Enfermería Clínica

Volume 30, Supplement 4, June 2020, Pages 196-200

Nutritional intake pattern of horticulture farmers in three ethnic populations in Indonesia and farmer susceptibility to chlorpyrifos insecticide ☆

Hasnawati Amqam [a], Umar Fahmi Achmadi [b], Budi Haryanto [b], Irawan Yusuf [c], Kusharisupeni [d]

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https://doi.org/10.1016/j.enfcli.2020.02.015

Abstract

Objective

This study aimed to give a description of nutritional intake pattern of farmers and analyze the relationship of antioxidants vitamins intake with farmer susceptibility to chlorpyrifos insecticides.

Method

This was an observational study with a cross-sectional design. There were 298 farmers, from three populations: Javanese, Sundanese, and Makassarese were participated as subjects. Data on nutrient intake, Body Mass Index, and Paraoxonase 1 activity were collected.

Results

The intake of macronutrients are different within the three ethnics. Magnesium and phosphor were micronutrients consumed by the majority of farmers among the three ethnic populations. Vitamin E, vitamin C, calcium, and zinc were the micronutrients which were the least consumed by farmers from all populations. The majority of farmers in the three ethnic community had low activity of PON1, and the highest prevalence was in the Sundanese group. There was no significant relationship was found between frequency of vitamin C and vitamin E consumption.

Conclusion

Majority of farmers have inadequate intake of antioxidant vitamins. There is no significant relationship between antioxidant vitamins intake and their susceptibility to chlorpyrifos.

Previous Next

Keywords

Nutrition; Agricultural farmers; PON1; Antioxidant; Vitamins

Introduction

To deal with insects, chlorpyrifos is commonly used by farmers due to its effectiveness in killing insects. However, this kind of insecticide brings to health effects. Chlorpyrifos is a member of the organophosphate compound. The commonly known impact of these compound is its acute effect, which inhibits acetylcholinesterase (AChE) enzyme activity in the neurology system, the primary mechanism of organophosphate poisoning.[1] Due to its widely use and its toxicity to nervous system, this compound becomes one of the causes of the high prevalence of pesticide poisoning within farmers in many countries.[2, 3, 4] Moreover, many studies also pay attention on the health effect result from chronic exposure to organophosphate pesticides, such as non-Hodgkin's lymphoma and leukaemia,[5] immunity system disorder, hypersensitive and endocrine system disorder,[6] disorder on the nervous system,[6] respiratory system disorder,[7] and thyroid function disorder.[8]

One of factors that play a role in chlorpyrifos related-health effect occurrence is individual susceptibility to chlorpyrifos.[9] Individual sensitivity which is measured from serum paraoxonase1 (PON1) status determines the risk a farmer has toward health outcome due to chlorpyrifos exposure. PON1 is a protein that hydrolyses the active metabolites of chlorpyrifos. Due to its act, PON1 become a biomarker of individual susceptibility to chlorpyrifos.[10] PON1 protein affect metabolism of chlorpyrifos compound[11] and decrease vulnerability to chlorpyrifos. The capability of PON1 in chlorpyrifos degradation determine the protection level of PON1 in countering toxic substances. The higher the concentration, the better it's protection.

The activity of PON1 is varied between and within ethnics. PON1 activity is influenced by some factors. One of them is high vitamin C and E intake which is include as antioxidant vitamins. They may increase PON1 activity. PON1 is an antioxidant enzyme.[12]

There are some vegetable centers in Indonesia, such as Central Java, East Java, West Java, and South Sulawesi. They belong to different ethnics name Javanese, Sundanese, and Makassarese. PON1 is influenced mainly by genetic polymorphism. Thus, the various ethnic may influence the susceptibility of the farmer to organophosphate exposure. Due to high cases of pesticides poisoning among Indonesian farmers, it is interesting to find some factors that may influence the susceptibility of farmers within difference ethnics, especially the nutritional aspect. This study aimed to get a description on nutrient intake patterns of vegetable farmers and to analyze the relationship of antioxidant vitamins with individual susceptibility to chlorpyrifos of horticulture farmers in the three ethnic population.

Method

This study was a cross-sectional study. There were 298 farmers from three Sub-Districts represent three ethnics in Indonesia participated in this study. The inclusion criteria were a healthy individual (no chronic disease history, such as diabetes mellitus, cancer, etc.). The history was self-report information which got from the subjects in an interview.

Data which consisted of farmers characteristic (age, and education level), factors influence PON1 activity covered diet, smoking, BMI, and ethnic were collected by interview using questionnaire. Diet information was obtained by means of Semi-Food Frequency Questionnaire (FFQ) and Recalled 2 × 24 h. Body weight and height were measured using body scale and microtome. PON 1 activity was measured as well in

Integrated Laboratory, Faculty of Medicine, University of Indonesia. It was measured from serum sample of farmers. As much as 2 ml of venous blood was drawn and centrifuged to 1 ml of serum. PON 1 activity then analyzed by means of micro plate reader. Ethical Clearance was approved by Ethic Commission of Faculty of Public Health, University of Indonesia.

Results

Characteristic of subjects

Characteristic of Subjects is presented in Table 1. Majority of subjects in the three populations were in productive age range. However, many of them were in the range of unproductive age (>45 years), but they were still active in the field for spraying even until 70 years old, especially in the Javanese groups. Most of the subjects had completed nine years basic education levels. They were an elementary school for six years and three years of junior high school. In the Javanese and the Makassarese groups, many of farmers had never attended formal school. Besides, from the BMI data, most of subjects had normal BMI in all ethnic groups.

Table 1. Characteristic of the farmers.

Variables	**Ethnic population**					
	Javanese		**Sundanese**		**Makassarese**	
	***n* (%)**		***n* (%)**		***n* (%)**	
Age (years)						
15–45	66	(68.8)	91	(89.2)	83	(83.0)
>45	30	(31.2)	11	(10.8)	17	(17.0)
Education						
No education	22	(22.9)	6	(5.9)	26	(26.0)
Complete basic education	62	(64.6)	77	(75.5)	65	(65.0)
Completed senior high school	12	(12.5)	19	(18.6)	9	(9.0)

Variables	Ethnic population					
	Javanese		Sundanese		Makassarese	
	n (%)		*n* (%)		*n* (%)	
BMI						
Underweight	4	(4.2)	22	(21.6)	7	(7.0)
Normal	65	(67.7)	57	(55.9)	67	(67.0)
Overweight	27	(28.1)	23	(22.5)	26	(26.0)

Nutrient intake pattern

Nutrient intake data presented in this study were nutrient contents as converted from a 2 × 24 h recall dietary assessment. Daily nutrient intake which were consist of macronutrient (total energy, total carbohydrate, total protein, and total fat), micronutrient (vitamin A, vitamin D, Zinc, Calcium, Magnesium, Phosphor), as well as antioxidants vitamins (vitamin C and vitamin E) were reported. Description of the intakes were presented in graphs (Figure 1, Figure 2).

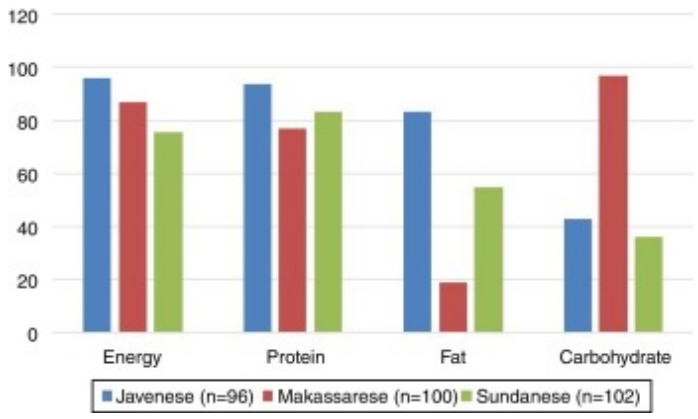

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Figure 1. Prevalence (%) of adequate macronutrient intake among ethnic populations.

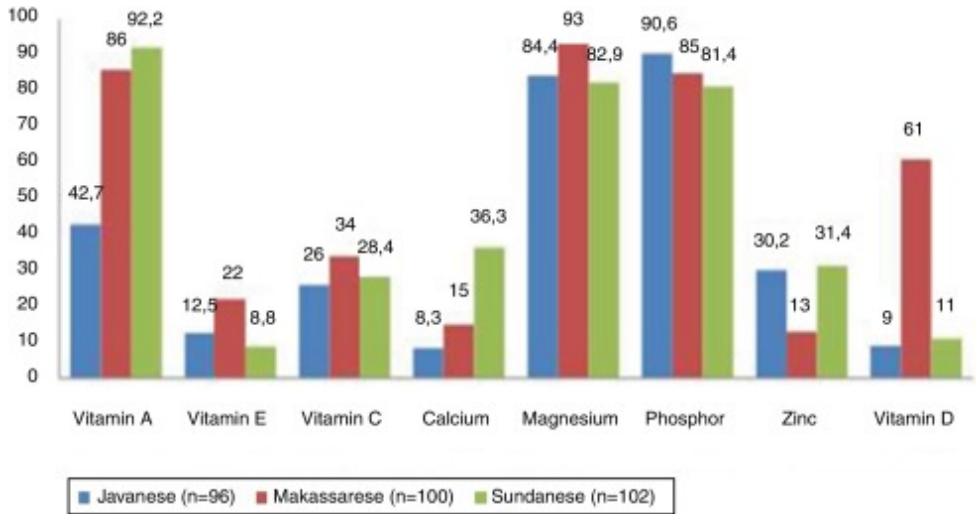

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Figure 2. Prevalence (%) of adequate micronutrients intake among ethnic populations.

Information on macronutrient and micronutrient intake of farmers provide description about adequacy of macronutrient in daily food composition. It is shown that majority of farmers had adequate intake of energy and protein for all of ethnic populations. It was a little bit different from the consumption of fat and carbohydrate. Farmers of the Makassarese population tended to consume more carbohydrate and less fat compared to other groups.

Magnesium and phosphor were micronutrients consumed by the majority of farmers among the three ethnic populations. In addition to these, the intake of vitamin A was adequate mostly among the Makassarese and the Sundanese population. while among the Javanese group there was only below 50% farmers had adequate vitamin A intake. In opposite, vitamin E, vitamin C, calcium, and zinc were the micronutrients which were the least consumed by farmers from all populations.

Individual susceptibility to chlorpyrifos insecticides

Individual susceptibility to chlorpyrifos insecticide was measured through PON1 activities level analysis. This study result showed that majority of farmers in the three populations had low activity of PON1. However, the prevalence of low PON1 level in the Makassarese was less than the other groups which were 49.0%. Thus, the majority of farmers had high sensitivity to the effect of chlorpyrifos exposure. It seemed in Table 2.

Table 2. Susceptibility of farmers to chlorpyryfos insectisides from PON 1 activities.

PON1 activity	Javanese		Sundanese		Makassarese	
	n (%)		*n* (%)		*n* (%)	
Low	63	(65.6)	66	(64.7)	49	(49.0)
Medium	6	(6.2)	27	(26.5)	15	(15.0)
High	27	(28.1)	9	(8.8)	36	(36.0)

Relationship of antioxidant vitamin intake to susceptibility to chlorpyrifos

The relationship between vitamins intake and susceptibility to chlorpyrifos is presented in Table 3.

Table 3. The relationship of frequency of antioxidant vitamines intake with pon1 activities.

Population	Frequency/Adequacy	PON 1 activities						*p*-value
		Low		Medium		High		
Javanese	*Vitamin C*							
	Seldom	26	65	3	7.5	11	27.5	0.912
	Often	37	66.1	3	5.4	16	28.6	
	Adequate	16	25.4	4	66.7	5	18.5	0.05
	Inadequate	47	74.6	2	33.3	22	81.5	
	Vitamin E							
	Seldom	20	69	2	6.9	7	24.1	0.846
	Often	43	64.2	4	6.0	20	29.9	
	Adequate	11	17.5	0	0	1	3.7	0.066

Population	Frequency/Adequacy	PON 1 activities						*p*-value
		Low		Medium		High		
	Inadequate	52	82.5	6	100	26	96.3	
Makassarese	*Vitamin C*							
	Seldom	43	49.4	14	16.1	30	34.5	0.611
	Often	6	46.2	1	7.7	6	46.2	
	Adequate	19	38.8	3	20.0	12	33.3	0.403
	Inadequate	30	61.2	12	80.0	24	66.7	
	Vitamin E							
	Seldom	31	43.7	10	14.1	30	42.3	0.121
	Often	18	62.1	5	17.2	6	20.7	
	Adequate	11	22.4	2	13.3	9	25.0	0.653
	Inadequate	38	77.6	13	86.7	27	75.0	
Sundanese	*Vitamin C*							
	Seldom	15	68.2	6	27.3	1	4.5	0.726
	Often	51	63.7	21	26.2	8	10.0	
	Adequate	18	27.3	10	37.0	1	11.1	0.308
	Inadequate	48	72.7	17	63.0	8	88.9	
	Vitamin E							
	Seldom	31	63.3	13	26.5	5	10.2	0.890
	Often	35	66.0	14	26.4	4	44.4	
	Adequate	4	6.1	5	18.5	0	0.00	0.09
	Inadequate	62	93.9	22	81.5	9	100	

Discussion

Nutrient intake pattern of populations were generally influenced by availability of food in an area as well as cultural habits, such as belief system and taboos. Nutrient intake pattern is likely as a result of ethnic heritage and some of environmental variables.

The mean energy intake of the three ethnics was ranged from 1256 to 3894 kcal. The highest consumption was among Sundanesenese population as well as the lowest intake. The median energy intakes of all the three populations were higher than what was expected based on the Indonesian's Recommended Dietary Allowances (RDA, 2150 kcal). From this study it obtained data that farmers from Makassarese ethnic consume more carbohydrate and less protein than other two ethnics. Those farmers from Makassarese group usually eat much rice with less side dish. The most important thing for them is a full stomach in order to do their activities. Farmers in Javanese and Sundanese groups also consume more fat from fried snack.

Some micronutrients were consumed inadequately by majority of farmers in all ethnic groups, such as vitamin C, vitamin E, calcium, and zinc. Vitamin C and E are antioxidant vitamins which serve to protect body of farmers from pesticides effect especially chlorpyrifos. These vitamins were known able to increase PON1 activity which works to metabolize chlorpyrifos effectively in order to prevent the emergence of adverse health effects. Statistically there was no significant relationship between these vitamins consumption with PON1 activity. However, there is an indication of effect of vitamin C and vitamin E in Javanese farmers group ($p = 0.05$ and $p = 0.0066$ respectively). Perhaps, it was related to the consumption of black tea which was commonly practised by people in the research area of Java. It is generally knew that black tea is high of antioxidant that could be influence PON 1 activity. This variable was not measure in this study. However, this study showed that low consumption of vitamin C and E tended to result in low activity of PON1. It means that farmers with low consumption of vitamin C and vitamin E will more susceptible to the effect of chlorpyrifos exposure.

Conclusion

It was conclude that majority of farmers in all ethnic population had adequate macronutrients intake but inadequate in some micronutrients intake, included antioxidant vitamins. There is no significant relationship between antioxidant vitamins intake and their susceptibility to chlorpyrifos.

Conflict of interest

The authors declare no conflict of interest.

Acknowledgements

This study was a part of research project funded by Neys Hoogestragen Foundation (NHF), The Netherlands with grant code IN251.

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☆ Peer-review under responsibility of the scientific committee of the 1st International Conference on Nutrition and Public Health (ICNPH 2019). Full-text and the content of it is under responsibility of authors of the article.

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