Das B.M.*
*Assistant Professor, Department of Anthropology, Haldia Government College, Debhog, Purba Medinipur, West Bengal, India*
*Email: bmohan07@gmail.com*
**Corresponding Author*

Kundu Chowdhury T.
*Cultural Research Officer, Cultural Research Institute, Kankurgachi, Kolkata, India*
*Email: tanayakunduchowdhury@gmail.com*

Mozumdar A.
*Senior Program Officer, Reproductive Health Program, Population Council, New Delhi, India*
*Email: arupendra@gmail.com*

Roy S.K.
*Professor, Biological Anthropology Unit, Indian Statistical Institute, Kolkata, India*
*Email: rsubrata@isical.ac.in*

DOI: 10.14673/IJA2021121072

KEY WORDS: *Blood pressure, indigenous group, rural areas, socio-demographic environments*

# Prevalence of hypertension and its socio-demographic correlates: A micro level study among Santals of Bankura district, West Bengal, India

Studies reported that marginalized populations are more vulnerable towards hypertension than the general populations in India. However, studies are inadequate to address the issues for intervention among the indigenous population. In view, the present study objectives are to investigate the prevalence of hypertension of the Santals of Bankura, West Bengal and also to find out the socio-demographic correlates of hypertension of the study group. Present cross-sectional study was conducted among the Santals living in rural areas of Bankura district of West Bengal. Total enumeration of all the Santal households had been done for socio-demographic data, collected by using standard household census schedule. A total of 472 adults including 206 males and 266 females were recruited as study participants. Blood pressure and different anthropometric data had been measured using standard methods and instruments. JNC 7 classification used to categorize blood pressure data and hypertension was diagnosed as SBP/DBP ≥140/90 mmHg. Descriptive statistics and logistic regression were used to analyze the data. Majority of the study participants were married, non-literate and engaged in agricultural activity as daily labourer. Blood pressure levels of the study population indicate that 22.3% males and 23.3% females were hypertensive. Compared to other tribal groups, Santals showed similar or relatively lower prevalence of hypertension. Results of logistic regression analysis demonstrates that age groups as middle aged (OR= 2.204), elderly (OR= 5.701), family types as joint (OR= 0.317) and nutritional status as overweight (OR= 9.480) were significantly associated with hypertension when other socio-demographic variables remain adjusted.

## Introduction

Hypertension or high blood pressure, diagnosed as diastolic blood pressure ≥90 mmHg and/or systolic blood pressure ≥140 mmHg (Carretero & Oparil, 2000), is well recognized as a leading cause of cardiovascular disease and premature death worldwide (WHO, 2013). Although in recent four decades global mean blood pressure remain constant or decreases slightly but the prevalence of hypertension increases, mostly in low and middle income countries (Mills et al., 2020) including India (Gupta et al., 2019). It attributes to the disparities between high income and

low income countries in awareness generation, treatment and control, where awareness and treatment increases less and control decreases in low income countries (Mills et al., 2016). Again, within a country, there remain disparities in hypertension prevalence across socio-economic status (Chambergo-Michilot et al., 2021) and also among different ethnic groups (van Laer et al., 2018). It is also reported that marginalised people are more vulnerable towards hypertension than their other counterpart (Khan & Beevers, 2005), which suggested the need for targeted intervention (Fei et al., 2017) but data on them are largely inadequate.

Hypertension is a physiological trait which is associated with increasing age (Pinto, 2007), higher body mass index (Hossain et al., 2019) and certain other physiological condition where behavioural factors like unhealthy diet, physical inactivity, high salt intake, excessive alcohol consumption further increases the risk (WHO, 2013). Presence of psychological stress is also associated with hypertension (Cuevas et al., 2017). It is reported that poor socio-economic condition increases the risk of hypertension (Leng et al., 2015) and the association differ across geographical region (Busingye et al., 2014) but the finding is inconsistent as Colhoun and colleagues (1998) reviewed that in underdeveloped or developing countries a direct association between socio-economic status and blood pressure exists which may happen due to higher prevalence of obesity, higher salt intake and consumption of alcohol among those of higher economic group; whereas Wu and Wang (2019) observed individual with lowest social quartile suffer the most in developing country.

In India, socio-economic status and prevalence of hypertension has association (Thrift et al., 2020) and it is affecting the poor people as well (Ghosh & Kumar, 2019). Again, Uddin and colleagues (2020) using national representative data, reported higher prevalence of hypertension among Scheduled Tribe and low caste people than upper caste people, where socio-economic status play a complex role. It is well reported that prevalence of hypertension increases among indigenous people of India (Rizwan et al., 2014) where socio-economic and demographic factors play a crucial role (Laxmaiah et al., 2015), but the results are inconsistent across different ethnic groups of different regions (Chakma et al., 2017; Deo et al., 2018). In view, the objectives of the present study are to investigate the prevalence of hypertension of the Santals of Bankura district of West Bengal and also to find out the socio-demographic correlates of hypertension of the studied group.

## Materials & Methods

### *Study area and population*

Present cross-sectional study was conducted in four adjacent villages under Barjora block of Bankura district, West Bengal as part of a bio-medical research project. The Bankura district is located approximately 200 kilometers away from state capital, Kolkata. The district is well connected with roads and railways from the city. This study area was purposively chosen as Santals (Scheduled Tribes) were the predominant inhabitants of these villages under Beliatore area. The study was restricted to a single ethnic group viz. Santals, they are the largest *scheduled tribe* community of West Bengal (Census of India, 2011) and spread almost all the districts of the state mostly as settle agriculturist. Santals has "Proto-Australoid" ethnic identity (Guha, 1944) and known for their economic hardship. There were lesser socio-economic heterogeneity in terms of education, occupation, and economic status between and among individuals in these rural ecological settings. Several studies focused on their BMI based nutritional status (Das & Bose, 2010; Das & Roy, 2013; Ghosh et al., 2017; Mukhopadhyay, 2010) and studies reported that majority of rural Santals are suffering from under nutrition. However, blood pressure level or hypertension status of the Santals was unreported except a few studies (Ghosh, 2011; Kshatriya & Acharya, 2019).

### *Study participants*

A total of 472 adults including 206 males and 266 females apparently healthy individuals were recruited as the study participants. No statistical sampling was adopted to collect data; complete enumeration of the households was carried out for the collection of demographic and socio-economic data. Then all the adult individuals were approached for blood pressure data, but those individuals who voluntarily agreed to take part in the process, was selected as study subject. To avoid inter-observer error one of the authors (BMD) was engaged in entire data collection. The nature, objectives and importance of the study were explained to all of the study participants and written consent was obtained prior to data collection. The study was conducted in compliance with the Scientific Ethical Committee for Protection of Research Risks to Humans of the parent institute (ISI) of the authors.

### *Data types and data collection methods*

Socio-demographic data were collected through standard household census schedule, which includes name, age, sex, marital status, education, occupation, all the household members' relationship with head of households, item-wise monthly household expenditure and household's assets. Later, family type data had been generated from data related to relationship with the head of households. It was difficult

to record the exact age of some of the participants due to the absence of proper birth records. In such cases, age was estimated by referring to some important local events of recent history, natural calamities, etc.; and cross-checked with the age of the individuals with birth records as well as with elderly individuals. Anthropometric measurements (height & weight) were taken following standard methodology and standard instruments (Weiner & Lourie, 1981).

***Blood pressure data***

Systolic blood pressure (SBP, mmHg) and Diastolic blood pressure (DBP, mmHg) were measured with mercury Sphygmomanometer and Stethoscope after 15 minutes of complete rest following the standard protocol of American Heart Association (Pickering et al., 2005). The instruments were standardized and also checked for its calibration before use every time. The cuff is then inflated rapidly to 20-30 mmHg above the pressure at which the radial pulse disappeared to palpation. The cuff was then gradually deflated at a constant rate of 2-3 mmHg per second. The mercury column is watched continuously and carefully. Systolic pressure was taken as the pressure at which the ear distinguished the first arterial sound (Korotkoff). Diastolic blood pressure was taken when the Korotkoff sound first becomes muffled and then disappears. Blood pressure was reported to the nearest 2 mm of height.

***Classification of data***

Hypertension status was assessed with 7$^{th}$ Report of the Joint National Committee (JNC 7; Chobanian et al., 2003) recommended standard cut-off values of systolic and diastolic blood pressure level to classify 'Normal' (SBP<120 mmHg and DBP<80 mmHg), 'Pre-hypertension' (SBP: 120-139 mmHg and/or DBP: 80-89 mmHg), 'Stage-1 hypertension' (SBP: 140-159 mmHg and/or DBP: 90-99 mmHg) and 'Stage-2 hypertension' (SBP≥160 mmHg and/or DBP≥100 mmHg). Furthermore, at times of logistic regression analysis, blood pressure data have been transformed into two categories i.e. hypertensive (SBP≥140 mmHg and/or DBP≥90 mmHg) and non-hypertensive (SBP<140 mmHg and DBP<90 mmHg). Nutritional status was assessed with standard cut-off values of Body Mass Index (BMI) to classify underweight (<18.50 kg/m²), normal (18.50-24.99 kg/m²), overweight/obese (≥ 25.00 kg/m²) in adults (WHO, 2004). Age was categorized into 3 age cohorts i.e., 18-39 years, 40-59 years, and 60-78 years. Marital status was classified as married, unmarried and widowed/divorced/separated; Educational level as non-literate, upto primary level (class I-IV), secondary level (class V-X) and above secondary level (above class X); Occupational types were categorized as agricultural worker (including daily wage/labour), salaried (service person/pensioner), students, household worker (mainly housewife and very few males who always actively engaged

in household work) and others (including petty business person /dependents /unemployed individuals in the household). Economic status was assessed by wealth index score (WIS) based on household assets and classified into two categories i.e. low (WIS < -0.819) and high (WIS ≥ -0.819) economic groups. Initially, family types data were classified into four categories viz. sub-nuclear (a family, where no married couple live), nuclear (family includes one pair married couple with their unmarried children), supplemented nuclear (here only one married couple live with their related or unrelated unmarried/married [without spouse] members), and joint (families with at least two pairs of married couple either vertical or horizontal expansion) family. However, during data analysis the sub-nuclear family members merged with nuclear families due to paucity of data in the previous categories.

***Statistical analysis***

Descriptive statistics were computed to explore the socio-demographic and health characteristics and prevalence of hypertension. $Chi^2$ test is carried out to find out association between the said variables and hypertensive category. Logistic regression models are separately fitted to explore significant predictors for hypertension status among different categorical independent socio-demographic and health variables like age groups, sex, marital status, educational levels, occupational types, economic status, family types and nutritional status. In this analyses, two logistic regression models i.e. multivariate enter (unadjusted) and multivariate stepwise (adjusted) were used. In multivariate logistic regression model, binary variable hypertensive vs. non-hypertensive used as dependent variables and all the above mentioned socio-demographic independent variables were used in single model to identify significant predictor/s for hypertension status along with other non-significant independent variables. The second multivariate logistic regression was conducted using stepwise backward elimination of variables. In this model, backward conditional method was preferred because the forward method produces "suppressor effects." The backward regression analysis started with the full least squares model with all the predictors. The analysis then iteratively removed the least useful predictor, one-at-a-time, until when all remaining variables contribute to the model significantly ($P < 0.05$). This analytical approach keeps most of the predictors in the model that are significantly associated with the outcome variable. All the independent variables were categorical as described earlier. For most of the categorical independent variable, the category with the highest frequency was considered as reference category and the association of other categories with the dependent variable were presented in terms of odds ratios (OR) and 95% confidence interval (CI) level. All statistical analyses were done using SPSS 16.0 (SPSS Inc., Chicago, IL, USA) and Microsoft Excel 2010 software packages.

## Results

TABLE 1: Blood pressure categories of the Santals

| **Blood pressure** (mmHg) **categories (JNC 7, 2003)** | **Male (n=206)** | | **Female (n=266)** | |
|---|---|---|---|---|
| | **No.** | **%** | **No.** | **%** |
| Normal (SBP<120 and DBP<80) | 70 | 33.98 | 98 | 36.84 |
| Pre-hypertension (SBP=120-139 and/or DBP=80-89) | 90 | 43.69 | 106 | 39.85 |
| Stage 1 Hypertension (SBP=140-159 and/or DBP=90-99) | 33 | 16.02 | 49 | 18.42 |
| Stage 2 Hypertension (SBP≥160 and/or DBP≥100) | 13 | 6.31 | 13 | 4.89 |
| ***Systolic Blood Pressure (SBP)*** | | | | |
| Normal (<120) | 99 | 48.06 | 138 | 51.88 |
| Pre-hypertension (120 - 139) | 78 | 37.86 | 90 | 33.83 |
| Stage-1 hypertension (140 - 159) | 20 | 9.71 | 27 | 10.15 |
| Stage-2 hypertension (≥160) | 9 | 4.37 | 11 | 4.14 |
| ***Diastolic Blood Pressure (DBP)*** | | | | |
| Normal (<80) | 94 | 45.63 | 129 | 48.50 |
| Pre-hypertension (80 - 89) | 79 | 38.35 | 93 | 34.96 |
| Stage-1 hypertension (90 - 99) | 24 | 11.65 | 37 | 13.91 |
| Stage-2 hypertension (≥100) | 9 | 4.37 | 7 | 2.63 |

*Table 1* shows the blood pressure categories of the Santals according to JNC 7 (2003) cut-off values. The results of overall blood pressure profile demonstrate that majority of the study population were categorized as 'pre-hypertension' (43.69% males and 39.85% females), followed by 'normal' (33.98% males and 36.84% females), 'stage-1 hypertension' (16.02% males and 18.42% females) and 'stage-2 hypertension' (6.31% males and 4.89% females) irrespective of sex. But in case of the systolic blood pressure, majority of the males and females classified under 'normal' (48.06% males and 51.88% females) category, followed by 'pre-hypertension' (37.86% males and 33.83% females) and 'stage-1 hypertension' (9.71% males and 10.15% females). Similar trend was observed in case of diastolic blood pressure, higher percentage of participants were classified as 'normal' (45.63% males and 48.50% females), 'pre-hypertension' (38.35% males and 34.96% females) and 'stage-1 hypertension' (11.65% males and 13.91% females) category. Besides, very small percentages (around 4%) of individuals irrespective of sex suffer from 'stage-2 hypertension' in terms of systolic and diastolic blood pressure.

TABLE 2: Socio-demographic characteristics and prevalence of hypertension of the Santal tribal population

| **Socio-demographic Characteristics** | | **Population** | | **Hypertension prevalence** | | **Chi²** (***p-value***) |
|---|---|---|---|---|---|---|
| Variables | Characteristics | **No.** | **%** | **No.** | **%** | |
| **Sex** | Male | 206 | 43.64 | 46 | 22.33 | 0.063 (0.802) |
| | Female | 266 | 56.36 | 62 | 23.31 | |
| **Age groups** | Younger (18-39 years) | 245 | 51.91 | 34 | 13.88 | **30.194** (<0.001) |
| | Middle aged (40-59 years) | 144 | 30.51 | 39 | 27.08 | |
| | Elderly (60-78 years) | 83 | 17.58 | 35 | 42.17 | |
| **Marital status** | Unmarried | 70 | 14.83 | 11 | 15.71 | **26.838** (<0.001) |
| | Married | 340 | 72.03 | 67 | 19.71 | |
| | Widow/Divorced/Separated | 62 | 13.14 | 30 | 48.39 | |
| **Educational levels** | Non-literate | 263 | 55.72 | 69 | 26.24 | 4.270 (0.234) |
| | Primary | 34 | 7.20 | 7 | 20.59 | |
| | Secondary | 140 | 29.66 | 27 | 19.29 | |
| | Higher Secondary and above | 35 | 7.42 | 5 | 14.29 | |
| **Occupational types** | Agricultural activity | 302 | 63.98 | 60 | 19.87 | **13.361** (0.01) |
| | Salaried | 19 | 4.03 | 5 | 26.32 | |
| | Student | 26 | 5.51 | 2 | 7.69 | |
| | Household work | 81 | 17.16 | 24 | 29.63 | |
| | Others* | 44 | 9.32 | 17 | 38.64 | |
| **Economic status** (By Wealth Index Score) | Low [WIS <- 0.8197] | 258 | 54.66 | 66 | 25.58 | 2.351 (0.152) |
| | High [WIS ≥- 0.8197] | 214 | 45.34 | 42 | 19.63 | |
| **Family types** | Nuclear | 173 | 36.65 | 48 | 27.75 | **15.162** (0.001) |
| | Supplemented nuclear | 143 | 30.30 | 41 | 28.67 | |
| | Joint | 156 | 33.05 | 19 | 12.18 | |
| **Nutritional Status** (By Body Mass Index values) | Underweight | 198 | 41.95 | 44 | 22.22 | **6.401** (0.041) |
| | Normal weight | 263 | 55.72 | 58 | 22.05 | |
| | Overweight/Obese | 11 | 2.33 | 6 | 54.55 | |

* Others include dependent, unemployed, small business, etc.

*Table 2* shows the socio-demographic characteristic and prevalence of hypertension of the Santal tribal population. Out of total 472 study participants, 56% were females and around 44% were males. Age group wise distribution of the study population indicates that higher percentages of participants belonged to younger age group i.e.18-39 years (51.91%), followed by middle aged (40-59 years; 30.51%), and elderly (60-78 years; 17.58%). An overwhelming majority of the participants were married (72.03%) and more than half of the participants were non-literate (55.72%). Among rest of literate individuals majority had either secondary level of education (29.66%) or above secondary level of education (7.42%) or upto primary level of education (7.20%). The occupational pursuit of the Santals indicates that majority of them were engaged in agricultural activity (63.98%), salaried job (4.03%) in public or private sectors, and another 17% individuals were engaged in household work (mostly females). Economic status of the study population was assessed by wealth index score, which further categorized into two economic groups i.e. low (54.66%) and high (45.34%). Majority of the participants belonged to nuclear family (36.65%), followed by joint family (33.05%) and supplemented nuclear family (30.30%). An overwhelming majority of the participants were either normal weight (55.72%) or underweight (41.95%).

This table also demonstrated the prevalence of hypertension between/among different socio-demographic characteristics of the studied groups. 22.33% of the male and 23.31% female participants were categorized as hypertensive. Age group wise distribution of hypertension prevalence data revealed that elderly (60-78years) individuals hold the highest prevalence of hypertension (42.17%), followed by middle aged (40-59years; 27.08%) and younger (18-39years; 13.88%) participants. In marital group, widowed/divorced/separated individuals showed the highest prevalence of hypertension (48.39%), followed by married (19.71%) and unmarried (15.71%) individuals. The prevalence of hypertension was decreasing with increasing level education from non-literate (26.24%), upto primary (20.59%), to secondary (19.29%), to higher secondary and above (14.29%) levels of education. According to occupational categories, highest prevalence of hypertension was observed among individuals who belonged to ‘others’ category (38.64%), followed by individuals engaged in household work (29.63%), salaried (26.32%), agricultural activity (19.87%) and students (7.69%) categories. Individuals belonged to low economic group (25.58%) shows little higher prevalence of hypertension than the high economic group (19.63%). Family types data indicates that prevalence of hypertension was higher among individuals who live in nuclear (27.75%) and supplemented nuclear (28.67%) families than joint (12.18%) families. Nutritional status wise distribution of hypertension categories indicates that overweight/obese individuals (54.55%) show higher prevalence of hypertension than the normal weight (22.22%) and underweight (22.05%) individuals.

Chi² analysis conducted between/among socio-demographic groups and hypertensive groups, the results show that hypertension categories were significantly associated with age groups ($p<0.001$), marital status ($p<0.001$), occupational types ($p<0.01$), family types ($p<0.01$), and nutritional status ($p<0.05$).

TABLE 3: Prevalence of hypertension among different Tribes from different regions of India

| Population (Study area) | Sample size | SBP Mean (SD) | DBP Mean (SD) | Hypertensive (%) | Study sample | References |
|---|---|---|---|---|---|---|
| Santal (West Bengal) | 472 | 122.1 (18.3) | 79.5 (10.3) | 22.9 | Pooled | Present Study |
| | 206 | 122.7 (18.2) | 79.9 (10.9) | 22.3 | Male | |
| | 266 | 121.6 (18.4) | 79.1 (9.7) | 23.3 | Female | |
| Santal (West Bengal) | 245 | 125.7 (21.3) | 79.1 (12.2) | 11.8 | Pooled | Kshatriya & Acharya (2019) |
| Kora (West Bengal) | 235 | 124.7 (21.6) | 79.8 (12.9) | 10.6 | Pooled | |
| Oraon (West Bengal) | 236 | 127.7 (18.3) | 82.3 (12.5) | 16.5 | Pooled | |
| Santal (Odisha) | 240 | 125.6 (16.0) | 79.1 (12.3) | 9.6 | Pooled | |
| Bhumij (Odisha) | 238 | 129.4 (23.4) | 79.7 (13.6) | 14.7 | Pooled | |
| Bathudi (Odisha) | 240 | 129.1 (21.0) | 81.1 (14.2) | 12.1 | Pooled | |
| Oraon (West Bengal) | 126 | NA | NA | 46.0 | Male | Kundu Chowdhury & Roy (2016) |
| | 210 | NA | NA | 25.7 | Female | |
| Oraon (West Bengal) | 357 | 124.1 (22.2) | 82.6 (13.6) | 28.6 | Pooled | Roy & Kundu Chowdhury (2013) |
| | 198 | 126.4 (20.6) | 83.0 (12.4) | 30.3 | Male | |
| | 159 | 121.3 (23.8) | 82.2 (15.0) | 26.4 | Female | |
| Santal (West Bengal) | 692 | 125.3 (11.4) | 81.7 (9.0) | NA | Male | Ghosh (2011) |
| | 570 | 122.1 (11.2) | 80.8 (8.9) | NA | Female | |
| Tribes (Ao) (Nagaland) | 472 | NA | NA | 43.2 | Pooled | Tushi et al. (2018) |
| Mishing Tribe (Assam) | 179 | 124.3 (13.3) | 83.2 (10.0) | 27.9 | Male | Misra et al. (2014) |
| | 153 | 122.3 (13.0) | 81.2 (9.2) | 22.9 | Female | |

*To be continued*

| | | | | | | |
|---|---|---|---|---|---|---|
| Ao Tribe (Nagaland) | 890 | NA | NA | 27.0 | Male | Maken & Verte (2013) |
| | 914 | NA | NA | 18.3 | Female | |
| Tangkhul Naga (Manipur) | 257 | 126.3 (17.7) | 79.9 (13.1) | 21.8 (SBP) & 33.8 (DBP) | Male | Mungreiphy et al. (2011) |
| Bhutias (Sikkim) | 315 | 127.3 (21.9) | 82.3 (14.2) | 25.4 | Pooled | Mishra et al. (2010) |
| Rais (Sikkim) | 582 | 125.5 (17.5) | 81.7 (11.3) | 20.4 | Pooled | |
| High Altitude Tribes (Himachal Pradesh) | 401 | 121.7 (16.9) | 75.6 (10.1) | 10.7 | Pooled | Raina et al. (2016) |
| | 270 | 124.6 (17.4) | 76.7 (10.4) | 12.9 | Male | |
| | 131 | 115.8 (14.0) | 73.3 (8.8) | 6.1 | Female | |
| Rang Bhotia (Uttarakhand) | 288 | NA | NA | 43.4 | Pooled | Kandpal et al. (2016) |
| Tribes of Madhya Pradesh | 1442 | NA | NA | 28.2 | Male | Chakma et al. (2017) |
| | 1648 | NA | NA | 23.6 | Female | |
| Dhidia (Gujarat) | 240 | 129.3 (21.4) | 81.2 (12.6) | 13.3 | Pooled | Kshatriya & Acharya (2019) |
| Kukna (Gujarat) | 240 | 127.8 (17.1) | 79.7 (10.3) | 11.3 | Pooled | |
| Chaudhari (Gujarat) | 241 | 124.7 (22.5) | 77.6 (12.9) | 6.2 | Pooled | |
| Katkari (Maharastra) | 191 | 129.0 (19.0) | 80 (12.2) | 17.8 | Male | Deo et al. (2017) |
| | 219 | 125.0 (19.9) | 79 (11.9) | 16.0 | Female | |
| Malayalee Tribe (TamilNadu) | 383 | 117.9 (16.4) | 74.8 (11.1) | 13.8 | Male | Sathiyanarayanan et al. (2019) |
| | 569 | 119.4 (21.1) | 73.3 (12.3) | 18.6 | Female | |
| Kani Tribe (Kerala) | 298 | NA | NA | 48.3 | Pooled | Sajeev & Soman (2018) |
| Jenu Kuruba (Karnataka) | 571 | 126.3 (14.5) | 79.2 (11.0) | 28.2 | Male | Hathur et al. (2013) |
| | 719 | 120.5 (13.2) | 76.0 (9.5) | 16.5 | Female | |

*To be continued*

| | | | | | | |
|---|---|---|---|---|---|---|
| Tribes of Kerala | 4192 | NA | NA | 39.9 | Pooled | Meshram et al. (2012) |
| | 1890 | NA | NA | 44.8 | Male | |
| | 2302 | NA | NA | 35.8 | Female | |
| Nicobarese tribe (Car Nicobar Island) | 975 | NA | NA | 50.5 | Pooled | Manimunda et al. (2011) |

*SBP – Systolic Blood Pressure; DBP – Diastolic Blood Pressure; NA-Information Not Available.*

*Table 3* shows the prevalence of hypertension among different tribal population from different regions of India. It may be mentioned that all the published studies including the present study are cross-sectional in nature and conducted among adult (age>18 years) tribal populations living in rural ecological setting. Hypertension prevalence was assessed using standard blood pressure criteria i.e. SBP/DBP $\geq$ 140/90 mmHg. Present study population shows 22.9% overall prevalence of hypertension and males (22.3%) show slight lower prevalence than females (23.3%). Some other studies on the same ethnic group (Santal) and region (West Bengal) indicated much lower prevalence of hypertension (around 12%) than present study population. In this particular region Oraon tribal population shows higher prevalence; Kora, Bhumij, and Bathudi shows lower prevalence than the present study population. Tribes of all North-eastern states, Southern state like Kerala, some other states like Uttarakhand, Madhya Pradesh, and Car Nicobar Island shows much higher prevalence of hypertension than the Santals of the present study. Some other tribal population like Dhidia, Kukna, Chaudhari of Gujarat; Katkari of Maharastra; Malayalee tribe of Tamilnadu; and Tribes of Himachal Pradesh reveals lower prevalence of hypertension than present study population. In most of the studies, males demonstrate higher prevalence of hypertension than females except a few (Santals of present study & Malayalee tribe of Tamilnadu).

TABLE 4: Results of multivariate logistic regression for hypertension of the Santals with respect to different socio-demographic and health variables

| Variables | Logistic Regression Models | |
|---|---|---|
| | **Unadjusted** | **Adjusted** (Backward Stepwise, step-6) |
| | Odds Ratio (95% CI) | Odds Ratio (95% CI) |
| ***Age Groups*** | | |
| Younger (18-39 years) | Ref. | Ref. |
| Middle aged (40-59 years) | 2.071* (1.141-3.762) | 2.204** (1.287-3.774) |
| Elderly (60-78 years) | 3.543** (1.504-8.350) | 5.701*** (3.089-10.522) |
| ***Sex*** | | |
| Male | Ref. | |
| Female | 0.963 (0.525-1.767) | |
| ***Marital status*** | | |
| Married | Ref. | |
| Unmarried | 1.291 (0.511-3.260) | |
| Widow/Divorced/Separated | 1.962 (0.943-4.082) | |
| ***Educational level*** | | |
| Non-literate | Ref. | |
| Primary | 0.963 (0.350-2.645) | |
| Secondary | 1.149 (0.591-2.235) | |
| Higher Secondary and above | 1.230 (0.276-5.490) | |
| ***Occupational types*** | | |
| Agricultural activity | Ref. | |
| Salaried | 1.140 (0.336-3.874) | |
| Student | 0.332 (0.053-2.079) | |
| Household work | 1.218 (0.573-2.591) | |
| Others[#] | 1.478 (0.631-3.463) | |
| ***Economic status*** (By Wealth Index Score) | | |
| Low [WIS <- 0.8197] | Ref. | |
| High [WIS ≥- 0.8197] | 0.674 (0.399-1.139) | |

*To be continued*

| | | |
|---|---|---|
| ***Family types*** | | |
| Nuclear | Ref. | Ref. |
| Supplemented nuclear | 0.958 (0.548-1.674) | 0.996 (0.588-1.686) |
| Joint | 0.360** (0.188-0.689) | 0.317*** (0.169-0.593) |
| ***Nutritional Status*** (By BMI values) | | |
| Underweight | Ref. | Ref. |
| Normal weight | 1.389 (0.828-2.331) | 1.376 (0.843-2.247) |
| Overweight | 10.148** (2.441-42.185) | 9.480*** (2.439-36.844) |
| **R Square** (Nagelkerke) | **0.192** | **0.169** |
| **Model correctly predicted** | **78.6%** | **78.4%** |

* $p < 0.05$, ** $p < 0.01$; *** $p < 0.001$; Ref.: reference category;
# Others include dependent, unemployed, small business, etc.

*Table 4* shows the results of multivariate logistic regression for hypertension of the Santals with respect to different socio-demographic and health variables. In multivariate logistic regression models (unadjusted), high blood pressure was found to be significantly associated with age, family types and nutritional status of the study participants. Individuals belong to higher age groups viz. elderly (OR= 3.543) and middle aged (OR= 2.071) were significantly more likely to be hypertensive compared to individuals with younger age. Participants who live in joint families (OR= 0.360) were less likely to be hypertensive than who live in nuclear families. Overweight individuals (OR= 10.148) were more likely to be hypertensive than the underweight individuals. Results of multivariate stepwise logistic regression model show that age groups as middle aged (OR= 2.204), elderly (OR= 5.701), family types as joint (OR= 0.317) and nutritional status as overweight (OR = 9.480) were significantly associated with hypertension when other socio-demographic variables remain adjusted.

## Discussion

Increasing prevalence of hypertension among the indigenous people is becoming an area of concern in India, where ethnic group specific data is required to address the problem and control the increasing burden, but the study regarding the matter is still inadequate. In view, the present study aims to explore the prevalence

of hypertension and its socio-demographic correlates among the Santals of Bankura district of West Bengal. Santals, the numerically dominant Scheduled Tribe population in West Bengal was taken for the study and the district Bankura was selected where this indigenous group is predominant. Demographic, socio-economic data obtained from all the households from the selected villages/areas and blood pressure data of the willing participants had been measured following standard protocol. Results indicate that a good percentage of individuals of either sex belonged to pre-hypertensive and hypertensive category where individuals living in joint family were less likely and individuals with higher age and being overweight were more likely to be hypertensive.

A good percentage (22.9%) of individuals was hypertensive in the present study which is corroborative with general population of West Bengal (IIPS & ICF, 2020) and district Bankura (IIPS & ICF, 2020); rural people of West Bengal and India (NNMB Rural Report, 2006) but relatively lower than Scheduled Tribe of West Bengal as well as India (NNMB Tribal Report, 2009). Again, Kshatriya and Acharya (2019) reported much lower prevalence of hypertension among some Scheduled Tribes in eastern India including Santal, but other authors (Kundu Chowdhury & Roy, 2016; Roy & Kundu Chowdhury, 2013) found higher prevalence than the present study. Studies have also been conducted in different indigenous groups of North-east India (Maken & Verte, 2013; Mishra et al., 2010; Mungreiphy et al., 2011; Tushi et al., 2014); Northern India (Kandpal et al., 2016; Raina et al., 2016); Central Iindia (Chakma et al., 2017), Western India (Deo et al., 2017; Kshatriya & Acharya, 2019;), South India (Hathur et al., 2013; Meshram et al., 2012; Sajeev & Soman, 2018; Sathiyanarayanan et al., 2019) and Car Nicobar Island (Manimunda et al., 2011) which depicted inconsistency in prevalence of hypertension as well as the reason for it across indigenous groups of different regions. However, Rizwan and colleagues (2014) in a meta-analysis opined that acculturation as the underline agent for the increase of the prevalence of hypertension among indigenous groups but also suggested not to consider the factor solely and to consider other confounding factors too.

Effect of acculturation cannot be ruled out in the present study population, who although live far remote areas from the urban centre like Kolkata, but influenced by the pace of development. They live close proximity with people of other community and share culture with them. It was evident from the socio- demographic status that a good number of people are living in nuclear or supplemented nuclear families instead of joint families which was not conventional for a agriculturist community and the prevalence of hypertension was higher among them. Again, the prevalence was higher among widow/widower/separated individuals and who engaged in ‘other’ occupation (including dependent, unemployed, and small business holders). This trend

may indicates the change in their traditional living which cause adverse effect in their health. Kapoor and Dhall (2016) reported that rapid urbanization in India forces the indigenous groups to change their conventional life ways and which further causes some adverse effect on the health status. Kshatriya (2014) further elaborated that with the availability of modern education and other facilities indigenous people are adopting urban life with change in food habit and activity pattern, which further leads to weight gain among them and increases the risk of several chronic diseases including hypertension at a young age with a lower body weight.

The present study also shows individuals with higher age and with overweight status were more likely to be hypertensive, whereas individuals living in joint families were less likely to be hypertensive. The association of higher age and hypertension was evident among other indigenous populations of India (Gupta et al., 2018; Kshatriya & Acharya, 2019; Kundu Chowdhury & Roy, 2016; Manimunda et al., 2011; Sajeev & Soman, 2018), thus corroborative with the present study. Again, studies also documented association of overweight status and hypertension (Godara et al., 2021; Manimunda et al., 2011; Sathiyanarayanan et al., 2019). The study links lower hypertension prevalence with living in joint family. Generally, agriculturist society like Santal tend to live in larger families to maintain the share of agricultural land and cultivated crops, but with the advent of urbanization this age old practice diminish and this discomfort may leads to some adverse effect on their health. Few studies have demonstrated that traditional societies can sometimes have high mean blood pressure or a high proportion of individuals had chances to be hypertensive (Marmot, 1979; Neilson & Williams, 1978), especially when such traditional groups need to cope with relatively modern areas (Little & Baker, 1976).

In sum, it can be stated that the finding of the study is in line with other studies which reveal increasing prevalence of hypertension among indigenous people and demonstrate socio-demographic environment as responsible factor for the outcome. It reveals apparently that rapid change in the physical environment in terms of change in conventional life ways may leads to adverse health outcome. The study is conducted in a single homogenous ethnic group, who live in remote areas with a view to eliminate the effect of genetic as well as certain behavioural factors on blood pressure. However, the result cannot be regarded as conclusive for the entire community but is true to the present group and shows some pathways to control the burden. Although, more studies with larger sample size and incorporating all the confounding variables is required to get a conclusive result in the issue and initiate intervention programme to manage and control the burden.

**Acknowledgements** —The authors would like to thank all of the study participants for providing their valuable time and the required data. The Indian Council of Medical Research, New Delhi is thankfully acknowledged for providing BMD with a research fellowship. Other financial and logistic supports to this study were provided by the Indian Statistical Institute (ISI), Kolkata.

## Declaration of Interest

The authors have no conflict of interest in writing the manuscript, authorship, and/or publication of this article.

## References

Businge, D., Arabshahi, S., Subasinghe, A. K., Evans, R. G., Riddell, M. A., & Thrift, A. G. (2014). Do the socioeconomic and hypertension gradients in rural populations of low-and middle-income countries differ by geographical region? A systematic review and meta-analysis. *International Journal of Epidemiology*, *43*(5), 1563-1577.

Carretero, O. A., & Oparil, S. (2000). Essential hypertension: part I: definition and etiology. *Circulation*, *101*(3), 329-335.

Census of India. (2011). Provisional Population Totals - West Bengal. West Bengal: Directorate of Census Operations. Government of India: New Delhi. Accessed from: http://www.census2011.co.in/census/district/13-bankura.html. on 11/06/2020.

Chakma, T., Kavishwar, A., Sharma, R. K., & Rao, P. V. (2017). High prevalence of hypertension and its selected risk factors among adult tribal population in Central India. *Pathogens and Global Health*, *111*(7), 343–350. https://doi.org/10.1080/20477724.2017.1396411

Chambergo-Michilot, D., Rebatta-Acuña, A., Delgado-Flores, C. J., & Toro-Huamanchumo, C. J. (2021). Socioeconomic determinants of hypertension and prehypertension in Peru: Evidence from the Peruvian Demographic and Health Survey. *PloS one*, *16*(1), e0245730. https://doi.org/10.1371/journal.pone.0245730.

Chobanian, A. V., Bakris, G. L., Black, H. R., Cushman, W. C., Green, L. A., Izzo Jr, J. L., & Roccella, E.J. (2003). The seventh report of the joint national committee on prevention, detection, evaluation, and treatment of high blood pressure: the JNC 7 report. *Journal of American Medical Association*, *289*(19), 2560-2571.

Colhoun, H. M., Hemingway, H., & Poulter, N. R. (1998). Socio-economic status and blood pressure: an overview analysis. *Journal of Human Hypertension*, *12*(2), 91-110. https://doi.org/10.1038/sj.jhh.1000558

Cuevas, A. G., Williams, D. R., & Albert, M. A. (2017). Psychosocial factors and hypertension: a review of the literature. *Cardiology Clinics*, *35*(2), 223-230.

Das, B. M., & Roy, S. K. (2013). Rural-Urban Differences in Nutritional Status and Physical Body Dimensions of Adult Santal Males of West Bengal. *International Journal of Anthropology*, *28*(4), 237-254.

Das, S., & Bose, K. (2010). Body Mass Index and Chronic Energy Deficiency among Adult

Santals of Purulia District, West Bengal, India. *Journal of Human Sciences*, *7*(2), 488-503.

Deo, M. G., Pawar, P. V., Kanetkar, S. R., & Kakade, S. V. (2017). Prevalence and risk factors of hypertension and diabetes in the Katkari tribe of coastal Maharashtra. *Journal of Postgraduate Medicine*, *63*(2), 106-113. DOI: 10.4103/0022-3859.194204.

Deo, M. G., Pawar, P. V., Kanetkar, S. R., & Kakade, S. V. (2018). Multicentric study on prevalence and risk factors for hypertension and diabetes in tribal communities in Western and Northern Maharashtra. *Journal of Postgraduate Medicine*, *64*(1), 23-34. DOI: 10.4103/jpgm.JPGM_245_17.

Dua, S., Bhuker, M., Sharma, P., Dhall, M., & Kapoor, S. (2014). Body mass index relates to blood pressure among adults. *North American Journal of Medical Sciences*, *6*(2), 89-95.

Dubey, M., Rastogi, S., & Awasthi, A. (2019). Hypertension prevalence as a function of different guidelines, India. *Bulletin of the World Health Organization*, *97*(12), 799-809.

Fei, K., Rodriguez-Lopez, J.S., Ramos, M., Islam, N., Trinh-Shevrin, C., Yi, S.S., & Thorpe, L.E. (2017). Racial and ethnic subgroup disparities in hypertension prevalence, New York City Health and Nutrition Examination Survey, 2013–2014. *Preventing Chronic Disease*, 14, 160478. DOI: http://dx.doi.org/10.5888/pcd14.160

Ghosh, S. (2011). Association between physique and blood pressure in an adult tribal population. *Anthrop Közl*, *52*, 119-130.

Ghosh, S., & Kumar, M. (2019). Prevalence and associated risk factors of hypertension among persons aged 15–49 in India: a cross-sectional study. *BMJ Open*, *9*(12), e029714. Doi:10.1136/ bmjopen-2019-029714

Ghosh, S., Dosaev, T., Prakash, J., & Livshits, G. (2017). Quantitative genetic analysis of the body composition and blood pressure association in two ethnically diverse populations. *American Journal of Physical Anthropology*, *162*(4), 701-714.

Godara, R., Mathews, E., Mini, G. K., & Thankappan, K. R. (2021). Prevalence, awareness, treatment and control of hypertension among adults aged 30 years and above in Barmer district, Rajasthan, India. *Indian Heart Journal*. (In Press)

Guha, B. S. (1944). Racial elements in the population. Issue 22 of Oxford pamphlets on Indian affairs. London: Oxford University Press.

Gupta, R., Gaur, K., & Ram, C. V. S. (2019). Emerging trends in hypertension epidemiology in India. *Journal of Human Hypertension*, *33*(8), 575-587. https://doi.org/10.1038/s41371-018-0117-3

Hathur, B., Basavegowda, M., & Ashok, N. C. (2013). Hypertension: An emerging threat among tribal population of Mysore; Jenu Kuruba tribe diabetes and hypertension study. *International Journal of Health & Allied Sciences*, *2*(4), 270-274.

Hossain, F. B., Adhikary, G., Chowdhury, A. B., & Shawon, M. S. R. (2019). Association between body mass index (BMI) and hypertension in south Asian population: evidence from nationally-representative surveys. *Clinical Hypertension*, *25*(1), 1-9.

International Institute for Population Sciences (IIPS) and ICF. (2020). National Family Health Survey (NFHS-5), 2019-2020. District Fact Sheet: West Bengal. Mumbai, India: IIPS.

International Institute for Population Sciences (IIPS) and ICF. (2020). National Family Health Survey (NFHS-5), 2019-2020. District Fact Sheet: Bankura, West Bengal. Mumbai, India: IIPS.

Kandpal, V., Sachdeva, M. P., & Saraswathy, K. N. (2016). An assessment study of CVD related risk factors in a tribal population of India. *BMC Public Health*, *16*(1), 1-8.

Kapoor, A. K., & Dhall, M. (2016). Poverty, malnutrition and biological dynamics among tribes of India. *Health Science Journal*, *10*(3), 1-5.

Khan, J. M., & Beevers, D. G. (2005). Management of hypertension in ethnic minorities. *Heart*, *91*(8), 1105-1109.

Kshatriya, G. K. (2014). Changing perspectives of tribal health in the context of increasing lifestyle diseases in India. *Journal of Environmental and Social Sciences*, *1*(1), 101-107.

Kshatriya, G. K., & Acharya, S. K. (2019). Prevalence and risks of hypertension among Indian tribes and its status among the lean and underweight individuals. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, *13*(2), 1105-1115. DOI:10.1016/j.dsx.2019.01.028. Epub 2019 Jan 22.

Kundu Chowdhury, T., & Roy, S. K. (2016). Blood pressure and body composition of rural Oraons of North 24 Parganas, West Bengal, India. *Anthropologischer Anzeiger, 73*(2), 145–154. Doi:10.1127/anthranz/2016/0600

Laxmaiah, A., Meshram, I. I., Arlappa, N., Balakrishna, N., Rao, K. M., Reddy, C. G., ... & Brahmam, G. N. V. (2015). Socio-economic & demographic determinants of hypertension & knowledge, practices & risk behaviour of tribals in India. *The Indian Journal of Medical Research*, *141*(5), 697-708. Doi: 10.4103/0971-5916.159592.

Leng, B., Jin, Y., Li, G., Chen, L., & Jin, N. (2015). Socioeconomic status and hypertension: a meta-analysis. *Journal of Hypertension*, *33*(2), 221-229.

Little, M. A., & Baker, P. T. (1976). Environmental adaptations and perspectives. In P.T. Baker, & M.A. Little (Eds.), *Man in the Andes: a multidisciplinary study of high altitude Quechua* (pp. 405-428). Stroudsburg, Pennsylvania: Dowden, Hutchinson & Ross, Inc.

Maken, T., & Varte, L. R. (2013). Anthropometric indicators as predictors of high blood pressure among the Ao tribe of North-East India. *Asian Journal of Medical Sciences*, *4*(3), 14-22.

Manimunda, S. P., Sugunan, A. P., Benegal, V., Balakrishna, N., Rao, M. V., & Pesala, K. S. (2011). Association of hypertension with risk factors & hypertension related behaviour among the aboriginal Nicobarese tribe living in Car Nicobar Island, India. *The Indian Journal of Medical Research*, *133*(3), 287-293.

Marmot, M. (1979). Epidemiological basis for the prevention of coronary heart disease. *Bulletin of the World Health Organization, 57*(3), 331-347.

Meshram, I. I., Arlappa, N., Balkrishna, N., Rao, K. M., Laxmaiah, A., & Brahmam, G. N. V. (2012). Prevalence of hypertension, its correlates and awareness among adult tribal population of Kerala state, India. *Journal of postgraduate medicine*, *58*(4), 255-261.

Mills, K. T., Bundy, J. D., Kelly, T. N., Reed, J. E., Kearney, P. M., Reynolds, K., & He, J. (2016). Global disparities of hypertension prevalence and control: a systematic analysis of population-based studies from 90 countries. *Circulation*, *134*(6), 441-450.

Mills, K. T., Stefanescu, A., & He, J. (2020). The global epidemiology of hypertension. *Nature Reviews Nephrology*, *16*(4), 223-237.

s

Mishra, S. K., Sarkar, S., Mukhopadhyay, S., & Mukhopadhyay, B. (2010). Hypertension and its correlates in two communities of dissimilar genetic ancestry in Sikkim, India. *Annals of Human Biology*, *37*(1), 23-43.

Misra, P. J., Mini, G. K., & Thankappan, K. R. (2014). Risk factor profile for non-communicable diseases among Mishing tribes in Assam, India: Results from a WHO STEPs survey. *The Indian Journal of Medical Research*, *140*(3), 370-378.

Mukhopadhyay, A. (2010). Anthropometric characteristics and undernutrition among adult Santal tribe of Birbhum District, West Bengal, India. *Anthropological Science, 118*, 57-60.

National Nutrition Monitoring Bureau (NNMB). (2006). Diet and nutritional status of population and prevalence of hypertension among adults in rural areas. NNMB Technical Report No: 24. Hyderabad, India: NIN.

National Nutrition Monitoring Bureau (NNMB). (2009). Diet and Nutritional Status of Tribal Population and Prevalence of Hypertension among Adults - Report on Second Repeat Survey. NNMB Technical Report No. 25. Hyderabad, India: NIN.

Neilson, G., & Williams, G. (1978). Blood pressure and valvular and congenital heart disease in Torres Strait Islanders. *Medical Journal of Australia*, *1*, 12-16.

Pickering, T.G., Hall, J.E., Appel, L.J., Falkner, B.E., Graves, J., Hill, M.N., & Roccella, E.J. (2005). Recommendations for blood pressure measurement in humans and experimental animals, part 1: blood pressure measurement in humans: a statement for professionals from the Subcommittee of Professional and Public Education of the American Heart Association Council on High Blood Pressure Research. *Hypertension*, *45*, 142-161.

Pinto, E. (2007). Blood pressure and ageing. *Postgraduate Medical Journal*, *83*(976), 109-114.

Raina, S. K., Chander, V., Prasher, C. L., & Raina, S. (2016). Prevalence of hypertension in a tribal land locked population at high altitude. *Scientifica*, *2016*, Article ID 3589720, 8 pages; http://dx.doi.org/10.1155/2016/3589720.

Rizwan, S. A., Kumar, R., Singh, A. K., Kusuma, Y. S., Yadav, K., & Pandav, C. S. (2014). Prevalence of hypertension in Indian tribes: a systematic review and meta-analysis of observational studies. *PLoS one*, *9*(5), e95896. Doi:10.1371/journal.pone.0095896

Roy, S.K., & Kundu Chowdhury, T. (2013). Differences in selected health traits between occupational groups among oraons of Jalpaiguri District, West Bengal. Journal of Anthropology, volume 2013, Article ID 582036. Doi:10.1155/2013/582036

Sajeev, P., & Soman, B. (2018). Prevalence of non-communicable disease risk factors among the Kani tribe in Thiruvananthapuram district, Kerala. *Indian Heart Journal*, *70*(5), 598-603. DOI: 10.1016/j.ihj.2018.01.022.

Sathiyanarayanan, S., Muthunarayanan, L., & Devaparthasarathy, T. A. (2019). Changing perspectives in tribal health: rising prevalence of lifestyle diseases among tribal population in India. *Indian Journal of Community Medicine*, *44*(4), 342-346. DOI: 10.4103/ijcm.IJCM_40_19.

Thrift, A. G., Ragavan, R. S., Riddell, M. A., Joshi, R., Thankappan, K. R., Chow, C., & Evans, R. G. (2020). Hypertension in Rural India: The Contribution of Socioeconomic Position. *Journal of the American Heart Association*, *9*(7), e014486. https://doi.org/10.1161/JAHA.119.014486

Tushi, A., Rao, S. R., Pattabi, K., & Kaur, P. (2018). Prevalence of risk factors for non-communicable diseases in a rural tribal population of Mokokchung, Nagaland, India. *The National Medical Journal of India*, *31*(1), 11-14. DOI: 10.4103/0970- 258X.243405.

Uddin, J., Acharya, S., Valles, J., Baker, E. H., & Keith, V. M. (2020). Caste Differences in Hypertension Among Women in India: Diminishing Health Returns to Socioeconomic Status for Lower Caste Groups. *Journal of Racial and Ethnic Health Disparities*, 7, 987–995. https://doi.org/10.1007/s40615-020-00723-9

van Laer, S. D., Snijder, M. B., Agyemang, C., Peters, R. J., & van den Born, B. J. H. (2018). Ethnic differences in hypertension prevalence and contributing determinants–the HELIUS study. *European Journal of Preventive Cardiology*, *25*(18), 1914-1922.

Weiner, J.S., & Lourie, J.A. (1981). *Practical Human Biology*. London: Academic Press.

WHO Expert Consultation. (2004). Appropriate Body-Mass Index for Asian Populations and its Implications for Policy and Intervention Strategies. *Lancet*, 363, 157-163.

World Health Organization. (2013). A global brief on hypertension: Silent killer, global public health crisis. World Health Day, pp. 1-40. Geneva, Switzerland: WHO. http://repository.poltekkes-kaltim.ac.id/1167/1/6.%20A%20Global%20Brief%20on%20Hypertention.pdf.

Wu, X., & Wang, Z. (2019). Role of socioeconomic status in hypertension among Chinese middle-aged and elderly individuals. *International Journal of Hypertension*, Volume 2019, Article ID 6956023. https://doi.org/10.1155/2019/6956023.