Research Article

A study on hypertension and comparability between one reading and average of three readings of blood pressure by mercury sphygmomanometer among adults in a slum of Kolkata

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ABSTRACT

Background: Hypertension, a major chronic lifestyle disease is most prevalent non communicable disease in India. Blood pressure (BP) measurements in the community are generally performed with a mercury sphygmomanometer. However, it is the common teaching that average of at least three readings of blood pressure measurement is considered to be the gold-standard method. How far this is true has been determined in this study with the **Aim**: To find out the prevalence of hypertension and compare the one reading of blood pressure taken by mercury sphygmomanometer with average of three such readings. **Materials and Methods:** This cross-sectional study was conducted from January-March 2015 among 160 adults of Chetla slum, Kolkata chosen through a two stage sample design. Subjects included -Male: 39.4%; Female: 60.6%. Data was collected by interview and blood pressure measurements. Comparison was made between the first reading and the average of three readings of BP taken by mercury sphygmomanometer. **Result:** The overall prevalence of hypertension was found to be 30 % (48). Strength of agreement between first reading of Blood Pressure with that of average reading was excellent, with kappa=0.940. **Conclusion:** Though the average of three blood pressure readings according to Standard operation Procedure is considered ideal for accurate Blood Pressure measurement it may not always be feasible to undertake such a practice especially at community level. This study observes that single reading can safely be considered for Blood Pressure measurement instead of average of three readings.

Key words: Blood Pressure measurement, One reading, Average of three readings, Mercury sphygmomanometer, Slum.

INTRODUCTION

Hypertension is a major chronic lifestyle disease and is the most prevalent non communicable disease in India. It is a chronic condition of concern due to its role in causation of coronary heart disease, stroke and other vascular complications. Pooled epidemiological studies show that the average prevalence of hypertension in India is 25% in Urban and 10% in rural population [1].

The prevalence of cardiovascular diseases and hypertension is rapidly increasing in developing countries [2]. This increase, most marked in the urban population, is likely to be related to changing life-styles and to an increased longevity.

Prevalence of hypertension in people aged ≥ 20 years by world region and gender in 2000 and 2025 showed that in India in 2000 the combined urban and rural prevalence was 20.6% among males and

20.9% among females. The projected rate will be 22.9% among males and 23.6% among females in 2025 [3].

Hypertension has been reported to be responsible for 57% of all stroke deaths and 24% of all cardiovascular deaths in East Asians [4]. The accelerating epidemic of hypertension in India was documented by studies done at various places across the country [1].Epidemiological studies to assess the prevalence of hypertension are essential to plan preventive strategies and promotion of health. So screening of High Blood pressure in the community has been given the utmost importance.

Blood pressure (BP) measurements in the community have generally been performed using mercury sphygmomanometer.It has been observed that repeated blood pressure measurement taken by mercury sphygmomanometer (considering its average of three readings) gives the more accurate value which is also being considered as a gold-standard method. But it is not always feasible to undertake such in a practical scenario to cover a large number of populations in the community. There is also a scarcity of literature regarding the comparability of single (1st) reading with the average of three reading. So this study was conducted to consider single reading taken by mercury sphygmomanometer as an alternative to average measurement which simplifies the blood pressure recording in a community survey.

Objective:

1. To find out the prevalence of hypertension.
2. To compare the 1st and average of three readings of blood pressure taken by mercury sphygmomanometer.

MATERIALS & METHODS

Study Setting: The study was conducted in slum of Chetla, Kolkata which is the service area of the urban health Centre (UHC), Chetla. This area is the urban field practice area of All India Institute of Hygiene and Public Health, Kolkata.A total of 3 units are working in the service area under UHC, Chetla. Again, each unit is divided into 2 sectors for operational feasibility. Thus there are total 6 sectors in the service area of Chetla.

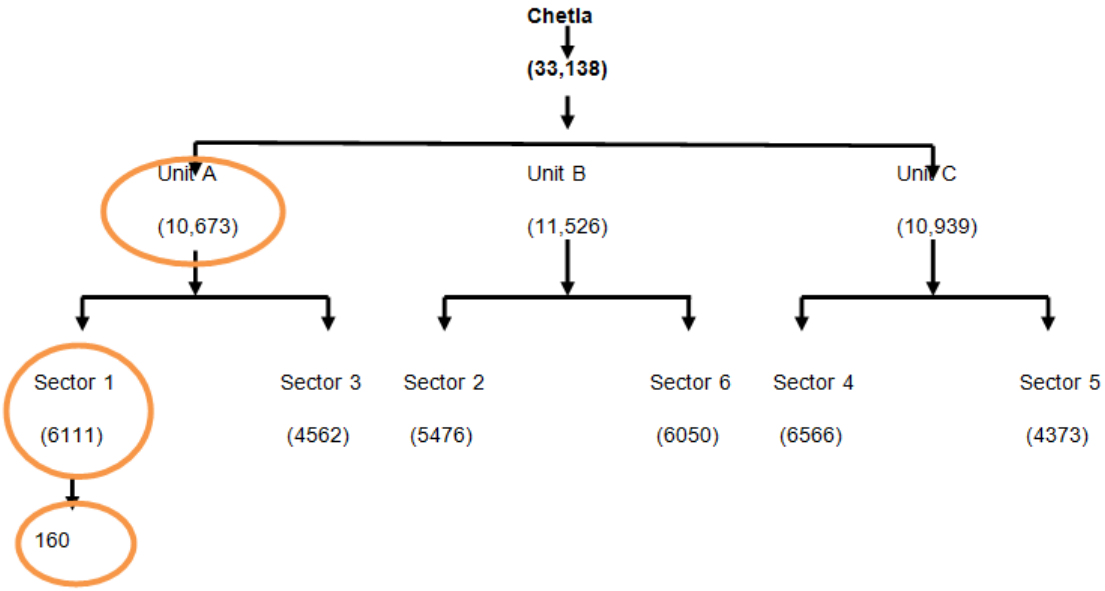
Study Population: Adult population aged 15 years and more (both male and female) residing in the slum area of Chetla.

Type of Study: This was a community based, cross-sectional study.

Study Period: The study was conducted from January 2015–March 2015

Sample size: A total sample of 160 adults aged 15 years and above (both male and female) was included in the study.

Sampling Design: A two stage design was employed. In 1st stage, Unit A of Chetla was selected randomly form 3 units, and then in 2nd stage Sector 1was selected among the 2 sectors of Unit A. Then desired sample is attained by interviewing subjects aged 15 years and more by house to house visit after going to sector 1.



Taking 24.9 %[5] as prevalence of hypertension from an urban study and with acceptable error of 0.1% at 95% confidence interval the sample size came **N=75**. Design effect taken 2, so it becomes 150.Taking 10% as non-respondents, it comes to be 165.The Final sample size of **160** was attained in the study, as there were 5 non respondents. Those who were very sick, pregnant women and those who refused to participatewere excluded from the study.

Study Tool: The study population were interviewed with a pre-designed, pre-tested questionnaire. Initially the questions were judged by a group of experts of this institute and necessary corrections were made to enhance the face validity and content validity. The questionnaire was divided into two parts.

The **first** part comprised of socio-demographic and other information covering a diverse set of variables like; age, sex, marital status, education, employment status, and the type of family system the subject was currently residing in.

The **second** part was for documentation of blood pressure measurement.For BP measurement, standardized calibrated mercury column type sphygmomanometer, stethoscope were used.

For using the English questionnaire in Bengali vernacular, at first, one forward and one backward translations were done parallel by one medical and one language expert so that the meaning, content and grammatical correctness of the items remained unaltered.

Following **Operational Definition** were used in the present study:

Hypertension- mean systolic BP ≥ 140mmHg and/or mean diastolic BP ≥ 90mmHg or history of anti-hypertensive treatment fifteen days before the survey [6].

Standard operation procedures for measurement of blood pressure [7]:

The blood pressure measurement setting was kept as private and as quiet as possible. Then patient was allowed to sit for at least 5 minutes before the measurement. Patient's arm was assessed for appropriate cuff size. Conversation was kept to a minimum level.

Patient Preparation and Positioning:

1. Accurate blood pressure measurement requires patients to be properly prepared. So it was ensured that patient should avoid tobacco, caffeine, alcohol, and physical activity/exercise for at least 30 minutes before the blood pressure measurement.
2. Patient was in sitting position with both feet on the floor, legs uncrossed, and back supported.
3. Upper arm was kept bare and unconstructed by clothing.
4. The left arm in which blood pressure measurement was taken, was supported at the level of the patient's heart.

BP measurement using a manual cuff and manometer:

1. First it was ensured that BP device is properly calibrated; as the starting and ending point should be "0".
2. The location of the brachial artery was palpated first and then the centre of the cuff's bladder was placed directly over the brachial artery.
3. The cuff was applied snugly to the bare arm, about 1 inch above the inside of the elbow at the level of the heart.
4. It was noticed that the arm should rest firmly supported on a table, slightly bent, with palm up.
5. While palpating the radial artery, the cuff was inflated and the number at which the pulse disappears was noted and the cuff was allowed to deflate.
6. A gap of 15 seconds maintained before placing the stethoscope on the brachial artery.
7. Now, the cuff was inflated to a level of between 20 and 30 mmHg above where the radial pulse disappeared.
8. Pumping the blood pressure cuff up too high at the beginning of the measurement was avoided as this could lead to an inaccurate reading.
9. In next phase, slowly the air in the cuff was released at 2 mmHg per second and when the first two consecutive beats occur (1^{st} phase of Korotkoff sounds) was noted, which was the systolic blood pressure.
10. Deflating the cuff was continued slowly until last sounds are heard (5^{th} phase of the Korotkoff sounds); this is the diastolic blood pressure. Continue deflation for 10 mmHg past the last sound (this assures that the absence of sound is not a

"skipped" beat, but is the true end of the sound). The remaining air was released rapidly if no further sounds are heard.

11. As there was 5 mmHg or more difference between the first and second readings in some participants, three measurements of blood pressure on each study participant with a mercury column sphygmomanometer were made using a standardized technique 1minute apart in sitting position. Then the average was calculated from the readings. Elevated readings were confirmed using the patient's controller alarm.
12. Blood pressure readings i.e., beginning sound (systolic) and end sound (diastolic) were documented in the questionnaire.

Blood pressure was classified as normal (SBP <120 and DBP <80 mmHg), pre-hypertension (SBP = 120-139 and/or DBP = 80-89 mmHg), stage I hypertension (SBP = 140-159 and/or DBP = 90-99 mmHg), and stage II hypertension (SBP > 160 and/or DBP > 100 mmHg) as per US Seventh Joint National Committee on Detection, Evaluation and Treatment of Hypertension (JNC VII) criteria [6].

Statistical Analysis: The data were analysed using the Statistical Package for Social Sciences (SPSS) software (Version 20).Sensitivity & Specificity analysis, Unpaired t test, Kappa was used to assess strength of agreement between two recordings of blood pressure.

RESULTS

Prevalence of Hypertension found in this study was 30 % (48) as seen from Average of 3 readings of Blood pressure and 28.8% (46) in 1st reading taken by Mercury sphygmomanometer.

Table I: Prevalence of Hypertension according to socio-demographic distribution of study population (n=160):

Characteristics	Hypertension		Total n(%)
Age group (years)	Yes n(%)	No n(%)	
15-24	1(2.8)	35(97.2)	36(22.5)
25-34	5(17.2)	24(82.8)	29(18.1)
35-44	5(20.8)	19(79.2)	24(15)
45-54	12(38.7)	19(61.3)	31(19.4)
55-64	13(56.5)	10(43.5)	23(14.4)
>=64	12(70.6)	5(29.4)	17(10.6)
Sex			
Male	16(25.4)	47(74.6)	63(39.4)
Female	32(33)	65(67)	97(60.6)
Religion			
Hindu	44(31.2)	97(68.8)	141(88.1)
Muslim	4(21.2)	15(78.9)	19(11.9)
Marital status			
Unmarried/Divorced	8(21.1)	30(78.9)	38(23.8)
Married	40(32.8)	82(67.2)	122(76.2)
Education			
Illiterate	13(43.3)	17(56.7)	30(18.8)
Literate	35(26.9)	95(73.1)	130(81.2)
Occupation			
Non-earning member	35(33.3)	70(66.7)	105(65.6)
Earning member	13(23.6)	42(76.4)	55(34.4)
Type of family			
Nuclear	37(33.3)	74(66.7)	111(69.4)
Joint	11(22.4)	38(77.6)	49(30.6)
Socio-economic status			
Lower(<773)	7(29.2)	17(70.8)	24(15)
Upper lower(773-1546)	18(28.1)	46(71.9)	64(40)
Lower middle(1547-2577)	17(33.3)	34(66.7)	51(31.9)
Upper middle(2578-5155)	6(31.6)	13(68.4)	19(11.9)
Upper(>=5156)	0	2(100)	2(1.2)
Total	48(30)	112(70)	160(100)

Table 2: Agreement of Blood Pressure measured by 1st & average reading of Mercury Sphygmomanometer (n=160)

	Blood Pressure by Average reading			
		Hypertensive >= 140/90	**Non-hypertensive <140/90**	**Total**
Blood Pressure by 1st reading	**Hypertensive >= 140/90**	45	1	**46(28.8%)**
	Non-hypertensive <140/90	3	111	114(71.2%)
	Total	**48(30%)**	112(70)	160(100%)
Kappa = **0.940** Kappa Shows excellent agreement between 1st& Average reading of blood pressure.				
Sensitivity=93.75%& Specificity = 99.10%(of 1st reading) Inherent validity = 97.50% Likelihood ratio : for positive test result= 104.17 & for negative test result = 0.06 Positive Predictive value= 97.83%, Negative Predictive value= 97.37%.				

22.5% of study population belonged to age group of 15-24 years, followed by 19.4% in age group of 45-54 years only 10.6% were over 65 years. Females were more in the study population (60.6%). Majority of them were Hindus (88.1%) and were from nuclear families (69.4%). 76.2% study population were currently married .18.8 %of study population were illiterate, 21.9% studied till primary school, 21.9% studied up to middle school while only 15 % studied up to Secondary or more.40 % were in upper lower class while 31.9 % in lower middle class according to modified Prasad Scale [Table 1].

Strength of agreement between one (1st) reading with that of average of three reading of blood pressure was excellent, kappa=0.940.Sensitivity of 1st reading was 93.75% and Specificity 99.10%with Inherent validity of 1st reading was 97.50%. Again, Positive predictive value was 97.83% and negative predictive value was 97.39%, Likelihood ratio (1st reading of blood pressure) for positive result 104.17 and for negative result 0.06 was found [Table 2].

Mean Systolic Blood Pressure (with SD) was 128.58± 19.86 mm Hg for 1st reading and 128.59 ± 20.53mm Hg for Average reading. Mean Diastolic Blood Pressure (with SD) was 80.76± 10.07 mm Hg for 1st reading and 80.88± 10.93mm Hg for Average reading. There was statistically no significant difference between single blood pressure reading and average of three readings, both in case of Systolic(p= 0.995) and Diastolic(p= 0.919) blood pressure [Table 3].

Table 3: Association between readings of SBP and DBP readings by Mercury Sphygmomanometer (n=160)

METHODS	**t**	**df**	**Significance (2 tailed)**	**Mean Blood Pressure Reading with SD(mm Hg)**	**Mean difference (95% CI)**
Between SBP 1st& average Reading	-0.006	18	0.995	SBP 1 =128.58 ± 19.86 SBP Avg =128.59 ± 20.53	-0.14 (-4.4 to 4.43)
Between DBP 1st& average Reading	-0.102	318	0.919	DBP 1 =80.76 ± 10.07 DBP Avg =80.88 ± 10.93	-0.12 (-2.43 to 2.19)
Statistically No significant difference between single blood pressure reading and average of 3 readings, both in case of Systolic(p= 0.995) and Diastolic(p= 0.919) blood pressure.					

DISCUSSION

The prevalence of hypertension has been increasing in India. Factors which are attributable to these changes are rapid urbanization, lifestyle changes, and dietary changes and increased life expectancy [8].The overall prevalence of hypertension was found to be 30% in the present study. Almost similar prevalence of 24.9% has also been reported in the study conducted in urban community in Malda [5]. A much lower prevalence (8.6%) was reported in the study conducted among adult population in an urban slum of Tirupati in comparison to present study, which might be due to their high (83.7%) awareness regarding hypertension [9]. Significant proportion of female

(33%) was found hypertensive in this present study, but higher prevalence among females (46.1%) was reported by Gupta R et al [10].

Strength of agreement between 1st reading is close to average reading (kappa=0.940).So single blood pressure reading can be used as an alternative to average reading of blood pressure in a large community survey.

CONCLUSION

Though ideally the average of three blood pressure readings according to Standard operation Procedure is considered ideal for accurate blood pressure assessment it may not always be feasible to undertake such a practice especially at community level. This study observes that single reading can safely be considered for blood pressure measurement instead of average of three readings.

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