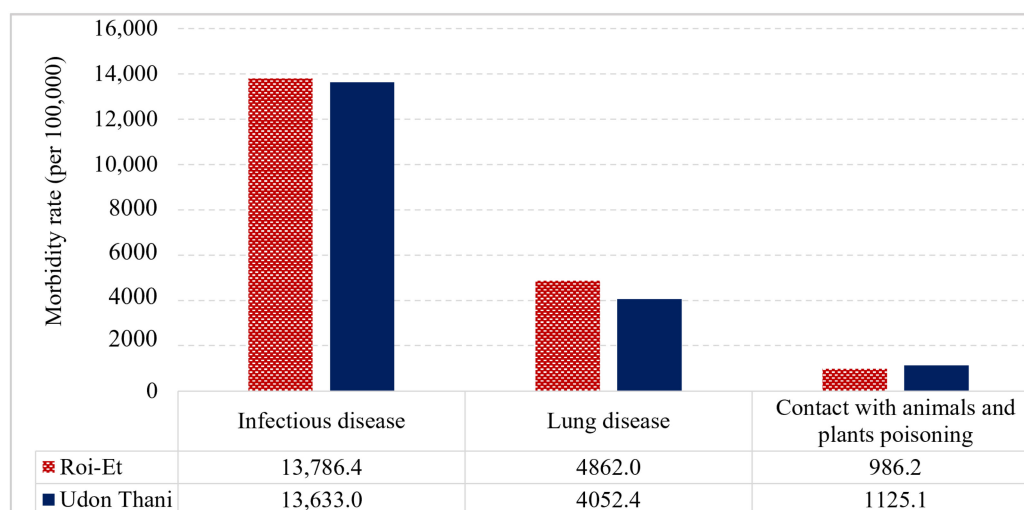


Figure 3. Three-year (2014–2016) morbidity rates (per 100,000) classified according to type of occupational disease among cultivating farmers.

This study found that the three-year (2014–2016) morbidity rates (per 100,000 cultivating farmers) of the disease group comprising toxicity of other chemicals, i.e., (1) organic solvent toxicity, (2) metal toxicity, and (3) toxicity of gases, fumes, and vapours in Roi-Et province were 3.4, 1.5, and 1.0, respectively. The morbidity rates in Udon Thani province were 2.6, 0.7, and <0.1, respectively.

In descending order, the top five morbidity rates of diseases and injuries relating to cultivating activities were those of WMSDs, injuries, infectious disease, skin disease, and lung disease. Almost all the diseases had a higher morbidity rate in Roi-Et province than in Udon Thani, except the groups of disease from contact with animals and plant poisoning, hearing loss, heat illness, air pressure effects, and pesticide toxicity (Table 3).

Table 3. The morbidity rates and 95% CI per 100,000 farmers for occupational diseases in a three-year period (2014–2016).

Disease	Roi-Et (<i>n</i> = 207,465)		Udon Thani (<i>n</i> = 154,478)	
	Rate	95% CI	Rate	95% CI
\$ WMSDs	56,442.5	56,228.8–56,656.0	55,739.3	55,491.2–55,987.2
\$ Injuries	23,117.0	22,935.8–23,299.1	22,542.4	22,334.2–22,751.6
@ Infectious disease	13,786.4	13,638.3–13,935.5	13,633.0	13,462.3–13,805.1
\$ Skin disease	11,292.0	11,156.1–11,428.9	8368.2	8230.6–8507.4
@ Lung disease	4862.0	4769.9–4955.4	4052.4	3954.6–4151.9
, Disease from contact with animals and plant poisoning	986.2	944.1–1029.6	1125.1	1073.1–1178.9
, Hearing loss, heat illness, air pressure effects	422.2	394.8–451.1	604.0	565.9–643.9
, Pesticide toxicity	33.3	25.9–42.1	67.3	55.0–81.6
+ Organic solvent toxicity	3.4	1.4–6.9	2.6	0.7–6.6
+ Metal toxicity	1.5	0.3–4.2	0.7	0.0–3.6
+ Toxicity from gases, fumes, and vapours	1.0	0.1–3.5	<0.01	<0.01–2.4

\$ means a main occupational disease group or injuries. @ means other work-related disease. * means the three-year morbidity rate of this occupational disease was higher in Roi-Et province than in Udon Thani province. + means part of the chemical hazard subset.

Concerning the annual rates between 2014 and 2016, the morbidity rates of those top five diseases and injuries in Roi-Et significantly increased from 2014 to 2016; this was also found in Udon Thani for lung disease as well as for pesticide toxicity (Supplementary Table S1).

4. Discussion

The study found that the highest morbidity rates of occupational diseases in a three-year period (2014–2016), in descending order, were WMSDs, infectious disease, skin disease, and lung disease. This confirms the results of a previous study which found that WMSDs had the highest morbidity rate among field crop farmers [10] and is consistent with the WMSD prevalence among farmers in Pathum Thani, Thailand [18]. In the surveillance report of the morbidity rates of occupational and environmental diseases in 2018, it was found that WMSDs had a morbidity rate of 189.37 per 100,000 persons of the Thai population [17]. Although the morbidity rate of WMSDs in this study, about 50,000 per 100,000 farmers, seems to be much higher than that of the surveillance report of the general Thai population, it strongly points toward being specific to the adverse health problems of cultivating farmers. In addition, the morbidity rate of about 50% is consistent with our previous meta-analysis which showed that WMSDs are the most prevalent occupational health problem among Thai agriculturists [11].

The morbidity rate for WMSDs in Roi-Et is higher than Udon Thani province, according to data from the most current year, 2020 [19]. The WMSDs ICD-10 codes in Table 1 were categorized in Thailand's surveillance system, but they only allow for the knowledge of disease incidence rates and cannot be used to identify the organs that are affected in WMSDs [19]. The previous study showed different types of cultivation led to pain in different body regions. The results showed that the workers on rubber plantations were more likely to feel knee/calf pain (OR = 1.59, 95% CI = 1.05–2.39) and lower limb pain (OR = 1.97, 95% CI = 1.35–2.89) than those who were working on rice and tobacco plantations [20]. These results could explain the higher rate in Roi-Et, where there were more rubber planting farmers in this study than in Udon Thani.

Infectious disease had the second highest incidence among all diseases, which has not yet been observed in the surveillance report of health data on the groups of occupational disease in Thailand [18]. Previous analysis of the health data files of Thai crop farmers found that infectious diseases were in the top three most severe diseases from the high case fatality rate [10]. Leptospirosis, melioidosis, and toxicity from plants and diseases from contact with animals were previously reported in crop farmers [10]. In the same way, it was found that workers were exposed to diseases from contact with animals and plant poisoning as much as they received injuries in the field. This was not only the case in Thailand; a previous study in Poland [21], which corresponded to annual reports in Greece [22], also reported a high incidence of infectious diseases.

However, with regard to the high morbidity rate of injuries, it was not certain whether such injuries occurred during work on farms because the external code specific to the workplace was missing. A previous study showed that insufficient primary healthcare personnel [23] and their lack of understanding with regard to coding occupational disease into the hospital information system with ICD-10 codes during the provision of routine services in the primary care units (PCUs) [14] were an issue. However, in recent years, the proportion of people with easy access to hospital treatment or treatment at PCUs was indicated as 68.55% of the Thai population [24], and the proportion of people accessing the health service had not increased much from the previous years. Therefore, the high incidence of occupational diseases found in this study could not be explained by the reason that health services had become more accessible. Moreover, the total number of cases among registered farmers visiting PCUs or hospitals for healthcare services in Udon Thani was lower than that of Roi-Et province and was far lower than the national rate.

At present, cultivating agriculturists have chances to be exposed to noise and gases, and fumes and vapours from agricultural machinery (water pumps, combine harvesters, and tractors) which is often used as power-saving machinery on farms [25]. This study found that morbidity rates of hearing loss, heat illnesses, and air pressure effects in Udon Thani province were higher than those of Roi-Et province although the number of registered agriculturists of Roi-Et was higher than that of Udon Thani province [2]. Another previous study showed that agriculturists who had work experience with noise exposure was correlated significantly with hearing loss [26]. It is possible that the high morbidity rate of hearing loss in Udon Thani was related with the fact that the number of factories and workers in the industrial sector was higher than in Roi-Et province [26].

In the same way as that of physical hazards, the incidence of pesticide toxicity in Udon Thani province was higher than that of Roi-Et province but not as high as that of other disorders. Pesticide toxicity has been shown to be a potential disease of the agricultural sector of Thailand, and there was a trend of increasing pesticide imports, particularly herbicide imports, during a 5-year period from 2013 to 2017 [16]. The ICD-10 records of pesticide poisoning on the health surveillance system were only coded in the T60 group, as presented in this study, which showed the morbidity rate was underrepresented but likely higher than the rate of the Thai adult population in 2019 (13–17 cases per 100,000 a year) [27]. The previous study of pesticide poisoning reports among farmers showed incomplete records for the secondary codes Y96 and Y97 as well as the external cause X48 which were found in 45.14% and 17.84% of cases, respectively [14]. Moreover, there were key concerns regarding public health personnel being responsible for multiple tasks, without any understanding of pesticide poisoning disease codes, and never having received training for occupational disease recording [14].

However, the acute effects of pesticides could possibly be skin health effects, e.g., infective dermatitis (L303), and lung health effects, e.g., respiratory symptoms due to inhalation of chemicals, including gases and vapours (J68) [28]. This study found that skin and lung diseases had the third and fourth highest morbidity rates of occupational diseases, which might be affected by exposure to all forms of chemicals. Moreover, a previous study in Roi-Et province found that ICD-10 identification and reports on the disease surveillance system with external code Y96 (work-related condition) were missing, as were reports

in severe cases of pesticide poisoning with T-toxicity coding [14,28]. Therefore, pesticide toxicity was shown to be underestimated in regard to occupation, particularly that of cultivating farmer. Thailand's public health policy should include ICD-10 code L (skin disease) and code J (lung diseases) to identify the acute and chronic effects of pesticide toxicity among applicators, as found in the previous case-control study of Thai cultivating farmers in Sakon Nakhon province on pesticide toxicity [28].

Regarding agricultural productivity in the study area, the Office of Agricultural Economics reports cassava, rubber, and rice had the highest productivity between 2016 and 2019 [29]. In comparison to Roi-Et province, Udon Thani province has almost five times the production areas of cassava and Para rubber [29]. This study reveals that Udon Thani has a higher morbidity rate for pesticide poisoning than Roi-Et province. Hence, it is clear that paraquat or glyphosate herbicide must be used continuously to treat the rubber and cassava while it is being harvested. This hypothesis was confirmed by previous study that the morbidity rate of pesticide toxicity by ICD-10 identification was highest in farmers who grew cassava and rubber, respectively [10]. Most intriguingly, it was found that between the years 2014 and 2016, the province of Roi-Et had the fourth-highest tonnage of inland rice production in the country [29]. In comparison to the province of Udon Thani, Roi-Et's in-season rice yield was approximately 2–3 times more productive [29]. This study discovered that the incidence of WMSDs in Roi-Et was also greater than in Udon Thani province, presumably because rice farming requires body exertion in various agricultural activities throughout the year more than farming of other crops, e.g., cassava farming. Moreover, previous study showed that farmers had higher MSDs prevalence rates than the non-farmer in the case-control and cohort studies [30].

This study has the strength of using big data of health from two provincial databases, as previously mentioned, to give a representation of farmers engaged in agricultural activities. Furthermore, the identified cases are linked to the entire farmer population. Although only two provinces were studied, the nature of the impact from agricultural work was found to be not much different from that of other areas. The higher rate of occupational diseases specific to a more cultivating-agriculture-based province, Roi-Et, than that of Udon Thani, from the observation of the five most common health problems, i.e., WMSDs, injuries, and infectious, skin, and lung diseases, could confirm our previous report from the meta-analysis of the occupational disease situation in Thailand [11]. However, this study was conducted prior to legislation of Thailand's Occupational Diseases and Environmental Diseases Control Act B.E. 2562 (2019), which suggests that healthcare providers identify occupational diseases through surveillance. Future research should compare the findings of this study to epidemiological studies currently being conducted among Thai agriculturists.

5. Conclusions

This three-year retrospective cohort study aimed to investigate the incidence of work-related diseases and injuries among cultivating farmers of Roi-Et and Udon Thani provinces, Thailand. The study was conducted among groups of 207,465 and 154,478 cultivating farmers of Roi-Et and Udon Thani provinces, respectively. There were 53,794 (34.82%) total cases who visited PCUs or hospitals for health services in Udon Thani, and 77,438 (37.32%) total cases in Roi-Et. The highest incidence rate was that of work-related musculoskeletal disorders (WMSDs), followed by injuries, infectious disease, skin disease, and lung disease, respectively. All of those effects had a higher rate in Roi-Et province, a more cultivating-agriculture-based province, than in Udon Thani province. These representative morbidity rates confirmed the high incidence of WMSDs and injuries, which are common work-related health problems of workers. Moreover, infectious, lung, and skin diseases were discovered in cultivating farmers. Therefore, the representative incidence of diseases obtained by using big data analysis of the health problems among registered agriculturists could be used to represent the real situation for strategic planning of occupational health services and prevention of diseases by a priority health surveillance program.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/safety8040078/s1>, Table S1: The annual morbidity rates per 100,000 farmers for occupational diseases and injuries from 2014–2016.

Author Contributions: Conceptualization, S.C.; methodology, S.C. and P.S.; validation, S.C. and P.S.; formal analysis, S.C., W.T. and W.P.; investigation, S.C., P.S. and W.T.; resources, S.C. and P.S.; data curation, S.C. and W.T.; writing—original draft preparation, W.P. and S.C.; writing—review and editing, S.C., P.S., W.P., W.T. and T.D.; funding acquisition, S.C.; project administration, S.C. All authors have read and agreed to the published version of the manuscript.

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