



STUDY ON NUTRITIONAL STATUS AND CARDIOVASCULAR RISK FACTORS IN PESTICIDE/HERBICIDE SPRAYERS IN TEA GARDEN

Home Science

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ABSTRACT

Globally CVD is one among the devastating non-communicable disease burdens. For the study 60 male adults working in tea estate were selected and grouped as control (n=20; non-pesticide handlers) and experimental/exposure (n=40; pesticide sprayers and mixers 20 each). BMI was calculated based on height and weight measurements for the selected subjects (n=60) while biochemical parameters including circulatory lipids and pro-inflammatory markers were done for sub-sample (control n=20; exposure n=20 (sprayers 10 and mixers 10)). Nutritional status as revealed by BMI indicated that 76% had normal height and weight and 5% and 26% of them were underweight and obese respectively. Information on dietary pattern all were non-vegetarians and food frequency revealed cereals and pulses were included predominantly while much importance was not given to vegetables; fruits and millets were neglected in the diet. In case of signs and symptoms experienced (exposure group) during pesticide/herbicide handling was more than 50% suffered from skin irritation & eye itching. It was saddening that precautionary measures were not adopted by majority during pesticide exposure. Sub-samples (control n=20 and exposure n= sprayer 10 & mixer 10) were selected for biochemical analysis namely serum LDL, VLDL, total cholesterol and pro-inflammatory markers. The levels of serum LDL, VLDL, total cholesterol and pro-inflammatory markers were significantly ($p<0.05$) higher in exposure group than the control group. Results conclude that one fourth of the sample were obese, subjects failed to adopt safety measures during pesticide exposure and risk for CVD was greater in exposed sample than control.

KEYWORDS

circulatory lipids, pro-inflammatory markers, CVD, pesticide/herbicide, lipid levels, PGE2, MDA

INTRODUCTION

Globally CVD is emerging as leading cause for mortality and morbidity.¹ Cardiovascular disease is the leading cause for major global mortality and a contributor to the reduced quality of people's life. In 2017, an estimated death of 17.8 million worldwide was due to cardiovascular diseases corresponding to 330 million total deaths.²

Previous studies suggested that in addition to tobacco/alcohol consumption, the possible CVD risks caused by exposure to pesticides are now in public domain. They are also known to cause skin and allergic reactions, common ailments among the agricultural labourers.^{3,4} However, there were only limited studies describing the CVD risk factors on tea-garden workers other part of India.

The research question of the current study is whether the tea-garden pesticide/herbicide handlers (as compared with non-pesticide/herbicide handlers working in tea gardens) of Nilgiri district, have high CVD prevalence risk.

MATERIALS AND METHODS

• Selection of area and sample

The study was undertaken in Pandalur Village, Nilgiri District, Tamil Nadu, India, where tea cultivation is the main agricultural activity. About 60 male adults, aged 25-55 years, including pesticide handlers (sprayer/mixer) and non-pesticide handlers from Parry agro Tea industry were enrolled for the study after obtaining their consent. For biochemical analysis subjects were grouped as control (n=20; non-pesticide handlers) and experimental/exposure (n=40; pesticide sprayers(n=20) and mixers(n=20)) groups.

• Nutritional Assessment

Nutritional assessment by means of anthropometric measurements and food frequency was done. Demographic information for the selected subjects was obtained through scheduled interview method.

• Height, Weight and BMI

Subjects were first asked to relax before taking measurements. For taking height subjects were made to stand erect and look straight with face forward and their heel, buttocks and shoulder blade touching the vertical backboard of stadiometer. The horizontal bar of the stadiometer was lowered and the point was noted as height in centimetres (cm). Subjects were weighed using weighing scale. They

were asked to stand straight and relaxed with normal breathing and head looking forward. Weight was measured in kilograms.⁵ BMI was calculated by dividing weight in kg by height in m^2 (kg/m^2).⁶

Food frequency was done using scheduled method to assess food consumption pattern of the selected tea-garden subjects.

• Bio chemical Assessment

Subjects (n=40) who consented and were available at that day for participation in the biochemical study were asked to assemble in the "Mangorango hospital" by 7.00 am at Nilgiri District. They were asked to refrain from caffeine and smoking. Blood sample was collected in a resting state. Sample collection was carried by trained technician. The biochemical parameters assessed by trained analysts from the hospital for the control and exposure group were circulatory lipids, lipid peroxidation, nitric oxide levels in serum and serum PGE2 and TNF- α levels.

• Statistical analysis

Data are expressed as mean $\pm$ SEM. All data were analysed using the statistical software Graphpad Prism version 6.0 for windows (GraphPad Software, La Jolla, CA). Statistical analysis was performed using one-way ANOVA following Dunnett's multiple comparisons test with a P value ($p<0.05$) indicating statistical significance.

RESULTS AND DISCUSSION

• Demographic Information

Information pertaining to religion, educational status, habits and work nature were collected by using the developed schedule and the results are enlisted in the table 1.

Table 1 Details On Demographic And Work Nature

Particulars	Number	Percent
Age		
25-35	8	13
35-45	25	42
45-55	27	45
Religion		
Hindu	48	80
Muslim	8	13
Christian	4	7

Educational status		
Illiterate	12	20
<5	23	38
5-10	14	23
+2	7	11
Degree	4	7
Personal Habits		
Smokers	35	58
Non smokers	25	42
Duration of work		
0-5 hours	27	45
6-10 hours	23	38
Above 10 hours	10	17
Occupation		
Pesticide Operators		
Pesticide Sprayers	10	17
Other Tea garden workers (Field workers, drivers, field officers & field supervisors)	20	33
	30	50

From the total subjects, more than 80% were above 35 years old. With regards to literacy rate, only 7% of them were degree holders and 20% were illiterates while about half (58%) of the subjects were smokers with respect to personal habits. Owing to the work nature most of the subjects (n=50) worked not more than 10 hours where as half of the subjects were pesticide handles (mixer/sprayers) and others were non pesticide handling tea garden workers.

• Anthropometric Measurements

Anthropometric measurements are important in assessing the body composition as they represent the diagnostic criteria for certain disorders like obesity and underweight as they significantly are involved as risk factors in conditions including cardiovascular diseases, diabetes mellitus, hypertension and malnutrition.

The selected subjects were measured for height, weight (table 2) and BMI was calculated using the formula weight (kg)/ height (m²).

Table 2 Height And Weight Of The Subjects

Criteria	Age		
	25-35 (n=8)	35-45 (n=25)	45-55 (n=27)
Weight (kg) (mean±SD)	59.12 ±5.35 62.75	60.28±6.81 65.6	60.11±6.89 66.4
Standard weight*			
Height (Cm) (mean±SD)	164.75±0.07 172.3	165.07±0.069 172.3	164.37±0.070 171.95
Standard Height*			

BMI was calculated using the above data (height and weight) for the workers and surprisingly most of them (71.6 percent) had normal BMI while 23.3 percent and 5 percent belonged to overweight and underweight categories respectively. The BMI was believed to be the reflection of physical work done.

Disorders such as diabetes mellitus, anaemia and cardiovascular diseases are highly influenced by the dietary habits and lifestyle. It is necessary to understand food composition pattern of the subjects and it revealed that 80 percent of the subjects were meat consumers and the remaining were ova-vegetarians while none of them was vegetarian. As the diet they followed was cereal-based South Indian diet, next to cereals, pulses consumption was higher because 75% of the subjects consumed dhals daily (n=45) (in the form of dhal or sambar) while weekly once everyone (n=60) consumed animal protein in the form of egg, beef, chicken and fish. Predominantly the subjects were chicken (52%) and beef (47%) lovers. Subjects are likely to have micro-nutrients deficiency as they did not give much importance to vegetables, fruits and millets as vegetables and fruits consumption was weekly once and monthly once respectively.

• Information on Safety Measures

There are several reports emphasizing the importance of usage of protective equipments namely, hats, gloves, glasses, shoes and mask as proper protective measures will enhance the worker's safety and also reduces the risk of pesticide exposure. The subjects were interrogated about the usage of protective equipment during handling (mixing/spraying) pesticides and the responses are given in the table 3.

Table 3 Information About The Safety Measures Adopted During Exposure

Information on Safety Measures during mixing/spraying	Percent	
	Yes	No
Wash your hands intensively	100	-
Training about the usage and caution of pesticides; importance of protective measures	66.6	33.3
Gloves	5.1	94.9
Face mask	15	85
Boots	21.6	78.4
Aprons	13.3	86.7
Hats	11.7	88.3
Hospitalized due to effect of working with pesticides	12	88
Whether medical check-up done annually	67	33

As reported in a study that sprayers hardly prioritized their personal safety as protective equipments cost high.7,8,9 A study mentioned that despite the knowledge inculcated, farmers' neglectful behavior is the reason for poor protective measures taken.10 Similarly in this study, even though 66% of the subjects had undergone the training about the usage & caution of pesticides and were aware of the importance of protective measures more than 75 percent (n=45) of them did not use gloves, mask, aprons or hats while mixing/spraying pesticides.

Skin contact and inhalation are considered as the main hazards for pesticide spraying workers. When experimental group subjects were enquired about the signs and symptoms including skin irritation, eye irritation, abdominal pain, nausea, cough, diarrhoea, stomach poisoning and sneezing experienced during work with pesticides/herbicides and answers were recorded.

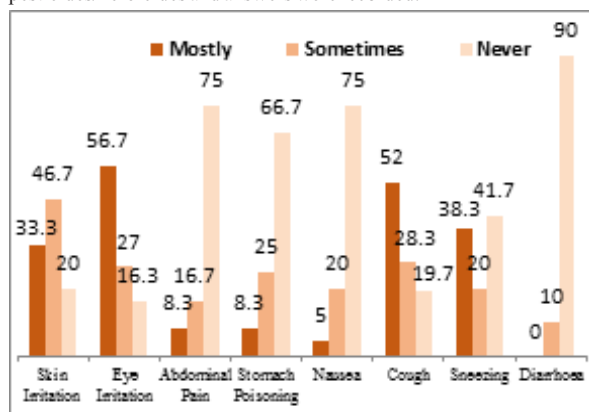


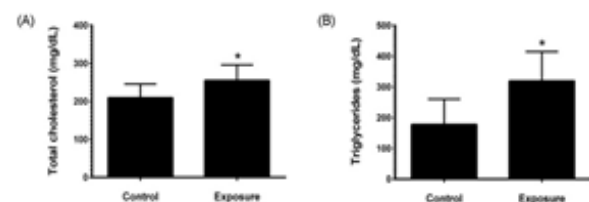
Figure 1: Signs & Symptoms Experienced During Pesticide Exposure

From the data (figure 1) it was found that about 33.3% and 56.7% of the subjects often suffered with skin and eye irritation respectively during mixing/spraying pesticides, while less than 10% suffered GI problems like abdominal pain, stomach poisoning and nausea. In case of symptoms related to respiratory tract, cough and sneezing were experienced by 52% and 38.3% of the experimental group subjects.

Biochemical Analysis

• Lipid profile of control and exposure group

Biochemical analysis is a diagnostic tool for identifying underlying sickness. Lipid profile is used for diagnosing cardiovascular diseases. In order to study the risk for CVD in pesticide mixers/sprayers the serum lipid profile of the study subjects namely, the total cholesterol, triglycerides, HDL, LDL and VLDL were measured and comparative chart of the above levels are given in Figure 2.



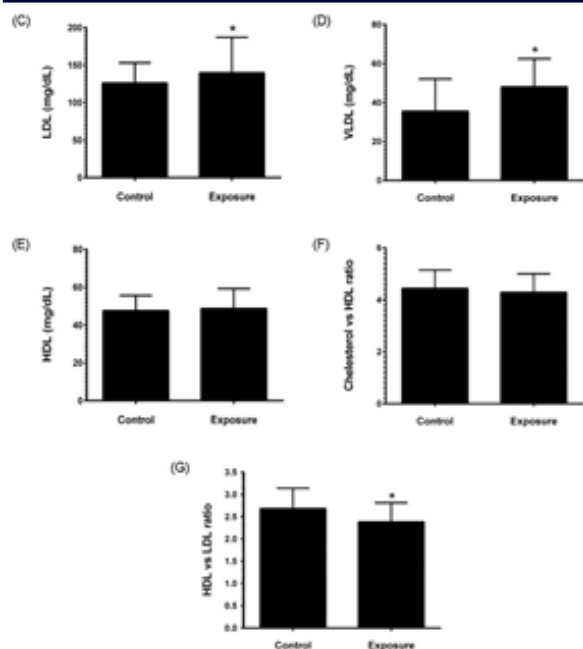


Figure 2: Lipid profile of control and exposure group

These assays revealed that serum lipid profile was significantly modified in the exposure groups compared to the control group. Compared to the non-exposure (control) group, total cholesterol levels were significantly ($p < 0.05$) higher in pesticide/herbicide exposure group (Figure 2A). Triglyceride levels showed a similar trend (Figure 2B). Similarly, the serum LDL and VLDL were significantly increased in exposure group (Figure 2C&D). However, no difference was detected in HDL and cholesterol/HDL ratio (Figure 2 E&F), whereas a detectable difference was observed in HDL/LDL ratio (Figure 2 G).

Pro-inflammatory Molecules

To compare the effect of pesticide/herbicide exposure and vascular inflammation, the pro-inflammatory factors such as nitric oxide, TNF- α (Tumour Necrosis Factor), PGE₂ (Prostaglandin E₂) and lipid peroxidation were measured by commercially available EIA kits.

Nitric oxide level in control and exposure groups

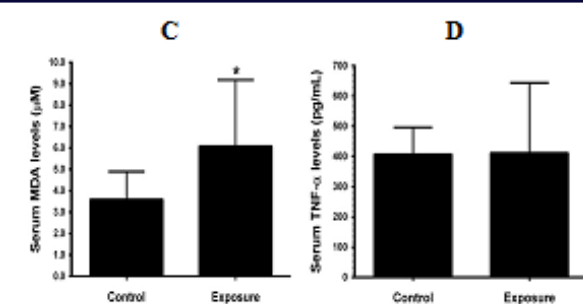
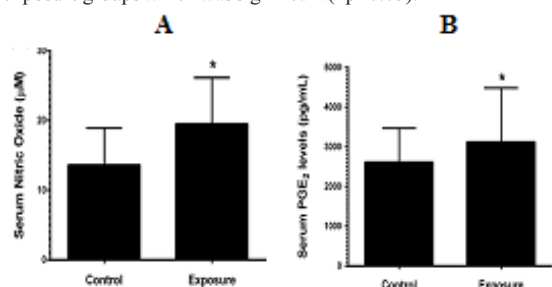
Nitric oxide (NO) was measured as the accumulation of its stable metabolite, nitrite, in the serum and the serum nitric oxide levels are compared with control and exposure groups in Figure 3A.

As shown in Figure 3A, significant ($p < 0.05$) increase in nitric oxide levels were observed in pesticide/herbicide exposed groups compared with non-exposed control group. This data suggests that pesticide/herbicide may have accelerated vascular inflammation.

PGE₂ level in control and pesticide/herbicide handling groups

The levels of PGE₂ in the serum were quantified because PGE₂ a product of vascular inflammatory activity as it is one of the stages in development of CVD.

On comparing the serum PGE₂ levels of control with experimental group as shown in Figure 3B. Similar to the changes in nitric oxide, an increased amount of PGE₂ were observed in pesticide/herbicide exposure groups which was significant ($p < 0.05$).



Lipid peroxidation levels in control and pesticide/herbicide handling groups

To determine the levels of lipid peroxidation in pesticide/herbicide exposed (experimental) and non exposed (control) groups, the level of malondialdehyde (MDA) in serum was measured as MDA is the final product of lipid peroxidation and is the marker for oxidative stress.¹¹

Direct measurement of MDA can be considered as confirmatory tool for toxic effect of pesticides.¹² As shown in Figure 3C, statistically significant ($p < 0.05$) elevated levels of serum MDA was observed in pesticide/herbicide handling subjects compared with non-exposed control groups. This data indicates that the increased lipid peroxidation may be associated with pesticide/herbicide exposure.

TNF- α levels in control and pesticide/herbicide handling groups

TNF- α is significantly associated with blood pressure and total cholesterol which plays a role in CVD was characterized as an important pro-inflammatory molecules.¹³ Therefore, the levels of TNF- α in the serum was determined and given in Figure 3D.

In contest with nitric oxide or PGE₂ levels, there is no significant difference of TNF- α levels between control and pesticide/herbicide exposure groups (Figure 3D). This data suggest that the exposure groups were may be or may not be free from TNF- α -mediated inflammatory disorders.

CONCLUSION

In this study the experimental group subjects who handled pesticide/herbicide were affected by eye irritation, coughing and sneezing as the precautionary measures were used least. Levels of circulatory lipids and inflammatory markers except TNF- α (Tumour Necrosis Factor) levels showed significant increase in subjects exposed to pesticides and this concealed that pesticide/herbicide exposed farmers are highly prone to cardiovascular risks. Further studies are recommended to do focussed group discussions/education to the farmers to bridge the gap between knowledge and practice for better usage of protective items; to farm with minimal or no pesticide usages like organic farming.

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