ORIGINAL ARTICLE

JIACM 2019; 20(1): 22-28

Study of Anthropometric Risk Factors for Cardiovascular Diseases Among the Tribal Population Attending a Tertiary Care Hospital of Eastern India

Kunal Som, Jayanti Ray**, Rudrajit Paul***, Dipanjan Bandyopadhyay*****

Abstract

***Background:** Cardiovascular disease (CVD) is the major cause of mortality in low and middle income countries. Obesity and hypertension, the two major risk factors for CVD, are rising in prevalence in all parts of society. Marginalised populations, like tribal and ethnic minority groups, are especially vulnerable to these risk factors. However, data on the prevalence of these risk factors in ethnic minorities from India are scarce.*

***Objective:** In this study we aimed to generate data on the prevalence of some CVD risk factors in the tribal population from West Bengal.*

***Patients and methods:** This was a hospital based cross-sectional survey including adult patients belonging to any tribal community. Anthropometric measurements were done and body mass index and waist circumference were categorised according to Asia-specific cut-off values. Blood pressure was categorised according to the ACC/AHA 2017 guidelines and also the ISH guidelines.*

***Results:** There were 211 subjects in our study (66% Mahato tribe, rest Santal). 15.2% (95% CI: 10.6 - 20.7%) of the subjects were obese and 27% (95% CI: 21.1 - 33.5%) were overweight. 47% of the subjects had waist circumference above their gender-specific cut-off, that is abdominal obesity. Female subjects had significantly higher abdominal obesity (n = 60; 89.5%) compared to males (n = 39; 27.1%) (p < 0.0001). 39% of the subjects had stage 1 hypertension; 25% had stage 2 hypertension (ACC/AHA criteria). There was no correlation of body mass index or waist circumference with blood pressure.*

***Conclusion:** There is high prevalence of obesity and hypertension in the tribal population. Abdominal obesity is found to be commoner in females. Health education and intervention studies are needed for this population group.*

***Keywords:** Tribal; body mass index; waist circumference; hypertension; India.*

Introduction

Cardiovascular diseases (CVD) are the major cause of mortality all over the world[1]. But the geographical distribution of CVD mortality is not uniform. According to the World Health Organisation (WHO), more than three-fourths of the deaths due to CVD occur in the middle and low income countries (MLIC) like India[1]. These MLIC are still burdened with various infectious diseases. Thus, these countries are now facing a double burden of diseases: infectious diseases and non-communicable diseases like CVD. This puts a severe burden on the already strained health finances of these countries. That is why in the sustainable development goals for health by the UNDP (Goal 3), major importance has been given to development of health system capacity for non-communicable diseases[2]. For non-communicable diseases, one of the main control strategies is risk factor modification. Many of the risk factors for CVD like obesity and hypertension are modifiable and proper intervention can reduce the risk to a large extent[1]. But before such preventive intervention can be implemented, a wider picture of the prevalence of such risk factors in the population must be documented and moreover, the people with the risk factors must engage with the health system.

Studies done earlier have shown that many people in the general population are unaware of their cardiovascular risk and this constitutes a potential large burden of CVD in the future[3]. There are various reasons for this lack of awareness. Inadequate medical contact, absence of home health visitors and poverty are some of the cited reasons for high number of people in the community who are unaware of their high risk status[4]. Moreover, cardiovascular risk factors are not screened routinely in all centres[5]. For example, a study in the USA found that out of obese adults visiting a physician for an unrelated disease, only about 40% were advised about the dangers of their obesity[5]. Thus, studies on the

***Specialist Medical Officer, Salboni Rural Hospital; **Assistant Professor, Department of Medicine, Medical College, Kolkata; ***Associate Professor, Department of Critical Care Medicine, IPGMER and SSKM Hospital, Kolkata; ****Professor and HOD, Department of Medicine, North Bengal Medical College.**

Corresponding Author: Dr Rudrajit Paul, Associate Professor, Department of Critical Care Medicine, IPGMER and SSKM Hospital, Kolkata. Tel: 9433824341, E-mail: r.paul.medicalcollege@gmail.com.

population prevalence of such risk factors are needed to sensitise clinicians to the extent of the problem.

Obesity is a medical condition whose prevalence is rising in all age groups, in all societies[3]. But studies from different parts of the world have shown that ethnic minorities and marginalised groups suffer disproportionately from obesity and hence, high cardiovascular risk[6]. For example, in the UK, while the general prevalence of obesity is taken as 23%, for the Pakistani population living in the UK, this is 28% and for Black African population group, this is 38%[6]. Similar disparity between general population and ethnic minorities has also been found for other conditions like hypertension. Thus, these marginalised communities are burdened with a silent epidemic. Studies on CVD risk factors in such minority populations are urgently needed to map their disease burden.

The tribal and ethnic minority groups in India are marginalised in terms of health access and knowledge. Studies on cardiovascular risk factors of tribal and ethnic minority population are rare from India. However, the few studies that have been done have shown that this particular population suffers from both undernutrition and obesity[6]. Hypertension is also quite common among these people[7]. Thus, some risk factors for CVD are already present to a significant degree in this population. A sharp rise in CVD mortality and morbidity is likely in this population in the near future, unless interventions to curb such risk factors are implemented quickly. In order to formulate effective health prevention and promotion programs, baseline data on the prevailing health status and factors affecting it are necessary. Thus, the health status of tribal and ethnic minority population should be studied in details in order to generate data which can help in formulating health prevention strategies.

In this study, we did a survey on risk factors for CVD among the tribal population from West Bengal, Eastern India. We aimed to generate data on the prevalence of CVD risk factors in this ethnic minority population, so that future preventive programs can be formulated. One of the major risk factors for CVD is obesity[4]. This can be defined according to either body mass index (BMI) or waist circumference (WC)[8]. Both are equivalent and have been found to correlate with the occurrence of CVD[7]. Hence, in our study, we have included both of these parameters.

Material and methods

This was a government hospital based cross-sectional survey. The study was conducted simultaneously in a tertiary care medical college of Kolkata, the capital of West Bengal and a remote rural hospital of the West Midnapore district. Both of these hospitals have high attendance of persons belonging to the tribal community; especially the West Midnapore rural hospital is situated in a block with very high tribal population. Adult patients coming to the medicine OPD for two months (July-August 2018) of these hospitals were screened for the study. Persons came with different complaints (like fever, cough, body ache, low back pain, etc.). Persons with any genetic disorders like Down's syndrome which can cause morphometric alterations of the body were excluded. Also persons diagnosed with any genetic form of hypertension were excluded from the study. Anyone who had kyphosis or who could not stand up straight for height measurement or anyone with ataxia which precluded standing on the weight machine, had to be excluded. Only persons belonging to any tribal community were included for the survey. Special "scheduled tribe" certificates are issued by the government of India for such communities. These certificates were used to identify the study subjects.

Sample size calculation

The average prevalence of overweight and obesity in the tribal population, according to one Indian study, is 15% (taking the median value of that survey)[7]. Taking this as an initial reference, for 80% power and a precision of 5 and 95% confidence interval, the calculated sample size is 195. In community-based surveys, it is customary to take a margin of non-response to be 10%. But since this was a hospital OPD based survey, we had taken that non-response margin to be 5%. Thus, target sample size was at least 205. We have also measured blood pressure and other risk factors in the study. But the prevalence of obesity is taken as the primary objective. Hence, the sample size was calculated according to this primary objective.

A purposive sampling method was used as it suited the busy work schedule of the authors.

The conventional cut-offs for BMI and waist circumference which can predict health risk, as formulated from a predominantly Caucasian population, are not applicable for Asian Indians. The WHO, in its Global Database on body mass index, acknowledges that BMI cut-offs may not mean the same thing in different populations due to racial differences in body proportions and muscle-fat ratio[9]. Hence, different populations need different BMI cut-offs for public health action. Studies have shown that Asian Indians show significant health risks (higher incidence of type 2 diabetes and cardiovascular disease) at BMI lower than the international cut-off of ≥ 25 kg/m^2, which defines overweight or ≥ 30.00 kg/m^2, which defines obesity. For Asian Indians, the BMI cut-off for public health action has been lowered to ≥ 23 kg/m^2 for overweight and ≥ 25 kg/m^2, for obesity[10].

Similarly, for waist circumference, the gender specific cut-offs (102 cm for men and 88 cm for women), as derived from Caucasian populations, are not applicable to Indian subjects. For Indians, the WHO and IDF have published a cut-off of > 90 cm for men and > 80 cm for women. But many Indian scientists have opined that even this cut-off is too high and liable to miss a proportion of subjects with increased risk[11]. Thus, according to this school of thought, for waist circumference, the following cut-offs (in cm) are to be used[11]:

Gender	Action level 1	Action level 2
Male	78	90
Female	72	80

We have used these India specific cut-offs (for both BMI and WC) in our survey.

Full ethics permission was obtained from the tertiary teaching institute before the study. For the rural non-teaching hospital, separate permission was also taken from the local health administrator, the block medical officer of health.

The participants selected for the study were informed about the details of the survey and informed consent was obtained. Those who volunteered for the survey were then subjected to clinical examination, including height, weight, waist circumference and blood pressure measurement. Standard medical instruments (personal possession of the researchers) were used: Crown™ weighing machine, DoctorPlus™ aneroid sphygmomanometer and local made measuring tape. The instruments were all manufactured by known reputed companies; they were first tested for reliability and validity by taking few (around 10) measurements and comparing them with measurements obtained on the same subjects by known valid and reliable instruments (gold standard) in the hospital. The persons were also asked about personal addiction habits. The investigators (one for each site) performing the actual anthropometric measurements were trained in the proper technique and asked to perform 10 such measurements under supervision in order to check the reliability of their technique. Blood pressure was measured in the sitting position with legs uncrossed. The patient must not have taken tea/coffee or tobacco for 30 minutes prior to the reading. Both upper limbs were measured and average of 3 readings was taken. Waist circumference was measured at the approximate midpoint between the lower margin of the last palpable rib and the top of the iliac crest in the standing subject, with a stretch resistant measuring tape held parallel to the floor, at the end of normal expiration (as per WHO 2011 guideline).

Blood pressure was categorised as normal, elevated, stage 1 or stage 2, according to the 2017 American College of Cardiology guidelines[12]. Also, the Indian Society of Hypertension (2013) guidelines were consulted[13].

The whole interview was conducted in the local language, familiar to the study subjects. For those who had difficulty in understanding, help was sought from an interpreter.

The data from each patient sheet was transferred to Microsoft Excel 2013 worksheet. Data entry was done by one investigator and cross-checked by another. Statistical calculators were done using online free statistical software like MedCalc and Graphpad. Data were expressed as proportion/percentage (for ordinal data like grade of hypertension or BMI) and/or mean ± standard deviation (for continuous variables like age). Suitable statistical tests were done: chi square test for proportions and Pearson or Spearman rank correlation co-efficient for continuous variables or categorical variables, respectively. P value < 0.05 was considered significant.

Results

We studied a total of 211 subjects in our study. There were 144 male and 67 female participants. Average age of the subjects was 47.6 ± 9.1 years. The age group distribution of the subjects is shown in Fig. 1. It was seen that maximum number of subjects (88.1%) belonged to the middle-ages (31 - 50 years). Among the subjects, 140 (66.4%) belonged to the Mahato tribe. The rest were Santals.

Based on the BMI, 32 subjects (15.2%; 95% CI: 10.6 - 20.7) were obese (BMI $\geq$ 25 kg/m^2) and 57 subjects (27%; 95% CI: 21.1 - 33.5) were overweight (BMI $\geq$ 23 kg/m^2 and < 25 kg/m^2). In male subjects, 17 (11.8%) were obese while in the female subset, 15 subjects (22.4%) were obese. Thus, obesity was more prevalent among female subjects compared to males, but the difference was not statistically significant (p = 0.06 by two-tailed Chi Square test).

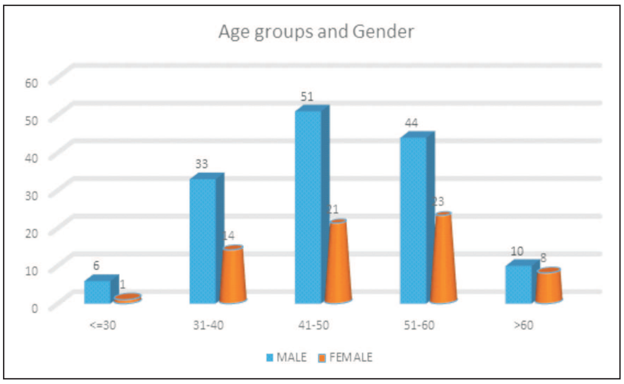

Fig. 1: *Age group distribution of the study subjects.*

The distribution according to waist circumference in shown in Fig. 2. Overall, 99 subjects (46.9%) had WC above the gender specific cut-off (action level II). It is seen that in the male subset, 39 persons (27.1%: 95% CI: 20 - 35.1) had waist circumference above recommended range while in the female subset, 60 persons (89.5%; 95% CI: 79.7 - 95.7) had high WC (p < 0.0001).

The distribution of blood pressure is shown in Fig. 3. It is seen that 39% of the subjects had stage 1 hypertension (SBP 130 - 139 and/ or DBP 80 - 89 mmHg) and 25% of the subjects had stage 2 hypertension (SBP ≥ 140 and/or DBP ≥ 90 mmHg). In male subjects, stage 2 hypertension was found in 25.7% and in female subjects, stage 2 hypertension was found in 22.4% (p = 0.73). Thus, hypertension was equally prevalent, irrespective of gender. Of the 64% subjects who were detected with hypertension in this survey, 28% were already known hypertensive and the rest were found to have hypertension only during this survey.

Further, ISH guidelines were used to see if there would be any difference in the distribution of various stages of hypertension (Fig. 4). It is seen that, according to the ISH guidelines, 75% of the subjects were normal, while only 17% had stage 1 and 8% had stage 2 hypertension. Thus, there was significant difference in outcome when blood pressure was classified by ACC 2017 guidelines vis-à-vis the ISH 2013 guidelines.

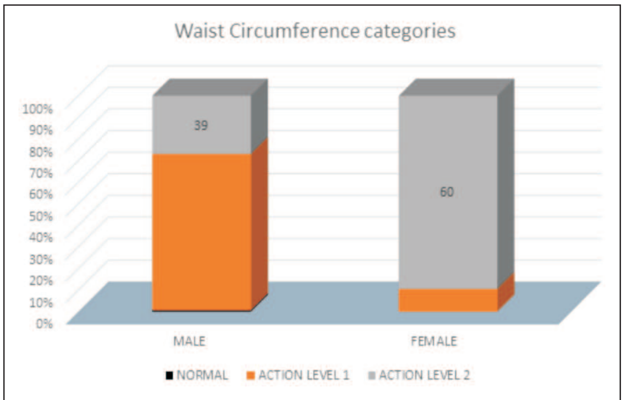

Fig. 2: *Bar diagram showing percentage of study subjects according to different categories of Waist circumference.*

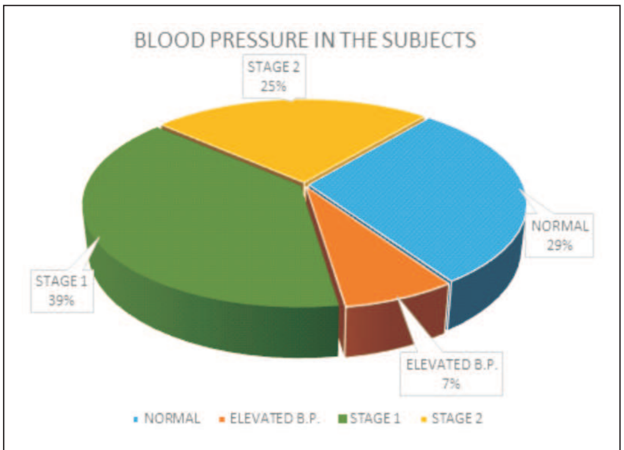

Fig. 3: *Pie chart showing the distribution of blood pressure according to different categories.*

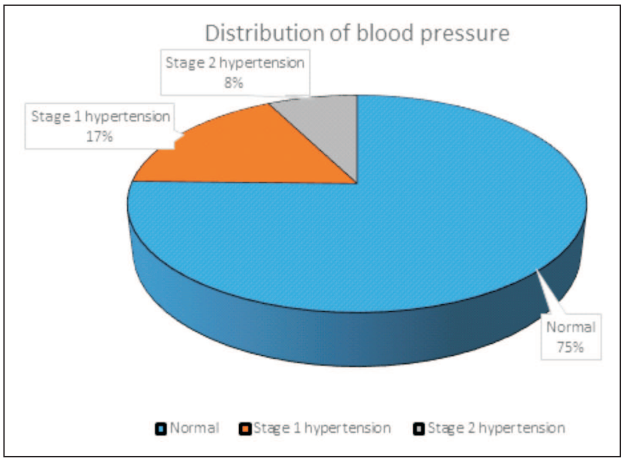

Fig. 4: *Pie chart showing the distribution of blood pressure in different categories according to ISH guidelines.*

Out of 211 subjects, 64 (30.3%; 95% CI: 24.2 - 37) were tobacco (smoking or smokeless) users and 58 (27.5%; 95% CI: 21.6 - 34) were alcohol (home-made or commercial) users. There was not much gender difference in the use. Among males, tobacco use, in any form, was reported by 30% of the subjects and in females, tobacco use was reported in 29.8%. For alcohol use, the corresponding figures were 30.6% (male) and 19.4% (female) (p = 0.09).

There was no significant statistical correlation between mean arterial pressure, DBP or SBP and either BMI or WC (Table I). There was only weak correlation between BMI and WC (r = 0.142).

Table I: Table showing the results of correlation tests (by Pearson correlation) between measured variables.

Parameter	BMI	WC	SBP	DBP	MAP
BMI		0.142; 0.03	-0.088; 0.2	-0.078; 0.25	-0.085; 0.21
WC	0.142; 0.03		-0.088; 0.2	-0.085; 0.21	-0.089; 0.19
SBP	-0.088; 0.2	-0.088; 0.2			
DBP	-0.078; 0.25	-0.085; 0.21			
MAP	-0.085; 0.21	-0.089; 0.19			

Discussion

In our study, it was seen that obesity was present in a significant number of subjects belonging to the Mahato and Santal tribes. Female subset had higher prevalence of obesity compared to males. Hypertension was also quite common with more than 60% of the subjects having either stage 1 or stage 2 hypertension (according to ACC guidelines).

This high prevalence of obesity in tribal and ethnic minority population in India has also been depicted in other studies. In a recent study from Central India, the prevalence of obesity (BMI $\geq$ 25 kg/m^2) in a tribal population was found to be 14.2%[14]. In our study, the prevalence of obesity was 15% and that of overweight and obesity combined together was 42%. Earlier, among the Santals of West Bengal, obesity was observed in 6.1%, while among the Bhumij and Dhodia tribes, it was 10%[7]. However, among the Oraon tribe, it was just 3%[7]. Thus, the prevalence of obesity may vary according to the geographical location and access to modern lifestyle. Also, genetic factors may be a contributing factor for obesity in some tribes. A very recent study done among tribals of North-East India have proved that genetic polymorphisms are associated with obesity[15]. But the validity of this observation in other tribal groups needs more research.

The prevalence of hypertension does not correlate with that of obesity. In earlier studies, even tribal persons with undernutrition were found to be hypertensive[7]. Hence, obesity cannot always be used as a surrogate marker for other CVD risk factors and each risk factor has to be examined separately. In our study also, there was no correlation between either systolic blood pressure or mean arterial pressure with BMI or WC (Table I). Thus, even lean persons may be hypertensive and this is sometimes called the obesity paradox[7,16].

Indian population in general and some pockets of India, like the tribal population, in particular are in the midst of a rapid epidemiological transition now. Surveys have repeatedly shown that CVD risk factors are increasing in prevalence in all parts of India over the last two decades. A survey done in 2007 - 2008 estimated that hypertension was present in 25% men and 23% women in the Indian society[17]. Another landmark survey in Delhi, involving two points of data collection at a gap of 20 years, showed that the prevalence of hypertension in both urban and rural India has more than doubled in two decades[18]. In our study, the prevalence of hypertension (stage 1 and 2 together) was found to be 64%, which is higher than other studies.

One contentious issue is the choice of guidelines while classifying hypertension. Some authors are of the opinion that the latest 2017 ACC guidelines have a lot of flaws and thus, this cannot be adopted for all populations[19]. Even many societies in the West have not yet endorsed this new guideline with its lower cut-off points[19]. In the present study also, it was seen that there was a remarkable difference between the two guidelines in terms of classifying the subjects as hypertensive. Logically, for Indian patients, ISH guidelines should be followed. But the ISH guidelines, while based on some Indian data, did not specifically include the tribal population. Some tribal groups in India are genetically quite different from the general population. Genetic studies involving Y-DNA haplogroups have shown that some ethnic groups in India may have originated from Europe or Central Asia[20]. Thus, specifically for the tribal population, ISH guidelines may not be the gold standard.

The rising trend of hypertension in various regions of India is an established fact[21]. In a study from coastal villages of Karnataka, 45.2% of young adults were found to be pre-hypertensive[21]. But that was a 2011 - 12 study where "pre-hypertension" was defined as SBP 120 - 139 mmHg and/or DBP 80 - 89 mmHg. Cut-offs for blood pressure have since been lowered. According to the current 2017 guidelines (which has been used in our study), most of these subjects with "pre-hypertension" would be re-classified as hypertension. In another study from Kerala, in an urban population, the prevalence of hypertension was found to be 47%[22]. But this was a 2009 study and if the current 2017 revised guidelines are applied, the prevalence would probably be even higher.

One of the major findings of these studies was the fact that most of the hypertensives were unaware of their status[22]. The study from Delhi, mentioned earlier, also found that although the prevalence of hypertension had doubled in 20 years, the awareness of the people had not kept pace with this trend[18]. In our study also, most of the hypertensive subjects were unaware of their status and ignorant of the dangers of hypertension. Of the 64% detected with hypertension, only 28% were aware of their status.

In our study, another significant finding was the higher prevalence of obesity in women, compared to men, in this tribal group. While high BMI was present in 1 out of every 5 women, the more worrying trend was that of high WC, that is abdominal obesity. Specially, most of them (almost 90%) had waist circumference above the Asia-specific cut-off. Thus, using WC led to more tribal women being classified as obese compared to the use of BMI. This trend of more obesity among women from ethnic minority backgrounds has also been documented in other studies. For example, in one survey from India, it was found that women from Manipur had higher average waist circumference compared to women from either Delhi or Kerala[23]. Another study from Naga tribal women of Manipur found the prevalence of overweight and obesity to be 27%[24]. In our study, the prevalence of obesity (according to BMI) in women was 22.4%. In another study from a tribal settlement of the Nilgiris, it was also shown that females had higher average BMI compared to males[25]. Thus, as a group, women from tribal and ethnic minority populations need special attention in order to reduce their CVD risk. Health education to raise awareness about the risks of abdominal obesity must be planned in this population. BMI is the more commonly measured parameter to define CVD risk. But WC has its own importance in predicting CVD risk[26]. In one study from Asia, it was seen that WC was a better predictor of CVD risk (than BMI) in women[26]. This study did not report whether there was significant correlation between BMI and WC of the subjects. In our present study, there was only a weak correlation between BMI and WC. However, both of these parameters are important and the aforementioned study depicted that when both BMI and WC were considered together, it led to better CVD risk prediction.

Limitations

Our study is a hospital-based study. Thus, the sampling may be biased and the results may not be representative of the whole community. Also, other risk factors of CVD like diet and daily salt intake has not been included in the questionnaire. It is a well-known fact that tribal people who are living in urbanised society have increased risk of CVDs. Thus future studies should include parameters like diet, socio-economic status and levels of physical activity, in order to find whether the "tribal" people have a traditional lifestyle or urbanised lifestyle. In this study, the term "tribal" has been used in a legal and ethnic sense, not according to a well-defined way of living. If such confounding factors are eliminated, only then genetic predisposition can be considered and genetic testing can be done to find if some tribal communities are predisposed to obesity or hypertension. Future studies including all of these parameters in this tribal population is thus warranted.

Conclusion

Cardiovascular risk factors like obesity and hypertension were highly prevalent among the tribal population attending the two hospitals in West Bengal. Proper screening of such risk factors should be done in this population in the community setting and health education programs should also be planned.

References

1. World Health Organisation. Cardiovascular disease. Geneva: WHO; 2018.
2. United Nations development Program (UNDP). Goal 3 Targets: Sustainable development goals (Internet). New York: UNDP (cited 2018 Oct 29). Available online from http://www.undp.org/content/undp/en/home/sustainable-development-goals/goal-3-good-health-and-well-being/targets.
3. Wadwa RP, Kinney GL, Maahs DM *et al*. Awareness and treatment of dyslipidaemia in young adults with type 1 diabetes. *Diabetes Care* 2005; 28: 1051-6.
4. Hruby A, Hu FB. The Epidemiology of Obesity: A Big Picture. *Pharmacoeconomics* 2015; 33: 673-89.
5. Ko JY, Brown DR, Galuska DA *et al*. Weight Loss Advice US Obese Adults Receive from Health Care Professionals. *Prev Med* 2008; 47: 587-92.
6. Comegna S. Prevalence of Obesity in the UK According to Sex, Age and Ethnicity: A Literature Review. *Sports Nutr Ther* 2017; 2: 1.
7. Kshatriya GK, Acharya SK. Triple Burden of Obesity, Undernutrition, and Cardiovascular Disease Risk among Indian Tribes. *PLoS One* 2016; 11: e0147934.
8. Flint AJ, Rexrode KM, Hu FB *et al*. Body mass index, waist circumference, and risk of coronary heart disease: a prospective study among men and women. *Obes Res Clin Pract* 2010; 4: e171-81.
9. WHO expert consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *The Lancet* 2004; 363: 157-63.
10. Aziz N, Kallur SD, Nirmalan PK. Implications of the Revised Consensus Body Mass Indices for Asian Indians on Clinical Obstetric Practice. *J Clin Diagn Res* 2014; 8: OC01-3.
11. Misra A, Vikram NK, Gupta R *et al*. Waist circumference cut-off points and action levels for Asian Indians for identification of abdominal obesity. *Int J Obes (Lond)* 2006; 30: 106-11.
12. 2017ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *J Am Coll Cardiol* 2018; 71: e127-248.
13. Shah SN (Conv.). Indian Guidelines on Hypertension. *J Assoc Physicians India* 2013; 61 (Suppl): 12.
14. Gupta VK, Rai N, Toppo NA *et al*. An epidemiological study of prevalence of hypertension and its risk factors among non migratory tribal population of Mawai block of Mandla district of central India. *Int J Community Med Public Health* 2018; 5: 957-62.
15. Ningombam SS, Chhungi V, Newmei MK *et al*. Differential distribution and association of FTO rs9939609 gene polymorphism with obesity: A cross-sectional study among two tribal populations of India with East-Asian ancestry. *Gene* 2018; 647: 198-204.
16. He J, Klag MJ, Whelton PK *et al*. Body mass index and blood pressure in a very lean Chinese population. *Am J Epidemiol* 1994; 139: 380-9.
17. National Nutrition Monitoring Bureau. Diet and Nutritional Status of Tribal Population and Prevalence of Hypertension among Adults – Report on Second Repeat Survey. National Institute of Nutrition - Indian Council of Medical Research; 2009. NNMB Technical Report No. 25.
18. Roy A, Praveen PA, Amarchand R *et al*. Changes in hypertension prevalence, awareness, treatment and control rates over 20 years in National Capital Region of India: results from a repeat cross-sectional study. *BMJ Open* 2017; 7: e015639.
19. Narang R, Srikant S. Implications of 2017 hypertension guidelines for Indian patients. *J Pract Cardiovasc Sci* 2018; 4: 3-5.
20. Mahal DG, Matsoukas IG. The Geographic Origins of Ethnic Groups in the Indian Subcontinent: Exploring Ancient Footprints with Y-DNA Haplogroups. *Front Genet* 2018; 9: 4.

21. Kini S, Kamath VG, Kulkarni MM *et al*. Pre-Hypertension among Young adults (20 - 30 years) in Coastal villages of Udupi District in Southern India: an alarming scenario. *PLoS One* 2016; 11: e0154538.
22. Vimala A, RanjI AS, Jyosna MT *et al*. The prevalence, risk factor and awareness of hypertension in an urban population of Kerala (south India). *Saudi J Kidney Dis Transpl* 2009; 20: 685-9.
23. Mungreiphy NK, Dhall M, Tyagi R *et al*. Ethnicity, obesity and health pattern among Indian population. *J Nat Sci Biol Med* 2012; 3: 52-9.
24. Mungreiphy NK, Kapoor S. Socio-economic changes as covariates of overweight and obesity among Tangkhul Naga tribal women of Manipur, north-east India. *J Biosoc Sci* 2010; 42: 289-305.
25. Ramalingam S, Murali A, Seethalakshmi A *et al*. Cardiovascular Disease Risk Factors in a Tribal Population of Nilgiris. *Nat.J Res Com Med* 2012; 1: 90-5.
26. Noushin Mohammadifard N, Nazem M, Sarrafzadegan N *et al*. Body Mass Index, Waist-circumference and Cardiovascular Disease Risk Factors in Iranian Adults: Isfahan Healthy Heart Program. *J Health Popul Nutr* 2013; 31: 388-97.