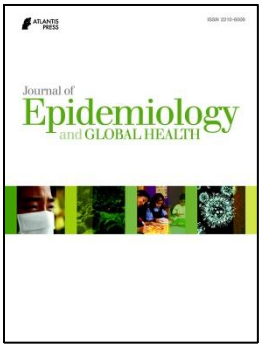

Journal of Epidemiology and Global Health

ISSN (Online): 2210-6014 ISSN (Print): 2210-6006
Journal Home Page: https://www.atlantis-press.com/journals/jegh

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To cite this article: Tulika G. Mahanta, Rajnish Joshi, Bhupendra N. Mahanta, Denis Xavier (2013) Prevalence of modifiable cardiovascular risk factors among tea garden and general population in Dibrugarh, Assam, India, Journal of Epidemiology and Global Health 3:3, 147–156, DOI: https://doi.org/10.1016/j.jegh.2013.04.001

To link to this article: https://doi.org/10.1016/j.jegh.2013.04.001

Published online: 23 April 2019

Journal of Epidemiology and Global Health (2013) 3, 147–156

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Prevalence of modifiable cardiovascular risk factors among tea garden and general population in Dibrugarh, Assam, India

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Received 26 August 2012; received in revised form 11 April 2013; accepted 12 April 2013
Available online 25 May 2013

KEYWORDS
CVD Risk factor;
Tea garden community;
Salt intake;
Assam;
India

Abstract *Introduction:* Risk factors for cardiovascular disease (CVD) are multifactorial. Previous research has reported a high prevalence of CVD risk factors in tea-garden workers. This study was conducted to assess prevalence and level of modifiable cardiovascular risk factors among tea-garden and general population in Dibrugarh, Assam.

Methods: A community-based cross-sectional study using the World Health Organization's (WHO) Stepwise methodology was conducted in Dibrugarh District of Assam. A multistep random sampling was done to include adults aged 35 years and above, with an intended equal sampling from tea-garden and general population. INTERHEART modifiable non-laboratory based risk score was estimated. Salt consumption was estimated using questionnaire-based methods in both subgroups.

Results: A total of 2826 individuals participated in the study (1231 [43.6%] tea-garden workers; 1595 [56.4%] general population). Tobacco consumption was higher in tea-garden workers as compared with general population (85.2% vs. 41.7% ($p < 0.0001$). Mean daily per-capita salt consumption was also significantly higher among tea-garden workers (29.60 vs. 22.89 g, $p = 0.0001$). Overall prevalence of hypertension was similar (44.4% vs. 45.2%), but among those who had hypertension, prevalence of undiagnosed hypertension was higher in tea-garden workers (82.8%

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http://dx.doi.org/10.1016/j.jegh.2013.04.001

vs. 74.4%, $p < 0.0001$). Tea-garden workers had lower BMI, were more physically active, and had a lower prevalence of diabetes mellitus and metabolic syndrome. Their INTERHEART modifiable risk score was also lower (1.44 [2.5] vs. 1.79 [2.8], $p = 0.001$).

Conclusion: High prevalence of modifiable risk factors like tobacco consumption, high salt intake and high prevalence of hypertension indicates the need for early implementation of preventive actions in this population.

1. Introduction

Cardiovascular disease (CVD) is a major contributor to the global burden of chronic diseases accounting for 29.3% of all deaths and 9.9% of total disease burden [1]. The burden of CVD is predicted to increase substantially in developing countries by the year 2020, largely due to rising rates of CVD risk factors [2–4]. Further, many communities across the developing world are undergoing an epidemiologic transition, where the burden of CVD in terms of mortality among adults is surpassing than that of infectious diseases. Such epidemiologic transitions have a potential to modify the understanding about high and low CVD risk communities.

Risk factors for CVD are multifactorial. The INTERHEART study showed that nine risk factors (abnormal lipids, smoking, hypertension, diabetes, abdominal obesity, psychosocial factors, consumption of fruits, vegetables, and alcohol, and regular physical activity) account for nine out of ten cardiovascular events [5]. More recently, an INTERHEART modifiable risk score has been proposed, which provides a comprehensive numeric assessment of these risk factors [6]. This has huge implications both at the individual and the population levels, as an overall quantification of risk makes it easier to evaluate if preventive strategies have been successful. A non-laboratory-based version of this risk score does not involve measurement of lipids, and has been shown to be equivalent to a laboratory-based version. Overall risk quantification using the INTERHEART risk score has not been previously reported in Indian populations.

Tea-garden workers are a distinct occupational group who migrated to Assam about a century ago from different states of India to work as tea-leaf pickers and have been residing within tea-estates [7]. They are known to have more predictable incomes, higher socio-economic status, and a high CVD risk factor prevalence (tobacco use 83.3%; hypertension varies from 27.7% to 63.3%; diabetes 2.3%; obesity 0.39%) [8–10]. Further, they are also known for their higher daily salt consumption (dietary salt intake 20 g or more), believed to be a key reason for hypertension in this community [9]. Although many previous studies have suggested tea-garden workers to be a special population ''sub-group'' at high CVD risk, concurrent comparison with the general population in the same region has been lacking.

While it is likely that tea-garden workers continue to have high risk factor levels, particularly hypertension, secular lifestyle changes in general population might have bridged epidemiologic differences. The research question of the current study is: *Do the tea-garden workers (as compared with the general population living in the same areas) have a higher CVD prevalence of modifiable risk-factors?*

2. Methods

2.1. Design

A cross-sectional study was conducted with multistep sampling to select a representative population (rural–urban tea-garden and non-tea-garden) from the district.

2.2. Ethics statement

The study protocol was approved by the institutional ethics committee of Assam Medical College, and necessary permissions were obtained in addition from the Joint Director of Health Services and the Assam Branch of the Indian Tea Association. After explaining study procedures, a written informed consent was sought from all eligible participants, and those consenting were included in the study. If a participant could not read or write, verbal information was provided, and consent was recorded as a thumb impression in the presence of two impartial witnesses. The surveys were preceded by meetings with community leaders to ensure community-wide participation.

2.3. Setting

This study was carried out in Dibrugarh district, of Assam, north-eastern India. The district is spread over more than 3000 square km and is populated by about 1.2 million individuals (0.9 million rural, 0.3 million urban). About 23% of the entire population work in 144 tea gardens located in the district, and some of these gardens are also located in urban areas. There are a total of 1362 villages situated in 231 health sub-centers of the district. In urban areas, there are 96 electoral blocs. A total of 169 rural sub-centers (73%) and 11 urban electoral blocs (11%) have tea gardens [11].

2.4. Participants

All adults, aged 35 years or more, on the electoral lists of their area were eligible for inclusion. The goal was to include a representative sample of such adults from those administrative units (rural sub-centers or urban electoral blocs) in the district that had at least one tea garden. From the list of such units, a total of four sub-centers and two electoral blocs were randomly selected. Furthermore, from these administrative units, electoral lists of all adults aged 35 years or more ($n = 4757$) were used, and 2400 respondents from four rural sub-centers (600 from each) and 600 from the two urban electoral blocs (300 from each) were randomly selected. Of the selected and eligible 3000 individuals, 2826 (94.2%) consented for participation in the study. From the random list of participants enrolled in the first two stages of the study, the first 20% of consecutive participants were invited to join the third stage of the study where sample collection was carried out at the nearest health facility to their village on a holiday so that all could participate in the laboratory-based survey.

2.5. Study procedures

The World Health Organization's (WHO) STEPS questionnaire [12], translated into the local language, was used to collect information in three stages. First, socio-demographic information was collected at households; secondly, the risk factor questionnaire was administered and physical measurement was performed; thirdly, biochemical measurements were obtained from 20% of the total sample. The risk factor questionnaire also included key variables to estimate INTERHEART non-laboratory-based modifiable risk score (diet, alcohol use, physical activity, stress and depression) [6]. Salt intake was assessed using a 24-h dietary recall. Cumulative salt intake was estimated by adding the estimated salt content of prepared food and beverages (especially salty tea offered at work places for tea-leaf pickers). The person in the household responsible for cooking was asked regarding the use of salt; it was estimated that about a spoonful of salt was used in each meal. Since one heaped standard spoon equals 5 g of salt [13], the product of the number of spoonful plus standard weight was the total salt consumed by the family. Assuming equal salt use by each member, per-capita salt used was estimated as total salt use divided by total family members. Monthly salt consumed by the family was used for triangulation of data.

All the equipment used to measure height, weight, waist and hip circumference and blood pressure were similar at all the centers to ensure uniformity. Height was measured using a stadiometer (to nearest 0.1 cm), weight using calibrated spring weighing machines (to nearest 0.5 kg), waist and hip were measured using non-stretchable tapes (to nearest 0.1 cm) and blood pressure using the Omron SDX (Omron, Inc., Japan) instrument. Standard protocols were used to obtain these measurements.

In the third step, fasting blood sugar and lipids were estimated from collected blood sent to the Biochemistry Laboratory of Assam Medical College. Blood sugar, cholesterol, high density lipoprotein (HDL) cholesterol and triglyceride levels were measured using enzyme-based assays. Values of low density lipoprotein (LDL) cholesterol, non-HDL cholesterol and the ratio of total HDL cholesterol were calculated using standard formulae.

2.6. Statistical analysis

The data were entered using Epidata, and analyzed using SPSS. The distribution of risk-factor variables between tea-garden workers and the general population was compared using Student's *t*-test for continuous variables and the Chi-square test for dichotomous variables. Prevalence odds were determined to quantify the risk among tea-garden workers. The sample size of 2556 was *a priori* estimated to detect at least a 2 mm Hg difference from the general population with 95% power, assuming a mean SBP of 131.98 ± 8.08 mm of Hg among tea-garden workers [9].

Risk factors were classified based on standard criteria. Smokers included subjects who smoked cigarettes, biddies, or other smoked forms of tobacco daily; past smokers were subjects who had smoked for at least 1 year and had stopped more than a year ago. Users of other forms of tobacco (nasal, oral, etc.) were classified as non-smoked tobacco use. Diagnostic criteria were used for tobacco use, as well as other coronary risk factors, as specified by WHO [12]. Individuals involved in any significant physical activity at work or during leisure time were classified as active and those with >30 min of activity were classified as moderately active. Hypertension was diagnosed when systolic BP was >140 mmHg and/or diastolic BP >90 mmHg or a person was a known hypertensive. Overweight or obesity was defined as BMI >25 kg/m^2 [14,15]. Truncal obesity was diagnosed when waist-to-hip ratio (WHR) was >0.95 in men and >0.85 in women or waist circumference was >100 cm in men and >90 cm in women according to the United States National Cholesterol Education Program (NCEP) guidelines [16]. Dyslipidemia was defined by the presence of high total cholesterol (>200 mg/dl), high LDL cholesterol (>130 mg/dl), low HDL cholesterol (<40 mg/dl in men and <50 mg/dl in women) or high triglycerides (>150 mg/dl) according to the International Diabetes Federation. Diabetes was diagnosed on the basis of either a history of known diabetes or fasting glucose >126 mg/dl. Metabolic syndrome was diagnosed based on IDF guidelines if three of the following five criteria were met: abdominal obesity (waist circumference >102 cm in men and >88 cm in women), high triglycerides (greater than 150 mg/dl), low HDL (less than 40 mg/dl in men and less than 50 mg/dl in women), high blood sugars (greater than 110 mg/dl or previously known diabetes mellitus), and high blood pressure (SBP >130 mm of Hg and diastolic blood pressure >85 mm of Hg) [17].

3. Results

A total of 2826 individuals participated in the study (1,231 [43.6%] tea-garden workers; 1,595 [56.4%] general population); about half (49.5%) of all participants were men (mean age 47.5 ± 10.8). As compared with the general population, tea-garden workers had a lower education, higher employment, but lower income. Tea-garden workers also consumed more salt. Mean daily per-capita salt intake was 29.60 grams vs. 22.89 g in the general population ($p = 0.0001$) (Table 1).

Tea-garden workers consumed more tobacco (proportion of current users 85.2% vs. 41.7% ($p < 0.0001$). The prevalence of previously known hypertension (11.6% vs. 16.6%), and diabetes mellitus (0.8% vs. 1.8%) was, however, lower in tea-garden workers. Tea-garden workers had higher levels of physical activity and had lower BMI (mean BMI 21.34 vs. 23.59 kg/m^2, $p < 0.0001$). Mean WHR was similar (0.941 vs. 0.948; $p = 0.02$) in the two groups. Tea-garden workers also had a smaller proportion of individuals in the highest tertile of INTERHEART modifiable non-laboratory-based risk score ($p = 0.008$). Their INTERHEART modifiable risk score was also lower (1.44 [2.5] vs. 1.79 [2.8], $p = 0.001$) (Table 2).

Based on measured blood pressure, and previously known hypertension, a total of 45.2% of all participants were hypertensive. This distribution was similar in tea-garden workers and the general population. The mean systolic and diastolic blood pressures were also similar in the two groups. Among all hypertensives, the proportion of previously undetected hypertension was 82.8% and 74.4% in the tea-garden workers and the general population, respectively ($p < 0.0001$). While the proportion of individuals with previously known hypertension was lower in tea-garden workers, overall prevalence of hypertension was equal, largely due to undetected hypertension (Table 3).

A total of 576 individuals participated in the third step of the study. The general population had higher mean triglyceride levels (148.1 ± 9.3 vs. 154.9 ± 33.6 mg/dl) and dyslipidemia. Among all individuals who participated in the third step, prevalence of diabetes mellitus and metabolic syndrome was 5.9% and 21.2%, respectively. The prevalence of these conditions was also higher in the general population (diabetes mellitus 3.9% vs. 7.7% and metabolic syndrome 15.1% vs. 26.9%). Individual components in the definition of metabolic syndrome are detailed in Table 4. The higher risk in the general population persisted, even after adjustment for age (Table 5). The association between metabolic syndrome and obesity was further explored in this study population. Prevalence of metabolic syndrome was 16.4% among individuals with BMI less than 25 kg/m^2, and 38.4% among individuals with BMI more than or equal to 25 kg/m^2. This difference was statistically significant ($p < 0.0001$).

4. Discussion

In the current study, it was found that tea-garden workers consumed more salt and tobacco. However, the overall prevalence of hypertension was similar in both groups. Tea-garden workers had lower BMI scores, were more physically active, and had a lower prevalence of diabetes mellitus and metabolic syndrome. Their INTERHEART modifiable risk score was also lower. These findings contradict earlier studies that tea-garden workers are at a higher CVD risk than the general population. The prevalence of CVD risk factors was high in both groups. It has been believed in the past that tea-garden workers being more affluent had distinct

Table 1 Demographic, socio-economic, and dietary variables among the study population ($n = 2826$).

Variable	Total (*n*, %)	Tea garden (*n*, %)	General population (*n*, %)	*p*-Value
Number	2826	1231	1595	
Mean age (years (SD))	47.5 (10.8)	46.1(10.3)	48.5 (11.2)	<0.0001
Male gender	1400 (49.5)	625 (50.8)	775 (48.6)	0.133
Education level				
None	1370 (48.5)	988 (72.1)	382 (27.9)	
1–8 Grades	568 (20.1)	202 (35.6)	366 (64.4)	<0.0001
9–12 Grade	586 (20.7)	29 (4.9)	557 (95.1)	
Trade School	28 (1.0)	5 (17.9)	23 (82.1)	
College/University	274 (9.7)	7 (2.6)	267 (97.4)	
Employed				
Yes	1507 (53.3)	833 (67.7)	674 (42.3)	
No	1319 (46.7)	398 (32.3)	921 (57.7)	<0.0001
Average household annual Income (In rupees(SD))	80872 (71036)	34421 (17252)	97827 (82763)	<0.0001
Asset ownership				
Any	2811 (99.5)	1228 (99.8)	1583 (99.2)	0.065
Land	2695 (95.4)	1174 (95.4)	1521 (95.4)	0.533
Livestock	774 (27.4)	182 (14.8)	592 (37.1)	<0.0001
Television	2318 (82.0)	977 (79.4)	1340 (84.0)	0.004
Vehicle	123 (4.4)	7 (0.6)	116 (7.3)	<0.0001
Average per-capita salt use (grams(SD))	25.8 (7.2)	29.6 (7.6)	22.8(5.2)	<0.0001
Additional non-cooked salt				
User	734 (59.6)	753 (47.2)	1487 (52.6)	
Non user	497 (40.4)	842 (52.8)	1339 (47.4)	<0.0001

Student's *t*-test was used for difference in means, and chi-square test was used for difference in proportions. *p*-Values are derived from these test statistics.

environmental exposures. While the cross-sectional study done at this time finds both populations at similar risk, it is likely that tea-garden workers have been at a higher risk longer (as reported in previous studies), and the general population has caught up more recently. In either case, it is speculated that any differences in CVD risk in both populations are likely to be environmental and related to lifestyle changes rather than genetics.

Cardiovascular risk is multifactorial, and hence it is difficult to come up with a summary measure of the risk. Recently, INTERHEART modifiable risk score has been proposed, which is derived from a global study, and is internally and externally validated. The non-laboratory version of this score had a similar performance as the full score, and has a special relevance for this population, where obtaining lipid levels for risk estimation is logistically difficult. Since all components of this score are potentially modifiable, this study also provides a population level baseline to guide effectiveness of future interventions.

Higher levels of tobacco consumption, salt intake, and unawareness of hypertension in tea-garden workers are likely to be related to lower literacy levels in this group. About 80% of tea-garden workers were illiterate, as compared with 24% in the general population. Education levels are considered a reliable surrogate for overall socio-economic status, which also has an impact on access to health-care and uptake of risk reduction strategies. Tobacco consumption practices include tobacco chewing with lime and betel nut, and use of hand-rolled tobacco (biddies) for smoking. High prevalence of cigarette smoking and other forms of tobacco use are common in South Asia, including reported prevalence of smoking biddies (a small amount of tobacco wrapped in a temburni leaf) of 5.9% among males, and of smokeless tobacco (chewing tobacco or chewing paan) of 7.3% (5.5% in women and 7.6% in men) [18,19]. INTERHEART case-control study of risk factors for acute myocardial infarction (MI) has documented that there is an increased risk of myocardial infarction associated with all forms of smoked and smokeless tobacco

Table 2 Distribution of key risk factors in study population ($n = 2826$).

Variable	Total (*n*, %)	Tea garden (*n*, %)	General population (*n*, %)	*p*-Value
Number	2826	1231	1595	
Tobacco and smoking				
Formerly used	161 (5.7)	58 (4.7)	103 (6.5)	
Currently used	1714 (60.7)	1049 (85.2)	665 (41.7)	
Never used	951 (33.7)	124 (10.1)	827 (51.8)	<0.0001
Physical activity at work				
Mainly sedentary	528 (18.7)	104 (8.5)	424 (26.6)	
Predominately walking	645 (22.9)	267 (21.7)	378 (23.8)	
Mainly walking	365 (12.9)	270 (22.0)	95 (6.0)	<0.0001
Heavy physical worker	513 (18.2)	355 (28.9)	158 (9.9)	
Does not work	768 (27.2)	232 (18.9)	536 (33.7)	
Physical activity during leisure time				
Mainly sedentary	435 (15.4)	135 (11.0)	300 (18.8)	
Mild exercise	613 (21.7)	225 (18.3)	388 (24.3)	<0.0001
Moderate exercise	1772 (62.7)	870 (70.7)	902 (56.6)	
Strenuous exercise	6 (0.2)	1 (0.1)	5 (0.3)	
Alcohol				
Daily	280 (20.8)	230 (26.8)	50 (10.3)	
5—6 days/week	22 (1.6)	6 (0.7)	16 (3.3)	
1—4 days/week	696 (51.8)	472 (55.0)	224 (46.1)	<0.0001
<4 days/month	301 (22.4)	127 (14.8)	174 (35.8)	
<Once month	45 (3.3)	23 (2.7)	22 (4.5)	
Or never	1482 (52.4)	373 (30.3)	1109 (69.5)	
Financial stress				
Little or none	1253 (44.4)	505 (41.0)	748 (47.0)	
Moderate or severe	1569 (55.6)	726 (59.0)	843 (53.0)	0.001
Mental stress				
Never or some period	2196 (77.8)	719 (58.5)	1477 (92.8)	
Several or permanent	625 (22.2)	511 (41.5)	114 (7.2)	<0.0001
BMI (kg/m²)				
Underweight (<18)	346 (12.2)	212 (17.2)	134 (8.4)	
Normal (18—25)	1731 (61.3)	854 (69.4)	877 (55.0)	<0.0001
Overweight (>25 to <30)	657 (23.2)	135 (11.0)	522 (32.7)	
Obese (⩾30)	92 (3.3)	30 (2.4)	62 (3.9)	
WHR quartiles				
Quartile1 (<0.873)	322 (11.4)	114 (9.3)	208 (13.0)	<0.0001
Quartile 2&3 (0.873—0.963)	1455 (51.5)	796 (64.7)	659 (41.3)	
Quartile 4 (⩾0.964)	1049 (37.1)	321 (26.1)	728 (45.6)	
Known Hypertension	407 (14.1)	143 (11.6)	264 (16.6)	0.0001
Known diabetes	39 (1.4)	10 (0.8)	29 (1.8)	0.023
Known MI	5 (0.2)	3 (0.2)	2 (0.1)	0.659
Known Stroke	4 (0.1)	0	4 (0.3)	0.137
INTERHEART modifiable risk score				
Lowest tertile (0—5)	2550 (90.2)	1126 (91.5)	1424 (89.3)	
Middle tertile (6—10)	240 (8.5)	95 (7.7)	145 (9.1)	
Highest tertile (11—15)	36 (1.3)	10 (0.8)	26 (1.6)	0.062
Mean INTERHEART score	1.64 (2.7)	1.44 (2.5)	1.79 (2.84)	0.001

Student's *t*-test was used for difference in means, and chi-square test was used for difference in proportions. *p*-Values are derived from these test statistics. BMI = body mass index. WHR = waist-to-hip ratio.

Table 3 Prevalence of hypertension and its distribution by demography and socioeconomics ($n = 2826$, 1277 with hypertension).

Variable	Total (*n*, %)	Tea garden (*n*, %)	General population (*n*, %)	*p*-Value
Number	2826	1231	1595	
Hypertension	1277 (45.2)	551 (44.8)	726 (45.5)	0.703
Hypertension grades				
Normal: SBP < 120 and DBP < 80	422 (14.9)	192 (15.6)	230 (14.4)	0.837
Pre-HTN: SBP 120–139 or DBP 80–89	1127 (39.9)	488 (39.6)	639 (40.1)	
Stage 1 HTN: SBP 140–159 or DBP 90–99	903 (32.0)	392 (31.8)	511 (32.0)	
Stage 2 HTN: SBP ⩾ 160 or DBP ⩾ 100	374 (13.2)	159 (12.9)	215 (13.5)	
Mean systolic blood pressure (SD)	137(19)	137(20)	137(19)	0.782
Mean diastolic blood pressure (SD)	82(10)	82(11)	82(10)	0.287
Total number of hypertensive	1277	551	726	
Newly detected hypertensive	996(78.0)	456(82.8)	540(74.4)	<0.0001
By area of residence				
Rural	1032 (45.8)	394 (45.1)	638 (46.3)	
Urban	245 (42.6)	157 (44.0)	88 (40.4)	0.434
Age group				
35 to <45	433 (32.7)	221 (34.8)	212 (30.7)	0.114
45 to <55	394 (50.4)	174 (50.0)	220 (50.7)	0.886
55 to <65	254 (56.8)	92 (56.8)	162 (56.8)	1.000
65 Above	196 (72.3)	64 (74.4)	132 (71.4)	0.663
Educational status				
None	625 (45.6)	451 (45.6)	174 (45.5)	1.000
1–8 Grade	235 (41.4)	83 (41.1)	152 (41.5)	0.929
9–12 Grade	248 (42.3)	12 (41.4)	236 (42.4)	1.000
Trade school	16 (57.1)	3 (60.0)	13 (56.5)	1.000
College/University	153 (55.8)	2 (28.6)	151 (56.6)	0.247
Marital status				
Unmarried	31 (41.3)	9 (45.0)	22 (40.0)	0.793
Married	949 (42.4)	392 (41.8)	557 (42.8)	0.665
Others	297 (57.9)	150 (54.7)	147 (61.5)	0.072
Occupation status				
Employed	706 (46.8)	375 (45.0)	331 (49.1)	0.199
Unemployed	409 (37.3)	103 (36.0)	306 (37.8)	0.619
Retired	162 (72.6)	73 (65.20	89 (80.2)	0.016

Student's *t*-test was used for difference in means, and chi-square test was used for difference in proportions. *p*-Values are derived from these test statistics. SBP = systolic blood pressure. DBP = diastolic blood pressure.

[19]. Therefore, use of tobacco in forms other than cigarette smoking (e.g., biddies) is both common and important as contributors to the CVD burden in South Asia.

Salt intake in the present study population was about 25 g per person per day, much higher than the NHLBI recommended 6 g/d [20] and previous estimates for India and Assam (10 and 10.6 g, respectively) [21,22]. The present study results show five times higher intake of salt in both tea-garden workers and the general population. Intake of salty tea during working hours in large mugs thrice a day may be one of the reasons for such a high consumption pattern among the tea-garden population.

This study showed a high prevalence of hypertension. Mean systolic and diastolic blood pressures are also higher as compared with other studies [23,24]. Prevalence of hypertension was found to be higher in both the population groups and in both urban and rural areas. Much more striking are high levels of hypertension unawareness, which again is

Table 4 Mean levels and differences of anthropometric and laboratory risk factors in individuals who participated in the third step of the study (n = 576).

Risk factor	Tea garden	General population	Mean difference	95% CI	p-Value
Number	279	297			
Age (years)	45.5	49.2	3.7	(1.96—5.47)	0.000
Male gender n (%)	143 (54.8%)	118 (45.2%)			
BMI (kg/m^2)	21.3 ± 3.6	23.5 ± 3.8	2.24	(1.96—2.52)	<0.0001
Waist (cm)	74.8 ± 13.5	81.5 ± 14.1	6.67	(5.65—7.70)	<0.0001
Waist:hip ratio	0.94 ± 0.07	0.95 ± 0.08	0.007	(0.008—0.01)	0.022
Total cholesterol (mg/dl)	189.0 ± 18.6	192.5 ± 20.6	3.51	(0.29—6.72)	0.033
Serum Triglycerides (mg/dl)	148.1 ± 9.3	154.9 ± 33.6	6.82	(2.73—10.92)	0.001
Serum HDL (mg/dl)	49.1 ± 17.2	65.4 ± 29.7	16.33	(12.32—20.33)	<0.0001
TGL:HDL ratio	3.21 ± 0.6	2.76 ± 1.2	0.44	(0.28—0.59)	<0.0001
Serum LDL (mg/dl)	112.1 ± 19.1	97.9 ± 32.1	14.10	(9.75—18.45)	<0.0001
Fasting blood sugar (mg/dl)	94.5 ± 21.0	97.8 ± 25.6	3.24	(0.61—7.09)	0.099
Prevalence					
Diabetes mellitus	3.9%	7.7%			<0.0001
Metabolic syndrome	15.1%	26.9%			<0.0001
Increased waist circumference[a]	10.0%	20.5%			0.001
High triglycerides[b]	32.3%	61.6%			<0.0001
Low HDL[c]	41.6%	22.2%			<0.0001
High blood sugar[d]	15.8%	17.2%			0.651
High blood pressure[e]	63.1%	62.6%			0.910

Student's t-test was used for difference in means, and chi-square test was used for difference in proportions. p-Values are derived from these test statistics. BMI = body mass index. CI = confidence interval. HDL = high density lipoprotein. LDL = low density lipoprotein.

[a] Elevated waist circumference defined as greater than or equal to 102 cm in men, and 88 cm in women.

[b] High triglycerides defined as greater than or equal to 150 mg/dl (1.69 mmol/L).

[c] Low HDL defined as less than 40 mg/dl (1.03 mmol/L) in men and less than 50 mg/dl in women (1.30 mmol/L).

[d] High blood sugar defined as greater than 110 mg/dl (6 mmol/L) or pre-existing diabetes mellitus.

[e] High blood pressure defined as greater than 130 mmHg systolic or 85 mmHg diastolic.

skewed more in favor of socio-economically disadvantaged tea-garden workers. Screening, access to health-care services, and promoting adherence to pharmacological and non-pharmacological therapies become important in this scenario. The global burden of hypertension shows it to be highly prevalent (20—40% among urban and 12—17% among rural adults) [25] and was affecting an estimated 118 million inhabitants in India in 2000; this number is projected to almost double to 214 million in 2025 [26].

A higher BMI rating, low physical activity levels, higher prevalence of diabetes mellitus and metabolic syndrome are all interrelated and were more prevalent in the non-tea garden general population. This may be due to their relative affluence and comparatively sedentary occupations. Multifactorial risks will need multiple strategies for risk mitigation. Promotion of physical activity and the simultaneous reduction in sedentary occupations remain important strategies in population subgroups. While the overall prevalence of diabetes mellitus was similar to population estimates for India, metabolic syndrome was found to be lower in this study population compared with other studies from India (21.2% vs. 26.6%) [27].

Stratified sampling was performed to select study participants from among a high proportion of participating individuals to be truly representative. Hence, the results are able to be generalized for similar settings in the region. This is an improvement over previous studies from the region where only occupational groups (tea-garden workers, or industrial workers) were sampled [10,28].

The present study has certain limitations. First, the assessment of salt consumption was based on recall, and is crude. Given the reported high salt consumption, biochemical studies are needed to confirm this finding. Second, the estimates for prevalence of diabetes and metabolic syndrome are from a sub-sample; however, this sub-sample has been taken care of to be representative. Last, this study took samples from only one district of the state, but the results are considered to be sufficiently generalizable as behavior risk factors, access to health-care and dietary practices are similar.

Table 5 Age-adjusted odds ratios and 95% confidence intervals for lifestyle and risk factor associations of general population as compared with tea-garden workers (logistic regression analysis).

Variable	Adjusted OR	95% CI	*p*-Value
Educational status			
None	46.7	16.1–45.1	<0.0001
1–8	33.4	3.6–35.7	0.002
9–12	4.8	0.5–6.3	0.17
College/University	Reference		
Marital			
Unmarried	Reference		
Married	2.6	0.2–40.2	0.48
Widowed	1.9	0.1–31.3	0.66
Smoking and/or tobacco use			
Non smoker	Reference		
Smoker	2.4	1.2–4.7	0.01
Alcohol			
Non user	Reference		
User	13.7	6.7–28.3	<0.0001
Financial stress			
Little/none	Reference		
Moderate/severe	1.3	0.6–2.6	0.44
Stress			
Never/some period	Reference		
Several/permanent	4.7	2.2–9.6	<0.0001
Active work			
Inactive	Reference		
Active	0.7	0.3–1.3	0.29
Overweight/obesity			
BMI < 25 kg/m^2	Reference		
BMI $\geqslant$ 25 kg/m^2	0.278	0.1–0.6	0.002
Risk factor			
High cholesterol			
<200 mg/dl	Reference		
$\geqslant$200 mg/dl	1.2	0.6–2.5	0.53
High triglycerides			
<150 mg/dl	Reference		
$\geqslant$150 mg/dl	0.2	0.1–0.4	<0.0001
Hypertension			
No	Reference		
Yes	0.7	0.4–1.5	0.46
Metabolic syndrome			
No	Reference		
Yes	1.3	0.5–3.0	0.48
Diabetes			
No	Reference		
Yes	0.7	0.386–1.2	0.26

5. Conclusion

The burden of cardiovascular risk factors among both tea-garden workers and the general population is high. Interventions directed at CVD risk mitigation are needed. Early implementation of health promotional measures, including avoidance of tobacco consumption, detection and control of hypertension and dietary modification, will help in reducing the future risk of manifest cardiovascular events.

Acknowledgments

Kindly acknowledge the support of — St Johns Research Institute as training grant for health research mentorship program from NHLBI.

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