Original Article

DOI: 10.7860/JCDR/2023/52597.17408

Paediatrics Section

Blood Pressure Reference Values of Nigerian Full-term Neonates in the First Week of Life at a Nigerian Tertiary Hospital: A Cross-sectional Survey

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ABSTRACT

Introduction: Knowledge of normative Blood Pressures (BP) is critical for appropriate neonatal care. Hypertension and hypotension are abnormalities of BP which could be a sign, outcome or complications of diseases or intervention carried out on neonates. Yet, there is a dearth of data on BP concerning Nigerian full-term neonates.

Aim: To determine BP values of apparently healthy term Nigerian neonates in relation to their weight in the first eight days of life and also to determine the BP values of apparently healthy term neonates in the first eight days and also to correlate the BP with postnatal age, weight and to generate percentile of age/sex specific BP.

Materials and Methods: This cross-sectional study was done from September 2012-April 2013, including 386 consecutive apparently healthy term newborns delivered at the UNIOSUN Teaching Hospital (UTH), Osogbo, Southwest Nigeria. Their weights and right arm Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP) and Mean Arterial Pressure (MAP) BPs measured using oscillometric method on days 1, 3, 5 and 8. Student's t-test and Pearson correlation coefficient was used to statistically analyse the data.

Results: Out of 386 newborns studied, the mean birth weight were 3.10±0.38 kg; {3.24±0.37 kg for boys and 2.97±0.33 kg for girls}. The mean values of SBP on day 1 were 67.3±5.6 mmHg; 71.0±6.0 mmHg on day 3; 73.8±5.2 mmHg on day 5 and 77.2±2.9 mmHg on day 8, respectively. A similar trend was also noticed in the mean values of DBP with 36.9±5.0 mmHg on day 1; 41.5±5.2 mmHg on day 3; 43.7±5.3 mmHg on day 5 and 46.4±4.7 mmHg on day 8, respectively, the rise being significant (p-value <0.001). There were a positive correlations between the weight and DBP on the 5th day (r=0.128; p-value=0.012), between weight and SBP at 49-72 hours and on day 8 (r=0.105; r=0.168, respectively) as well as weight and MAP on day 8 (r=0.166).

Conclusion: Neonatal BP in the first eight days following birth correlated positively to weight and age without significant gender differences.

Keywords: Hypertension, Hypotension, Mean arterial pressure, Newborn

INTRODUCTION

The BP is a vital sign and an indicator of clinical stability, in addition to other clinical signs like respiratory rate, heart rate and temperature. BP is not routinely measured in apparently healthy newborn. This might be partly explained by the fact that indirect BP measurement was not practicable in newborn before the development of the oscillometric technology. The oscillometric method is the current indirect method of BP measurement in modern neonatal practice [1]. Previous studies have reported hypotension in 16-50% of babies admitted into a Neonatal Intensive Care Unit (NICU) in Philadephia, USA [2,3]. Also, hypertension is increasingly being diagnosed in other NICUs with 0.2-2.6% of neonates discharged from such units having hypertension [4-6]. Hypotension and hypertension can lead to irreversible damage of cellular metabolism, severe disease and death during the neonatal period and early infancy. Thus, there is the need for routine measurement of BP in neonates and infants in order to be able to diagnose its abnormalities. The advances in the practice of neonatology in general and particularly in the identification, evaluation and care of infants with hypertension have led to an increase in the awareness of the existence of hypertension in modern ICUs, however there is a paucity of data on BP normogram in developing countries and this is partly due to lack of appropriate facilities for measuring BP in this age group [7]. In the absence of appropriate facilities for measuring BP, diagnosis will be presumptive.

Sadoh WE and Ibhanesebhor SE found mean SBP, DBP and MAP of 66.8, 38.5 and 47.9 mmHg, respectively, on day 1, however the subjects included both small for gestational age and large for gestational age as well as post-term babies, hence it cannot be used as a reference standard for appropriate for gestational age babies [8]. Nwokye IC et al., on the other hand used appropriate for gestational age babies and found mean SBP, DBP and MAP of 63.3, 36.8 and 46.4 mmHg, respectively on day 1 but their study ended on day 2 [9]. The generated data has been used to generate percentile charts but contrary to what obtained in developed nations [8,9]; data on BP in neonates are very scanty in Nigeria as well as in Africa.

Hence, present study was conducted to determine the BP values of apparently healthy term neonates in the first eight days and also to correlate the BP with postnatal age, weight and to generate percentile of age/sex specific BP.

MATERIALS AND METHODS

The present cross-sectional study was done over a period of eight months, from September 2012-April 2013 at UTH, a tertiary healthcare centre, Osogbo, south-western Nigeria. Ethical clearance was obtained from the Institutional Ethical Committee (IEC) of the hospital (IEC no LTH/REC/11/03/14/83). Informed written consent was obtained from the mother or parents before enrolling the subjects into the study.

Inclusion criteria: Healthy term (37-41 weeks) newborn, weighing between 2.5-4.0 kg, with normal Appearance, Pulse, Grimace, Activity, and Respiration (APGAR score ≥7 and between the ages of 1 and 8 days in the postnatal ward were included in the study. This was determined by mother's last menstrual period and modified Ballard's score for those whose mothers were unsure of their date.

Exclusion criteria: Babies with obvious congenital anomaly and other morbidities and babies of mothers with high BP, diabetes mellitus and substance abuse were excluded from the study.

Sample size calculation: Sample size was determined by the formula $n=Z^2 \times S^2 \div d^2$, which is $1.96^2 \times 7.7^2 \div 0.85^2=316$. "n" is the minimum sample size, Z is the critical value of the standard normal deviate in a two tailed test, which is 1.96, which corresponds to the 95% confidence interval. The sample size came to 348 after adding 10% to the 316 sample size for possible attrition. However the sample size was increased to 386 to increase the significance of findings.

Data Collection

Neonatal demographic data were recorded including the gestational age, birth weight, length, systemic examination was also done. BP measurement was determined using the oscillometric technique (STELLAR 300). An appropriate sized cuff was used to measure BP on the right arm in supine position when subject was at rest or sleeping, half hour after feeding. The newborn was left for 10-15 minutes after cuff application to ensure quietness. Measurement started from 6 hours in the first 24 hours and on day 3, 5 and 8. Three BP measurements at two minutes interval were measured and the mean of the values was recorded as the BP. This procedure was adopted from standard protocol for assessment of BP measurement in newborns [10]. Measurements were taken at age 0-24 hour, 48-72 hours, 96-121 hours and 168-192 hours. The infant's weight was measured with the baby placed naked using on an infants' weighing scale (sensitivity-0.05 kg, SALTER, Model-180 England). The scale was checked for zero error before and after each reading. Follow-up was continued in each subject's home amongst those discharged before the 8th day. Percentile charts were generated for age and sex using Tukey's Hinge (weighted average) [11].

STATISTICAL ANALYSIS

Data were statistically analysed using Statistical Package for Social Sciences (SPSS) version 18. Means, Standard Deviations (SD) and ranges were generated and compared using Student's t-test and then related to weight and age using Pearson correlation coefficient (r). Statistical significance was established when values of probability 'p' were <0.05.

RESULTS

Out of total 649 babies delivered in the labour ward during the eight-month study period, 386 (59.5%) met the inclusion criteria; 187 boys and 199 girls giving a male:female ratio of 0.94:1, were enrolled in the study. Maximum babies 106 (27.5%) were born at 39 weeks, followed by 80 (20.7%) each at 40 weeks and 38 weeks [Table/Fig-1].

Estimated gestational age (weeks)	Number	N (%)
37	73	18.9
38	80	20.7
39	106	27.5
40	80	20.7
41	47	12.2

[Table/Fig-1]: Number of study subjects in relation to estimated gestational age (N=386).

There were 386 mothers and maternal age ranged between 18 and 42 years with mean age of 29.7±4.4 years maximum 222 (57.5%) were aged between 21-30 years, followed by 149 (38.6%), aged between 31-40 years. 147 (38.1%) delivered per vagina and 239 (61.9%) by caesarean section [Table/Fig-2].

Maternal age (years)	Number	(%)
≤20	12	3.1
21-30	222	57.5
31-40	149	38.6
>40	3	0.8
Mode of delivery		
Vaginal	147	38.1
Caesarean section	239	61.9

[Table/Fig-2]: Maternal age of study subjects at delivery.

The weights on the first day ranged from 2.500 to 3.900 kg with mean (SD) 3.10±0.38 kg. The length of babies ranged between 41-56 cm with a mean of 48.3±2.4 cm. The mean weight, length of males was significantly higher than the mean length and weight for females (p-value <0.001), but there was no statistically significant difference among males and females regarding head circumference (p-value=0.955) [Table/Fig-3].

Parameters		p-value
Weight (kg)		
Range	2.500-3.900	0.001
Mean	3.10±0.38	
Male	3.24±0.37	
Female	2.97±0.33	
Length (cm)		
Range	41- 56	0.001
Mean	48.3±2.4	
Male	49.1±2.2	
Female	47.6±2.4	
Head circumference (cm)		
Range	33-38	0.955
Mean	34.8±1.6	
Male	34.8±1.7	
Female	34.8±1.6	

[Table/Fig-3]: Anthropometric indices of study subjects in the first eight days of life.

The SBP, DBP and MAP at the age of 6-24 hours ranged between 53 and 91, 30 and 52 and 39 and 64 mmHg, respectively. The values for DBP and MAP for females were higher than those for males; and this difference were statistically significant (0.005 and 0.004, respectively), but there was no statistical difference was found among males and females for SBP (p-value=0.936) [Table/Fig-4].

Gender	SBP (mmHg)	DBP (mmHg)	MAP (mmHg)
Males	67.3±6.3	36.2±4.8	47.5±5.2
Females	67.4±4.9	37.6±5.1	49.0±5.1
Total	67.3±5.6	36.9±5.0	48.3±5.2
p-values	0.936	0.005	0.004

[Table/Fig-4]: Blood Pressure (BP) values at the age of 6-24 hours.

The SBP, DBP and MAP values at the age of 48-72 hours range between 53 and 87, 31 and 53 and 39 and 65 mmHg, respectively. The was no significant difference among males and females for SBP, DBP and MAP at 48-72 hours. The ranges of the SBP, DBP and MAP values at the 96-121 hours were between 58 and 92, 31 and 59 and 40 and 71 mmHg, respectively. The means of SBP, DBP and MAP for males were higher than that of females but the differences was not statistically significant [Table/Fig-5].

BP readings						
Timing (hours)	Values (mmHg)	Males (n=187)	Females (n=199)	Overall (n=386)	t	p-value
48-72	SBP	71.2±5.2	70.8±6.7	71.0±6.0	0.612	0.538
	DBP	41.8±5.6	41.2 (4.8)	41.5±5.2	1.093	0.275
	MAP	51.9±4.9	51.5±4.7	51.7±5.1	0.772	0.441
96-121	SBP	74.3±5.8	73.3±4.9	73.8±5.2	2.900	0.077
	DBP	44.1±6.0	43.4±4.6	43.7±5.3	1.748	0.171
	MAP	54.5±5.6	53.5±4.1	54.0±4.9	2.713	0.053

[Table/Fig-5]: Comparison of means of SBP, DBP and MAP of the study subjects at the age of 48-72 and 96-121 hours.
New born boys have slightly higher systolic (SBP), diastolic (DBP) and mean arterial (MAP) Blood Pressures (BP) than girls though this difference lacked statistical significance

The SBP, DBP and MAP of the subjects at the 168-192 hours ranged from 65-91, 35-56 and 46-67 mmHg, respectively. The mean SBP, DBP and MAP of males were higher than those of the females. The differences were statistically significant for SBP and MAP (p-value=0.004 and 0.007, respectively) [Table/Fig-6].

Gender	SBP	DBP	MAP
Males	78.0±5.1	46.9±5.1	56.6±4.3
Females	76.5±5.3	46.0±4.2	55.5±3.6
Total	77.2±2.9	46.4±4.7	56.0±3.9
p-values	0.0045	>0.05	0.007

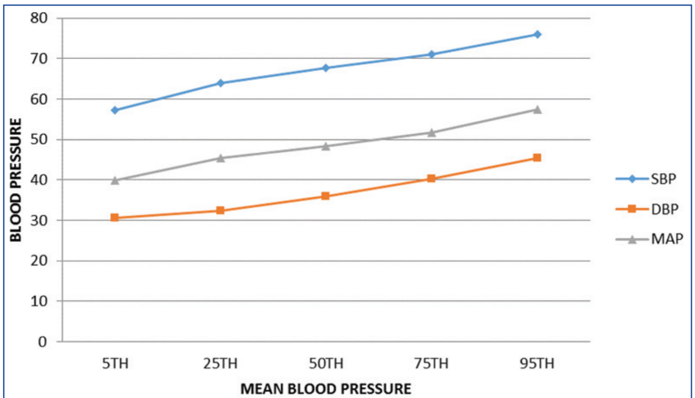
[Table/Fig-6]: Blood Pressure (BP) at the eighth day (168-192 hours).

The SBP, DBP and MAP increased from 6-24 hours to 168-192 hours and this difference was found to be statistically significant (p-value <0.001) [Table/Fig-7].

Blood Pressure (BP) (mmHg)	6-24 hours	48-72 hours	96-121 hours (5th day)	168-192 hours (8th day)	p-value
SBP	67.3±5.6	71.0±6.0	73.9±5.2	77.2±2.9	<0.001
DBP	36.9±5.2	41.5±5.2	43.7±5.3	46.8±5.1	<0.001
MAP	48.3±5.2	51.7±5.1	53.9±4.9	56.0±3.9	<0.001

[Table/Fig-7]: Changes in means of SBP, DBP and MAP values in the first eight days.
The Systolic (SBP), Diastolic (DBP) and Mean arterial (MAP) Blood Pressures (BP) rise with age

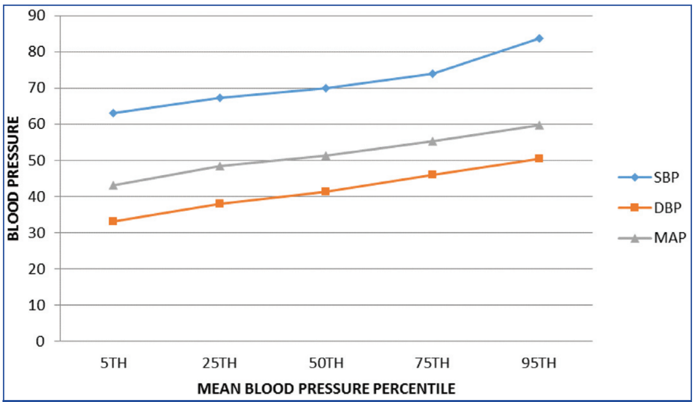
The 5th, 50th and 95th percentiles of the SBP were 57, 68 and 76 mmHg, respectively. The corresponding values for DBP were 31, 36, 45 mmHg, respectively while those for MAP were 40, 48 and 57 mmHg, respectively [Table/Fig-8].



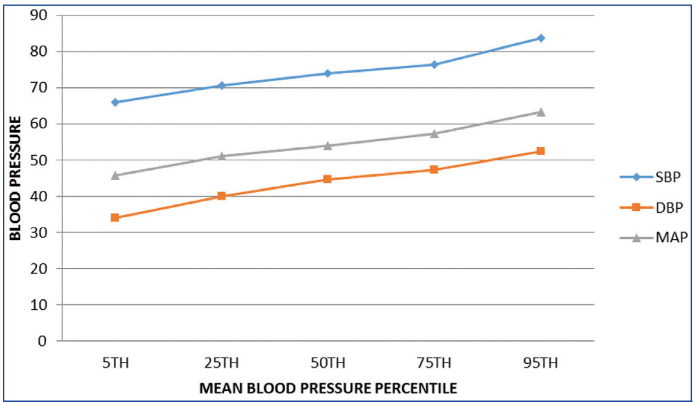
[Table/Fig-8]: The 5th, 25th, 50th, 75th and 95th percentiles of SBP, DBP and MAP of the overall study subjects at 6-24 hours of age.

The 5th, 50th and 95th percentiles of the SBP at 48-72 hours were 63, 70 and 84 mmHg, respectively, while the 5th, 50th and 95th percentiles of the DBP were 33, 41 and 50 mmHg. The corresponding values for MAP were 43, 51and 60 mmHg, respectively [Table/Fig-9].

The 5th, 50th and 95th percentiles of the SBP on fifth day were 66, 74 and 84 mmHg, respectively. For the DBP, the 5th, 50th and 95th, percentiles were 34, 45 and 52 mmHg, respectively while the 5th, 50th, and 95th percentiles for the MAP were 46, 54, 63 mmHg, respectively [Table/Fig-10].

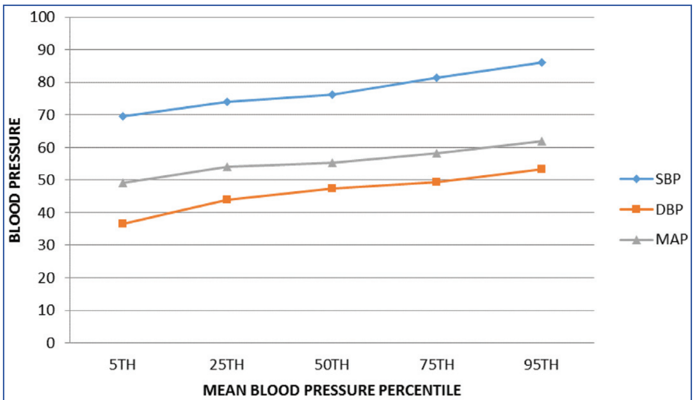


[Table/Fig-9]: The 5th, 25th, 50th, 75th and 95th percentiles of SBP, DBP and MAP of the overall study subjects at 48-72 hours of age.



[Table/Fig-10]: The 5th, 25th, 50th, 75th and 95th percentiles of SBP, DBP and MAP of the overall study subjects at 96-121 hours of age.

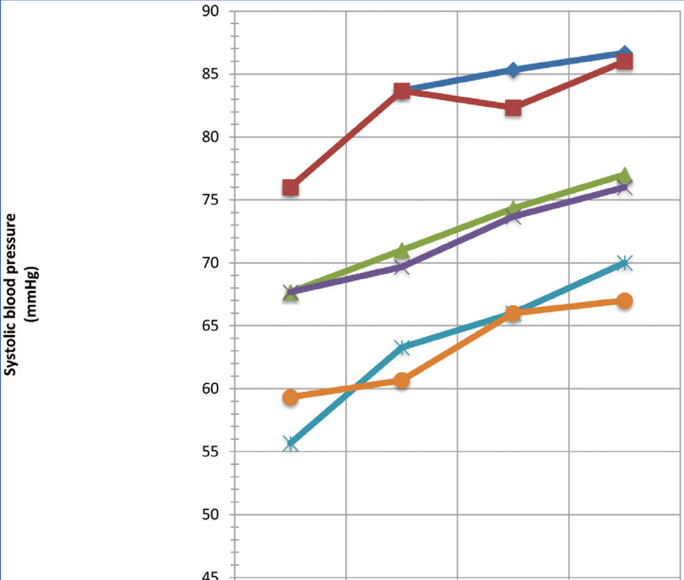
The 5th, 50th, and 95th, percentiles of the SBP on the eighth day were 69, 76 and 86 mmHg, respectively. The 5th, 50th and 95th percentiles for the DBP were 37, 47, and 53 mmHg, respectively, while the consecutive 5th, 50th and 95th percentiles for the MAP were 49, 55 and 62 mmHg, respectively [Table/Fig-11].



[Table/Fig-11]: The 5th, 25th, 50th, 75th and 95th percentiles of SBP, DBP and MAP of the overall study subjects at 168-192 hours of age.

The 5th percentile of the SBP for females on the first, third, fifth and eighth days were 59.33, 60.67, 66 and 67 mmHg, respectively. The corresponding values for 5th percentile for males were 55.67, 63.27, 66 and 70 mmHg, respectively and that of the 95th percentile values were 76, 83.67, 85.33 and 86.67 mmHg [Table/Fig-12].

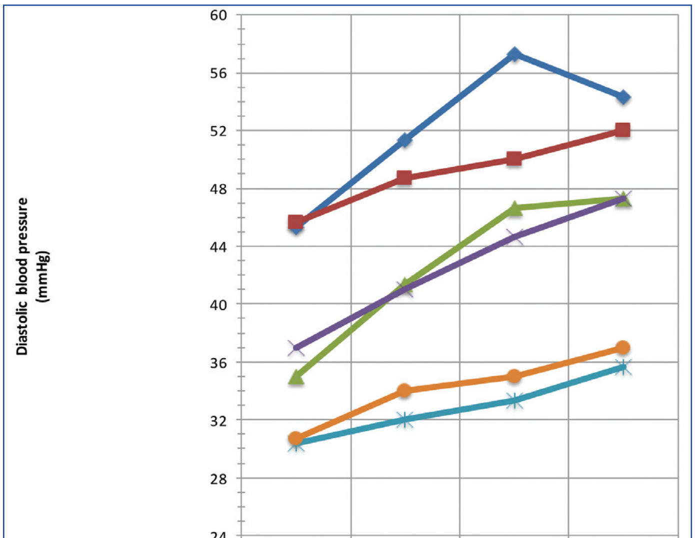
The 5th percentile of the DBP for females on the 1st, 3rd, 5th and 8th days were 30.67, 34, 35 and 37 mmHg, respectively while the corresponding values for the 95th percentiles were 45.67, 48.67, 50 and 52 mmHg, respectively. For the males, the 5th percentiles BP values were 30.33, 32, 33.33 and 35.67 mmHg, respectively and that of the 95th percentile were 45.33, 51.33, 57.33 and 54.33 mmHg [Table/Fig-13].



	6-24 Hours	49-72 Hours	96-12 Hours	169-192 Hours
95TH PERCENTILE MALE	76	83.67	85.33	86.67
95TH PERCENTILE FEMALE	76	83.67	82.33	86
50TH PERCENTILE MALE	67.67	71	74.33	77
50TH PERCENTILE FEMALE	67.67	69.67	73.67	76
5TH PERCENTILE MALE	55.67	63.27	66	70
5TH PERCENTILE FEMALE	59.33	60.67	66	67

Postnatal age

[Table/Fig-12]: Comparison of male and female SBP percentile charts in the first 8 days.



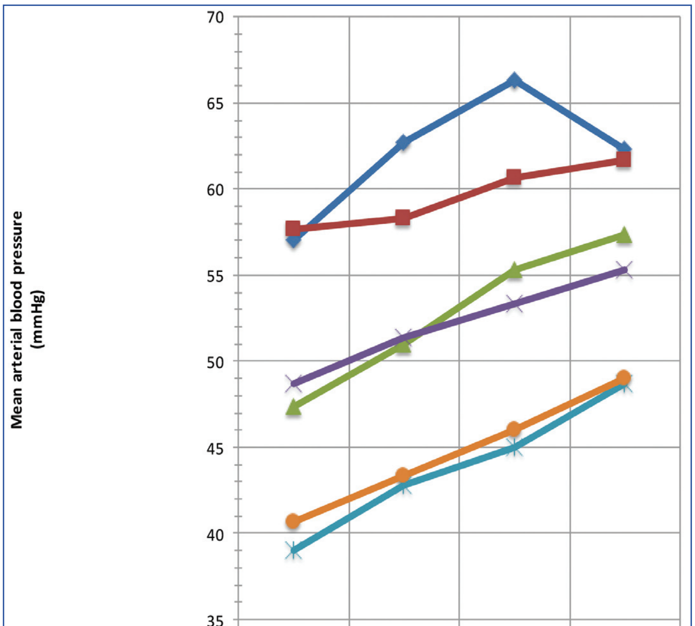
	6-24 Hours	49-72 Hours	96-121 Hours	169-192 Hours
95TH PERCENTILE MALE	45.33	51.33	57.33	54.33
95TH PERCENTILE FEMALE	45.67	48.67	50	52
50TH PERCENTILE MALE	35	41.33	46.67	47.33
50TH PERCENTILE FEMALE	37	41	44.67	47.33
5TH PERCENTILE MALE	30.33	32	33.33	35.67
5TH PERCENTILE FEMALE	30.67	34	35	37

Postnatal age

[Table/Fig-13]: Comparison of male and female DBP percentile charts in the first 8 days.

The 5th percentiles for the MBP for females on the 1st, 3rd, 5th and 8th days were 40.67, 43.33, 46 and 49 mmHg, respectively. The corresponding values for 95th percentiles were 57.67, 58.33, 60.67 and 61.67 mmHg, respectively. The corresponding 5th percentiles values for males were 39, 42.8, 45 and 48.67 mmHg, respectively and that of the 95th percentile were 57, 62.67, 66.33 and 62.33 mmHg [Table/Fig-14].

On the whole, there were weak but positive correlation, between the weights and BP readings in all the age groups with correlation coefficients (r) ranging between 0.059 and 0.168 for SBP. Even for the highest r-value of 0.168, the coefficient of determination $r^2=0.168^2$ was 0.028 or 2.8% [Table/Fig-15].



	6-24 Hours	49-72 Hours	96-121 Hours	169-192 Hours
95TH PERCENTILE MALE	57	62.67	66.33	62.33
95TH PERCENTILE FEMALE	57.67	58.33	60.67	61.67
50TH PERCENTILE MALE	47.33	51	55.33	57.33
50TH PERCENTILE FEMALE	48.67	51.33	53.33	55.33
5TH PERCENTILE MALE	39	42.8	45	48.67
5TH PERCENTILE FEMALE	40.67	43.33	46	49

Postnatal age

[Table/Fig-14]: Comparison of male and female MAP percentile charts in the first 8 days.

	SBP		DBP		MAP	
Age	r	p-value	r	p-value	r	p-value
6-24 hours	0.059	0.244	-0.120	0.018	-0.089	0.079
48-72 hours	0.105	0.039	0.075	0.140	0.058	0.258
5th day	0.085	0.094	0.128	0.012	0.099	0.051
8th day	0.168	0.001	0.021	0.688	0.166	0.001

[Table/Fig-15]: Correlation between weights and BP values in relation to postnatal age.
Coefficient of determination $r^2=0.168^2=0.028$. There were positive correlations between the weight and Systolic Blood Pressure (SBP) on the 3rd day and 8th day; Diastolic Blood Pressure (DBP) on the 1st and 5th day and Mean Arterial Blood Pressure (MAP) only on the 8th day

DISCUSSION

The present study has provided normative BP values of an apparently healthy cohort of Nigerian neonates. A similar result was obtained from the second of such studies by Sadoh WE and Ibhanesebhor SE in a study of term neonates at the postnatal ward in UBTH, Benin [8]. They used the oscillometric method to measure the SBP, DBP and the MAP from day 1 to day 4. The characteristics of neonates in the present study had some similarities with the population studied in Benin city [8]. In that and the present studies, full-term normal babies were evaluated in the postnatal ward from day one, and their mothers did not have confounding factors such as diabetes and hypertension. However, present study followed-up at home till the eighth day of life. Nwokye IC et al., also did a similar study at Enugu using newborns of similar characteristics; however, BP was measured at 0-24 hours and 25-48 hours [9].

Comparison between the BP values were recorded by Youmbissi TJ et al., and that of the present study should be taken with caution because of the differences in the types of equipment used [12]. The mean SBP value at birth reported by Youmbissi TJ et al., was 65.1±1.30 mmHg which was lower than that 68.1±5.8 mmHg in the present study [12]. Different devices for measuring BP may have accounted for the differences in BP values. Higher BP values have previously been recorded by oscillometer as compared with mercury sphygmomanometer [13,14]. Part of the difficulties in the use of mercury sphygmomanometer is that it is only SBP that is easy to measure due to limitations with the equipment in determining the fourth or fifth Korotkoff sounds which are faint in the newborn and therefore difficult to auscultate. The use of the oscillometric devices eliminates this difficulty and provides SBP, DBP and MAP arterial readings. Further advances are still being made to mitigate the various difficulty and improve sensitivity of the various devices being used in the measurement and monitoring of BP [15].

The BP values (SBP, DBP and MAP) obtained in the present study when compared with the study of Sadoh WE and Ibhanesebhor SE at Benin showed some slight differences: the values obtained in the present study were slightly higher than the values obtained by Sadoh WE and Ibhanesebhor SE [8]. The reason for this is not very clear. The difference may be partly due to the difference in the time of recording of the BP. Sadoh WE and Ibhanesebhor SE measured the BP of the neonates at specific time interval of 11.00-13.00 hours every day, irrespective of the postnatal age [8]. The mean birthweight of subjects in the Benin study was higher than the mean birthweight in the present study. This was expected to result in a higher mean value of BP for the subject in their study since higher body weight is associated with higher BP as documented by some researchers [8,16]. This effect may have been masked by the effect of postnatal age, weight having a weaker influence on BP than age.

The present study documented BP values up to the eighth day of life, whereas that of Nwokye IC et al., was limited to the second day of life [9]; while Sadoh WE and Ibhanesebhor SE was limited to the fourth day of life [8]. This does not allow comparison with the Benin study beyond the fourth day. In a recent similar study conducted in Australia by Kent AL et al., using a different model of oscillometric device, and recording only the median BP values reported the BP ranges of between 46 and 94, 24 and 57, and 31 and 63 mmHg for SBP, DBP and MAP on day one and day three, respectively [7]. These median values were however comparable to means of BP values in the present study.

In contrast to the present study, some of the previous studies [17,18] evaluated high-risk neonates in the neonatal wards, some of whom were preterm babies. The ranges of the BP in these studies were however comparable with the BP values of the present study. This would suggest that normative BP values obtained in apparently healthy neonates may be applied to high-risk newborns that are otherwise well.

The systolic, diastolic and mean arterial BP's in the present study showed progressive increases from the first day to the eighth day. This trend was consistent with reports of other studies from Benin City in Nigeria [8], Australia [7] and America [16]. In the present study, there was a higher increase in the BP in the first five days as compared with the fifth to eighth day. The progressive increase in the values of BP obtained from the first day to the eighth day was statistically significant. The higher rise in BP trend in the first five days was similar to that documented in Brompton, London by de Sweit M et al., [18]. Possible reasons for the increases in the postnatal BP may be related to the increase in peripheral vascular resistance which occurs at delivery with cord clamping and lung expansion. This trend is known to occur throughout the first six weeks of life [19,20].

The mean value of SBP on the 5th day in the present study was lower than the value obtained by de Sweit M et al., who measured only SBP using a doppler ultrasound [18]. The difference in the results may be due to the difference in the instruments used in measuring BP, as oscillometers have been found to record higher BP than other indirect methods of measuring BP [21-23]. Other differences in the methodology such as the use of the mean of the total BP values obtained over 4 to 6 days documented by de Sweit M et al., could have skewed their findings [18].

The present study showed very weak but positive correlation between SBP and birthweight on the first day, lower than the finding in the study of Sadoh WE and Ibhanesebhor SE who also found a weak positive but statistically significant correlation between SBP and birthweight [8]. The slight difference may be explained by the difference in sample size. Kent AL et al., Lalan SP and Warady BA in Brazil and in Australia also documented weak and no statistically significant correlation between SBP and birthweight [7,24]. On the other hand, a study done in Scotland reported a statistically significant correlation between SBP and birthweight but did not give the mean weight or the range in weight [25]. de Sweit M et al., reported significant correlation between weight and BP among newborn weighing between 2,800 to 3,800 g [18]. The authors however described the correlation coefficient as "low" although statistically significant and recommended further investigation. This also agreed with the study of Sadoh WE and Ibhanesebhor SE in Benin city [8].

The mean values of systolic, diastolic and MAP for females in the present study were higher than that for males at 6-24 hours. This was similar to the findings of Sadoh WE and Ibhanesebhor SE [8]. The mean values of SBP, DBP and MAP for males became higher than that of females from 48-72 hours to the eighth day in the present study. The difference in BP was found to be statistically significant on the day-5. This finding was different from the finding in the study of Kent AL et al., who found slightly higher but not statistically significant values in females than males. The reason for the difference is not very clear but may be due to the fact that Kent AL et al., used medians values [7].

The higher BP documented for the males might be attributed to the higher body weight of males as compared to females, as documented in some previous studies [7,25]. This cannot however explain the difference noticed on the first day. Males have been found to have higher levels of carboxyhaemoglobin in the first 72 hours, and this has been associated with lower BP [26]. Sadoh WE and Ibhanesebhor SE as well as O'Sullivan MJ et al., documented similar findings [8,27].

The ranges of SBP, DBP and MAP in the present study were also similar to what were documented previous by authors as well as the changes in BP from day one to day eight [7,8,16]. The present study showed a steady rise in SBP, DBP and MAP with increasing postnatal age. The BP values obtained in the first eight days were used to construct BP normograms of each day. As expected, 90% of the BP values lie within the 5th and 95th percentile range with 5% lying below and above the 5th and 95th lines, respectively because the normogram was generated from the raw data of the study population. A few of the study subjects had values of BP which were noticed to be outliers. This was especially so on the first day DBP normogram where some of the study subjects had BP values which were below the 5th percentile line.

The BP values along the percentile lines were comparable with the values obtained by Sadoh WE and Ibhanesebhor SE but lower than the values other workers in the developed countries [8,28]. The lower values may be attributed to the lower weight of the subjects in the present study to that of other workers [28]. In addition, the differences in ethnicity, genetic and environmental factors could have contributed to the difference observed.

Limitation(s)

The BP pattern over the entire neonatal period was not evaluated for logistic reasons. The time available for the study and cost were major constraints.

CONCLUSION(S)

The study provided BP normogram for a healthy population of Nigerian neonates in the first eight days of life. It was found that newborn boys have slightly higher BP than females. BP in the first eight days following birth correlate to weight and age without significant gender difference and also the BP of Nigerian newborn are lower than the values obtained for Caucasian newborns. It is recommended that these normograms be used as a guide in evaluating the BP of Nigerian neonates in the first eight days of life.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Sep 28, 2021
- Manual Googling: Oct 13, 2022
- iThenticate Software: Nov 21, 2022 (9%)

ETYMOLOGY: Author Origin

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Sep 27, 2021**
Date of Peer Review: **Dec 02, 2021**
Date of Acceptance: **Nov 23, 2022**
Date of Publishing: **Jan 01, 2023**