

Nutritional and Health Status of the Tea Garden Workers of West Tripura District, Tripura, India

Suman K. Nath¹, Ananta M. Dutta², Sutapa Datta¹, Subhra Chattopadhyay¹, Asankur S. Das¹

Assistant Professor, Professor, Assistant Professor, Assistant Professor, Assistant Professor

¹ Department of Medical Laboratory Technology, Tripura Institute of Paramedical Sciences, Hapania, Amtali, Tripura-799014, India.

² Department of Chemistry, Assam Down Town University, Gandhi Nagar, Panikhaiti, Guwahati, Assam-781026, India.

Abstract : This cross sectional study was undertaken to study the nutritional and health status of the male and female tea garden workers of age group 18-60 years of West Tripura district, Tripura, India. Nutritional and health status were analysed by using body mass index (BMI) and Rohrer index (RI) respectively. Based on BMI, the prevalence of chronic energy deficiency (CED) was found in 45.99% of the total workers studied. The prevalence of CED was found more severe in female workers than male. Result also revealed that the health status of the 46.59% of these workers were below the subnormal state. Haemoglobin level revealed that 97.63% of the studied subjects are suffering from anaemia and females are more sufferer than the males. Results of serum proteins showed that 52.82% of the tea garden workers are having hypoalbuminemia (defined as a serum albumin concentration of <35gm/L). This study reveals that both nutritional and health status of the tea garden workers of the West Tripura district of Tripura are in critical situations.

Index Terms - Tea Garden Workers; West Tripura District; Nutritional Status; Health Status; Anaemia.

1. INTRODUCTION

India is the second largest producer of tea plantation and biggest consumer of the tea. In India, tea industry occupies a prime position. It holds a considerable potential for the economic development, as it earns substantial foreign exchange and provides employment to a large number of unskilled labourers in India (Choudhury, 1978). The tea sector is also India's largest private employer with production concentrated primarily in the northeastern states of Assam and West Bengal and to a lesser extent in the southern states of Tamil Nadu and Kerala. The biggest production of tea in India is at Assam, West Bengal, Kerala and Tamil Nadu (Panwar, 2017). Tripura has a history of tea plantation since back to 1916. Tripura has been categorized as tea growing state where about 54 tea estates, 21 tea processing factories and more than 4000 small tea growers are situated. About 8.66 million kg of tea is produced in year and Tripura achieved the 5th largest, among the 16 tea producing state in India. There is considerable scope to increase the productivity and area under tea plantation (<http://industries.tripura.gov.in/tea/>). Tea is also an important agro-industry of Tripura, which contributes immensely to the state's economy.

It is well known that health and socioeconomic status of the worker of any industry is one of the important factors for the productivity, development and growth of it. It is reported that most of the tea workers in northeastern India are descendants of tribal communities from different states of India. During India's colonial period they were brought to the tea estates as bonded or forced labor (Panwar, 2017). Tribal populations are generally having poor nutritional status due to their traditional socio-cultural practices and low literacy level. So it is expected that prevalence of malnutrition may be found in the tea garden workers of north-eastern states. Several reports support this postulation. High magnitude of undernutrition and infectious diseases among tea garden population of Assam was reported by Medhi *et al.*, (2006). Nutritional problems like underweight among children, thinness among adults and micronutrient deficiency disorders like anaemia were widespread. In another report by Deka, (2011) revealed that tribal populations those who are working in the tea industry are affected by various social, economical and developmental constraints that potentially expose them to high rates of malnutrition and health problems. Tea-garden workers had lower BMI, were more physically active, and had a lower prevalence of diabetes mellitus and metabolic syndrome (Mahanta *et al.*, 2013). Several studies had revealed that the tea garden workers vulnerable to various communicable diseases and malnutrition due to the poor socio-economic conditions, ignorance due to illiteracy, over-crowded and unhygienic living conditions in the residential colonies. In study with the male

workers of tea processing factory of West Bengal, India by Sengupta and Sahoo, (2014), it was found that the workers are suffering from malnutrition. A study by Debnath and Debnath (2017) with the workers of a garden of West Tripura district revealed that they are living in a poor socio-economic condition. This study reported that the socio-economic condition of the tea garden workers of West Tripura District of Tripura is in a very despondent condition during study period.

In view this background the aim of this study was to study the nutritional and health status of the tea garden workers of West Tripura district of Tripura, India.

2. RESEARCH METHODOLOGY

2.1 Subjects :

This cross sectional study was carried out during the period from December, 2017 to March, 2018. The studied population was from the workers of tea gardens of the West Tripura district, Tripura, India, of age 18-60 years. Approval for the study was taken from the Ethics Committee of the Assam Down Town University, Guwahati, Assam, India (Memo No. adtu/ethics/PhD Scholar/2017/003 dated : 21/11/2017). A multistage stratified random sampling method was utilized to finally select the subjects of this study. At first 5 tea gardens were randomly selected from the 21 tea gardens of the West Tripura district. On the next stage, 380 tea garden workers were randomly selected and asked for their age. The information provided by the subjects was subsequently verified from official records. In the subsequent stages, subjects were further screened based on their compliance or noncompliance for all kinds of tests and measurements, history of chronic disease or chronic medication or consumption of alcohol or tobacco use for prolonged period. At this stage 31 workers were excluded. Finally, after explanation of objective and protocol of the research work, only the voluntarily participated subjects with written consent were included in this study. At this stage 12 workers were excluded. The final sample size of both groups of subjects was 337 [Group A: Male (n=143) and Group B: Female (n=194)]. As the number of female workers is more than the male workers in the tea garden, the equal number of subjects could not be achieved. Most of them work as tea plucker, and very few of them work in factory and office.

2.2 Anthropometric Measurements:

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 Harpenden type Anthropometer. Measurements were taken twice by the same trained person. 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 internationally accepted World Health Organization (WHO), 1995. Chronic energy deficiency-III (CED III) was defined as BMI less than 16.0, CED II as BMI of 16.0 to 16.9, CED I as BMI of 17.0 to 18.4, and normal as BMI of 18.5 to 24.9. We followed the WHO (1995) classification of the public health problem of low BMI (<18.5), 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 with respect to nutritional state of the workers was assessed by Rohrer Index [RI = (Body weight in gm./Stature in cm³)X100] or Index of Corpulence ($RI \leq 1.19 \text{ gm/cm}^3$) (Datta Banik *et al.*, 2009).

2.3 Physiological Measurements:

Blood pressures were measured with the help of sphygmomanometer and stethoscope. The subjects had sat for a 5-min rest period before measurement. Both systolic (SBP) and diastolic (DBP) blood pressure was measured twice, and the average values of the two readings of the systolic and diastolic pressures were recorded. The measurements were recorded from the left arm at the height of the heart (Takagi *et al.*, 2013). Pulse rate was measured at the left radial artery by palpating for 1 min. Resting heart rate (HR) was determined by measuring the pulse rate at the left radial artery by palpating for 1 min (Agrawal *et al.*, 2013).

2.4 Collection of Blood Samples and Analysis:

Blood samples were taken from each subject between 8 am and 10 am after the subjects had fasted overnight. A total of 5mL fasting venous blood was collected. Two millilitre of blood was collected into

EDTA containing sterile tubes for the analysis of haemoglobin, while the remaining 3mL was collected into an evacuated tube containing no anticoagulant for the analysis of total protein, serum albumin, serum globulin.

Haemoglobin, serum protein, albumin and globulin were assayed to determine the nutritional status of the subjects. Haemoglobin was estimated from whole blood by following cyanmethaemoglobin method by using a biochemical kit (Coral Clinical Systems, Tulip Diagnostics(P) Ltd., India). Total protein, albumin and globulin were estimated by using biochemical kit (Coral Clinical Systems, Tulip Diagnostics(P) Ltd., India). Prevalence of anaemia was determined by using the cutoff values for mild, moderate and severe anaemia as recommended by the study group of WHO (1968). As albumin concentration can be considered as an indicator of overall health and studies have shown that a low serum albumin concentration is found with conditions such as malnutrition, chronic inflammation, enteropathy, or liver disease (Sudfeld *et al.*, 2013), the hypoalbuminemia (defined as a serum albumin concentration of <35g/L) was also determined in the studied population.

2.5 Statistical Analysis:

All statistical tests were performed following standard techniques. Descriptive data were presented as mean $\pm$ SD. Unpaired *t*-tests were performed to check for differences in between the groups. Statistical analyses were performed with SPSS, version 17.0. $P < 0.05$ was considered to indicate statistical significance.

3. RESULTS

Mean values for age, physical and physiological characteristics of the two groups are presented in table 1. Results revealed that there were significant differences in height (cm) and weight (kg) in between the male and female workers, these characteristics were found significantly higher for males ($P < 0.001$) compared to female. No significant differences in BMI (kg/m^2), RI (gm/cm^3) systolic and diastolic blood pressures were observed between males and females workers. Also there were no significant differences in heart rate.

Table 1: Age, physical and physiological characteristics of the male and female tea garden workers.

Variables	Male (Group A) (n=143)	Female (Group B) (n=194)	P Value * (Gr. A Vs Gr. B)
Age (Years)	39.45 $\pm$ 11.20	36.67 $\pm$ 11.50	0.027
Height (cm)	159.13 $\pm$ 7.38	152.23 $\pm$ 5.97	0.000
Weight (kg)	50.32 $\pm$ 9.50	44.54 $\pm$ 8.21	0.000
Systolic Blood Pressure (mm of Hg)	119.14 $\pm$ 18.69	116.68 $\pm$ 20.19	0.127
Diastolic Blood Pressure (mm of Hg)	76.81 $\pm$ 11.29	75.45 $\pm$ 11.88	0.065
Heart Rate (Beats/min)	84.97 $\pm$ 8.30	85.78 $\pm$ 09.09	0.393
BMI (kg/m^2)	19.82 $\pm$ 3.14	19.21 $\pm$ 3.36	0.091
RI (gm/cm^3)	1.25 $\pm$ 0.20	1.26 $\pm$ 0.23	0.487

Values are expressed as mean $\pm$ SD. * denotes P value based on the unpaired *t*-test.

Table 2 presents gender-wise nutritional status based on BMI of tea garden workers. The prevalence of CED, based on a BMI of less than 18.5 kg/m^2 , was 39.86% in male (CED I: 22.38%; CED II 11.19%; and CED III: 6.29%) and 50.52% in female (CED I: 24.23%; CED II 14.95%; and CED III: 11.34%). As far as overweight and obesity of overall population are concerned, only 5.59% male and 3.09% of female workers were found overweight and there was only 0.70 % male and 1.55% of female workers showed obesity. When the total population was considered 46% population was under CED category.

Table 2: 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=143)	Female (n=194)	Total Population
BMI (kg/m^2)	CED III	<16.00	6.29%	11.34%	9.20%
	CED II	16.00 – 16.99	11.19%	14.95%	13.35%
	CED I	17.00 – 18.49	22.38%	24.23%	23.44%

	Total CED	< 18.50	39.86%	50.52%	45.99%
	Normal	18.50 – 24.99	53.85%	44.85%	48.66%
	Over Weight I	25.00 – 29.99	5.59%	3.09%	4.15%
	Obese	>= 30.00	0.70%	1.55%	1.19%
	Health Status				
	Very Low	≤1.12	26.57%	30.93%	29.08%
	Low	1.13–1.19	21.68%	14.43%	17.51%
RI (gm/cm ³)	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 2 also depicts the health status of these subjects. Measurement of health status by Rohrer Index/Index of Corpulence in both genders of the worker groups revealed that the males and female workers respectively showed 48.25% and 45.36% subnormal state of health ($RI \leq 1.19$). When health status of overall population was considered, 46.59% of the population was found in subnormal state of health.

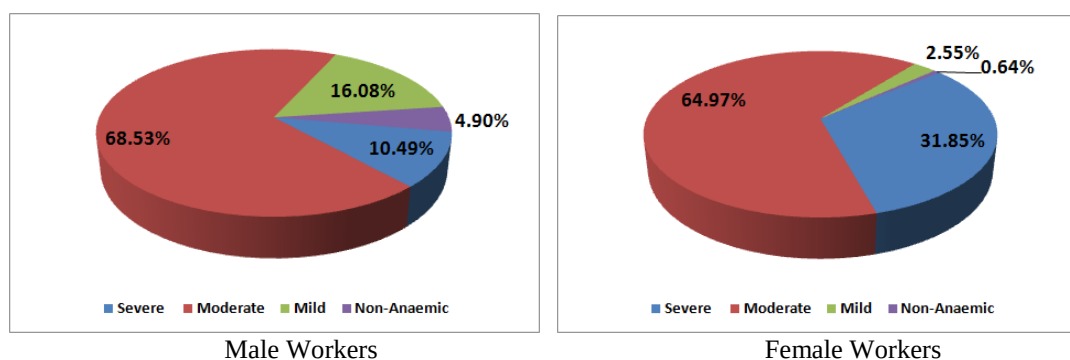
Table 3 depicts the results of haemoglobin level of these subjects. Results revealed that compared to the female, males are having significantly higher ($P < 0.001$) level of haemoglobin. Significantly higher level of total protein ($P < 0.01$) and serum albumin ($P < 0.01$) was found in male workers than the female. However, no significant difference ($P > 0.05$) was found in serum globulin and albumin:globulin ratio.

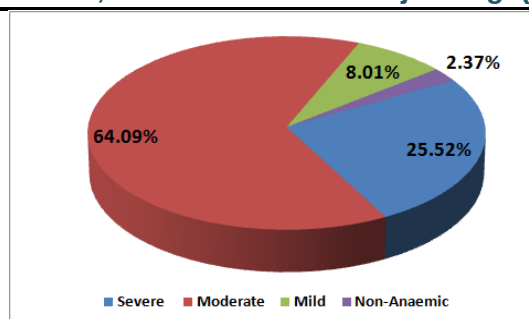
Table 3: Blood level of haemoglobin and serum proteins of the male and female of the tea garden workers.

Variables	Male (Group A) (n=143)	Female (Group B) (n=194)	P Value * (Gr. A Vs Gr. B)
Haemoglobin (gm/dL)	9.64 ± 1.51	8.31 ± 1.25	0.000
Total Protein (gm/dL)	7.26 ± 1.04	6.93 ± 1.02	0.004
Albumin (gm/dL)	3.73 ± 0.52	3.56 ± 0.57	0.004
Globulin (gm/dL)	3.52 ± 0.90	3.37 ± 0.88	0.110
Albumin : Globulin	1.13 ± 0.34	1.13 ± 0.34	0.987

Values are expressed as mean ± SD. * denotes *P* values based on the unpaired *t*-test.

Figure 1 depicts the prevalence of anaemia among the teagarden workers based on the haemoglobin concentration in accordance to the WHO recommendation (1968). The result revealed that 95.10% of male (Mild : 16.08%; Moderate : 68.53% and Severe:10.49%) and 99.48% female (Mild : 2.55%; Moderate : 64.97% and Severe: 36.60%) tea garden workers are suffering from anaemia. When overall population was considered, 97.63% of the tea garden workers are suffering from the anaemia (Fig. 1).





Overall Population

Figure 1: Prevalence of anaemia among the tea garden workers.

When the result of serum albumin was further analysed for determination of hypoalbuminemia, it was found that 38.46% of the male and 53.61% of the female tea garden workers are having low levels of serum albumin (Fig. 2). Moreover 47.18% of whole studied population showed hypoalbuminemia.

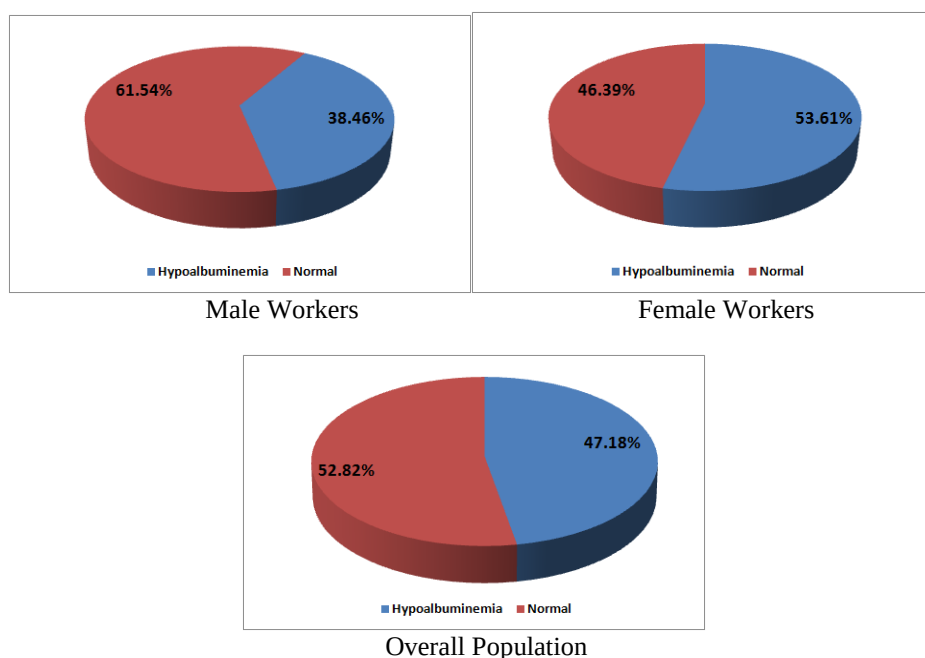


Figure 2: Prevalence of hypoalbuminemia among the tea garden workers.

4. DISCUSSION

Tea garden workers of India are particularly vulnerable to the malnutrition due to poor socio-economic conditions, ignorance due to illiteracy, over-crowded and unhygienic living conditions in the residential colonies. Several reports revealed that tea garden workers are suffering from malnutrition. In view this main objective of this study was to study the nutritional and health status of the tea garden workers of West Tripura district, Tripura, India.

The body mass index (BMI) is the most well established anthropometric indicator used for assessment of adult nutrition status (Lee and Nieman, 2003). 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. 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 are of West Tripura are in a critical nutritional problem as they are having very high prevalence of undernutrition (Male: 39.86%; Female: 50.52%). Earlier, studies have well-documented the association and significance of CED with socio-economic, nutrition and health status of adult population (Naidu and Rao, 1994; Khongsdier, 2005). In view of this the health status was determined in this study. Result of health status, as indicated by RI, revealed that a major portion of the male and female workers belongs to subnormal state of health ($RI \leq 1.19$). This result well corroborates with the recommendation for a 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. In view of this some corrective measures like nutritional intervention programs from local health authority are immediately required for tea garden workers through government, semi-government or private initiatives.

Such presumption of undernutrition and low health status further reinforced by our observation of high prevalence of anaemia in the total population studied. Results revealed that 97.63% of the tea garden workers studied are suffering from anaemia and the females (99.48%) are worst affected. This result finds support from the earlier studies with the tea garden workers of the Assam (Medhi *et al.*, 2006; Das *et al.*, 2012). Nutritional anaemia is the most common type and cause of anaemia. Severe undernutrition might be one of the important factors for development of anemia. This study clearly suggests that the extent of anaemia is higher among the tea garden workers of West Tripura district.

Levels of serum total protein, transferrin, albumin, and prealbumin are all commonly used for nutrition assessment of visceral protein stores. Among all these proteins, albumin is most often used to assess visceral stores of protein. Serum albumin has a long half-life (18 to 20 days) and is often considered as a late marker of malnutrition (Goldstein-Fuchs and LaPierre, 2014). Individuals with conditions such as malnutrition, chronic inflammation, enteropathy, or liver disease can have reduced serum albumin concentrations (Don and Kaysen, 2004). However, low serum albumin levels are often accompanied by abnormal levels of other indices that reflect malnutrition (e.g., anthropometrics, total lymphocyte count, ferritin), and usually indicate a state of poor nutrition. Although the low level of serum proteins may also be mediated by some non-nutritional factors, we included the serum total protein, serum albumin and globulin in our study. Result of serum albumin in this study revealed that tea garden workers are suffering from hypoalbuminemia (Male: 38.46% and Female: 53.61%). In combination with anthropometric indices it may be suggested that they are suffering from chronic nutritional deficiency. As serum albumin concentration can be considered an indicator of overall health, and studies have shown that hypoalbuminemia is a strong predictor of mortality for various acute and chronic illnesses (Sudfeld *et al.*, 2013), the result of serum albumin along with the anthropometric indices (BMI and RI) and haemoglobin level claims a strong evidence for the nutritional deficiency of the studied population.

Although the present study was a cross sectional study, it has inherent limitation 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 health and nutritional status of tea garden workers of West Tripura district. This study revealed that tea garden workers of West Tripura district are in a critical condition in relation to their nutritional and health status. The prevalence of anaemia among them is also very high and requires immediate preventive measures to ameliorate their health status. Moreover, this study suggests that a comprehensive public health policy should be developed to undertake preventive, promotive and curative measures so that the health and nutritional needs of the tea garden workers can be addressed. This study also emphasizes the need of more research on the tea garden workers of other districts of Tripura, India.

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