Introduction

In a vast country like India, variation occurs in the morbidity pattern due to various factors like geographical and seasonal diversity, different socio-economic gradient and other related factors. It is crucial to assess the health needs of tea-garden workers in order to formulate appropriate public health interventions. This study aims to assess the morbidity pattern and nutritional status of tea-garden workers in West Bengal, which is crucial to meet their health needs by formulating appropriate public health interventions. The present cross-sectional study was conducted among 463 tea-garden workers of randomly selected three tea gardens in Alipurduar district of West Bengal, India, chosen by multi-stage sampling. Pre-designed and pre-tested questionnaire was used to collect information on socio-demographic and other variables by means of interview. Physical examination and anthropometric assessment were performed. The haemoglobin was estimated by the ‘filter paper cyanmethemoglobin method’. Morbidities were assessed on the basis of history, clinical examination, evaluation of medical records if any and relevant laboratory investigations and classified and coded as per the 10th revision of the international classification of the diseases. Morbidity profile and nutritional status were assessed through history taking, clinical examination, review of medical records if any, anthropometric assessment and laboratory investigations. Statistical Analysis: Simple proportion was used for interpretation of point prevalence. Chi-square test was applied as the test of significance wherever applicable. Results: Out of total 463 tea-garden workers, majorities (76%) were female and from backward social class (81.2%). More than half (55.9%) were illiterate and three-fourth (67.2%) belonged to lower income quartile. Anaemia was found widespread (87.9%) and more than one-third (36.1%) of the tea-garden workers were found undernourished. Also 43.8% of the workers had airway obstruction as measured by peak expiratory flow rate. Majority (69.8%) of the garden workers had any form of morbidity. Non-communicable diseases (24.2%), musculoskeletal disorders (17.9%), skin disorders (17.7%), respiratory morbidities (16.2%), febrile illness (12.3%), gastrointestinal disorders (8.6%), ocular problems (8.4%), vitamin and micronutrients deficiencies were found the common morbidities among tea-garden workers. Scheduled tribe caste, undernutrition and anaemia were found independent determinants of any morbidity among the tea-garden workers. Conclusions: Morbidities, anaemia and under-nutrition were found very much prevalent among tea-garden workers of West Bengal, which necessitates urgent public health interventions through multi-disciplinary approach in a focussed manner with an aim to improve the overall quality of life of the tea-garden workers.

Keywords: Anaemia, morbidities, PEFR, tea-garden workers, undernutrition
nutritional and cultural factors. There is scarcity of health information in many sub-populations or at-risk populations in India which needs to be explored for effective public health interventions for sustainable development. Tea is an important agricultural industry of West Bengal and Assam in the eastern part of India. The industry holds a considerable potential for economic development and provides employment to a large number of people mainly categorized as the garden workers who are responsible for plantation as well as plucking of tea leaves and other group who engaged in tea processing. Both the category of workers remained exposed to a wide variety of allergens including pollen grains, pesticides, tea dusts and so on, which coupled with poverty, under-nutrition and low literacy status ultimately leads to several morbidities. The vicious cycle of under-nutrition including micro-nutrient deficiencies and morbidities coupled with unhygienic environment, illiteracy and poverty adversely affect their health status.

Through and reliable information on health problems of any population is essential for formulating any healthcare system to address health needs. India is in the process of disease transition which is posing a great challenge to its health system due to the changing health needs of the population. Though non-communicable diseases and lifestyle disorders are found escalating in all parts of the society due to various reasons, communicable diseases including deficiency disorders still remain the major causes of disease burden in India. Considering those facts in mind, the present study was planned with the objectives to know the prevalence and pattern of morbidity as well as nutritional status of the tea-garden workers of Alipurduar district, West Bengal.

Materials and Methods

Study design and setting

The present community-based cross-sectional study was conducted among the tea-garden workers of randomly selected tea gardens of Alipurduar district of West Bengal, India. West Bengal is the second major tea-producing state of India and contributes about one-fourth of tea production of India. Darjeeling, Terai and Dooars are the three major tea-growing areas of the state. Among them, highest tea is produced in Dooars. Alipurduar is a newly formed district in the Dooars region of West Bengal, India. The total area of the district is about 3383 km² and consists of two municipalities and six community development blocks. The atmosphere is humid throughout the year with heavy rainfall. Most of the tea gardens were situated in the north-east part of the district which forms the foothill belt of the Himalayas. Three tea gardens, namely Birpara, Hantapara and Chinighora, were chosen randomly for the study purpose. As per the records, around 2454, 2403 and 1110 workers (majority were predominantly tribal and seasonal migratory workers from Chotonagpur and Santal parganas of Jharkhand state, India) were registered in the above-mentioned three tea gardens, respectively, which constituted the sampling frame.

Study participants

All the adult tea-garden workers (aged ≥18 years), those who are willing to participate voluntarily, were included in the present study. Majority were predominantly tribal and seasonal migratory workers from Chotonagpur and Santal parganas of Jharkhand state, India.

Sample size and sampling technique

Considering the rough estimate that the proportion of adult tea-garden workers could have any morbidity to be 0.5%, 95% confidence level, 5% absolute allowable error and 10% nonresponse rate, the minimum required sample size was calculated to be 422 by using the formula $n = \frac{z^2_{\alpha/2}pq}{\delta^2}$.

Multi-stage random sampling technique was used for selection of the study participants. Around 150 garden workers, each from the three selected tea gardens, were chosen randomly for the study purpose. A total of 468 tea-garden workers participated/included in the present study, which was more than the desired sample size.

Ethical issues and necessary approval

The study was approved by the ‘Institutional Ethical Committee’ of the Midnapore Medical College, West Bengal, India. Necessary permission was taken from the management authority of the selected tea gardens for smooth and sustained cooperation. Informed consent was obtained from each of the study participants. Those who were found either having any morbidity understudy or presence of any modifiable risk factors for development of chronic life-style disorders were managed by the accompanied medical team and or referred to the nearest Madarhat or Birpara hospital for further management.

Data collection and measurements

After obtaining necessary permission from appropriate authorities and informed consent from the study participants, a team of trained and qualified physicians interviewed the study participants by using a pre-tested and pre-designed semi-structured questionnaire. Information collected on selected socio-demographic, socio-economic and relevant behavioural factors. Self-reported morbidities or disease symptoms in last 6 months preceding the survey were obtained by the study participants with emphasis on common morbidities. The medical team performed relevant physical and systemic examinations. All the available medical records and reports were evaluated and recorded. Diagnosis of the morbidities was based on all the collected information by the same physician who collected the data for better consistency. For maintaining data uniformity, morbidities were classified and coded as per the 10th revision of the international classification of the diseases. Whenever possible, some morbidities or diseases/system-specific symptoms were grouped together to make common and easy/simple interpretation.

Blood pressure (BP) was recorded three times by a mercury sphygmomanometer (Diamond Co. made) in the right arm in

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sitting position after a 10-min rest before each recording nearest
to 2 mmHg. The averages of lowest two readings of systolic
and diastolic BPs were taken. Hypertension/BP was classified
according to the ‘JNC-8’ classification.\(^1\)

Anthropometric measurements like weight and height were
measured by digital weighing scale and potable stadiometer (both
manufactured by SECA) to nearest 0.1 kg and 0.1 cm, respectively,
by using standard techniques.\(^4\)

For interpretation, body mass index (BMI) was calculated
(weight in kg/height in m\(^2\)) and considered as an index of
overweight and obesity. The recommendation made by the WHO
for Asians was used as the BMI cut-off values.\(^3\)

Haemoglobin estimation was done by the ‘Filter paper
cyanmethemoglobin method’.\(^6\) Anaemia was classified according
to the WHO guideline.\(^7\) Stool examination for helminthic
infestation was assessed by the formal-ether concentration
technique in sub-samples.\(^8\)

Peak expiratory flow rate (PEFR) was measured by simple
colour-coded peak-flow meter by using standard technique to
evaluate the obstructive airway diseases at field level. Three
readings were taken and highest value (in litre/minute) was used
as the recorded PEFR. Reference values of the EU scale were
used for interpretation of the PEFR.\(^8\) PEFR readings were
classified into three colour-coded zones such as (a) green zone:
80–100% of the usual or normal REFR, indicate no airway
obstruction; (b) yellow zone: 50–79% of the usual or normal
PEFR indicate mild-to-moderate airway obstruction; and (c)
red zone: <50% of the usual or normal REFR indicate severe
airway obstruction.\(^9\)

**Statistical analysis**

Statistical analysis was done by SPSS 12.0.1 software package (SPSS
for windows, version 12.0.1. 2001, Chicago: SPSS Inc.). The continuous variables were presented by mean ± SD and
categorical variables expressed in percentage. The Chi-square test
was applied to test the significance between two groups. Odds
ratio (OR) and 95% confidence interval (95% CI) were calculated
for each categorical risk factor. Multiple logistic regression was
done with metabolic syndrome as dependent variable with
selected modifiable risk factors such as personal habits, physical activity, obesity, central obesity, eating
habits and so on as independent variables. For all statistical tests,
P < 0.05 was considered as statistically significant.

**Results**

A total of 463 tea-garden workers participated in the study.
Majority of the study participants were found seasonal
migratory workers from Chota Nagpur and Santhal parganas
of Jharkhand state, India. The average age (mean ± SD) was
37.97 ± 13.18 years. More than three-fourth (352/463; 76%) were
female. Majority belonged to scheduled tribe (376/463; 81.2%)
and more than half of them (259/463; 55.9%) were illiterate.
Total average (mean ± SD) family income was 3475.59 ± 1840.10
and about two-third (311/463; 67.2%) of them belonged to
lowest income quartile. About 43% (199/463) of the study
participants had history of any addiction (mostly tobacco and
alcohol). The average BMI was 18.89 ± 2.11 kg/m\(^2\) and mean
haemoglobin percentage was 9.95 ± 1.35 mg/dl.

Nutritional status, BP, classification of anaemia and grading
of the peak exploratory flow rate were illustrated in Table 1. It
was evident that 56.8% of the tea-garden workers had normal
nutritional status while 38% were under-nourished. Only 5.2% of
the study participants were found overweight. According to the
‘JNC-8 classification’, 17.3% and 6.9% of the study participants
were found in stage-I and stage-II hypertension, respectively.
Another 57.8% of them found pre-hypertensive and rest 18.1%
had normal BP. The prevalence of anaemia among the tea-garden
workers was as high as 87.9%. Majority of the anaemia patients
were either mild (37.1%) or moderate (47.3%). Only 3.5%
suffered from severe anaemia. In more than half (56.2%) of
the study participants, the mean PEFR fallen in the green zone
which reflected good airway control. Among 35.2% the study
participants, the PEFR fallen in yellow zone which indicates
mild-to-moderate airway narrowing and thus necessitates caution.
In rest 8.6%, it fallen in red zone which means severe airway
obstruction [Table 1].

The prevalence and pattern of morbidities were shown in
Table 2. Among the tea-garden workers, the prevalence of
any morbid condition was found in 69.8%. Distribution
of various morbidities indicates that non-communicable

| Table 1: Nutritional status, blood pressure, anaemia and grading of peak expiratory flow rate (PEFR) among the study participants (n=463) |
| Variables | n | Percentages |
|-----------------|----|------------|
| Nutritional status (based on BMI) | | |
| Under nutrition (BMI: <18.5 kg/m\(^2\)) | 167 | 36.1 |
| Normal nutritional status (BMI: 18.5-22.99 kg/m\(^2\)) | 271 | 58.5 |
| Overweight (BMI: ≥23 kg/m\(^2\)) | 25 | 5.4 |
| Classification of blood pressure* | | |
| Normotensive | 84 | 18.1 |
| Prehypertension | 267 | 57.7 |
| Stage I hypertension | 80 | 17.3 |
| Stage II hypertension | 32 | 6.9 |
| Classification of anaemia* | | |
| No anaemia | 56 | 12.1 |
| Mild anaemia | 172 | 37.1 |
| Moderate anaemia | 219 | 47.3 |
| Severe anaemia | 16 | 3.5 |
| Grading of peak exploratory flow rate (PEFR)* | | |
| Green zone | 260 | 56.2 |
| Yellow zone | 163 | 35.2 |
| Red zone | 40 | 8.6 |
| Total | 463 | 100.0 |

*Blood pressure classification as per the JNC-8 criteria. *Anaemia classification as per WHO Criteria. *Grading of PEFR according to reference value of the ‘Mini-Wright EU scale’
diseases were the commonest (24.2%) pattern of morbidities followed by musculoskeletal disorders (17.9%), dermatological morbidities (17.7%), respiratory morbidities (16.2%), other illness (14%), febrile illness (12.3%) and ocular morbidities (8.4%). Clinical signs of vitamin and micronutrient deficiencies were observed among 7.9% of the study participants while 3.9% suffered from worm infestation. The prevalence of pulmonary tuberculosis was found in 3% and 5.8% of the study participants gave history of injuries and accidents [Table 2].

After adjustment with possible confounders, scheduled tribe caste [OR (95% CI): 2.1 (1.1–3.8)], undernutrition or BMI <18.5 kg/m² [OR (95% CI): 3.2 (1.9–5.2)], and mild and moderate anaemia [OR (95% CI): 3.1 (1.7–5.3) and 5.2 (2.8–9.9), respectively] were found independent determinants of any morbidity among the tea-garden workers [Table 3].

### Discussion

The present study revealed that majority of the tea-garden workers were female (76%) and from marginalized community (scheduled caste (ST): 81.2%). Illiteracy (55.9%) as well as poverty (mean family income: 3475.59 ± 1840.10 with lowest income quartile: 67.2%) were very much prevalent among the study participants. In spite of female preponderance, a quite sufficient proportion (43%) of the study participants had addiction to tobacco and alcohol. Several studies also reported similar findings (majority of the tea-garden workers were female and tribal seasonal workers). Majority of the studies also reported problems of illiteracy and poverty among the tea-garden workers which was very much similar to our study findings.[12-14] A study from Dibrugarh district of Assam reported that addiction of tobacco was as high as 85.2% and that of alcohol was 26.8% among the tea-garden workers.[13] Another study also reported widespread use of tobacco and alcohol among the tea-garden workers.[14]

In the present study, morbidities were found quite prevalent among the tea-garden workers. Overall, 69.8% of the study participants experienced morbidity. The common morbidities among the studied tea-garden workers were non-communicable diseases, musculoskeletal disorders, skin problems, respiratory disorders, febrile illness, ocular morbidities, vitamin and micronutrient deficiency disorders, worm infestation and so on.

A study from two tea gardens of Jalpaiguri district of West Bengal revealed that sore throat, cough, pain abdomen, headache, backache and skin diseases were prevalent morbidities of tea-garden workers. The common morbidities were sore throat and cough among male workers while backache and headache among female workers.[12-14] Another study reported common morbidities among tea-garden workers were skin problems, worm infestation, musculoskeletal disorders, respiratory morbidities including tuberculosis, filariasis and so on in communicable diseases and hypertension and stroke in non-communicable diseases.[14]

Another study reported that diarrhoea (25.9%), dysentery (23.8%), typhoid (17%), scabies (14.3%) and intestinal worm infestations (10.2%) were the predominant morbidities among the tea-garden workers. The study findings differed because it mainly focused on diseases related to health and hygiene practices among the tea-garden workers.[15]

The present study revealed dual burden of morbidities, both communicable diseases including under-nutrition and deficiency disorders as well as non-communicable diseases among the tea-garden workers. Contrary to the popular belief, non-communicable diseases were found the commonest form of morbidities (24.2%) among the study participants, which probably reflected that the disease transition disproportionally affected the poor tea-garden workers, even those engaged in heavy manual works. High BP, a known important risk factor

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**Table 2: Prevalence and pattern of morbidity among the study participants (n=463)**

| Morbidities                                | ICD 10 coding | n   | Percentages |
|--------------------------------------------|---------------|-----|-------------|
| Overall (at least any one morbidity)       | -             | 323 | 69.8        |
| Febrile illness                            | B50-51; A92; R50,51 | 57  | 12.3        |
| AGE and other GTP problems                 | A06,09        | 22  | 4.8         |
| Respiratory morbidities                    | J00-03,06,18,20,31,40,44-45 | 75  | 16.2        |
| Pulmonary tuberculosis                     | A15,16        | 14  | 3.0         |
| Musculoskeletal disorders                  | M10,13,47,70  | 83  | 17.9        |
| Neurological problems                      | G61,64,72     | 32  | 6.9         |
| Vitamin and micronutrient deficiencies    | E50,52-54,63  | 37  | 7.9         |
| Worm infestations                          | B76-77,83     | 18  | 3.9         |
| Disorders related to digestive system and abdomen | R10-11,14; K29 | 40  | 8.6         |
| Ocular morbidities                         | H04,10,11,25  | 39  | 8.4         |
| ENT morbidities                            | H60,66,90,92  | 17  | 3.7         |
| Dermatological morbidities                 | B86; I00,02,30 | 82  | 17.7        |
| Injury and accidents                       | T11,13,51; X20 | 27  | 5.8         |
| NCDs (hypertension, stroke, CVDs, type 2 diabetes mellitus etc.) | I10,25,42,64; E11 | 112 | 24.2        |
| Others                                     | E07,K02,70;N39,95; O03,06,80; R53 etc. | 65  | 14.0        |

NB: Morbidities not mutually exclusive; cumulative proportions may exceed 100%
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of several cardiovascular morbidities, was found very much prevalent (57.7% pre-hypertension, 17.3% stage-I hypertension and 6.9% stage-II hypertension) in the present study. Only 18.1% of the study participants had normal BP.

Chronic airway obstruction as reflected by the mean PEFR revealed that around 35.2% of the tea-garden workers had mild-to-moderate airway obstruction, whereas 8.6% had severe airway obstruction. A study from northern part of West Bengal also reported that shortness of breath, nasal allergy and airway obstruction were the common respiratory morbidities among tea industry workers which included both garden as well as factory workers.16

More than one-third (36.1%) of the tea-garden workers were found under-nourished (BMI < 18.5 kg/m²) which was more than the reported prevalence (20.6%) of undernutrition among adult population of West Bengal.87 Some studies from Assam among tea-garden workers reported much higher prevalence (66.2% and 69.9%, respectively)14,18 while another study from Assam reported lower (17.2%) prevalence. The difference in prevalence of undernutrition may be due to different study area, time period and cut-offs used for undernutrition.

The present study revealed that anaemia prevalence among the tea-garden workers was as high as 87.9%. Several studies also reported similar widespread prevalence of anaemia among tea-garden workers.12,18 A study reported that presence of nutritional anaemia among tea-garden workers was 43.9%20 while another study reported almost universal (96.3%) prevalence of anaemia among tea-garden workers. Even NFHS 5 says that anaemia among rural females of 15–49 years is 74.4%.21 So we can conclude that healthcare of these workers require special attention as also reiterated by a study in Jorhat Assam by R. Preet22 that there are lot of dissatisfaction among tea plantation workers regarding available healthcare.

Novelty of this study was that all 463 workers were interviewed by trained physicians and diagnosis was made by them who examined them to remove any discrepancy. The workers were very satisfied by being examined with utmost care.

**Conclusions**

So, to summarize, among these 463 tea-garden workers of Alipurduar district of West Bengal who were mostly female

| Table 3: Determinants/Correlates of morbidity among the study participants |
|-----------------------------|---------------------|-----------------|-----------------|-----------------|-----------------|
| Variables                  | Number studied n (%) | Any morbidity n (%) | P    | Crude OR (95% CI) | Adjusted OR (95% CI) |
| Overall                    | 463 (100.0)          | 323 (69.8)       |      |                 |                  |
| Age group (years)          |                     |                  |      |                 |                  |
| 18-30                      | 168 (36.3)           | 115 (68.5)       | 0.29 | 1.4 (0.8-2.3)   | 1.2 (0.6-2.2)    |
| 31-44                      | 146 (31.5)           | 111 (76.0)       |      | 0.6 (0.4-1.0)  | 0.6 (0.3-1.2)    |
| 45-59                      | 104 (22.5)           | 62 (59.6)        |      | 1.4 (0.7-3.1)  | 2.3 (0.9-5.6)    |
| ≥60                        | 45 (9.7)             | 35 (77.8)        |      |                 |                  |
| Sex                        |                     |                  |      |                 |                  |
| Male                       | 111 (24.0)           | 75 (67.6)        | 0.84 | 1.2 (0.8-1.9)  | 0.9 (0.5-1.9)    |
| Female                     | 352 (76.0)           | 248 (70.5)       |      |                 |                  |
| Caste                      |                     |                  |      |                 |                  |
| Others                     | 87 (18.8)            | 51 (58.6)        | 0.020| 1.02 (0.4-2.9) | 1.3 (0.4-4.1)    |
| Scheduled tribe            | 376 (81.2)           | 272 (72.3)       |      | 2.0 (1.2-3.2)  | 2.1 (1.1-3.8)    |
| Education                  |                     |                  |      |                 |                  |
| >10                        | 80 (17.3)            | 41 (51.2)        | 0.008| 1.02 (0.4-2.9) | 1.3 (0.6-4.3)    |
| Class 5-10                 | 100 (21.6)           | 66 (66.0)        |      | 2.8 (1.4-5.5)  | 3.5 (1.5-7.9)    |
| Classes 1-4                | 24 (5.2)             | 18 (75.0)        |      | 2.5 (0.9-6.8)  | 2.2 (0.7-7.2)    |
| Illiterate                 | 259 (55.9)           | 198 (76.4)       |      | 2.7 (1.7-4.3)  | 2.5 (1.3-4.8)    |
| Monthly Income             |                     |                  |      |                 |                  |
| Highest quartile           | 36 (7.8)             | 20 (55.6)        | 0.016| 1.02 (0.4-2.9) | 1.3 (0.6-4.1)    |
| Third quartile             | 32 (6.9)             | 22 (68.8)        |      | 1.4 (0.5-3.8)  | 1.5 (0.5-5.1)    |
| Second quartile            | 84 (18.1)            | 69 (82.1)        |      | 3.2 (1.3-7.7)  | 3.8 (1.4-10.5)   |
| Lowest quartile            | 311 (67.2)           | 212 (68.2)       |      | 1.4 (0.7-2.9)  | 1.3 (0.6-3.0)    |
| H/O any addiction          |                     |                  |      |                 |                  |
| No                         | 264 (57.0)           | 180 (68.2)       | 0.27 | 1.02 (0.4-2.9) | 1.3 (0.4-4.1)    |
| Yes                        | 199 (43.0)           | 143 (71.9)       |      | 1.1 (0.7-1.6)  | 0.7 (0.4-1.3)    |
| BMI (kg/m²)                |                     |                  |      |                 |                  |
| ≥18.5                      | 296 (63.9)           | 186 (62.8)       | 0.000| 1.02 (0.4-2.9) | 1.3 (0.6-4.1)    |
| <18.5                      | 167 (36.1)           | 137 (82.0)       |      | 3.0 (1.9-4.6)  | 3.2 (1.9-5.2)    |
| Grades of anaemia          |                     |                  |      |                 |                  |
| No anaemia                 | 87 (18.8)            | 38 (43.7)        | 0.02 | 1.02 (0.4-2.9) | 1.3 (0.4-4.1)    |
| Mild                       | 188 (40.6)           | 139 (73.9)       |      | 2.9 (1.7-4.9)  | 3.1 (1.7-5.5)    |
| Moderate                   | 172 (37.1)           | 138 (80.2)       |      | 4.2 (2.4-7.3)  | 5.2 (2.8-9.9)    |
| Severe                     | 16 (3.5)             | 08 (50.0)        |      | 1.02 (0.4-2.9) | 1.3 (0.4-4.1)    |
illiterate workers from marginalized community, most of them complained some morbidity or the other (69.8%). A percentage of 24.2 were hypertensive and another 57.8% were pre-hypertensive. A percentage of 87.9 were anaemic in spite of being heavy workers; 24.2 had some non-communicable diseases. Other diseases were musculoskeletal disease neurological disease, fever and so on.

Poverty, faulty food intake when coupled with unhygienic environment and sanitation probably exaggerated the situation. Hence, the vicious cycle of under-nutrition, anaemia and morbidities continues.

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Conflicts of interest
There are no conflicts of interest.

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