

DIFFERENCES IN PRACTICES OF HANDLING ORGANOPHOSPHATE PESTICIDES (OPS) AND OPS-RELATED SYMPTOMS BETWEEN INDONESIAN AND SOUTH AUSTRALIAN MIGRANT FARMWORKERS: PRE AND POST EDUCATIONAL INTERVENTION

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INTRODUCTION

Organophosphate pesticides (OPs)-related symptoms have been investigated in both developing and developed countries. In developing countries, a study by Kishi, et al. [1] in Indonesia found that 21% of 204 OP sprayers in Tegal and Brebes Regency had at least four symptoms related to OPs exposure, including neurobehavioral, gastrointestinal, and respiratory symptoms. Similarly, Dasgupta, et al. [2] in the Mekong Delta in Vietnam reported that all 190 farmworkers assessed had some symptoms after mixing and spraying OPs. These symptoms consisted of skin irritation (66%), headache (61%), dizziness (49%), eye irritation (56%), and shortness of breath (44%). Rajashekhara, et al. [3] found that 25% of 76 patients working as agricultural workers and admitted to Jawaharlal Nehru Medical College were suffering from congested conjunctiva (87%), pin point pupil (83%), lacrimation (80%), vomiting (78%), non-reactive pupil (75%), respiratory distress (60%), and abdominal pain (37%). In developed countries, a study conducted by Strong, et al. [4] in eastern Washington State, (U.S.) among 211 farmworkers showed that the most common symptoms due to OPs exposure reported by the participants were: headaches (50%), burning eyes (39%), pain in muscles, joints, or bones (35%), a rash or itchy skin (25%), and blurred vision (23%). Johnstone [5] in Australia, assessing 50 farmworkers found that headache (2%), fatigue (3.9%), and watery eyes (3.9%) were the most frequently experienced symptoms reported by farmworkers due to OPs exposure.

Field practices like mixing and spraying pesticides, use of personal protective equipment (PPE), washing hands or

BACKGROUND: The aim of this study was to describe the differences of field practices in handling OPs and the prevalence of OPs-related symptoms among Indonesian and South Australian (SA) migrant farmworkers between pre and post educational intervention.

METHOD: This was a quasi-experimental study. Thirty Indonesian farmworkers at Dukuhlo Village, Brebes Regency, Indonesia, were provided the educational intervention using a method of group communication whereas seven migrant farmworkers in Virginia, South Australia were provided the educational intervention individually. Data were collected by interview using a structured questionnaire.

RESULTS: Some significantly behavioural improvements ($p < 0.05$) in handling OPs as the result of the intervention occurred among Indonesian farmworkers as follows: 1) proportions of farmworkers who touching crops after OPs application dramatically decreased from 63% in pre intervention to 17% in post intervention; 2) proportions of farmworkers who spraying OPs against wind direction sharply declined from 60% in pre intervention to 30% in post intervention; 3) proportions of farmworkers who avoiding spray drift when applying OPs dramatically rose from 47% in pre intervention to 97% in post intervention; 4) proportions of farmworkers who ensuring to not affect other people by over applied spray drift when applying OPs sharply increased from 53% in pre intervention to 93% in post intervention; and 5) proportions of farmworkers who suffering from OPs-related symptoms slightly decreased from 67% in pre intervention to 63% in post intervention. On the other hand, generally, field practices of SA migrant farmworkers in post educational intervention remained constant as they did in pre intervention.

CONCLUSION: Provision of appropriate equipment and long-term educational intervention linked to workplace was needed to improve their knowledge, perceptions, and work practices to reducing adverse effects due to OPs exposure.

Keywords: educational intervention; field practices; organophosphate pesticides-related symptoms, Indonesian farmworkers, South Australian migrant farmworkers

taking a shower after applying OPs, wearing contaminated clothes, eating, drinking and smoking during working with OP compounds were the most common factors contributing to OPs exposure among farmworkers in developing and developed countries [6].

This study was conducted to further understand the results of a study by Suratman, et al. [7] among 30 Indonesian farmworkers and 7 SA migrant farmworkers that reported knowledge and perceptions of OPs exposure among farmworkers in both countries. Comparisons of field practices in handling OPs and the prevalence of OPs-related symptoms among farmworkers in both countries between pre and post educational intervention had not been previously investigated. Here we present results of a comparison of field practices in handling OPs and the prevalence of OPs-related symptoms among Indonesian

and SA migrant farmworkers, pre and post educational intervention. The educational intervention (described in detail in Suratman, et al. [7] in review) was a short (one hour) delivery of information using group approach for Indonesian farmworkers and individual approach for SA migrant farmworkers relating to pesticide exposure, including definition of pesticides, groups of pesticides, pathways of OPs exposure at workplace and at home, adverse health effects of OPs exposure, signs and symptoms of acute and chronic effects due to OPs exposure, self-protection from OPs exposure at workplace, self-protection from OPs exposure at home, personal protective equipment (PPE), and first aid when exposed to OP exposure.

METHODS

Study population

This was a quasi-experimental study conducted in two research sites, Virginia, South Australia, Australia from May 2014 to June 2014 (pre educational intervention) and from September 2014 to October 2014 (post educational intervention); and at Dukuhlo Village, Brebes Regency, Central Java province, Indonesia from July 2014 to August 2014 (pre educational intervention) and from November 2014 to December 2014 (post educational intervention). Inclusion criteria of population were: 1) male; and 2) had to be employed in farm work within the past 3 months. Ethics approvals were obtained from Southern Adelaide Clinical Human Research Ethics Committee (SACHREC) with approval number: 319.13 and from Commission on Health Research Ethics, Faculty of Public Health, Diponegoro University, Semarang, Indonesia with approval number: 183/EC/FKM/2013.

Brebes Regency in Indonesia and Virginia in South Australia in this study were chosen as study sites conducted by Suratman, et al.[7]. Thirty Indonesian farmworkers and seven SA migrant farmworkers involved in this study were the same as the research participants in a study conducted by Suratman, et al. [7]. The ethnicity of the SA migrant farmworkers is Vietnamese.

Research questionnaire instrument

Data collection used an interviewer-administered questionnaire. The questionnaire was written in English and Indonesian. Previous similar research was used to develop the questionnaire. Additional questions were constructed based on the following literature: Workplace Health and Safety Queensland [8]; and other studies [5, 9-14]. The questionnaire consisted of: 1) activities associated with OPs application as assessed by 5 closed-ended questions; 2) methods of OPs application as assessed by 10 close-ended questions; 3) types of PPE usually worn when working with OPs as assessed by 6 closed-ended questions; 4) personal hygiene behaviour when working with OPs as assessed by 4 close-ended questions; 5) types of packaging and active ingredients of OPs products as assessed by 2 close-

ended questions and 1 open-ended question; 6) workplace conditions as assessed by 9 close-ended questions; 7) OPs-related symptoms as assessed by 16 symptoms questions.

Thirty Indonesian farmworkers were provided the intervention using a method of group communication whereas seven SA migrant farmworkers were provided the intervention individually. The intervention program in each group lasted for one hour. The provided educational intervention covered the following: 1) definition of pesticides; 2) groups of pesticides; 3) pathways of OPs exposure at workplace and at home; 4) adverse health effects of OPs exposure; 5) signs and symptoms of acute and chronic effects due to OPs exposure; 6) self-protection from OPs exposure at workplace; 7) self-protection from OPs exposure at home; 8) personal protective equipment (PPE); and 9) first aid when exposed to OP exposure. Greater detail about study sites, study participants, and the contents of the educational intervention is presented in Suratman, et al. [7].

Data collection

The questionnaire was administered by an interviewer, face-to-face. This method was selected to obtain more accurate and complete answers, as the interviewer could clarify questions and responses at the same time. In South Australia, data collection was conducted from May to June 2014 for pre-intervention measurements and from September to October 2014 for post-intervention measurements. In Indonesia, data collection was conducted from July to August 2014 for pre-intervention measurements and from November to December 2014 for post-intervention measurements.

Data analysis

Data were analysed using the statistical package SPSS. Categorical data were expressed as frequencies and proportions and were analysed using McNemar Test [15].

RESULTS

Activities associated with OPs application

Table 1 presents activities associated with OPs application by Indonesian and SA migrant farmworkers between pre and post educational intervention. Generally, both groups did not differ in terms of the activities relating to OPs application between two measurements.

Methods of OPs application

Some methods of OPs application among Indonesian and SA migrant farmworkers are presented in Table 2. Indonesian farmworkers usually used backpack sprayer to apply OPs to their crops (100%) in both measurements, poured OPs into the application tank using equipment such as bucket, dipper, cup, tablespoon, and trowel (90%), and used equipment to stir the mixture when mixing OPs such as dipper, tablespoon, and trowel (97%). On the other hand, a large majority of SA migrant farmworkers

Table 1 - Activities associated with OPs application by Indonesian and SA Migrant Farmworkers

Activity	Indonesian farmworkers (n=30)		SA migrant farmworkers (n=7)	
	Pre	Post	Pre	Post
I personally mixed OPs for farm purposes in the last three months:				
- Yes	30 (100%)	22 (73%)	7 (100%)	7 (100%)
- No	0 (0%)	8 (27%)	0 (0%)	0 (0%)
I personally loaded pesticides for farm purposes in the last three months:				
- Yes	30 (100%)	22 (73%)	4 (57%)	4 (57%)
- No	0 (0%)	8 (27%)	3 (43%)	3 (43%)
I personally sprayed crops in the last three months:				
- Yes	30 (100%)	21 (70%)	5 (71%)	5 (71%)
- No	0 (0%)	9 (30%)	2 (29%)	2 (29%)
I touched crops or plants after pesticides had been applied in the last three months: *)				
- Yes	19 (63%)	5 (17%)	3 (43%)	3 (43%)
- No	11 (37%)	25 (83%)	4 (57%)	4 (57%)
I rode equipment, such as a tractor or harvester for farm purposes in the last three months:				
- Yes	9 (30%)	0 (0%)	4 (57%)	4 (57%)
- No	21 (70%)	30 (100%)	3 (43%)	3 (43%)

*) Statistically significant among Indonesian farmworkers ($p < 0.05$)

Table 2 - Methods of OPs application by Indonesian and SA Migrant Farmworkers

Activity	Indonesian farmworkers (n=30)		SA migrant farmworkers (n=7)	
	Pre	Post	Pre	Post
Methods usually used for applying OPs to crops				
- Distribute granules	1 (3%)	0 (0%)	0 (0%)	0 (0%)
- Backpack sprayer	30 (100%)	30 (100%)	0 (0%)	0 (0%)
- Hand spray gun	0 (0%)	0 (0%)	6 (86%)	6 (86%)
Ways to pour the chemicals into the application tank when mixing OPs				
- Pour into tank by hand	3 (10%)	6 (20%)	5 (71%)	5 (71%)
- Other	27 (90%)	24 (80%)	2 (29%)	2 (29%)
Kind of equipment usually used to stir the mixture when mixing OPs				
- Hand/Arm	1 (3%)	0 (0%)	3 (43%)	3 (43%)
- Stick/Paddle	0 (0%)	1 (3%)	3 (43%)	3 (43%)
- Automatic Stir	0 (0%)	0 (0%)	1 (14%)	1 (14%)
- Other	29 (97%)	29 (97%)	0 (0%)	0 (0%)
Used a towing vehicle, such as tractor, trailer, or truck when applying OPs				
- Yes	1 (3%)	0 (0%)	2 (29%)	2 (29%)
- No	29 (97%)	30 (100%)	5 (71%)	5 (71%)
Spraying OPs on crops				
- Yes	30 (100%)	30 (100%)	7 (100%)	7 (100%)
- No	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Ways to spray OPs on crops *)				
- Wind direction	12 (40%)	21 (70%)	7 (100%)	7 (100%)
- Against wind direction	18 (60%)	9 (30%)	0 (0%)	0 (0%)
Avoiding spray drift when applying OPs *)				
- Yes	14 (47%)	29 (97%)	6 (86%)	6 (86%)
- No	16 (53%)	1 (3%)	1 (14%)	1 (14%)
Ensuring to not affect other people by over applied spray drift when applying OPs *)				
- Yes	16 (53%)	28 (93%)	6 (86%)	6 (86%)
- No	14 (47%)	2 (7%)	1 (14%)	1 (14%)

*) Statistically significant among Indonesian farmworkers ($p < 0.05$)

reported the use of hand spray gun (86%) to apply OPs, used their hands to pour the chemicals into tank (71%), and used their hands/arms (43%) and stick/paddle (43%) to stir in both measurements.

Meanwhile, nearly all (97%) of Indonesian farmworkers did not ride on equipment when applying OPs in pre inter-

vention and all Indonesian farmworkers did not ride on equipment when applying OPs in post intervention. In contrast, 29% of SA migrant farmworkers rode a towing vehicle for applying OPs in both measurements. All research participants in both groups (100%) sprayed OPs on their crops in both pre and post intervention. More

Table 3 - Types of PPE usually worn by Indonesian and SA Migrant Farmworkers when working with OPs

Types of PPE	Indonesian farmworkers (n=30)		SA migrant farmworkers (n=7)	
	Pre	Post	Pre	Post
Clothes:				
- Long sleeved shirt	26 (87%)	30 (100%)	0 (0%)	0 (0%)
- Short sleeved shirt	0 (0%)	0 (0%)	0 (0%)	0 (0%)
- Coveralls	0 (0%)	0 (0%)	1 (14%)	1 (14%)
- Long pants/Leg covering	13 (43%)	15 (50%)	3 (43%)	3 (43%)
- Shorts	17 (30%)	4 (13%)	7 (100%)	7 (100%)
Headwear:				
- Wide brim hat	18 (60%)	1 (3%)	1 (14%)	1 (14%)
- Cap	12 (40%)	29 (97%)	6 (86%)	6 (86%)
Footwear:				
- Chemically resistant boots or shoes	0 (0%)	0 (0%)	2 (29%)	2 (29%)
- Waterproof boots	0 (0%)	0 (0%)	5 (71%)	5 (71%)
- Sneaker	0 (0%)	0 (0%)	0 (0%)	0 (0%)
- No shoes	30 (100%)	30 (100%)	0 (0%)	0 (0%)
Mask:				
- Gas mask, Cartridge mask	0 (0%)	0 (0%)	5 (71%)	5 (71%)
- A filtering facepiece	2 (7%)	1 (3%)	1 (14%)	1 (14%)
- Other mask/respirators	3 (10%)	1 (3%)	1 (14%)	1 (14%)
- No mask	25 (83%)	28 (93%)	0 (0%)	0 (0%)
Gloves:				
- Leather gloves	0 (0%)	0 (0%)	2 (29%)	2 (29%)
- Waterproof elbow length gloves	0 (0%)	0 (0%)	0 (0%)	0 (0%)
- Waterproof gloves	0 (0%)	1 (3%)	1 (14%)	1 (14%)
- Other types of gloves	2 (7%)	1 (3%)	2 (29%)	2 (29%)
- No gloves	28 (93%)	28 (93%)	2 (29%)	2 (29%)
Eye protections:				
- Safety glasses	1 (3%)	0 (0%)	5 (71%)	5 (71%)
- A face shield	0 (0%)	0 (0%)	0 (0%)	0 (0%)
- Chemical goggles	0 (0%)	0 (0%)	0 (0%)	0 (0%)
- Other types of eye protections	0 (0%)	0 (0%)	0 (0%)	0 (0%)
- No eye protection	29 (97%)	30 (100%)	2 (29%)	2 (29%)

than 50% of Indonesian farmworkers were against wind direction when spraying OPs in preintervention, whereas only 30% of them were upwind when spraying OPs in post intervention. On the other hand, all SA migrant farmworkers (100%) sprayed OPs following wind direction in both measurements. More than 50% of Indonesian farmworkers did not avoid spray drift when spraying OPs in pre intervention, whereas only 3% of them did not avoid spray drift when spraying OPs in post intervention. Approximately 47% of Indonesian farmworkers did not ensure that other people were not affected by applied spray drift, whereas in post intervention, only 7% of them did not ensure that other people were not affected by applied spray drift. In contrast, a large majority of SA migrant farmworkers (86%) avoided spray drift and also ensured that other people were not affected by spray drift in both pre and post intervention.

Types of PPE usually worn when working with OPs

Types of PPE usually worn by farmworkers during working with OPs in pre and post educational intervention are shown in Table 3. In pre intervention, most of Indonesian farmworkers reported usually wearing long sleeved shirt (87%), wearing wide brim hat (60%), not wearing footwear (100%), not wearing mask (83%), not wear-

ing gloves (93%), and not wearing eye protection (97%) when working with OPs. In post intervention, most of Indonesian farmworkers reported usually wearing long sleeved shirt (100%), wearing cap (97%), not wearing footwear (100%), not wearing mask (93%), not wearing gloves (93%), and not wearing eye protection (100%) when working with OPs. Meanwhile, most of SA migrant farmworkers in pre and post intervention reported usually wearing shorts (100%), cap (86%), waterproof boots (71%), gas mask or cartridge mask (71%), leather gloves (29%), and safety glasses (71%) during working with OPs.

Personal hygiene behaviour when working with OPs

Table 4 presents personal hygiene behaviour by Indonesian and SA migrant farmworkers when working with OPs in pre and post educational intervention. Most Indonesian farmworkers (80%) reported always washing their hands using clean water and soap before eating in

pre intervention and it increased to be 100% in post intervention measurement. In contrast, all SA migrant farmworkers (100%) reported always washing their hands using clean water and soap before eating in both measurements. Similarly, most of the research participants among Indonesian farmworkers (90%) reported always washing their hands after work using clean water and soap before touching regular clothes in pre intervention and it increased to be 97% in post intervention. On the other hand, most of SA migrant farmworkers (86%) reported always washing their hands after work using clean water and soap before touching regular clothes in both measurements.

The proportion of Indonesian farmworkers always taking a shower immediately after work increased from 87% in pre intervention to 100% in post intervention. In contrast, the proportion of its activity remained constant among SA migrant farmworkers in both measurements (57%). The proportion of Indonesian farmworkers never

wearing the same clothes more than one day without washing them increased from 20% in pre intervention to 37% in post intervention. In contrast, the proportion of its activity remained constant among SA migrant farmworkers in both measurements (71%).

Table 4 - Personal hygiene behaviour of Indonesian and SA Migrant Farmworkers when working with OPs

Activity	Indonesian farmworkers (n=30)		SA migrant farmworkers (n=7)	
	Pre	Post	Pre	Post
How often do you wash your hands after work using clean water and soap before eating?				
- Always	24 (80%)	30 (100%)	7 (100%)	7 (100%)
- Usually	0 (0%)	0 (0%)	0 (0%)	0 (0%)
- Sometimes	6 (20%)	0 (0%)	0 (0%)	0 (0%)
- Never	0 (0%)	0 (0%)	0 (0%)	0 (0%)
How often do you wash your hands after work using clean water and soap before touching regular clothes?				
- Always	27 (90%)	29 (97%)	6 (86%)	6 (86%)
- Usually	0 (0%)	1 (3%)	0 (0%)	1 (14%)
- Sometimes	2 (7%)	0 (0%)	1 (14%)	0 (0%)
- Never	1 (3%)	0 (0%)	0 (0%)	0 (0%)
How often do you take a shower immediately after work?				
- Always	26 (87%)	30 (100%)	4 (57%)	4 (57%)
- Usually	0 (0%)	0 (0%)	1 (14%)	1 (14%)
- Sometimes	4 (13%)	0 (0%)	0 (0%)	0 (0%)
- Never	0 (0%)	0 (0%)	2 (29%)	2 (29%)
How often do you wear the same clothes more than one day without washing them?				
- Always	24 (80%)	12 (40%)	2 (29%)	1 (14%)
- Usually	0 (0%)	0 (0%)	0 (0%)	0 (0%)
- Sometimes	0 (0%)	7 (23%)	0 (0%)	1 (14%)
- Never	6 (20%)	11 (37%)	5 (71%)	5 (71%)

Table 5 - Types and active ingredients of OPs products used by Indonesian and SA Migrant Farmworkers

Type and Active Ingredient	Indonesian farmworkers (n=30)		SA migrant farmworkers (n=7)	
	Pre	Post	Pre	Post
Types of OPs packaging:				
- Bags	18 (32%)	29 (97%)	0 (0%)	0 (0%)
- Cans	23 (41%)	26 (87%)	0 (0%)	0 (0%)
- Liquid containers	0 (0%)	1 (3%)	6 (86%)	7 (100%)
- Bottles	15 (27%)	1 (3%)	1 (14%)	1 (14%)
- Other types	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Types of Pesticides:				
- Insecticides	30 (100%)	30 (100%)	7 (100%)	7 (100%)
- Fungicides	30 (100%)	30 (100%)	6 (86%)	6 (86%)
- Herbicides	0 (0%)	0 (0%)	3 (43%)	3 (43%)
- Rodenticides	0 (0%)	0 (0%)	2 (29%)	2 (29%)
Active ingredients of OPs:				
- Chlorpyrifos	15 (50%)	3 (9%)	3 (43%)	3 (43%)
- Triazophos	7 (23%)	0 (0%)	0 (0%)	0 (0%)

Types of packaging and active ingredients of OP pesticide products

Table 5 presents types and active ingredients of OP pesticide products used by Indonesian and SA migrant farmworkers in pre and post educational intervention. Cans (41% and 87%) and bags (32% and 97%) were the most common types of OP pesticide packaging used by Indonesian farmworkers in both measurements respectively. In contrast, most of the SA migrant farmworkers (86% and 100%) used liquid containers in both measurements respectively. All research participants

(100%) in both groups used insecticides in both pre and post intervention. However, fungicides and herbicides were also used by SA migrant farmworkers. Generally, chlorpyrifos was commonly used by approximately 50% of the research participants in Indonesian and SA migrant farmworkers in pre intervention. Meanwhile, triazophos was the other type of OP compounds commonly used by Indonesian farmworkers in pre intervention. The use of chlorpyrifos decreased to be 9% of Indonesian farmworkers in post intervention.

Workplace conditions

Table 6 presents details of provided facilities to support personal hygiene in workplaces of Indonesian and SA migrant farmworkers in pre and post educational intervention. Generally, water and cups to drink were available in farm areas in both groups in both measurements. Notwithstanding, nearly all Indonesian farmworkers did not provide water, soap, and towels to wash hands, toilet, and break room in their fields in both measurements. In contrast, these facilities were available in all SA migrant farmworkers' workplaces.

OPs-related symptoms

OPs-related symptoms are all symptoms reported by farmworkers after working with OPs like weakness, headache, dizziness, nausea, vomiting, diarrhoea, salivation, watery eyes, sweating, difficulty working, psychic disturbances, chest pain, blue lips, heart palpitations, and muscle twitching.

At least two or more OPs-related symptoms suffered by Indonesian and SA migrant farmworkers. As many as 67% of Indonesian farmworkers reported OPs-related symptoms in pre intervention and 63% in

Table 6 - Workplace conditions of Indonesian and SA Migrant Farmworkers

Facility	Indonesian farmworkers (n=30)		SA migrant farmworkers (n=7)	
	Pre	Post	Pre	Post
There is water for you to drink in the fields: - Yes - No	29 (97%) 1 (3%)	30 (100%) 0 (0%)	4 (57%) 3 (43%)	4 (57%) 3 (43%)
There are enough cups provided to drink using a clean cup for each worker: - Yes - No	26 (87%) 4 (13%)	30 (100%) 0 (0%)	6 (86%) 1 (14%)	6 (86%) 1 (14%)
There is water to wash your hands: - Yes - No	4 (13%) 26 (87%)	0 (0%) 30 (100%)	7 (100%) 0 (0%)	7 (100%) 0 (0%)
Soap is available for handwashing: Yes No	1 (3%) 29 (97%)	0 (0%) 30 (100%)	7 (100%) 0 (0%)	7 (100%) 0 (0%)
Single use towels are available for handwashing: - Yes - No	3 (10%) 27 (90%)	0 (0%) 30 (100%)	2 (29%) 5 (71%)	2 (29%) 5 (71%)
Washing water is separated from drinking water: - Yes - No	11 (37%) 19 (63%)	11 (37%) 19 (63%)	7 (100%) 0 (0%)	7 (100%) 0 (0%)
There is any break room to take a rest for meals: - Yes - No	10 (33%) 20 (67%)	10 (33%) 20 (67%)	7 (100%) 0 (0%)	7 (100%) 0 (0%)
There is a toilet facility: - Yes - No	1 (3%) 29 (97%)	0 (0%) 30 (100%)	7 (100%) 0 (0%)	7 (100%) 0 (0%)

post intervention whereas 14% of SA migrant farmworkers reported such symptoms in pre intervention and no one reported such symptoms in post intervention.

DISCUSSION

This study provides useful information on all aspects of field practices in handling OPs and OPs-related symptoms in two different groups of farmworkers, Indonesian and SA migrant farmworkers between pre and post educational intervention.

Generally, activities in handling OPs were relatively similar between pre and post educational intervention in both farmworker groups. This result indicated that the educational intervention provided to both groups did not significantly change their behaviour to reduce OPs exposure. However, the intervention had significantly improved some work practices ($p < 0.05$) among Indonesian farmworkers in not touching crops after OPs application (Table 1), spraying method (Table 2), avoiding spray drift when applying OPs (Table 2), and ensuring to not affect other people by over applied spray drift when applying OPs (Table 2). In addition, proportions of farmworkers who suffering from OPs-related symptoms slightly decreased from 67% in pre intervention to 63% in post intervention (Table 7). In contrast, generally, field practices of SA migrant farmworkers in post educational intervention remained constant as they did in pre intervention.

Suratman, et al. [7] reported that the simple educational intervention had significantly improved

knowledge and perceptions about OPs exposure among the participants involved in this study. According to Ajzen [16] in the Theory of Planned Behaviour (TPB), there are three kinds of considerations in changing human behaviour as follows: 1) beliefs about outcomes; 2) beliefs about important other's attitude to behaviour; and 3) internal control factors (i.e. information, skills, abilities) and external control factors (i.e. opportunities, obstacles). Beliefs about outcomes result attitude towards the behaviour; beliefs about important other's attitude to behaviour give rise to subjective norm; and control beliefs produce perceived behavioural control [16, 17]. These factors predict behavioural intentions that are related to behaviour [16, 17].

Regarding the conditions in which the research participants in both groups worked, farming methods used by Indonesian and SA migrant farmworkers were completely different. Farmworkers in Indonesia cultivated their crops using a method of outdoor growing (open farm) whereas SA migrant farmworkers planted their crops in greenhouse. These differences in worksite conditions might play an important role in their behavioural intentions before deciding to change behaviour. If applied to OPs application, the TPB would make the following prediction: If farmworkers believed that wearing PPE during working with OP compounds would make their life more protective from OPs exposure and be beneficial to their health (attitude to the behaviour) and believed that important people in their life wanted them to protect their selves (subjective norm), and they were capable of using less OP compounds due to their past behaviour and evaluation of internal and

external control factors (high behavioural control), then this would predict high intentions to reduce OPs exposure by wearing PPE (behavioural intentions).

In tropical area like Indonesia, most of farmworkers were reluctant to wear adequate PPE during working in the field due to hot weather and expensive [1]. Notwithstanding, Indonesian government, particularly Ministry of Agriculture and Ministry of Health has regulated the use of pesticides and wearing PPE during working with chemical compounds including OPs. On the other hand, Australian government, particularly The National Occupational Health and Safety Commission, the Australian Pesticides and Veterinary Medicines Authority (APVMA) (previously known as the National Registration Authority), and the states have strictly regulated farm chemical users to minimise the risks of adverse effects due to farmworker exposure to hazardous substances, including OPs [18]. In addition, the national training and accreditation program for farm chemical users, known as ChemCert Australia, was conducted by the National Farmer's Federation (NFF) and the Rural Training Council of Australia (RTCA). One of the aims of these programs was to improve the knowledge, skills, attitude, and behaviour of farm chemical users [18].

CONCLUSIONS

Generally, provided educational intervention did not significantly change field practices in handling OPs in both Indonesian and SA migrant farmworkers. However, some significantly behavioural improvements ($p < 0.05$) in handling OPs as the result of the intervention occurred among Indonesian farmworkers as follows: 1) proportions of farmworkers who touching crops after OPs application dramatically decreased from 63% in pre intervention to 17% in post intervention; 2) proportions of farmworkers who spraying OPs against wind direction sharply declined from 60% in pre intervention to 30% in post intervention; 3) proportions of farmworkers who avoiding spray drift when applying OPs dramatically rose from 47% in pre intervention to 97% in post intervention; 4) proportions of farmworkers who ensuring to not affect other people by over applied spray drift when applying OPs sharply increased from 53% in pre intervention to 93% in post intervention; and 5) proportions of farmworkers who suffering from OPs-related symptoms slightly decreased from 67% in pre intervention to 63% in post intervention. On the other hand, generally, field practices of SA migrant farmworkers in post educational intervention remained constant as they did in pre intervention.

Provision of appropriate equipment and long-term educational intervention linked to workplace conditions was needed to improve their knowledge, perceptions, and work practices to reducing adverse effects due to OPs exposure.

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References

1. KISHI, M., HIRSCHHORN, N., DJAJADISASTRA, M., et al., *Relationship of pesticide spraying to signs and symptoms in Indonesian farmers*. Scand J Work Environ Health. 124-33, 1995;
2. DASGUPTA, S., MEISNER, C., WHEELER, D., XUYEN, K., LAM, N.T., *Pesticide poisoning of farm workers-implications of blood test results from Vietnam*. Int J Hyg Environ Health. 2007 Mar;210(2):121-32. PubMed PMID: 17008128. Epub 2006/09/30. eng.;
3. RAJASHEKHARA, D., PRASAD, M.M., JIRLI, P.S., MAHESH, M., MAMATHA, S., *Relevance of plasma cholinesterase to clinical findings in acute organophosphorous poisoning*. Asia Pac J Med Toxicol. 2(1):23-7, 2013;
4. STRONG, L.L., THOMPSON, B., CORONADO, G.D., et al., *Health symptoms and exposure to organophosphate pesticides in farmworkers*. Am J Ind Med. 2004 Dec;46(6):599-606. PubMed PMID: 15551369, 2004;
5. JOHNSTONE, K., *Organophosphate exposure in Australian agricultural workers: Human exposure and risk assessment* [Thesis]. Queensland: Queensland University of Technology, Queensland, Australia; 2006;
6. SURATMAN, S., EDWARDS, J.W., BABINA, K., *Organophosphate pesticides exposure among farmworkers: pathways and risk of adverse health effects*. Rev Environ Health. 30(1):65-79, 2015;
7. SURATMAN, S., ROSS, K., BABINA, K., EDWARDS, J.W., *The effectiveness of an educational intervention to improve knowledge and perceptions for reducing organophosphate pesticides (OPs) exposure among Indonesian and South Australian migrant farmworkers*. Submitted. 2015;
8. Workplace Health and Safety Queensland *Organophosphate pesticide health monitoring guidelines. Queensland, Australia: Department of Justice and Attorney-General*; 2012;
9. BERLIN, A., YODAIKEN, R., HENMAN, B., editors., *Assessment of the toxic agents at the work-place. role of ambient and biological monitoring*. Proceedings of NIOSH-OSHA-CEC Seminar 1980. Luxembourg: MartinusNijhoff Publishers, 1980;
10. STRONG, L.L., THOMPSON, B., KOEPEL, T.D., MEISCHKE, H., *Factors associated with pesticide safety practices in farmworkers*. Am J Ind Med. 2008 Jan;51(1):69-81. PubMed PMID: 18033725, 2008;
11. ZHANG, X., ZHAO, W., JING, R., et al., *Work-related pesticide poisoning among farmers in two villages of Southern China: a cross-sectional survey*. BMC public health. 2011;11:429. PubMed PMID: 21639910. Pubmed Central PMCID: 3126745, 2011;
12. ATREYA, K., *Pesticide use knowledge and practices: a gender differences in Nepal*. Environ Res. 2007 Jun;104(2):305-11. PubMed PMID: 17303108, 2007;
13. LEPREVOST, C.E., BLANCHARD, M.R., COPE, W.G., *The pesticide risk beliefs inventory: a quantitative instrument for the assessment of beliefs about pesticide risks*. Int J Environ Res Public Health. 2011 Jun;8(6):1923-35. PubMed PMID: 21776210. Pubmed Central PMCID: 3138005. Epub2011/07/22. eng.;
14. YASSIN, M.M., MOURAD, T.A.A., SAFI, J.M., *Knowledge, attitude, practice, and toxicity symptoms associated with pesticide use among farm workers in the Gaza Strip*. Occup Environ Med. 59(6):387-94, 2002;
15. SHESKIN, D.J., *Handbook of parametric and nonparametric statistical procedures*. Third Edition. Florida: CRC Press Company; 2004;
16. AJZEN, I., *Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behavior*. J Appl Soc Psychol. 32(4):665-83, 2002;
17. OGDEN, J., *Health psychology. A textbook. Fourth Edition. England: McGraw-Hill Open University Press; 2007;*
18. RADCLIFFE, J.C., *Pesticide use in Australia: a review undertaken by the Australian Academy of Technological Sciences and Engineering*. Parkville Victoria: anl publishing; Available from www.atse.org.au, 2002.