Original Article

Sociodemographic correlates of abnormal blood profile in tribal districts of Eastern India

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ABSTRACT

Objective: To assess the correlates of sociodemographic profile with abnormal blood profile in tribal districts of Odisha. **Design:** This was a cross-sectional study. The abnormal blood profile cut-offs were: Random blood sugar >200 mg/dl, Triglycerides >150 mg/dl, and Cholesterol >200 mg/dl. **Setting:** The study was carried out in Daringbadi and Tangi (Choudwar) blocks from Kandhamal and Cuttack district, respectively, in the eastern state of Odisha in India. **Participants:** Data of 2,000 households selected consecutively from 30 villages was collected for persons aged more than 6 years from either block on sociodemographic aspects and food consumption by households. Anthropometric measurements were taken for persons aged 11 years and above. Approximately 10%, that is, 400 households were chosen for blood sample collection for estimation of random blood sugar (RBS) and lipid profile [Serum Triglycerides (TG) and cholesterol] in persons aged 11 years and above. **Results:** The blood reports revealed that out of the total samples collected, 9.2% had elevated RBS, 20.8% had elevated TG, and 8.8% had elevated cholesterol levels overall. The prevalence of elevated RBS, TG, and Cholesterol was 2.3%, 15%, and 5.3%, respectively, in Daringbadi, while in Tangi-Choudwar the elevated markers were 17%, 27.2%, and 12.8% for RBS, TG, and Cholesterol, respectively. Our study found that compared to the Daringbadi block, a significantly higher ($P < 0.05$) proportion of people from the Tangi-Choudwar block suffered from hyperglycemia (OR = 0.11; 95% CI: 0.06, 0.20), hypertriglyceridemia (OR = 0.47; 95% CI: 0.34, 0.64), and hypercholesterolemia (OR = 0.38; 95% CI: 0.24, 0.59). Hence, it was observed that the population of Daringbadi was 89%, 53%, and 62% less likely to have elevated random blood sugar level, serum triglycerides, and serum cholesterol, respectively, than the population of Tangi-Choudwar block. Overall, the population of Tangi-Choudwar was found to be more predisposed to an abnormal blood profile which might be indicate a less healthy lifestyle and diet in this block as compared to Daringbadi block. **Conclusions:** This study found that the sociodemographic factors influencing lifestyle and diet patterns of a population have an impact on the health of a population. We found that the tribal block which was more developed and had more intake of junk food and sedentary lifestyle similar to urban areas also had a greater proportion of population with an abnormal blood profile as compared to the less-developed tribal block. Hence, health promotion for a healthy lifestyle and diet is needed as a part of national health policy to implement primordial prevention and to prevent the emergence of risk factors from an early age. The frontline health workers and family physicians can play an important role in promoting a healthy lifestyle.

Keywords: Blood profile, health promotion, healthy lifestyle, sociodemographic correlates, tribal health

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Introduction

Foods high in fat, salt, and sugar (HFSS foods) are defined as foods which contain low amount of proteins, vitamins, phytochemicals, minerals, and dietary fibre but are rich in fat (saturated fatty acids), salt and sugar and high in energy (calories) that are known to have negative impact on health if consumed regularly or in high amounts.[1]

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Nutrition transition over the past 30 years (1973--2004) in India has resulted in a 7% decrease in energy derived from carbohydrates and a 6% increase in energy derived from fats.[2] Recent Survey of National nutrition Monitoring Bureau (NNMB) carried out among urban households in 16 states also indicated lower intake of cereals [69.6% of recommended dietary intake (RDI)] compared to fats and oils (159.5% of RDI).[3] HFSS foods/ junk foods/fast foods are consumed mainly for its taste, easy availability, and convenience[4-7] and its consumption is mainly influenced by television advertisement and peer pressure.[8-11]

National Sample Survey (2011--12) carried out by Ministry of Statistics and Programme Implementation reported number of households per 1,000 households consuming processed foods was higher in urban areas compared to rural areas.[12] Rural to urban migration is reported to be associated with both positive (higher fruit and vegetables intake) and negative (higher energy and fat intake) dietary changes.[13]

A large multi-centric cross-sectional study was carried out to review existing evidence from India on the consumption of foods high in fats, salts, sugar (HFSS) and their impact on the burden of non-communicable diseases (NCDs) in India and to identify priority areas of research relating to consumption of HFSS foods. This study presents findings from the eastern zone of India from this multicentric study. The objective of this study was to assess the consumption pattern of food and food products/items high in fat, salt and sugar and their relation to blood markers from two tribal districts of Odisha.

Methodology

A large multi-centric study on "Consumption pattern of food and food products/items high in fats, salts, sugar among selected cities/towns and rural population" covering all zones of the country, that is, North, North-east, Central, East, West and South was conducted from 1st July, 2018 to 30th December, 2019. This study describes part of the findings from the Eastern zone, covering tribal areas of Odisha.

The state of Odisha is located on the eastern coast of India with a population of 4.2 million (3.47% of total) and constitutes the third largest population of Scheduled Tribes in the country. Thirteen out of the total 30 districts of Odisha are covered under the Scheduled (Tribal) areas. The proportion of people living below the poverty line is currently 32.6% (2011--12).

This study was carried out in the rural districts of Kandhamal and Cuttack in Odisha from June 2018 to Dec 2019. It was a cross-sectional study involving all individuals aged more than 11 years of age from 4,000 selected households. Participants not willing to give consent for the study were excluded. The sample size was calculated assuming the proportion of people in rural/ tribal areas consuming HFSS as 8%. Considering 95% level of confidence interval, relative precision of 15% and design effect as

2, the sample size was calculated to total 3,898 households which was approximated to 4,000 households (HHs). A household was considered as the sampling unit [Figure 1].

Two districts, that is, Kandhamal and Cuttack were selected for the study as they have high proportion of tribal population. One block from each district was selected randomly. Daringbadi block of Kandhamal and Tangi-Chaudwar block of Cuttack were identified for the purpose of study. Thirty villages in each block were selected by PPS method. Hence, a total of 60 villages from two blocks were covered. Since, the total HHs to be covered from rural area is 4,000; approx. 67 HHS were covered from each village. Inside the village, 67 HHs were identified so as to capture representative sample. A landmark was identified and data collection was started from the first house on the right of the landmark to the consecutive houses till the sample size was reached.

Data collection was carried out by trained Research Assistants who were supervised by the Principal Investigators (PI). The data collection was carried out with the help of local person who aided in translation of Odia language used by the research assistant. Using different pretested questionnaire, data of 2,000 households was collected for persons aged more than 6 years from either block on sociodemographic aspects and dietary patterns of households (24-h dietary assessment and consumption in preceding 7 days). Anthropometric measurements taken for persons aged 11 years and above. Approximately 10%, that is, 400 households were chosen for blood sample collection for estimation of different biomarkers such as random blood sugar (RBS) and lipid profile (Serum Triglycerides and cholesterol) in persons aged 11 years and above. The total samples were distributed according to age in three groups- 11--18 years (adolescents), 19--60 years (adults), and more than 60 years (older adults). Hence, total 400 samples were collected from each age group. There was equal proportion of males and females included for the study (50:50 male to female gender ratio). Thus, a total of 1,200 blood samples (600 samples from each block) were collected. However, owing to non-consent, only 565 blood samples (94%) could be obtained from the Daringbadi block and 499 samples (83%) from the Tangi-Choudwar block, that is, total 1,064 instead of 1,200 samples as planned.

Selection of study areas

The samples were collected proportionately from different socioeconomic status. The samples collected at the site were transferred to Central Laboratory at CNRT, New Delhi for analysis of Random Blood Glucose and Lipid Profile in NABL accredited laboratory. The serum and plasma samples after proper labelling were transferred maintaining the cold chain, that is, at -20°C.

Criteria and definitions used

Elevated RBS: Individual samples with a random blood sugar of >200 mg/dl
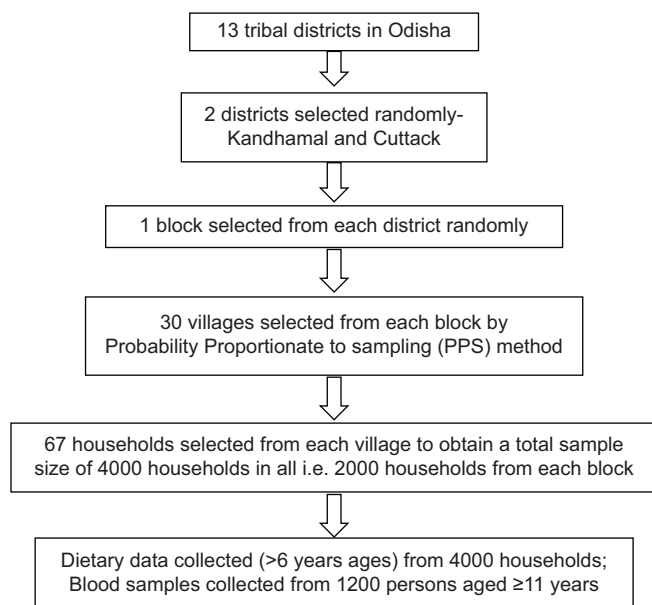
Figure 1: Flowchart of the study methodology

Elevated TG: Individual samples with Serum Triglyceride level of >150 mg/dl

Elevated Cholesterol: Individual samples with Serum Cholesterol level of >200 mg/dl

Data entry and analysis

Frequency and percentage were calculated for age and age-distribution of samples. Odds ratio was calculated and Chi-square test applied for testing the association. The analysis was performed using SPSS package version 20.0. Quality of data collection was ensured. Project PIs/Research Assistant supervised data collection and data cleaning prior to sending for data entry and analysis. The data for anthropometric measurements and dietary intake could not be analyzed.

Results

The total population of Daringbadi block and Tangi-Choudwar block is 63,524 and 83,690, respectively, with considerable differences in their sociodemographic characteristics [Table 1].

While the Daringbadi block is a hilly region, the Tangi-Choudwar block is a coastal region. The Daringbadi block also has a considerably higher proportion of scheduled tribes with fewer educational, industrial, telecommunication, and health facilities. The Tangi-Choudwar block is more industrialized and the dietary habits of its population included more intake of junk foods.

From the sociodemographic profile of the two tribal blocks, many differences were noted. While the Daringbadi block has a greater proportion of scheduled tribes than the Tangi-Choudwar block, it also had fewer facilities for education, health, transport, and communication. The Tangi-Choudwar block also had livelihood
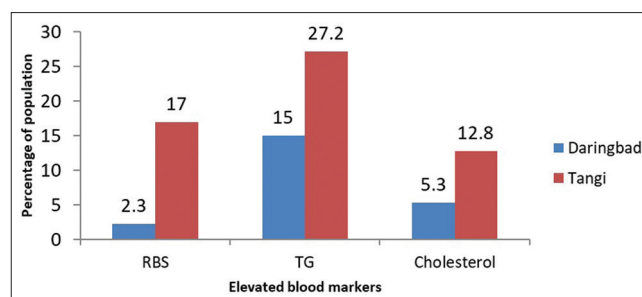
Figure 2: Comparison between two population in respect to hyperglycaemia, hypertriglyceridemia and hypercholesterolemia

on industries in addition to agriculture while Daringbadi block relied only on the latter.

The socioeconomic status of the Tangi-Choudwar population was also better as evident from the average per-capita income. In addition, the Tangi-Choudwar block has more intake of junk foods as compared to Daringbadi. Moreover, the distance of Tangi-Choudwar block from the state capital city Bhubaneswar is much lesser (40 km) as compared to Daringbadi block which is approximately 450 km from Bhubaneswar. This might be the likely explanation for the change in lifestyle and food habits.

The number of samples collected from the Daringbadi and Tangi-Choudwar blocks were 565 and 499, respectively [Table 2]. The sample collection was distributed among 3 age-groups, that is, 11--18 years (adolescents), 19--60 years (adults), and >60 years (older adults) with total 311, 429, and 322 samples collected from each age group, respectively.

The blood reports revealed that out of the total samples collected, 9.2% had elevated RBS, 20.8% had elevated TG, and 8.8% had elevated cholesterol levels overall. Out of 565 samples collected from the Daringbadi block, it was observed that 2.3%, 15%, and 5% had elevated RBS, TG, and cholesterol, respectively which was considerably lesser as compared to the Tangi-Choudwar block which had elevated RBS, TG, and cholesterol in 17%, 27.2%, and 12.8% of the samples, respectively [Figure 2].

From the blood reports, it was evident that a higher proportion of people in Tangi suffered from hyperglycemia, hypertriglyceridemia, and hypercholesterolemia. This could be likely because of various factors leading to a higher intake of junk foods and a less healthy lifestyle.

Further analysis [Table 3] revealed that the levels of RBS, TG, and cholesterol were significantly higher in the population of Tangi-Choudwar, Cuttack ($P < 0.05$ for all three blood markers). The chance of elevated random blood sugar was 89% less likely (Odds ratio: 0.11) in Kandhamal population as compared to Tangi-Choudwar. The chances of Kandhamal population having an elevated Serum Triglyceride level was 53% (Odds ratio: 0.47), lower than that on Tangi-Choudwar population. Also, an elevated

Table 1: Sociodemographic profile of Daringbadi and Tangi-Choudwar blocks

Characteristics	Daringbadi	Tangi-Choudwar
Total Population	63, 524	83,690
Topography	Hilly	Coastal
Proportion of scheduled tribe	67.42%	11.63%
Educational facilities	Few	More
Health facilities	Few	Good private and public facilities near by
Road and Communication network	Difficult to access, one has to walk off to reach destination.	All places are accessible with fairly good roadways
Socio-economic status	Poor	Well off
Livelihood	Traditional agriculture and collection of forest produce	Agriculture and industries
Average per capita income	Rs 150/- or less	Rs 400/-
Health seeking behaviour	Faith on traditional healers	Govt and Private. doctors
Food	Rice and green leafy vegetables, no junk food intake	Mixed veg and non-veg diet, plenty of junk food intake
Physical activity	More	Less
Risk of developing Non-communicable diseases	Less	More

Table 2: Block-wise age-distribution of samples collected

Characteristics	Daringbadi	Tangi-Choudwar	Total
Age-distribution of samples			
11-18 years	196 (35%)	115 (23%)	311 (29%)
19-60 years	188 (33.3%)	241 (48%)	429 (40.5%)
>60 years	179 (31.7%)	143 (29%)	322 (30.5%)
Total Sample collection (*n*)	565	499	1064

level of Serum Cholesterol was 62% less likely in Kandhamal than Tangi-Choudwar (Odds ratios: 0.38). This might be owing to the relatively more urbanization in Tangi block than in Kandhamal leading to higher consumption of junk foods.

Discussion

The socioeconomic status, education, income, livelihood, cultural practices are important determinants for health, nutritional status, morbidity, and mortality of an individual and ultimately one community. These factors also influence the accessibility, affordability, acceptability, and actual utilization of available health facilities for betterment of their overall health and nutritional status.

Our staff could capture many cultural differences in food and feeding practices adopted between rural and urban communities (with a high proportion of scheduled tribe in the selected study areas). In a nutshell, our team observed that the urban people usually take lot of fast-food/junk food on most of the days, whereas the people residing in far off/difficult to reach areas are not taking commercially available foods rich in fat, salt, and sugar, the reason could be attributed to socioeconomic status, purchasing power, accessibility of such food items, etc., This might be the reason that the higher proportion of people in Tangi-Chowdwar suffered from hyperglycaemia, hypertriglyceridemia, and hypercholesterolemia.

From the blood reports among the two tribal districts, it was evident that the relatively rural Daringbadi block population was less likely to show elevated levels of RBS, TG, and cholesterol as compared to the more socioeconomically developed Tangi-Choudwar block. This might be owing to the relatively more urbanization in Tangi block than in Kandhamal leading to higher consumption of junk foods and unhealthier lifestyle in the former population. While the chances of the Kandhamal population having elevated blood sugar was almost 90% lesser than that of Tangi-Choudwar, it was almost half as likely to suffer from elevated levels of triglycerides and cholesterol as well compared to Tangi population.

The food patterns particular to specific regions influence the health of the population as is reported by various studies conducted in India. A systematic review of studies modelling[14] on the dietary patterns in India reported that sweets and snacks were more likely to be characteristic of the East and South regions while fruit, vegetables, rice, and pulses were more likely characteristic of the Northern and Western region diets. Moreover, as compared to the North and West, the dietary patterns from the East and the South were also more likely defined by meat or fish in their diet. Five out of the six models found that those consumers whose diets were defined by high-fat and high-sugar foods had significantly greater body size (BMI) while one of the models showed that consumers with a varied dietary pattern defined by consumption of vegetables, sweets, fruits, pulses, nuts, poultry, and eggs had significantly lower cholesterol. Hypertension, diabetes, and cholesterol levels were also found to be significantly related to particular dietary patterns. The present study has managed to capture a similar picture.

Misra *et al.* (2011)[2] carried out a review on the relationship between dietary intake and diet-related NCDs by reviewing the secular trends. It found that over the past 30 years (1973--2004) the nutrition transition had caused 7% decrease in energy derived from carbohydrates while on the other it resulted in a 6% increase in energy derived from fats. A reduction in intake of coarse cereals, pulses, fruits and vegeratbles, an increase in intake of meat products and salt coupled with declining levels of physical activity because of rapid urbanization have resulted in higher levels of obesity, atherogenic dyslipidemia, subclinical

Table 3: Comparison of abnormal blood profiles of Daringbadi and Tangi-Choudwar					
Blood markers	No. of abnormal blood samples			χ^2	Odds ratio (*P*)
	Daringbadi (*n*=565)	Tangi (*n*=499)	Total (*n*=1064)		
Random blood sugar (RBS)	13 (2.3)	85 (17)	98 (9.2%)	68.78	0.11 (0.06-0.20)
Triglycerides (TG)	85 (15)	136 (27.2)	221 (2.8%)	24.01	0.47 (0.34-0.64)
Cholesterol	30 (5.3)	64 (12.8)	94 (8.8%)	18.58	0.38 (0.24-0.59)

inflammation, metabolic syndrome, type 2 diabetes mellitus and coronary heart disease in the Indian population. This is similar to the findings of our study which showed that the Tangi-Choudwar block which had a higher consumption of high fat salt and sugar diet in addition to higher economic status and lower physical activity levels also had a significantly higher level of elevated blood sugar, cholesterol and triglycerides.

It reported that even in rural populations who consume traditional frugal diets, such as those included in the present study, there is a rising prevalence of cardiovascular risk factors and metabolic syndrome owing to dietary and lifestyle changes.A review article by Misra *et al.* (2008),[15] regarding nutrient intake, insulin resistance, and cardiovascular risk factors in Asian Indians and South Asians reported similar findings. Dietary imbalances such as low intake of MUFA, n-3 PUFA, and fibre but high intake of fats, saturated fats, carbohydrates and trans-fatty acids (mostly in the form of Vanaspati ghee, a widely-used hydrogenated oil) are associated with insulin resistance, dyslipidemia, and subclinical inflammation in South Asians.

Various studies have found a link between unhealthy diet and lifetyle in more developed regions with an increased risk of non-communicable diseases. In an article by Dasgupta *et al.* (2015),[16] analysis showed a clear link between the state of development and prevalence of cardiometabolic risk factors- regional prevalence of diabetes in high and medium human development index (HDI) states was 12% while in low HDI states it was 9%. The per capita consumption of sugar was found to be almost twice in higher HDI states (>0.5) as compared to other states. In a study on regional patterns of diet and cardiovascular risk in India, diets across all regions characterised by dairy, fried snacks, and sweets appeared to be positively associated with abdominal adiposity. Truncal obesity, impaired glucose, and lipid levels as well hypertension in a high-proportion of study participants corresponds with the high-risk "Asian Indian phenotype" that may be a product of genetic adaptations to food insecurity, fetal or early childhood malnutrition, as well as more recent environmental exposures including adult diet. Also, compared to other Asian countries, high amounts of sugar are consumed in India.[17]

Although most tribal populations reside on difficult-to-approach hilly regions, fast acculturation that would influence disease pattern is seen in these communities. Hence, even though infectious diseases and malnutrition are still prevalent among the tribal, the burden of NCDs is rising like the rest of

India.[18] In a cross-sectional study on prevalence of risk factors of NCDs in tribal district of Kinnaur in Himachal Pradesh with 100% rural population reported that the proportion of the tribal population consuming vegetables and fruits daily was substantially low in both men (21.8% and 4.7%) and women (21.9% and 2.7%), respectively, across all age-groups. The prevalence of hypertension and diabetes reported was 19.7% and 6.9%, respectively.[19] This study area was more similar to the Daringbadi block of our study which showed a better health profile than the partly urban Tangi-Choudwar block.

Another multicentric cross-sectional study was carried out on prevalence and risk factors for hypertension and diabetes in tribal communities in western and northern Maharashtra. The study reported a prevalence of 11.7% for hypertension, 6.7% for diabetes, and 0.6% for hypercholesterolemia. However, almost all the study participants in this study were reported to be underweight.[20] The prevalence of NCDs found in was very low probably because of near absence of risk factors like obesity, sedentary lifestyle, and hyperlipidemia found in their study which reflects the picture found in the Daringbadi block in our study. However, another study in a tribal population of Rang Bhotia, Uttarakhand which is believed to be in an epidemiological transition reported 6.9% individuals with an elevated Fasting Blood Glucose ($\geq$126 mg/dl), 43.4% with hypertension and 57.6% with high BMI which was found associated significantly with age, gender, physical inactivity.[21] Hence, many of the studies have reported a picture where the formerly untouched tribal populations are recently falling victim to the adverse influence of rising urbanization in India.

Strengths

This study was conducted in two tribal areas from different regions of Odisha, that is, hilly and coastal. Hence, it can be representative of the tribal areas. As the blood samples were collected from participants aged 11 years and above, the study managed to capture the adolescent age group, which from many previous studies has been observed to be consuming increasing amounts of foods high in fat, salt and sugar owing to increased cardiovascular risks in the future.

Limitations

Our study could not capture the anthropometric and dietary intake parameters as all the data could not be accessed. The blood collection could not be done as per the defined sample size due to nonresponse and unwillingness to consent owing different cultural beliefs in the tribal areas against blood tests. The

cross-sectional nature of this study limits the ability to establish a temporal association between the variables studied.

Conclusion

In this study, we have attempted to find an association between the sociodemographic factors and physical health in relation to NCDs in two tribal districts of Odisha. From the evidence gathered from this study and various other studies, there is an increase in the consumption of foods high in fats, salt and sugar across various regions of India.

Our study found that the tribal block which was more developed and had more intake of junk food and sedentary lifestyle similar to urban areas, also had a greater proportion of population with an abnormal blood profile as compared to the less-developed tribal block. It is evident from the sociodemographic data we collected that the livelihood, food, shelter, clothing, healthcare facilities and standard of living is better in Tangi-Choudwar block most likely because of its proximity to the State Capital city that makes this tribal block relatively urban. These factors seem to be leading to differences in food and lifestyle between the two tribal blocks [Table 1]. This study shows that with increasing development and urbanization prevalence of NCDs are rising. The urbanization is going to happen in every region sooner or later. Hence, there is a dire need of health education and health promotion to prevent the rising trend of NCDs. Thus, nutritional and lifestyle education should be started in schools with focus on children as a policy to implement primordial prevention and to prevent the emergence of risk factors from an early age. An integration of such health promotional policies along with the existing programmes for children such as Mid-day Meal programme and Integrated Child Development Services (ICDS) scheme is necessary which can be brought about by a strong political willpower with regard to public health nutrition. The frontline health workers and family physicians can play an important role in promoting a healthy lifestyle.

These findings can be enriched if a study on prevalence of NCDs in these areas is conducted. The compiled result from all centres which participated in this study will be able to throw light on consumption pattern and prevalence of NCDs all over India.

Ethical approval
Institutional ethical clearance was obtained.

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Conflicts of interest
There are no conflicts of interest.

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