

Kertas Asli/Original Articles

**Adoption of the Mobile Health Screening Programme for Farming Communities:
A Study Among Pesticide-Exposed Farmers from North East of Peninsular Malaysia**
(Perlaksanaan Program Penyaringan Kesihatan Secara Bergerak untuk Komuniti Petani: Kajian dalam kalangan Petani Terdedah Pestisid dari Utara Timur Semenanjung Malaysia)

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ABSTRACT

Health awareness promotion among farming communities are important for a sustainable agriculture activities. A cross-sectional study was conducted to assess health status among farming communities in Cameron Highlands, Pahang (n = 61) and Bachok and Pasir Puteh, Kelantan (n = 143). Mobile Health Screening Programme composed of assessment of blood glucose, blood cholesterol, haemoglobin, blood pressure, pterygium, lung function and nerve conductive velocity was utilized. Our results indicate that the percentage of Cameron Highland's farmers with hyperglycaemia, systolic hypertension, diastolic hypertension and anaemia were 8.2%, 14.8%, 11.5% and 8.2%, respectively. However, higher percentage of farmers in Bachok and Pasir Puteh, Kelantan with hyperglycaemia (32.8%), hypercholesterolaemia (83%), anaemia (24.2%) and systolic hypertension (41.9%) were observed. Pterygium was positive for 88.6% of farmers in Cameron Highlands and 94.4% in Bachok and Pasir Puteh. Lung function test shows that 61.7% and 11.4% of farmers in Cameron Highlands had restrictive and obstructive lung, respectively. In Bachok and Pasir Puteh, a total of 19.8%, 55.5% and 23.9% of farmers were found to have obstructive, restrictive and combined obstructive and restrictive lung, respectively. Current Perception Threshold (CPT) value which indicate nerve conductive velocity were significantly increased ($p < 0.05$) among Cameron Highland's farmers for both median and peroneal nerve at all frequencies (5 Hz, 250 Hz and 2000 Hz). In Bachok and Pasir Puteh, the values of the CPT for median nerve was significantly increased ($p < 0.05$) for all frequencies (5, 250 and 2000 Hz). Meanwhile, a significant increased ($p < 0.05$) was observed for the CPT values for peroneal nerve at the frequencies of 250 and 2000 Hz as compared to control groups. In conclusion, analysis revealed different health problem among the studied farming communities which could be influenced by the differences in farming practices. Thus, employed Mobile Health Screening Programme offers a monitoring approach that could highlight the need for suitable health services and awareness programmes for different farming communities.

Keywords: Pesticide; mobile health screening programme; farmers; Cameron Highlands; Kelantan

ABSTRAK

Promosi kesedaran kesihatan di kalangan komuniti petani adalah penting bagi kelangsungan aktiviti pertanian. Satu kajian keratan rentas telah dijalankan untuk menilai status kesihatan di kalangan petani di Cameron Highlands, Pahang (n = 61) dan Bachok serta Pasir Puteh, Kelantan (n = 143). Program Penyaringan Kesihatan Bergerak yang terdiri daripada pemeriksaan glukosa darah, kolesterol darah, hemoglobin, tekanan darah, kehadiran pterygium, fungsi paru-paru dan halaju pengaliran saraf telah digunakan. Hasil menunjukkan peratusan petani di Cameron Highlands yang menunjukkan hiperglisemia, hipertensi sistolik, hipertensi diastolik dan anemia masing-masing adalah sebanyak 8.2%, 14.8%, 11.5% dan 8.2%. Peratusan petani di Bachok dan Pasir Puteh, Kelantan pula adalah lebih tinggi bagi keadaan hiperglisemia (32.8%), hiperkolesterolemia (83%), anemia (24.2%) dan hipertensi sistolik (41.9%). Pterygium adalah positif bagi 88.6% daripada petani di Cameron Highlands dan 94.4% di Bachok dan Pasir Puteh. Ujian fungsi paru-paru menunjukkan sebanyak 61.7% dan 11.4% daripada petani di Cameron Highlands masing-masing mempunyai paru-paru restriktif dan obstruktif. Di Bachok dan Pasir Puteh, sebanyak 19.8%, 55.5% dan 23.9% daripada petani masing-masing menunjukkan keadaan obstruktif, restriktif dan kombinasi obstruktif dan restriktif paru-paru. Nilai Persepsi Ambang (CPT) yang menunjukkan halaju pengaliran saraf didapati meningkat dengan signifikan ($p < 0.05$) di kalangan petani Cameron Highlands untuk saraf median dan peroneal pada setiap frekuensi (5 Hz, 250 Hz dan 2000 Hz) yang dikaji. Petani di Bachok dan Pasir Puteh, Kelantan pula menunjukkan peningkatan halaju pengaliran saraf secara signifikan ($p < 0.05$) pada saraf median pada setiap frekuensi (5 Hz, 250 Hz dan 2000 Hz). Bagi halaju pengaliran saraf pada saraf peroneal, didapati hanya pada 250 Hz dan 2000 Hz terdapatnya peningkatan yang signifikan ($p < 0.05$) berbanding kawalan. Kesimpulannya, analisis menunjukkan terdapatnya masalah kesihatan yang berbeza dikalangan komuniti petani

di antara kawasan kajian yang mungkin dipengaruhi oleh perbezaan di dalam amalan pertanian. Oleh itu, penggunaan Program Penyaringan Kesihatan Bergerak dapat membantu memberi maklumat keperluan program kesedaran dan perkhidmatan kesihatan yang bersesuaian kepada komuniti petani yang berbeza.

Kata kunci: Pestisid; program penyaringan kesihatan bergerak; Cameron Highlands; Kelantan

INTRODUCTION

Worldwide, the use of pesticides is considered the most attractive method for controlling pests which involves less labour and contributes to higher output per hectare of land. However, extensive use of such pesticides results in substantial health and environmental threats. Being the principle polluters and victims of pollution, farmers are the most at risk to be exposed with health related-pesticide toxicity effects especially in long-term occupational exposure (Strong et al. 2004).

Pesticides contain numerous active compound that are hazardous to human health (Fernandez-Cornejo et al. 1995) and farmers were mostly exposed to pesticides during pesticide's handling activities such as pesticides mixing and spraying. (Mekkonen & Ejigu 2005). A number of studies exploring farmer's behaviour found that insufficient knowledge, improper handling of pesticides, lack of use of personal protective equipments (PPE), inappropriate working habits such as food consumption during pesticides handling, poor hygiene habits and lack of occupational training, regulation enforcement and health monitoring programme lead to widespread hazards of pesticides on health (Gomes et al. 1999, Avory & Coggon 1994).

In Malaysia, agriculture sectors contribute significantly to country's economy. Farmers in Malaysia use pesticides to govern agriculture activities with limited knowledge for its deleterious effects on community, health, and environment. While pesticide exposure is known for its potential toxicity effects, epidemiological studies to address health hazards in occupationally exposed farmers and their families in Malaysia are remain understudied.

Therefore, in order to encounter the cases for pesticide-related health problems more frequently, contributions from many parties such as government agencies, research institutions, farmers and pesticide manufacturers are required. The objective of this study is to conduct a Mobile Health Screening Programme among farming communities in order to evaluate the impact of farming practices on farmer's health. The adoption of Mobile Health Screening Programme consisting of examinations for blood glucose, blood cholesterol, hemoglobin, blood pressure, pterygium, lung function and nerve conductive velocity is expected to generate information on the health and safety status of the farming communities in Malaysia.

METHODOLOGY

STUDY DESIGN

The study design is a cross-sectional. Universal sampling method was employed to recruit farmers and a structured questionnaire was used to gather information on social-demographic and farming practices. The study areas were selected by using purposive sampling method. Sampling unit was farmers in Cameron Highlands, Pasir Puteh and Bachok. Sample size estimation was determined using Krejcie and Morgan (1970) based on the number of farmers in the selected area. Study in Cameron Highlands was conducted between September 2009 to June 2010 while study in Bachok and Pasir Puteh were performed between September 2010 to June 2011. The inclusion and exclusion criteria for subjects' selection were as follows: a. Inclusion criteria: Farmer who has been working as a farmer for a minimum of 2 years and never stop for longer than 3 months in a year; aged between 19 to 60 years old. b. Exclusion criteria: Farmer who has history of diabetes mellitus, hypercholesterolaemia, hypertension and other chronic diseases such as cardiac diseases and mental retardation. The total numbers of subjects were 143 for Bachok and Pasir Puteh and 61 for Cameron Highlands.

QUESTIONNAIRE ASSESSMENT

This study was based on a questionnaire which includes information on socio-demographic, farming experiences, pesticides application and the use of personal protective equipment (PPE). A survey was conducted prior to health examinations and interview was performed face-to-face after obtaining given consent.

MOBILE HEALTH SCREENING PROGRAMME

Basic Health Examinations Blood pressure was measured using Automatic Blood Pressure Monitor (OMRON®). Assessment of blood cholesterol, hemoglobin and blood glucose were determined using commercial reader namely EasyTouch®, HemoCue® and EasyMate®, respectively. Pterygium was identified through visual assessment.

Lung Function Test Recruitment of subjects for lung function test was done using systemic random sampling. Subject with known respiratory problem is excluded from the test. Measurement of lung function was conducted using a portable Spirometer COSMED Pony-FX. Spirometry is a physiological analysis for measuring the volume and the rate of air inspired and expired by the lungs over a

specified period of time. The variables measured are forced expiratory volume in 1 second (FEV1), forced vital capacity (FVC) and percentage for FEV1/FVC. Spirometry analysis will enable lung functions to be categorized into three types as normal, obstructive and restrictive. Following the exclusion criteria, the total numbers of subjects included for the test were 87 for Bachok and Pasir Puteh and 37 for Cameron Highlands.

Nerve Conductive Velocity Prior to nerve conductive velocity assessment, subjects were screened for blood glucose level as the subject with diabetes mellitus is excluded from the test. Thus, subject with random blood glucose level higher than 7.8 is excluded from the test. Determination of nerve conductive velocity was achieved by measuring current perception threshold (CPT) using a portable constant current electric nerve stimulator known as Neurometer (CPT/Eagle). Neurometer® CPT® tests are painless and permit the earliest possible detection of sensory nerve damage. Assessments were carried on the index finger (median digital nerve) and the great toe (peroneal digital nerve). The nerve will be stimulated using 3 neuroselective frequencies of 2000 Hz, 250 Hz, and 5 Hz. The total numbers of subjects were 53 for Bachok and Pasir Puteh and 56 for Cameron Highlands. A total of 41 and 13 age-matched control subjects without history of exposure to pesticide were used for studies conducted in Cameron highlands and Kelantan (Pasir Puteh and Bachok), respectively. Control subjects were administrative and support staff from Universiti Kebangsaan Malaysia, Kuala Lumpur Campus.

RESULTS

SOCIO-DEMOGRAPHIC CHARACTERISTICS

Socio-demographic data (Table 1) indicates that majority of the farmers in Cameron Highlands (62.3%) were aged between 19 to 30 years old, completed secondary school (50.9%) and were immigrant farmers (72.1%). In contrast, farmers in Bachok and Pasir Puteh were mostly aged between 61-70 years old (30.8%), had educational background at primary level (44.7%) and were Malaysian (100%).

FARMING EXPERIENCE AND FREQUENCY OF PESTICIDE APPLICATION

Pesticides usage experience and frequency of pesticides application among farmers were as depicted (Table 2). Our results indicate that farmers in Bachok and Pasir Puteh were mostly had farming experience between 11-20 years (26.6%) which was longer as compared to farmers in Cameron Highlands which majority of them had farming experience of 10 years or less (93.4%). Majority of farmers from both areas however showed similar practice of pesticide spraying with a frequency of between 1 to 3 times weekly.

TABLE 1. Socio-demographic characteristic of farmers

Characteristic	Cameron Highlands n = 61(%)	Bachok and Pasir Puteh n = 143(%)
Age groups (years)		
19-30	38(62.3)	8(5.6)
31-40	18(29.5)	17(11.9)
41-50	3(4.9)	35(24.5)
51-60	2(3.3)	39(27.3)
61-70	0(0)	44(30.8)
Education levels		
Primary school	26(42.6)	64(44.8)
Secondary school	31(50.9)	57(39.8)
Higher Education	0(0)	6(4.2)
No information	4(6.5)	16(11.2)
Nationality		
Malaysian		
Malay	11(18.0)	143(100)
Indian	4(6.6)	0(0)
Aborigines	2(3.3)	0(0)
Non-Malaysian	44(72.1)	0(0)

TABLE 2. Farming experience and frequency of pesticide application

Farming activities	Cameron Highlands n = 61(%)	Bachok and Pasir Puteh n = 143(%)
Farming experience (years)		
1-10	57(93.4)	36 (25.2)
11-20	2(3.2)	38 (26.6)
21-30	1(1.7)	27(18.9)
31-40	1(1.7)	15(10.5)
41-50	0(0)	22(15.3)
51-60	0(0)	5(3.5)
Frequency of pesticide spraying weekly		
1-3 times	54 (88.5)	125(87.4)
> 3 times	7(11.5)	18(12.6)

APPLICATION OF PERSONAL PROTECTIVE EQUIPMENT (PPE)

Survey on personal protective equipment (PPE) (Table 3) indicates that most of farmers in both areas claimed the use safety attire and face mask during pesticide handling. However, the used of gloves was found to be lower among farmers in Bachok and Pasir Puteh with 59.4% of them reported that they never use gloves while applying pesticides.

TABLE 3. Application of personal protective equipment (PPE) among farmers

PPE	Cameron Highlands n = 61(%)	Bachok and Pasir Puteh n = 143(%)
Safety attire		
Yes	52 (85.0)	102 (71.3)
No	9 (15.0)	41 (28.7)
Gloves		
Yes	51 (84.0)	58 (40.6)
No	10 (16.0)	85 (59.4)
Face mask		
Yes	52 (85.0)	94 (65.7)
No	9 (15.0)	49 (34.3)

BASIC HEALTH EXAMINATIONS

The status of the respective health parameters as assessed among farmers were shown in Table 4 and Table 5. Overall, the percentage of Cameron Highlands's farmers with hyperglycaemia, systolic hypertension, diastolic hypertension and anaemia were 8.2%, 14.8%, 11.5% and 8.2%, respectively. However, higher percentages of farmers in Bachok and Pasir Puteh, Kelantan with hyperglycaemia (32.8%), hypercholesterolaemia (83%), anaemia (24.2%) and systolic hypertension (41.9%) were observed. Finally, pterygiums were positive for majority of farmers in all areas.

TABLE 4. The status of respective health parameters among farmers

Health Status	Cameron Highlands n = 61(%) (Mean ± s.d)	Bachok and Pasir Puteh n = 143(%) (Mean ± s.d)	Reference Range
Random Blood Glucose	6.17 ± 1.71 mmol/L	8.31 ± 3.73 mmol/L*	(4.0-7.8)
Blood Cholesterol	4.13 ± 0.84 mmol/L	7.44 ± 1.14 mmol/L*	(≤ 5.7)
Haemoglobin	16.26 ± 1.77 mmol/L	14.34 ± 1.57 mmol/L	(≥ 13.5)
Systolic Blood Pressure	130 ± 16 mmHg	147.15 ± 27.55 mmHg*	(90 - ≤ 140)
Diastolic Blood Pressure	78 ± 11mmHg	79.53 ± 20.52 mmHg	(≤ 90)

* Higher than reference range

TABLE 5. Distribution of farmers with the respective health problem

Health Status	Cameron Highlands n = 61(%)	Bachok and Pasir Puteh n = 143(%)
Hyperglycaemia	5 (8.2)	47 (32.8)
Hypercholesterolaemia	0 (0)	119 (83)
Systolic Hypertension	9 (14.8)	60 (41.9)
Diastolic Hypertension	7 (11.5)	17 (11.9)
Anaemia	5 (8.2)	35 (24.2)
Pterygium		
Positive	54 (88.6)	135 (94.4)
Negative	7 (11.4)	8 (5.6)

TABLE 6. The status of lung function among farmers

Lung Function	Cameron Highlands n = 34(%)	Bachok and Pasir Puteh n = 87(%)
Obstructive	4 (11.8)	17 (19.5)
Restrictive	21 (61.8)	49 (56.3)
Obstructive & Restrictive	0 (0%)	21 (24.2)
Normal	9 (26.5)	0 (0%)

Meanwhile, about 23.9% of farmers in Bachok and Pasir Puteh had the combined lung problems.

ASSESSMENT OF LUNG FUNCTION

Lung function examination revealed that majority of farmers in Cameron Highlands (61.7%) and Bachok and Pasir Puteh (55.5%) had restrictive lung functions. None of farmers in Cameron Highlands was reported to have combined restrictive and obstructive lung problems.

ASSESSMENT OF NERVE CONDUCTIVE VELOCITY

In Cameron Highlands, the values of the CPT for median and peroneal nerves were significantly higher ($p < 0.05$) for all frequencies (5, 250 and 2000 Hz) as compared to control groups (Table 7). In Bachok and Pasir Puteh, the values of the CPT for median nerve was significantly higher ($p < 0.05$) for all frequencies (5, 250 and 2000 Hz) as compared to control. Meanwhile, a significant increase

TABLE 7. Nerve conductive velocity among farmers in Cameron Highlands

Nerves	Farmers (n = 56) (Mean ± s.d)			Control (n = 41) (Mean ± s.d)		
	5 Hz	250 Hz	2000 Hz	5 Hz	250 Hz	2000 Hz
Median	92 ± 36*	151 ± 60*	335 ± 96*	73 ± 17	115 ± 27	247 ± 51
Peroneal	153 ± 55*	246 ± 75*	487 ± 118*	122 ± 24	204 ± 30	418 ± 74

*Significantly difference as compared to control group ($p < 0.05$)

TABLE 8. Nerve conductive velocity among farmers in Bachok and Pasir Puteh

Nerves	Farmers (n = 53) (Mean ± s.d)			Control (n = 13) (Mean ± s.d)		
	5 Hz	250 Hz	2000 Hz	5 Hz	250 Hz	2000 Hz
Median	83 ± 23*	131 ± 39*	313 ± 82*	61 ± 16	103 ± 31	242 ± 71
Peroneal	134 ± 48	199 ± 57*	408 ± 112*	117 ± 24	104 ± 31	245 ± 79

*Significantly difference as compared to control group ($p < 0.05$)

($p < 0.05$) was observed for the CPT values for peroneal nerve at the frequencies of 250 and 2000 Hz as compared to control groups (Table 8).

DISCUSSION

Farmers in Cameron highlands were mostly migrant workers and this may be influenced by the demand in growth sectors for agriculture activities that attracts migration of worker from countries such as Bangladesh, Nepal and Indonesia. Furthermore, data indicates that majority of them were between 19 to 30 years old which probably due to the age requirement for obtaining working visa that must be within 18 to 45 years old (Jabatan Imigresen Malaysia 2010). Therefore, farmers in Cameron Highlands may work on contract basis which may explain shorter working experience as observed in Cameron Highlands as compared to farmers in Bachok and Pasir Puteh, Kelantan who were Malaysian and permanent residence of the area.

Survey of PPE applications revealed the lack of PPE use among farmers in Bachok and Pasir Puteh as compared to those in Cameron Highlands. Such lack of awareness may enhance risk of pesticide toxicity. Studies have shown that hot weather in Malaysia cause farmers of not using the PPE when handling pesticides (Lubis et al. 1999). According to Park et al. (2008), hot and humid weather cause uncomfortable among the farmers to use PPE, particularly the use of mask and goggle. Nordin et al. (2002) demonstrated that safety behaviours in pesticide use significantly prevented occurrence of acute symptoms in male and female tobacco farmers in Bachok District, Kelantan, Malaysia. This finding emphasizes the importance of proper PPE application and appropriate pesticide handling practices during farming activities.

Long-term and low-dose exposure of a number of pesticides has been linked to human health effects such as immune suppression, hormone disruption, diminished intelligence, reproductive abnormalities, cancer, neurological problem, cardiorespiratory and gastrointestinal symptoms (Brouwer et al. 1999, Crisp et al. 1998). Overall, farmers in Cameron highlands showed better health status than in Bachok and Pasir Puteh. At this stage of study, we cannot conclude whether higher number of farmers with hyperglycaemia, hypercholesterolaemia, systolic hypertension and anaemia as observed in Bachok and Pasir Puteh were directly associated with pesticides exposure or due to external factors such as nutritional status or lifestyle habits. Thus, inclusion of this information in future study can further establish the conclusion for the observed events. However, reduced quality of health among them could be associated with the lack of PPE application during pesticide handling.

The study found the percentage of farmers who have restrictive lung was higher in all areas. The results of this study are similar to those made by Peiris-John et al. (2005) who showed that farmers who were exposed to pesticides had restrictive lung. Restrictive lung is characterized by a decline in activities of expansion and contraction of lung during breathing. This is due to the disruption of the respiratory neuromuscular junction that are important to help the process of expansion and contraction of the lungs. Toxic effects of pesticides can cause inhibition of cholinesterase enzyme activities which is important for functional nervous system. Disturbances in the nervous system lead to muscle weakness including respiratory muscles that can affect respiratory system.

Organophosphates and carbamates can inhibit the activity of acetylcholinesterase (AChE) enzyme that can lead to the accumulation of acetylcholine (ACh) in

cholinergic receptor (Jokanovic 2009). Such accumulation of acetylcholine will cause excessive stimulation on postsynapse of muscarinic and nicotinic receptors (Jokanovic & Kosanovic 2011), leading to interference of nerve conduction on central and peripheral nervous systems. Lubis et al. (2008) reported a significant elevation in CPT values among paddy farmers who exposed to pesticides as compared to non-exposed groups of fisherman. This may suggest the presence of chronic neuropathies due to pesticides exposure. In our study, the CPT values on both median and peroneal among farmers in all areas were remarkably higher as compared to control subjects. The risk for increased CPT is normally associated with the lack use of gloves and boots while farming which increase the exposure of peroneal and median nerves to pesticides through skin (Moore & Agur 2002, Hofmann et al. 2009). Eventhough farmers claimed the use of such PPE, the elevation of CPT at both nerves could be influenced from the use of improper materials for gloves and boots which do not provide adequate protection (Ministry of Agriculture, British Columbia 2014).

In conclusion, farmers are at risk for the pesticide-related health hazard following the occupational exposure to pesticides. The employment of Mobile Health Screening Programme as utilized in this study could contribute to the establishment of a comprehensive training programme inclusive of health surveillance and management of the pesticides-related issues. Such efforts are important in order to promote safety awareness among farmers which the outcome can ensure a sustainable agriculture activities and economic growth in Malaysia.

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The author(s) declared no potential conflicts of interest with respect to the authorship and/or publication of this article.

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