

A COMMUNITY BASED ANALYTICAL CROSS SECTIONAL STUDY AMONG AGRICULTURAL WORKERS IN MADURAI EAST COMMUNITY BLOCK, TAMILNADU

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ABSTRACT

Background: World Health Organization(WHO) states that diabetes is the ninth leading cause of death in 2019. The study by Velmurugan et.al in 2021 in rural Tamilnadu shows a high prevalence of diabetes among agricultural workers(15.0%) compared to non-farming communities (8.7%). Pesticides, a source of Endocrine Disruptive Chemicals(EDCs) play a major etiological role in diabetes among them. Hence this study aims to explore the association between pesticides and diabetes. **Aim:** 1. To estimate the Occupation wise Prevalence of Diabetes among agricultural workers (Prevalence among Pesticide applicators/Pesticide Mixers/ field workers) in selected village panchayats of Madurai East Community Development Block, Madurai district, Tamilnadu. 2. To find out the association of Diabetes Mellitus with Sociodemographic factors, lifestyle factors, occupational exposure to pesticides for a minimum of 1 year, and metabolic factors. **Materials and Methods:** A community-based cross-sectional study was conducted among 215 agricultural workers in Madurai East-Kallandhiri PHC, using multistage cluster sampling. Sample size was calculated using the Velmurugan et.al study. After obtaining informed consent, study population was interviewed at the doorstep by evening using a semi-structured questionnaire (containing details about sociodemographics, pesticide exposure, diabetic status, etc) and advised for fasting that night. Anthropometric and BP measurements were done. Next day morning by 6 am, fasting capillary blood glucose(CBG) was collected using Accu-Chek glucometer. Data was analyzed using SPSS software version 21.0. **Results:** The mean age of the study population is 52 ± 12.8 years. Females constituted 63.25% of study population. The mean years in agricultural work by study participants is 25.5 ± 12.6 years. The prevalence of diabetes among study population was 29.36%. 19 persons were newly diagnosed. There was a slightly higher proportion (37.9%)of pesticide applicators having diabetes, compared to other agricultural workers (32.3%). The chi-square test between diabetes prevalence and variables yielded a significant p-value for age, BMI and duration of agricultural work. **Conclusion:** It is concluded that further exploration to prove the hypothesis of pesticide exposure and diabetes is needed.

INTRODUCTION

As per the World Health Organization (WHO), type 2 diabetes results from the ineffective use of insulin by the body.^[1] WHO also stated that all non-communicable diseases together accounted for 74% of deaths globally in 2019, in which diabetes was the ninth leading cause contributing to 1.6 million deaths.^[2] An estimate in 2021 showed that 537 million people had diabetes globally of which India stands second with about 74.2 million people and is

expected to rise over 124.9 million by 2045.^[3] ICMR-INDIAB study final report (2008-2011) revealed the prevalence of diabetes as 7.8% in the rural population of Tamil Nadu in the age group of 28-58 years.^[4]

The prevalence of diabetes was found to be on an increasing trend in recent days and it has become a growing menace among agricultural workers (both field workers and pesticide applicators) without any notable risk factors and family history.^[5] There is growing evidence of the etiological role of Endocrine Disrupting chemicals (EDC) in diabetes. Pesticides

are the main source of EDCs among agricultural workers.^[5]

Pesticides include organochlorides, organophosphates, carbamates, pyrethroids etc. Several animal experiments has shown an increase in blood glucose level after malathion treatment which is suggestive of link between pesticides and diabetes.^[6-8] In a study done by Velmurugan et.al in 2021 from 61 villages of Tamil Nadu, the prevalence of diabetes was found to be 15.0% among the farming community which was considerably higher than non-farming community which was 8.7%.^[5] Another study done by S. Jothi Lakshmi et.al in 2019 in Theni district has given the prevalence of nearly 39% among the pesticide applicators and only 10.47% were found to have family history of diabetes.^[9] Current studies have revealed a possible association between pesticide exposure and diabetes through various mechanisms like impairment of glucose metabolism, hormonal disruption, and cardiac oxidative stress.^[10,11] However, India holds the record of second largest agricultural land in the world with around 60% rural Indian households earning their daily bread from agriculture.^[12] As agriculture sector contributes for about 18.8% to the country's Gross Value Added (GVA).^[13] and employs half of the country's population, we are greatly dependent on farmers to provide us with means of sustenance and economic growth of our country.

However, after an exhaustive literature review, it was found that there were only a few studies done among agricultural workers mainly pesticide applicators in rural south India especially in Tamil Nadu. Moreover, diabetes associated with EDCs is the need of the hour so that new strategies can be framed to prevent and manage diabetes in the rural world. Hence this study is proposed to explore the link between pesticides and human diabetes.

Objectives

Primary objective

1. To estimate the Occupation wise Prevalence of Diabetes among agricultural workers (Prevalence among Pesticide applicators/Pesticide Mixers/field workers) in selected village panchayats of Madurai East Community Development Block, Madurai district, Tamilnadu

Secondary Objective

1. To find out the association of Diabetes Mellitus with Sociodemographic factors, lifestyle factors, occupational exposure to pesticides for a minimum of 1 year, and metabolic factors.

MATERIALS AND METHODS

Study Design

A Community based Analytical Cross sectional study was done among agricultural workers Madurai East Community block, Madurai district, done by multistage sampling method. The study was done between August 2023 to November 2023.

This is an observational community-based cross-sectional study done among agricultural workers in the field practice area of Madurai Medical College. A line list of agricultural workers of Kallandiri area was prepared. The study subjects selected using a simple random sampling technique.

Sample size calculation

The sample size was calculated, based on the prevalence of Diabetes among agricultural workers in a study done by Velmurugan et al. The formula $N = (Z^2 \cdot p \cdot (1-p)) / L^2$ was used, where Z (constant) = 1.96, P=15%, and L=5% and, a sample size of 215 people was calculated, with 10% non response rate.

Inclusion Criteria

1. Agricultural workers of >18yrs of age and both gender
2. Agricultural workers of those involved in pesticide application or pesticide mixing or field work for minimum of one year

Exclusion Criteria

1. Those not willing to participate in the study
2. Children (<18yrs of age)
3. Pregnant and lactating mothers

After obtaining informed consent, the study population was interviewed by using a semi-structured validated questionnaire (containing details about sociodemographics, pesticide exposure, diabetic status, etc) and followed by anthropometric measurements (height, weight and BMI) the previous day evening and advised fasting for 8 hours that night.

The next day morning by 6 am, a second visit was done to check for fasting capillary blood glucose (CBG) using an Accu-Chek glucometer. Data was analyzed using SPSS software version 21.0

As per WHO recommendation, the Fasting CBG value is equivalent to Fasting venous sample and hence CBG can be used at the field level to diagnose diabetes.

RESULTS

Among the study participants, 76.8% of study participants belonged to ages 36 to 65 years, with the mean age being 52 ± 12.8 years. Females constituted 63.25% of the study participants. The mean years of agricultural work by the study participants is 25.5 ± 12.6 years

13.4% (n=29) of participants were pesticide applicators with high pesticide exposure, while the remaining 86.6% (n= 186) were agricultural workers were considered as intermediate pesticide exposure, as seen in Fig 1. Among the pesticide applicators, none of them used Gloves, Apron or PPE while spraying. 62% (n=18) of them took bath after each spraying episode.

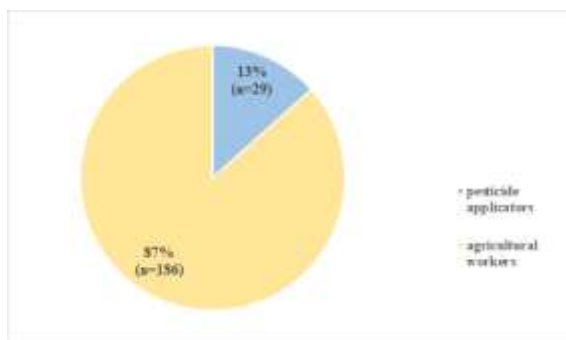


Figure 1: Distribution of study participants according to occupation wise category (n=215)

Our study participants consisted of 52 individuals who were already confirmed to have diabetes, as well as 59 individuals who had fasting blood glucose levels exceeding 126 mg/dl. This led to a total of 79 participants with diabetes after the study. After

deducting the 19 new cases of diabetes discovered during the study, we confidently assert that the prevalence of diabetes in our study was 29.36% as seen in Fig 2.

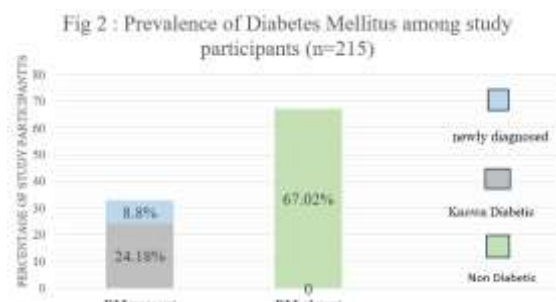


Figure 2: Prevalence of Diabetes Mellitus among study participants (n+215)

Table 1: Association between Diabetes Mellitus and variables among study participants (n=215)

		DM PRESENT (n,%)	DM ABSENT (n,%)	Chi square and p-Value
1	Degree of Exposure			0.365
	Pesticide applicators	11(37.9%)	18(62.1%)	0.546 (> 0.05)
	Field workers	60 (32.3%)	126(67.7%)	
2	Age category			13.749 0.003 (< 0.05)
	20-35	2 (8.7%)	21 (91.3%)	
	36-50	21 (28%)	54 (72%)	
	51-65	33 (36.7%)	57 (63.3%)	
	66-80	15 (55.6%)	12 (44.4%)	1.384
3	Gender category			0.239 (> 0.05)
	Male	30 (38%)	49(62%)	
	Female	41 (30.1%)	95(69.9%)	1.430
4	Family history of DM			0.232 (> 0.05)
	Present	9 (45.0%)	11(55.0%)	
	Absent	62 (31.8%)	133(68.2%)	8.978
5	Duration of agricultural work(years)			0.0395 (< 0.05)
	1 – 15	11 (22.4%)	38 (77.6%)	
	16 -30	29(29.6%)	69 (70.4%)	
	31- 45	22 (42.3%)	30 (57.7%)	
	46 – 60	9(56.3%)	7 (43.8%)	11.8
6	BMI category			0.019 (< 0.05)
	Underweight	2 (12.5%)	14 (87.5%)	
	Normal	34 (28.8%)	84 (71.2%)	
	Overweight	25 (38.5%)	40 (61.5%)	
	Obese	10 (62.5%)	6 (37.5%)	

Table No.1 shows the prevalence of Diabetes mellitus is slightly higher among pesticide applicators 37.9% (n=11) than agricultural workers, 32.3% (n=60). But there was no statistical significance. (p value=0.546). There was association between degree of exposure and age category and there was statistical significance too (p value = 0.003).

DISCUSSION

Over the past few decades, there has been a theory of a link between endocrine disruptive chemicals (EDCs) and the development of endocrine disorders like diabetes, neurological problems, and

reproductive tract disorders.^[14] The most common pesticides implicated in the causation of diabetes are Dioxins, Organochlorines, Organophosphorus compounds, and Carbamates. An interesting fact about Organochlorines is they had an increased diabetogenic effect in higher BMI individuals, due to their lipophilic nature.^[15] A study done by Shipra Tyagi Etal found that higher levels of OCPs in blood disturb the plasma glucose levels and insulin resistance and damage β -cells which increases the risk of developing diabetes.^[16]

In our study, the prevalence of diabetes among farming people was calculated as 29.36%. This is more than the prevalence of 15%, as found in a study done by Velmurugan Etal.^[5]

In our study, 33.3% of pesticide applicators were found to be diabetic. This is almost similar to the study done by S. Jothi Lakshmi Etal, where it was 38.4%.^[9]

A study by Swaminathan Etal in 2015 found that 39.5% of pesticide applicators and 17.5% of intermediate exposure were diabetic, whereas, in comparison, our study found the proportion as 37.9% and 32.3% respectively.^[17]

79 persons were diagnosed with diabetes in our study and 11.39% among them had a family history of diabetes, in comparison to 10.47% in a study done by S. Jothi Lakshmi Etal.^[9]

It is crucial to conduct a comprehensive investigation to comprehend the molecular mechanism responsible for diabetes linked to traditional risk factors such as obesity, as well as diabetes associated with Endocrine-Disrupting Chemicals (EDCs). This will aid in developing new strategies to prevent and manage diabetes in rural areas.

The study has some limitations in analysing a small number of participants and better screening of exposure and estimation of pesticide levels in the blood might have been done for a more careful evaluation of the associated risk.

CONCLUSION

The outcome of our study shows an almost similar finding to other studies, of a higher incidence of diabetes among agricultural workers. Further evaluation and exploration into this association are needed. This will result in better safety precautions and reduce pesticide exposure during pesticide application. Moreover, adequate awareness should be given to agricultural workers about the effects of pesticide exposure and its possible association with diabetes mellitus

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