KNOWLEDGE, ATTITUDE AND PRACTICE ASSOCIATED WITH CHOLINESTERASE LEVEL IN BLOOD AMONG RICE FARMERS IN CHAINART PROVINCE, THAILAND

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ABSTRACT: Most of pesticide uses in Thailand are insecticides such as organophosphate and carbamate which are acting as cholinesterase inhibitors. Erythrocyte cholinesterase (AChE) is typically used as biomarker of chronic exposure and plasma cholinesterase (PChE) is a short-term indicator. This study was a cross-sectional study using face to face questionnaire and measurement analyzer to quantify AChE and PChE in blood. The objectives of this study were to investigate the association among knowledge, attitude, and practice on pesticide uses and cholinesterase levels in blood of farmers at Nang Ler sub-district in Chainart province, Thailand. Farmers (n= 98) were separated into 2 groups which consisted of directly exposed farmers (n=51) and indirectly exposed farmers (n=47). The directly exposed farmers were defined as the farmers dealt with spraying, mixing and loading pesticide; the indirectly exposed farmers were defined as the farmers involving with growing rice and harvesting rice and particularly, without pesticides applying by themselves. Participants were composed of 44 male and 54 female. Average age (±SD) was 46.0 (±12.3) years old. The results showed that the association between knowledge and practice in directly exposed farmers and indirectly exposed farmers were significant positive correlation with *p-value* < 0.001 (Spearman's rho = 0.412 and 0.662, respectively). Considering in AChE residue, directly exposed farmers had been getting higher risk than indirectly exposed farmers using independent t-test (*p-value* = 0.013). The AChE level was not significantly associated with KAP in both of directly and indirectly farmers. Regarding to indirectly exposed farmers, PChE level was significant positive correlation with knowledge (Spearman's rho 0.538, *p-value* < 0.001). Using Chi-square test, the significant associations were found between PChE level and both of attitude (*p-value* = 0.012) and knowledge (*p-value* = 0.015) in the directly exposed farmers. In conclusion, the directly exposed farmers in the study area may be getting more risk than indirectly exposed farmers according to the statistically lower level of AChE. Directly exposed farmers who had lower attitude level may be increasing more risk associated with PChE level than those who had higher attitude level. On the other hand, indirectly exposed farmers who had lower knowledge level may be getting risk more than those who had higher knowledge level. The further studies should determine the appropriated intervention to increase the knowledge and attitude regarding to the harmful effects of pesticides and proper use of PPE in rice farm.

Keywords: Knowledge attitude and practice (KAP), Organophosphate and carbarmate, Erythrocyte cholinesterase (AChE), Plasma cholinesterase (PChE)

INTRODUCTION

Thailand is considered as an agricultural country despite its expansion of industrial country. In 2009, Thailand has the entire area for rice farming approximately 66 million rising across the country [1]. Agrochemicals i.e. fertilizers and pesticide become a major part of farming in Thailand allowing for increased crop production and income [2]. However, the framework of the operations usually leads to the problems that undermine people's way of living particularly

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health problems.

Organophosphate (OP) and Carbamate insecticides form are the groups of chemicals that are mainly used in agriculture [3]. They are described as being highly acute toxic [4]. Those insecticides have an effect on the nervous system by causing which controls acetylcholine or neurotransmitter [5].

Most of organophosphate or carbamate pesticides inhibited the blood enzymes that called "erythrocyte cholinesterase" (AChE) and/ or "plasma cholinesterase" (PChE). AChE is typically used as biomarker of chronic exposure; plasma cholinesterase (PChE) is a short-term indicator. AChE is basically chosen because its biological variability and destitution of interferences is lower than PChE [6]. There are three main ways of pesticides exposure which were composed of inhalation, dermal, and oral exposure. The farmers as well as the general public will have the possibility of running the risk of gaining exposure to such substances from various forms of exposure such as breath, oral cavity, and skin. By the way they can avoid or decrease the risk of exposure pesticide by using Personal Protective Equipment (PPE) [7]. Therefore, the aims of this research were to evaluate the knowledge, attitude and practice (KAP) of rice farmers on pesticide uses and to assess an association between KAP and level of cholinesterase in farmer's blood.

MATERIALS AND METHODS

A cross-sectional study in March 2013 was conducted on rice farmers in Nang Ler sub-district, Chainart province, Thailand. The purposive sampling technique was used to select the study area (Nang Ler sub-district). Then, the random sampling technique used for select the farmer A total of 98 participants were divided into 2 group i.e. directly exposed farmers (n=51) and indirectly exposed farmers (n=47). The directly exposed farmers were defined as the farmers who worked and used pesticide (sprayed and mixed pesticide by themselves) before blood test around 24 hours; the indirectly exposed farmers were defined as the farmers who worked without spraying and mixing pesticide by themselves before blood test around 24 hours. We should to collected the samples on 24 hours after the end of their exposure because they had lower AChE activities [8]. Current inclusion criteria for the subject's selection included the persons with age between 18 and 65 years with both males and females, and had been working in farm for at least 6 months. And the exclusion criteria were the subjects who were child or pregnant women or the person who had about hepatic disease cardiovascular disease, taking anti-malarial drugs or malnutrition, and taking amphetamine. The questionnaire consisted of the following five categories: (1) socio-demographic characteristics, (2) information regarding pesticide used, (3) knowledge of pesticide used and prevention, (4) attitude of pesticide used and prevention, (5) practice of pesticide used and prevention. The analysis of cholinesterase level in blood was performed using the EQM test-mate Cholinesterase Test System, Model 400 [9].

Data analysis

The score level of KAP was classified into 3 levels as follow: Bloom's Theory [10]:

Score:	Less than 60%	=	Low levels
	60-80%	=	Moderate levels
	81-100%	=	High levels

After measuring the cholinesterase level of farmers, it was interpreted by mean of the continuous scale of cholinesterase level (normal distribution)

AChE

More than 2.92 U/ mL*	=	normal
Less than or equal 2.92 U/mL*	=	abnormal

PChE

More than 1.56 U/mL*	=	normal
Less than or equal 1.56 U/mL*	=	abnormal

* (U/mL reference from Test-mate ChE (Model 400)

This study used SPSS software licensed Chulalongkorn University version 17.0. General characteristics and socio-demographic were described by frequency, percentage, and mean. Independent T-Test was used for determining differentiation between blood cholinesterase levels of direct and indirect exposed farmers. Mann – WhitneyU was used for comparing mean of non-parametric variables, such as age, education years, duration time as farmers, knowledge, attitude, and practice. Spearman's rho correlation was used for testing the association between characteristics and cholinesterase level. Chi – square test was used for testing odds ratios and 95% confidence intervals for the significant variables (knowledge, attitude and practice) of cholinesterase level in blood.

Ethical consideration

The experimental protocol was approved by the Ethics Review Committee for Research Involving Human Research Subjects, Health Sciences Group, Chulalongkorn University with the certified code no.071/2013.

Table 1 Distribution of KAP levels on using pesticide and prevention

Levels	Knowledge (%)			Attitude (%)			Practice (%)		
	Total (n=98)	Direct exposed farmers (n=51)	Indirect exposed farmers (n=47)	Total (n=98)	Direct exposed farmers (n=51)	Indirect exposed farmers (n=47)	Total (n=98)	Direct exposed farmers (n=51)	Indirect exposed farmers (n=47)
High level (81% - 100%)	10.2	13.7	17	8.2	9.8	4.3	8.2	5.9	10.6
Moderate level (60% – 80%)	74.5	76.5	74.5	81.6	78.4	87.2	78.5	74.5	80.9
Low level (Less than 60%)	15.3	9.8	8.5	10.2	11.8	8.5	13.3	19.6	8.5

Table 2 Characteristics between direct exposed farmers and indirect exposed farmers

Characteristics	Direct exposed farmers (n=51)			Indirect exposed farmers (n=47)			*P-value**
	Median	Mean	SD	Median	Mean	SD	
Age	47.00	44.53	13.37	50.00	47.19	10.95	0.344
Education years	6.00	7.27	3.37	6.00	6.64	2.94	0.188
Duration time as farmers	20.00	20.78	13.54	15.00	19.94	15.60	0.562

* Nonparametric, Mann – Whitney U test

RESULTS

The average age (SD) of the participants was 46.0 (±12.3) years old. The majority of the respondents was in the range of 51-60 (31.6%) and 41-50 years old (26.5%), while 18.4% and 14.3% of them were in the range of 31-40 and younger than 30 years old, respectively. And 9.2% of them were older than 60 years old. The participants were 44.9%male and 55.1% female. The study of education level shows that 90.8% of them had been educated, 55.1% had been graduated from primary school, and 24.5% had been graduated from secondary school. Subjects' survey and observation found that, they were involved in transporting pesticides 48%, mixing pesticide 27.6% and spraying pesticide 24.5%. Approximately 80.6% of respondents sprayed pesticides during 9.00 a.m.– 12.00 a.m. Most of participants were 20.4 (±14.5) years old in average.

In this rice farm area, the farmers faced with insect (99.0%), weed (94.9%), and plant disease (77.6%), and animal disease (55.1%). The common agrochemicals used during rice growing were abamectin (85.7%), organophosphate (69.4%), and carbamate (48.0%). Most of participants received information about pesticide from agriculture officer 57.1%, television 48%, and more than 30% from their neighbor and community leader.

Moreover, 50% of the respondents never had symptom related pesticide exposure. About 33.7% of them had reported on few symptoms such as headache, fatigue, dizziness, stomach cramps and throat irritation. While 13.3% of them reported on moderate signs for example, contracted pupils of the eyes, excessive sweating, and salivation. When they had symptom related pesticides exposure, they had medical treatment by health care center, provincial hospital, alternative herbals medicine by themselves, district hospital, and private clinic.

The distribution of the knowledge of the respondents shows that 15.3 % of respondents had "low knowledge level", 74.5% of them had "moderate knowledge level", and 10.2% of them had "high knowledge level" (Table 1). The average knowledge score for all respondents were 11.4 (SD = 1.3) out of a possible 15 points. Table 1 illustrates rice farmers who answered a total of 15 questions with the total score of 75 points. The distribution of residents' attitudes level was shown in Table 1. About 10.2% of them had "not concern attitude", 81.6% of them had "moderate attitude", while there was 8% of farmers who had "concern attitude". The average attitude score for all respondents were 54.9 (SD = 5.3) out of a possible 60 points. Table 1 illustrates the respondents that answered a total of 23 questions. The distribution of respondents' practice shows that, there were 8.2% of respondents who had "good practice", 78.5% of them had "fair practice" and 13.3% of respondents had "poor practice". The average practice score for all respondents were 60.7 (SD = 4.9) out of a possible 69 points.

The average age (SD) of the direct exposed farmers and indirect exposed farmers were 47.0 (±13.37) years old and 50.0 (±10.95) years old, respectively. The study of education years shows that the average education years of both direct exposed farmers and indirect exposed farmers were

Table 3 KAP between direct exposed farmers and indirect exposed farmers

Variables	Direct exposed farmers (n=51)			Indirect exposed farmers (n=47)			*P-value**
	Median	Mean	SD	Median	Mean	SD	
Knowledge	12.00	11.35	1.28	11.00	11.43	1.32	0.941
Attitude	54.00	54.06	5.36	58.00	55.74	5.08	0.079
Practice	62.00	59.90	5.42	62.00	61.55	4.09	0.171

* Non – parametric, Mann – Whitney U test

Table 4 Percentages and comparision of cholinesterase level of the respondents (n = 98)

Cholinesterase level	Number	Percentage (%)
AChE		
All (n=98)		
Normal	74	75.5
Risk	24	24.5
Direct exposed farmer (n = 51)		
Normal	31	60.8
Risk	20	39.2
Indirect exposed farmers (n=47)		
Normal	43	91.5
Risk	4	8.5
* Mean comparison of AChE residue in blood between direct and indirect exposed farmer : *p-value* = 0.001		
PChE		
All (n=98)		
Normal	86	87.8
Risk	12	12.2
Direct exposed farmer (n = 51)		
Normal	44	86.3
Risk	7	13.7
Indirect exposed farmers (n=47)		
Normal	42	89.4
Risk	5	10.6
* Mean comparison of PChE residue in blood between direct and indirect exposed farmer : *p-value* = 0.145		

* Parametric, Independent t-test

6 years. Subjects' survey and observation found that, duration time as farmers of both direct exposed farmers and indirect exposed farmers were 20.0 (±13.54) years old and 15.0(±15.60) years old in average, respectively (Table 2, 3).

About the differences of characteristics (age, education years, duration time as farmers, knowledge, attitude, and practice) between both farmers was shown that among of characteristics of directly and indirectly exposed farmers were not significantly different (Mann – Whitney U test, *P-value* > 0.05) (Table 4 and 5).

Moving forward, Table 4 shows AChE and PChE levels in both directly and indirectly exposed farmers. For AChE residue in blood, it shows that 75.5% of total participants had normal AChE level (> 50% Normal). 60.8% of the directly exposed farmers were not at risk and 91.5% of the indirectly exposed farmers had normal level of AChE. The average AChE residue (± SD) for all respondents were 2.9 ± 0.6 U/mL. The average of AChE residue between directly exposed farmers (2.7 ± 0.6 U/mL) and indirectly exposed farmers (3.1 ± 0.6 U/mL) was significantly different (independent t-test, *p-value* = 0.001). Regarding to PChE residue, it shows that, 87.8% of total participants had normal PChE level. 86.3% of directly exposed farmers were not at risk and 89.4% of the indirectly exposed farmers had normal PChE level, as well. The average PChE residue (± SD) for all respondents was 1.6 ± 0.3 U/mL. The average residue of AChE between directly exposed farmers (1.5 ± 0.3 U/mL) and indirectly exposed farmers (1.7 ± 0.3 U/mL) was not significantly different (independent t-test, *p-value* = 0.145).

The result shows that the association between knowledge and practice in directly exposed farmers and indirectly exposed farmers was significantly moderate positive correlation (Spearman's rho 0.412 and 0.662, *P-value* < 0.001).

Table 5 illustrates the AChE levels of both directly and indirectly exposed farmers were not

Table 5 Odds ratios and 95% confidence intervals of knowledge, attitude, and practice of cholinesterase level in blood of direct exposed farmers and indirect exposed farmers

Type of farmers	Variables	AChE				PChE			
		X^2	*P-value*	OR	95% CI	X^2	*P-value*	OR	95% CI
Direct exposed farmers (High risk and low risk)	Knowledge	0.489	0.484	1.513	0.473,4.836	1.343	0.246	2.078	0.597,7.236
	Attitude	3.063	0.080	2.840	0.868,9.289	6.356	0.012*	4.813	1.360,17.051
	Practice	0.110	0.741	1.213	0.386,3.813	0.544	0.461	1.574	0.469,5.278
Indirect exposed farmers (High risk and low risk)	Knowledge	0.339	0.560	1.429	0.429,4.753	5.880	0.015*	6.667	1.269,35.035
	Attitude	3.245	0.072	3.094	0.887,10.795	0.056	0.813	0.846	0.212,3.371
	Practice	0.221	0.638	1.333	0.402,4.428	0.05	0.943	0.952	0.252,3.596

* There was significant at the 0.05

significantly associated with KAP. However, the indirectly exposed farmer's PChE level has significantly positive correlation with knowledge (Spearman's rho 0.538, *P-value* < 0.001). Regarding PChE level, attitude of directly exposed farmers were significant (chi – square test, OR = 4.813 (1.3809, 17.051), *p-value* = 0.012), and knowledge of the indirectly exposed farmers were significantly associated (chi – square test, OR = 6.667 (1.269, 35.035), *p-value* = 0.015).

DISCUSSION

In general, there was a significant difference of pesticide uses between male and female [11]. The average age of the participants was 46 years which was similarly to the study of Raksanam [12]; the average age of the participants was 45 years. Approximately 60% of the participants applied pesticides for more than 10 years. Similarly to the study of Un Mei Pan, they reported that the average working years with pesticide uses was 19.2 years [13]. Most of the participants had educated in primary school which was similarly to the study of Raksanam [12]; more than 50% of the rice farmers in the central of Thailand had educated in primary school.

General pesticide uses were abamectin, organophosphate (such as chlorpyrifos), carbamate (such as carbosunfan, carbofuran). The study of Raksanam [12] also supported that the popular pesticides used in rice farms were abamectin, organophosphate, carbamate because most of the rice farms in this area were faced with the several pests i.e. insect and plant louses. Similarly to the study of Sematong [14], they found that most of the farmers used pesticides in their farming activity; the common uses were herbicides and insecticides particularly chlopyrifos. Most farmers were received general information of pesticide from the agricultural officers. The study in chilli farm at Ubonrachathani province, Thailand [15] also revealed that most of the farmers received general information of pesticide from the agricultural officers. The farmers had closely relationship with agricultural officer in this area; therefore, the information of pesticide was easy to assess. Considering the symptoms related to the pesticides exposure in this study, most of the participants never had toxicity symptom; they were provided their health by health center. There was similarly in the study in Ubonrachathani province, Thailand [15]; the farmers provided themselves by health center and more than of 50% of the farmers never had toxicity of symptom. In this area, health center is the source of information which was convenient and accessible for the farmers.

There was significantly different in the average of AChE residue between directly exposed farmers and indirectly exposed farmers using independent t-test (*p-value* = 0.001); the higher risk was found in the directly exposed farmers more than the indirectly exposed farmer. Similarly to the study of Simoniello's et al. [16], they compared AChE level between the directly and the indirectly exposed farmers and found that directly exposed famers had many ways of pesticides exposure. The turnover rate for red blood cells is slow (about 3 months), and AChE measurements reflect this slow replacement rate [5]. The pesticide products can be splashed or spilled to contact skin during the pouring and mixing process and pesticide; the spray or dust can contaminate to expose skin or clothing. The average of PChE residue between directly exposed farmers and indirectly exposed farmers were not significantly different (*p-value* = 0.145). There was similarly in the research of Carbonell [17]; the PChE level in the agricultural workers group during the period of major exposure with respect to the period of minor exposure, these concentration residues were not significantly different when compared with the average level in the pooled control. PChE turnover is much quicker.

PChE is a better short-term indicator due to its more rapid response to exposure [5].

Regarding to the indirectly exposed farmers, the association between AChE level and age, and AChE level and duration time as farmers were significant negative correlation (Spearman's rho correlation= -0.415 and -0.683, respectively). In addition, the younger age and lower exposed duration time as farmers had higher AChE level than older age and higher duration time as farmers. There was a similarity with the study in the Rangsit agricultural area [13]; years of pesticide exposure increased the higher risk of abnormal AChE level. The associations between PChE level and knowledge of indirectly exposed farmers was significant positive correlation (Spearman's rho correlation= 0.538). The farmers with higher knowledge increased the PChE level more than the farmers with lower knowledge. The association between AChE level and KAP of indirectly exposed farmers and directly exposed farmers were not significant. In addition, the attitude of directly exposed farmers were significantly using chi – square test (OR = 4.813); the lower attitude increased the higher risk of abnormal PChE level about 4.8 times more than the higher attitude. Considering the knowledge of indirectly exposed farmers, there were significant using chi – square test (OR = 6.667); the lower knowledge increased the higher risk of abnormal PChE level about 6.7 times more than the higher knowledge.

CONCLUSION

This study cloud be summarized that the directly exposed farmers in the study area are likely to get higher risk on AChE level than indirectly exposed farmers. The directly exposed farmers who have lower attitude are likely to get higher risk on PChE than higher attitude ones. And indirectly exposed farmers who have lower knowledge are likely to get higher risk than higher knowledge ones.

The further studies should be emphasized on how to reduce exposure of health effects uwith an appropriate prevention; the intervention to increase the knowledge regarding harmful effects of pesticides and the proper use of PPE in farm were required.

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REFERANCES

1. Office of Agricultural Economics. Land use for agricultural purpose of Thailand at national, regional, provincial levels in the year 2009. [cited 2012 September 1]. Available from:http://www.oae.go.th/download/use_soilNew/article_soil2552.html.
2. Wongwichit D, Siriwong W, Robson MG. Herbicide exposure to maize farmers in Northern, Thailand: Knowledge, attitude, and practices. Asia Pacific Conference on Environmental Science and Technology Advances in Biomedical Engineering. 2012: 6.
3. Jaga K, Dharmani C. Sources of exposure to and public health implications of organophosphate pesticides. Rev Panam Salud Publica. 2003 Sep; 14(3): 171-85.
4. Zou MQ, Yang R, Wang DN, Li JF, Jin QH. A novel immobilized cholinesterase for on-site screening of organophosphate and carbamate compounds. Pestic Biochem Physiol. 2006; 86: 162–66.
5. John RJP, Wickremasinghe R. Impact of low-level exposure to organophosphates on human reproduction and survival. Trans R Soc Trop Med Hyg. 2008 Mar; 102(3): 239-45. doi: 10.1016/j.trstmh.2007.11.012.
6. Brown AE, Miller M, Keifer M. Cholinesterase monitoring: a guide for the health professional. Pesticide Information Leaflet. 2006: 30.
7. Occupational Safety and Health Administration [OSHA]. Personal protective equipment. OSHA Fact Sheet. OSHA; 2006.
8. Mason HJ. The recovery of plasma cholinesterase and erythrocyte acetylcholinesterase activity in workers after over-exposure to dichlorvos. Occup Med (Lond) 2000; 50(5): 343–7.
9. EQM Research, Inc. Test-mate ChE Cholinesterase Test System (Model 400). Instruction Manual. EQM Research; 2003.
10. Bloom BS. taxonomy of educational objectives: handbook 1 cognitive domain. London: Longman; 1956.
11. Atreya K. Pesticide use knowledge and practices: a gender difference in Nepal. Environmental Research 2007; 104: 305-31.
12. Raksanam B, Taneepanichskul S, Robson MG, Siriwong W. Health Risk Behaviors Associated With Agrochemical Exposure Among Rice Farmers in a Rural Community, Thailand: A Community-Based Ethnography. Asia Pac J Public Health. 2012 Nov 20; Article in press.
13. Pan UM, Siriwong W. Risk assessment for dermal exposure of organophosphate pesticides in rice-growing farmers at Rangsit agricultural area, Pathumthani Province, Central Thailand. J Health Res. 2010; 24: 141–8.
14. Sematong S, Zapumg K, Ktana N. Pesticide use, farmer knowledge and awareness in Thong Pha Phurn region, Kanchanaburi Province. J Health Res. 2008; 22(1): 15-20.
15. Norkaew S, Siriwong W, Siripattanakul S, Robson M.

Knowledge, attitude, and practice (KAP) of using personal protective equipment (PPE) for chilli – growing farmers in Huarua sub-district, Mueang district, Ubonrachathani Province, Thailand. J Health Res. 2010; 24(Suppl 2): 93- 100.

16. Simoniello MF, Kleinsorge EC, Scagnetti JA, Mastandrea C, Grigolato RA, Paonessa AM, et al. Biomarkers of cellular reaction to pesticide exposure in a rural population. Biomarkers. 2010 Feb; 15(1): 52-60. doi: 10.3109/13547500903276378
17. Carbonell E, Valbuena A, Xamena N, Creus A, Marcos R. Temporary variations in chromosomal aberrations in a group of agricultural workers exposed to pesticides. Mutat Res. 1995 Oct; 344(3-4): 127-34.