



Prevalence of Non-Communicable Diseases Among Tea Garden Workers in West Tripura, India

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Abstract: This study addresses the prevalence and risk factors of non-communicable diseases (NCDs) among tea garden workers in the West Tripura district, India. NCDs, including cardiovascular diseases, cancers, chronic respiratory diseases, and diabetes, account for 71% of global deaths, with a significant burden in low and middle-income countries like India, where they are responsible for 63% of fatalities. The World Health Organization (WHO) developed the STEP approach to monitor NCD risk factors, which was employed in this study to understand the health challenges faced by tea garden workers.

The research was conducted from March 2019 to February 2020 among 225 tea garden workers aged 21-60 years, using a multistage stratified random sampling method. Data collection included demographic details, lifestyle habits, and clinical measurements, following the WHO STEP protocol. Key findings revealed that 81.33% of participants used tobacco, and 69.33% consumed alcohol, with a significant overlap between these habits. Physical activity levels were generally high, with 83.56% engaging in vigorous activities. However, 60% consumed fewer than five servings of fruits and vegetables daily. The study found that 20% of participants had hypertension, with a higher prevalence in men (22.22%) compared to women (17.95%). Among those with hypertension, 86.24% were newly diagnosed during the study. Chronic energy deficiency (CED) was prevalent, with 39.86% of males and 50.52% of females affected, indicating critical nutritional problems. Despite high physical activity levels, 45.99% of the population was undernourished, with a significant portion in a subnormal state of health.

The findings underscore the vulnerability of tea garden workers to NCDs due to socio-economic and occupational factors. High tobacco and alcohol use, combined with poor dietary habits, contribute to the NCD burden. Recommendations include improving healthcare access, implementing health education programs, introducing occupational health interventions, and advocating for policy reforms to improve living and working conditions.

In conclusion, the high prevalence of NCDs among tea garden workers in West Tripura highlights the need for targeted health interventions and policy changes to mitigate the health risks and improve the well-being of this marginalized population. Addressing socioeconomic determinants and promoting healthy lifestyles are crucial steps towards reducing the NCD burden.

Index Terms - Tea Garden Workers, West Tripura, Non-Communicable Disease, NCD, WHO STEP.

I. INTRODUCTION

Noncommunicable diseases (NCDs) are medical conditions or diseases that are not caused by infectious agents and cannot be transmitted from one person to another. Non-communicable diseases (NCDs) primarily include cardiovascular diseases, cancers, chronic respiratory diseases, and diabetes [1]. These four categories of diseases are responsible for 71% of global deaths and 80% of premature deaths caused by NCDs. The burden of these diseases is hefty in low and middle-income countries, which experience over three-quarters of all NCD-related deaths worldwide [2]. In India, NCDs are responsible for 63% of all fatalities [3].

In 2004, noncommunicable diseases (NCDs) were responsible for 50% of all deaths and 62% of the overall disease burden in India. These diseases also contributed to nearly 40% of hospital admissions and 35% of outpatient visits that year. Globally, the main risk factors for NCDs include high blood pressure, tobacco use, alcohol consumption, unhealthy diets, and lack of physical activity. In India, additional significant contributors to the NCD burden are elevated blood glucose, abnormal cholesterol levels, overweight, and obesity. Effectively addressing these risk factors could potentially prevent 40-50% of premature deaths due to NCDs in the country [4].

The World Health Organization (WHO) created the STEP approach to monitor risk factors for noncommunicable diseases (NCDs), aiming to support member countries in implementing suitable interventions. Currently, 79 countries have published findings from STEP surveys, with some conducting repeated surveys. In India, the Indian Council of Medical Research (ICMR), with WHO's support, carried out an NCD risk factor survey in five regions of India from April 2003 to March 2005 [5]. This survey provided estimates of major NCD risk factors in these areas. Additionally, another survey, which included STEP 1 (questionnaire) and STEP 2 (clinical measurements) but excluded STEP 3 (biochemical measurements), was conducted in Andhra Pradesh, Kerala, Madhya Pradesh, Maharashtra, Mizoram, Tamil Nadu, and Uttarakhand during 2007-2008, offering state-level estimates [6].

In India, the tea garden worker demographic stands out as particularly disadvantaged regarding health metrics. Addressing NCDs within these vulnerable groups is pivotal for significantly reducing the overall burden of NCDs. While some studies have highlighted specific risk factors such as hypertension, tobacco use, and alcohol consumption, comprehensive data on other factors like dietary habits, physical activity, and a complete risk profile as outlined by the WHO remain limited [7].

The current study aims to assess the prevalence of NCD risk factors among tea garden workers in the west Tripura district using the WHO STEPs approach. This comprehensive assessment will help in understanding the health challenges faced by this specific population and provide insights for targeted interventions.

II. RESEARCH METHODOLOGY

This study was carried out in the tea gardens of the West district of Tripura state from March 2019 to February 2020. The age group of the subjects between 21 to 60 years was included in this study. The sampling method chosen for this study was a multistage stratified random sampling technique. There are 21 tea gardens available in the West Tripura district, and 2 tea gardens were randomly selected for this study, which was 10% of the total gardens. Then, 130 workers from each tea garden were selected randomly and filtered via inclusion and exclusion criteria. In this stage, 35 workers were rejected. Basic verification of data, including name, age, and gender, was done through the voter ID card/birth certificate of the participants. Then, the research work was explained in detail, including the aim, objective, and procedure in local languages, and written consent was taken from the interested participants. The final sample from both gardens was 225. The participants of this study are mainly tea pluckers, and some of them work in the tea processing factory.

The present study was conducted among 21-60-year-old people of tea garden workers living in the West district of Tripura, India, from March 2019 to February 2020. Among the 8 districts in Tripura, one district (West) was randomly selected for the study. Before conducting the study, ethical clearance was obtained from Assam Downtown University (Memo No. adtu/ethics/PhD Scholar/2017/003 dated 21/11/2017).

A revised version of the WHO STEPs questionnaire was employed for surveillance of noncommunicable disease (NCD) risk factors. The questionnaire, originally in English, was translated into Bengali, the local language, and subsequently back-translated into English by independent translators. Despite the different languages used by this population of tea garden workers, the majority were proficient in Bengali. Due to resource constraints, biochemical analysis (STEP 3) was not conducted. STEP 1 covered demographic details such as age, sex, education, marital status, tobacco and alcohol use, fruit and vegetable intake, and physical activity levels. Locally brewed alcoholic beverages were commonly consumed by the population.

In STEP 2, measurements included height, weight, waist circumference, and blood pressure. The body weight of the subjects was measured with a standard weighing scale to the nearest 0.1 kg with minimum clothing and standing height to the nearest 0.1 cm in the standard arm hanging position with a Harpenden-type Anthropometer. Measurements were taken twice by the same trained person. Blood pressure was assessed using an Omron digital automatic blood pressure monitor (HEM 7120), with readings taken three times in a seated position, right arm at heart level. The average of the last two readings was recorded as the final reading for each participant. All measurements adhered to the STEP protocol, with equipment recalibration performed at regular intervals according to manufacturer specifications.

The data analysis was done according to WHO guidelines. Physical activity levels at low, moderate, and vigorous intensities were determined using Metabolic Equivalent (MET) values as per WHO criteria. Consumption of tobacco referred to individuals who had used any tobacco product in the past month. Consumption of alcohol use included those who had consumed alcohol within the previous 30 days. Binge drinking was defined as consuming ≥ 5 standard drinks for men or ≥ 4 standard drinks for women in a single day. Physical activity was assessed across work, travel, and leisure domains and classified based on MET minutes per week into three categories: low (< 600), moderate (600–2999), and vigorous (≥ 3000). An unhealthy diet was characterized by consuming fewer than five servings of fruits and vegetables daily. BMI was calculated as the weight in kilograms divided by the square of the height in meters. The nutritional status of individuals was evaluated according to the internationally accepted World Health Organization (WHO), 1995. Chronic energy deficiency-III (CED III) was defined as a BMI less than 16.0, CED II as a BMI of 16.0 to 16.9, CED I as a BMI of 17.0 to 18.4, and normal as a BMI of 18.5 to 24.9. The WHO (1995) classification of the public health problem of low BMI (< 18.5) was followed, based on adult populations worldwide. According to this classification, a low prevalence (5%–9%) of low BMI is considered a warning sign requiring monitoring, a medium prevalence (10%–19%) as indicating a poor situation, a high prevalence (20%–39%) as indicating a serious situation, and a very high prevalence ($\geq 40\%$) as indicating a critical situation. Health status concerning the nutritional state of the workers was assessed by the Rohrer Index [RI = (Body weight in gm./Stature in cm³) X 100] or Index of Corpulence (RI ≤ 1.19 gm/cm³) [8]. Individuals were considered overweight or obese if their BMI was ≥ 25 kg/m². Abdominal obesity was identified as a waist circumference ≥ 90 cm for men and ≥ 80 cm for women. Hypertension was defined as having a systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg or being on antihypertensive medication.

Statistical analyses were conducted using SPSS, version 17.0, with a significance threshold set at $P < 0.05$. The WHO STEP approach was utilized to analyze NCD risk factors. Student's t-test was employed to compare mean values of continuous variables between males and females.

III. RESULT

The mean age of the sample population was 38.06 ± 11.35 years. Table 1 presents the basic demographic and behavioural risk factors for both men and women. Tobacco use was reported by 81.33% of participants, with 88.89% of men and 74.36% of women reporting usage. Men typically began smoking at the average age of 18 years, consuming around five cigarettes or beedis per day. Table 2 outlines the mean values of NCD risk factors by sex. Alcohol use was reported by 69.33% of participants, with 85.19% of men and 54.70% of women reporting consumption. A significant association was observed between alcohol and tobacco use ($P < 0.001$), with 94.63% of alcohol users also using tobacco. Among the 183 tobacco users, 82.51% (151) also consumed alcohol. In total, 68.54% of participants used both alcohol and tobacco.

Most tea garden workers followed a vegetarian diet. Meal consumption patterns showed that 71.58% of males and 70.28% of females ate only two meals per day. The concept of a packed lunch was uncommon among the subjects. None of the participants reported low levels of physical activity. Vigorous activity was engaged in by 83.56% of participants, with 86.11% of males and 81.20% of females reporting such activity. A majority, 60% of participants, consumed fewer than five servings of fruits and vegetables per day, with 58.33% of males and 61.54% of females falling into this category. Overweight status was observed in 8.89% of participants, comprising 10.19% of males and 7.70% of females, while abdominal obesity was found in 11.56% of participants, with rates of 14.81% for males and 8.54% for females. Hypertension was present in 20% of participants, affecting 22.22% of males and 17.95% of females.

Among the total participants, 20% were identified as having hypertension, with a higher occurrence in men (22.22%) than in women (17.95%). Among those with hypertension, 86.24% were newly diagnosed during the survey. Of the 45 individuals with hypertension, 19.45% were aware of their condition, 9.5% were receiving treatment, and 3.54% had their hypertension adequately controlled.

Table 1: Demographic factors and prevalence (%) of STEP 1 and STEP 2 risk factors by sex

Variable	Male (n=108)	Female (n=117)	Total (n=225)
Age groups 21-30	43 (39.81)	52 (44.44)	95 (42.22)
Age groups 31-40	32 (29.63)	37 (31.62)	69 (30.67)
Age groups 41-50	21 (19.44)	23 (19.66)	44 (19.56)
Age groups 51-60	12 (11.11)	5 (4.27)	17 (7.55)
Married	78 (72.22)	91 (77.78)	169 (75.11)
Illiterates*	62 (57.41)	94 (80.34)	156 (69.33)
Tobacco Consumption*	96 (88.89)	87 (74.36)	183 (81.33)
Smoking only	11 (10.19)	5 (4.27)	16 (7.11)
Smokeless only	30 (27.78)	76 (64.96)	106 (47.11)
Non-tobacco users	8 (7.41)	24 (20.51)	32 (14.22)
Alcohol Consumption*	92 (85.19)	64 (54.70)	156 (69.33)
Eating <5 servings of fruits and vegetables per day	63 (58.33)	72 (61.54)	135 (60.00)
Work activity (Moderate) ¹	15 (13.89)	22 (18.80)	37 (16.44)
Work activity (Vigorous) ²	93 (86.11)	95 (81.20)	188 (83.56)
Overweight ³	11 (10.19)	9 (7.70)	20 (8.89)
Abdominal obesity ⁴	16 (14.81)	10 (8.54)	26 (11.56)
Hypertension ⁵	24 (22.22)	21 (17.95)	45 (20.00)

*P<0.05 (men vs women); MET-metabolic equivalent

¹(600-2999 MET minutes per week); ²(≥3000 MET minutes per week); ³BMI >25 kg/m²; ⁴waist circumference ≥ 90cm for men and ≥ 80 cm for women; ⁵SBP ≥140 mm of Hg and/or DBP ≥ 90 mm of Hg or on medication for hypertension.

Table 2 presents the NCD risk factors of the two groups. The results indicated significant differences in height (cm) and weight (kg) between male and female workers, with males having significantly higher values (P<0.001). However, there were no significant differences observed between males and females in terms of BMI (kg/m²), RI (gm/cm³), systolic and diastolic blood pressure, or heart rate.

Table 2: Select NCD risk factors by sex

Variables	Male (n=108)	Female (n=117)	Total (n=225)
Age (Years)	39.45 ± 11.20	36.67 ± 11.50	38.06 ± 11.35
Height (cm)*	159.13 ± 7.38	152.23 ± 5.97	155.68 ± 7.55
Weight (kg)*	50.32 ± 9.50	44.54 ± 8.21	47.43 ± 8.88
Systolic Blood Pressure (mm of Hg)	119.14 ± 18.69	116.68 ± 20.19	117.91 ± 19.45
Diastolic Blood Pressure (mm of Hg)	76.81 ± 11.29	75.45 ± 11.88	76.13 ± 11.59
Physical activity (MET minutes per week)*	10741.28 ± 4452.43	8763.25 ± 4153.19	9752.27 ± 4305.41
Waist circumference (cm)*	74.49 ± 7.82	69.66 ± 6.54	72.07 ± 7.21
BMI (kg/m ²)	19.82 ± 3.14	19.21 ± 3.36	19.52 ± 3.25
RI (gm/cm ³)	1.25 ± 0.20	1.26 ± 0.23	1.25 ± 0.15

Values are means ± SD; *P<0.05 (men vs women); MET-Metabolic equipment.

Table 3 represents gender-wise nutritional status based on the BMI of tea garden workers. The prevalence of Chronic energy deficiency CED, based on a BMI of less than 18.5 kg/m², was 39.86% in males (CED I: 22.41%; CED II 11.18%; and CED III: 6.27%) and 50.52% in female (CED I: 24.24%; CED II 14.94%; and CED III: 11.36%). As far as overweight and obesity of the overall population are concerned, only 10.19% of male and 7.70% of female workers were found overweight and there was only 0.70 % of male and 1.54% of female workers showed obesity. When the total population was considered 45.99% population was under the CED category.

Table 3: Nutritional status and Health status of male and female tea garden workers based on BMI classification and RI

Anthropometric Variables	Nutritional Status	Cut-off Value	Male (n=108)	Female (n=117)	Total Population (225)
BMI (kg/m ²)	CED III	<16.00	6.27%	11.36%	9.20%
	CED II	16.00 – 16.99	11.18%	14.94%	13.35%
	CED I	17.00 – 18.49	22.41%	24.24%	23.44%
	Total CED	< 18.50	39.86%	50.52%	45.99%
	Normal	18.50 – 24.99	49.25%	40.24%	43.92%
	Over Weight I	25.00 – 29.99	10.19%	7.70%	8.89%
	Obese	>= 30.00	0.70%	1.54%	1.20%
RI (gm/cm ³)	Health Status				
	Very Low	≤1.12	26.57%	30.93%	29.08%
	Low	1.13–1.19	21.68%	14.43%	17.51%
	Middle	1.20–1.25	11.19%	15.98%	13.95%
	Upper Middle	1.26–1.32	11.19%	6.70%	8.61%
	High	1.33–1.39	11.19%	8.76%	9.79%
	Very High	≥1.40	18.18%	23.20%	21.07%

BMI: Body Mass Index; CED: Chronic Energy Deficiency; RI: Rohrer Index

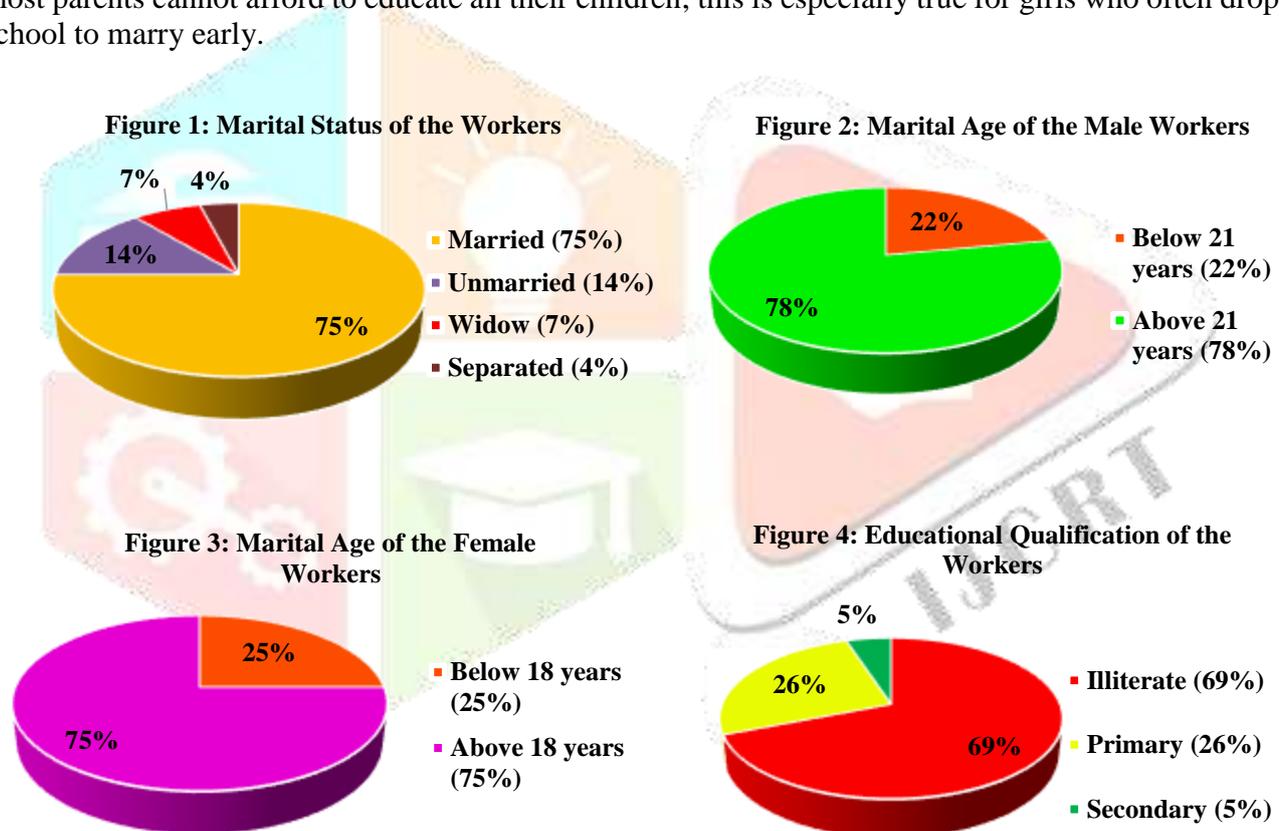
Table 3 also depicts the health status of these subjects. Measurement of health status was done by the Rohrer Index. Rohrer Index of corpulence in both genders of the worker groups revealed that the male and female workers respectively showed 48.25% and 45.36% subnormal state of health (RI≤1.19). When the health status of the overall population was considered, 46.59% of the population was found in a subnormal state of health.

In Figure 1 it has been found that 75% of the workers were married, and 14% were unmarried. Furthermore, 7% of the population were widows because their husbands had died due to different types of diseases such as liver disease, lung disease etc. which were caused by excessive consumption of alcohol, smoking habits etc.; 4% were separated females with deplorable financial conditions.

Figure 2 shows an early marriage trend among the workers. 78% of male workers marry before they turn 21, and 22% do so after turning 21. Early marriage deprives the young generation of proper education which causes persistent poverty. Early marriage may present financial difficulties to some men due to early marriage. Early marriage among tea garden workers has serious consequences for the community.

Figure 3 shows that 25% of female workers in this community have married before they reached 18 years old, while 75% of these women are currently married above 18 years old. Early marriage may negatively impact their mental and physical development by causing them to be less educated than they might otherwise be.

According to Figure 4, 69% of workers are illiterate. 5% studied up to 6th grade or above, and 26% studied up to 5th grade. Despite the Tea Plantation Act 1952, which provides that every tea garden should have at least one school. However, most respondents discontinued their education due to financial constraints since most parents cannot afford to educate all their children; this is especially true for girls who often drop out of school to marry early.



IV. DISCUSSION

Tea garden workers in India are particularly vulnerable to malnutrition due to poor socio-economic conditions, ignorance due to illiteracy, and over-crowded and unhygienic living conditions in the residential colonies. Several reports revealed that tea garden workers are suffering from malnutrition. In view the main objective of this study was to explore the risk factors for non-communicable diseases (NCDs) among tea garden workers in the West Tripura district, employing the WHO STEP methodology.

The body mass index (BMI) is the most well-established anthropometric indicator used for the assessment of adult nutrition status [9]. As per WHO (1995), a low prevalence (5%–9%) of low BMI is considered a warning sign requiring monitoring, a medium prevalence (10%–19%) as indicating a poor situation, a high prevalence (20%–39%) as indicating a serious situation, and a very high prevalence ($\geq 40\%$) as indicating a critical situation [10]. This study revealed a very high prevalence of undernutrition (45.99%) among the tea garden population of West Tripura. Results suggest that both male and female tea garden workers of West

Tripura are in a critical nutritional problem as they have a very high prevalence of undernutrition (Male: 39.86%; Female: 50.52%). Earlier, studies have well-documented the association and significance of CED with the socio-economic, nutrition and health status of the adult population [11,12]. It is well known that nutritional screening with anthropometric measurements is an important first step in the early identification of malnutrition in any population. It initiates the whole nutrition care process of any population. Our previous study with tea garden workers of West Tripura District [13] revealed that both male and female workers are suffering from chronic energy deficiency. In view of this, the health status was determined in this study. The result of health status, as indicated by RI, revealed that a major portion of the male and female workers belong to a subnormal state of health ($RI \leq 1.19$). This result well corroborates the recommendation for nutritional and health surveillance as reported by WHO's (1995) classification of the public health problem of low BMI (<18.5), based on adult populations worldwide and the result also corroborates the previous study done in the West Tripura district [14]. In view of this, some corrective measures like nutritional intervention programs from local health authorities are immediately required for tea garden workers through government, semi-government or private initiatives.

The findings indicate a significant prevalence of tobacco use, with 88.89% of men and 74.36% of women reporting usage. Tobacco is one of the most common causative factors for oral cancers in addition to other diseases such as hypertension, lung cancer and coronary heart disease. According to the Global Adult Tobacco Survey 2016-17 (GATS-2), 13.5 lakh people die every year in India from Tobacco-related diseases. Consumption of tobacco in any form smoke or smokeless, has an equal risk for many respiratory infections and increases the severity of respiratory diseases [15]. The consumption of alcohol is also high among the workers, which is 69.33%. The male workers are mainly addicted to alcohol which is 85.19% but in the case of female workers, approximately half of the population (54.70%) is addicted to alcohol consumption. As compared with the rest of India and NE states, Tripura with the specific prevalence of smoking and alcohol consumption remains high [16].

Gender-specific and age-stratified analyses indicated that khaini/gudkha consumption was associated with an increased risk of hypertension in women only, while locally prepared alcohol consumption was a significant risk factor for hypertension in both genders. Despite the lack of obesity within the community, workers in tea gardens experience a substantial disease burden from hypertension. High BP, a known important risk factor of several cardiovascular morbidities, was found very much prevalent (20% pre-hypertension,) in the present study. This result finds support from the earlier studies done in Assam [17].

The percentage of participants consuming fewer than five servings of fruits and vegetables per day (60%) was higher than the general population of Tripura. Participants frequently consumed potatoes, which were not counted as vegetables in this study. A higher prevalence of consuming fewer than five servings of fruits and vegetables per day has been reported in rural areas of India, with 82.1% of men and 87.2% of women falling into this category. The findings support the outcome of earlier studies on tea garden workers in the west Tripura district [18].

The high prevalence of NCDs among tea garden workers in West Tripura can be attributed to a combination of socio-economic, occupational, and lifestyle factors. Poor living conditions, unhealthy lifestyles, and limited access to health care exacerbate the risk of developing NCDs. These findings are consistent with other studies highlighting the vulnerability of marginalized populations to NCDs. Although the present study was a cross-sectional study, it has inherent limitations and may not depict the true scenario of all the tea garden workers of Tripura as a whole, but this kind of study is the first initiative to find the prevalence of Non-Communicable Diseases Among tea garden workers in West Tripura, India. Tobacco and alcohol use, major NCD risk factors, are prevalent among tea garden workers in West Tripura, especially among men. Despite high physical activity levels contributing to lower overweight and abdominal obesity rates, unhealthy diets are more common among illiterates. Hypertension prevalence is lower than in other populations but comparable to the general Indian population, with awareness and treatment rates also higher among this group. Addressing these issues through culturally appropriate tobacco cessation services and improving health education is crucial to mitigating NCD risks in this population. Interventions directed at these workers as well as studies to determine the reasons for the high prevalence of hypertension are required.

V. RECOMMENDATIONS

To address the health challenges faced by tea garden workers, the following recommendations are proposed:

1. **Improving Healthcare Access:** Establishing mobile health clinics and subsidizing healthcare costs can enhance access to medical services.
2. **Health Education Programs:** Implementing community-based health education programs can promote healthy lifestyles and early detection of NCDs.
3. **Occupational Health Interventions:** Introducing protective measures and regular health check-ups in tea gardens can mitigate occupational health risks.
4. **Policy Reforms:** Advocating for policy changes to improve the living and working conditions of tea garden workers is crucial for sustainable health improvements.

VI. CONCLUSION

The prevalence of NCDs among tea garden workers in West Tripura is alarmingly high, underscoring the need for targeted health interventions and policy reforms. By addressing the socio-economic and occupational determinants of health, it is possible to improve the well-being of this vulnerable population and reduce the burden of NCDs.

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