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Percentile Charts of Neonatal Blood Pressure Values at a Tertiary Iranian Hospital

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ABSTRACT

Background: Blood pressure (BP) is an important vital sign and indicator of clinical stability. Therefore, the accurate measurement and interpretation of this physiological signal is essential for the optimal management of ill newborns. In this regard, the present study aimed to determine BP values and percentiles in stable newborns in the first weeks of life and evaluate the relevant factors.

Methods: This prospective observational study was conducted on 320 term and preterm newborns between 26 and 42 weeks gestational age (GA) within 2015-2017. The exclusion criteria entailed: 1) birth asphyxia,2) preeclampsia, 3) gestational diabetes mellitus (GDM) type I, 4) illicit substance use, and 5) major congenital anomaly. The oscillometric technique was used for BP measurement and systolic and diastolic BPs were analyzed by regression analysis for various percentiles (5th to 95th).

Results: The neonates in the current study consisted of 185 (57.8%) males and 135 (42.2%) females with mean (SD) birth weight of 2058.3±582.5grams. Mean (SD) gestational age was reported as 32.95(3.97) weeks. 69.1 % of neonates were delivered via cesarean section. Percentile charts (5th- 95th values) which were developed for systolic (SBP) and diastolic (DBP) demonstrated a steady rise on the respective days that were comparable between different groups. Term neonates were found to have higher BPs, compared to their preterm counterparts on the respective days. Moreover, the neonates who were delivered vaginally had higher mean BP values than neonates delivered via cesarean section.

Conclusion: The current study provided normative BP values among neonates, especially in the first two weeks of life. Data presented in this study which include delivery-mode-specific BP percentile curves using an oscillometric method serve as a valuable reference for physicians in the management of newborns in the neonatal unit.

Keywords: Blood pressure, Infant, Gestational age, Newborn, Nomograms

Introduction

The monitoring of vital signs is of utmost importance in the management of ill neonates. Normal blood pressure (BP) is a result of cardiac output and peripheral vascular resistance (1). Low BP leads to impaired tissue perfusion, organ hypoxia, such dysfunction as renal injury, cerebral hypoperfusion, cerebral hemorrhage, and/or ischemia that later induce long-term neurological effects (2). Neonatal hypertension results in numerous side effects, including cardiomyopathy, encephalopathy (e.g., seizure, hemiparesis, nerve palsies, and hemorrhage), retinopathy, and renal abnormalities (3, 4). Oscillometric technology as an indirect method is an expanded routine measurement of neonatal BP (1). The development of this technique denotes the necessity of normative data and standard BP values for neonates. Some studies demonstrated that racial and geographical varieties limit the generalization of produced nomograms; nonetheless, there is no specified BP nomogram for Iranian neonates (5).

There exists a knowledge gap in this regard due to the paucity of data on PB values in neonates, diversity of maternal status, gestational

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age, and anthropometric characteristics among published studies (6-8), as well as the absence of BP percentiles in Iranian neonates (9) . In order to bridge this gap, the present study was conducted to determine BP values in Iranian newborns within the first two weeks of life and identify the impact of possibly influential components, such as gestational age, birth weight, gender, height, mode of delivery, and maternal conditions.

Methods

This longitudinal study was carried out within September 2015-November 2016 in two tertiary Centers in Iran (Aliasghar Pediatric Hospital and Akbarabadi Hospital in Tehran). The research was approved by the Human Research Ethics Committee of Iran University of Medical Sciences (IUMS), Tehran, Iran (IR.IUMS.REC. 1392.23193)). Before the commencement of the study, written informed consent was obtained from the patients' parents or guardians. The sample size was calculated at 218 using the following formula:

$$n = \left[\frac{Z^2 xp(1-p)}{d^2} \right]$$

where Confidence level=95%, Marginal error (d)=5.5%, and population proportion (p)=50%.

The exclusion criteria entailed: birth asphyxia, preeclampsia, gestational diabetes, type I diabetes mellitus, illicit substance use, and major congenital anomalies. BP was measured three times daily until the 14th days of postnatal life; thereafter, it was assessed on 21st and 28th days of life. The multichannel monitor was used for oscillometric measurement of systolic BP (SBP) and diastolic BP (DBP) (ANSI/AAMI SP-10/2002 Memory 500 Records, SAADAT Company, http://saadatco.com). The obtained ranges were as follows: SBP=30-135 mmHg, DBP=15-110 mmHg, and mean arterial pressures (MAP)=20-125 mmHg.

The transducer full range accuracy was ±3 mmHg, initial inflation target was 85 mmHg. An appropriately sized BP cuff was used (sizes 6-11 cm, 4-6 cm, or 1-4 cm) covering at least two-thirds of the upper arm length and 75% of arm circumference. It fastens on the right upper arm of the neonate on a quiet supine position. Three successive SBP and DBP recordings were taken in 2-min intervals, and their average was calculated for further analysis.

Other collected information included gender, gestational age, birth weight and height, mode of delivery, 1-and 5-minute Apgar scores, the period of oxygen requirement, the length of umbilical arterial line insertion, cause of admission, final diagnosis, and maternal history (e.g., age, gravidity, parity, hypertension, and medication). All these data were registered in the prepared forms by two specified staff and the condition of neonates during discharge was recorded.

Statistical analysis

Quantitative variables were reported as mean (SD) and qualitative variables as frequency (%). The independent t-test was used to compare the mean of quantitative variables in two groups. The one-way analysis of variance (ANOVA) was used to compare the mean of quantitative variables in more than two groups. In addition, Chi-Square and Fisher's exact were used to assess the relationship between qualitative variables. On the other hand, to investigate the relationship between the two quantitative variables, Pearson's correlation coefficient test was used. SBP and DPB were statistically analyzed by regression analysis for various percentiles (5th to 95th), and the graph was depicted.

The obtained data were analyzed in SPSS software (version 20). A p-value less than 0.05 was considered statistically significant.

Results

A total of 374 neonates were enrolled in the current study, and the data of 320 cases were available for analysis (Figure 1). Demographic

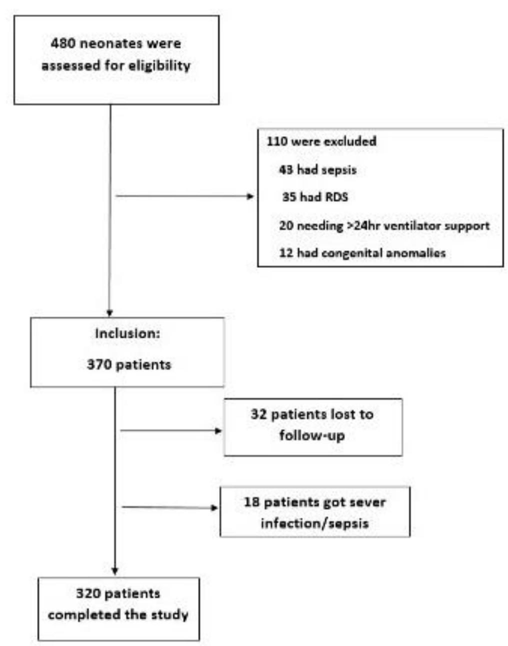

Figure 1. Flow diagram of the study participant

Table 1. Demographics and baseline characteristics of the infants (N=320)

Variable	
Gender, n (%)	
Male	185 (57.8)
Female	135 (42.2)
Gestational age, Mean(SD), week	33.02(3.97)
< 28 week, n (%)	43(14.1)
28-32 week, n (%)	88(28.8)
32-36 week, n (%)	118(38.6)
>36 week, n (%)	57(18.6)
O_2 therapy ,Mean(SD) , L/min	3.99±7.61
Yes, n (%)	187(89.9)
Twin	
Yes, n (%)	68 (21.5)
Birth weight(gram) ,Mean(SD)	2063.31(855.96)
<2500, n (%)	219 (69.3)
2500-3200, n (%)	65(20.6)
>3200, n (%)	32(10.1)
Height (cm), Mean(SD)	44.77(5.53)
<40, n (%)	63(22)
40-49, n (%)	167(58.2)
>49, n (%)	57 (19.8)
Apgar score, Mean(SD)	7.28(1.75)
<7 ,n(%)	113(43)
>7,n (%)	150(57)
Mode of delivery, n(%)	
Vaginal	99(32)
C/S	210(68)
Maternal hypertension, n(%)	10(3)

Table 2. Percentiles of the mean blood pressure of the infants under study according to some important variables

	5Th		25Th		50Th		75Th		90Th		95Th		99Th	
Percentile	SBP mmHg	DBP mmHg	SBP mmHg	DBP mmHg	SBP mmHg	DBP mmHg	SBP mmHg	DBP mmHg	SBP mmHg	DBP mmHg	SBP mmHg	DBP mmHg	SBP mmHg	DBP mmHg
Gender														
Male	57	29.1	66.4	36.6	71.1	40.4	74.6	44.2	79.3	47.6	81.9	50.4	90.2	59.2
Female	60.5	32.1	67.8	37.6	72	40.8	75.6	43.2	79.7	46.6	81.1	49.2	83.2	51.1
Total	58.1	30.7	67.2	37	71.4	40.6	75.4	43.7	79.4	47	81.4	49.9	88.8	55.5
Gestational age (Weeks)														
≤ 28	45.5	23.8	61.9	33.6	68.2	37.2	73.1	41.5	75.9	47.2	80.8	50.4	87.8	53.9
28-32	57.1	28.7	66.3	36.6	70	39.6	73.1	41.8	77.7	44.4	79.8	47.9	90.1	57.8
33-36	61.6	33.6	68.1	39.1	72.6	41.6	76.2	44.4	80.4	47.9	82.8	50.1	90.8	65.5
≥37	61.6	33.7	68.8	38.7	73.5	42.4	77.2	45.4	79.8	47.8	82.9	50.8	87	53.1
Total	58.1	30.7	67.2	37	71.4	40.6	75.4	43.7	79.4	47	81.4	49.9	88.8	55.5
Birth height														
< 40 cm	57	29.6	63.6	35.1	69.7	39	73.2	41.9	77.4	44.4	80.7	47.2	87.5	53.9
40-49 cm	58.5	32	68	38.1	71.6	41	75.7	44.4	80	48	82.1	50.6	90.4	60.9
>49 cm	62.1	33.9	68.2	37.9	72.5	41.2	76	43.8	78.1	48.2	81.9	46.6	87	51
Total	58.1	30.7	67.2	37	71.4	40.6	75.4	43.7	79.4	47	81.4	49.9	88.8	55.5
Apgar score														
< 7	55.6	27.8	65.8	36.2	70.4	39.8	74.3	43.2	79.3	46.6	80.1	48.1	86.6	50.5
> 7	61.2	32.1	68	38.3	71.2	40.7	74.8	44	79.7	47.5	81.2	50.6	90.6	62.7
Total	58.1	30.7	67.2	37	71.4	40.6	75.4	43.7	79.4	47	81.4	49.9	88.8	55.5

characteristics and basic variables are presented in Table 1. The mean BP values which are displayed in Table 2. suggest that gestational age is positively correlated with SBP and DBP ($P<0.05$). Nonetheless, no statistically significant correlation was observed between birth height and BPs values. Furthermore, although girls had higher SBP values than boys (Table 3), it was not statistically significant ($P>0.05$).

The results obtained from the Pearson's correlation coefficient test indicated that there was a positive but weak correlation between birth weight and BPs in the first two weeks of life (r-0.2; $P<0.05$). As illustrated in Table 4, the frequency (percentage) of BP values was less than 5th and over 95th percentile. Moreover, percentile blood pressure charts plotted on birth weight (figures 2 and 3), age (figures 4 and 5), condition on discharge (figures 6 and 7), gender (figures 8 and 9), and height (figures 10 and 11).

Table 3. Comparison of mean blood pressure in terms of gender during the study

Days	Systolic BP (mmHg), mean (SD)			Diastolic. BP (mmHg).mean(SD)		
	Total	Male	Female	Total	Male	Female
1	67.21 (10.83)	66.74 (10.82)	68.10(10.89)	37.31 (9.42)	37.34 (9.05)	37.34 (10.10)
2	69.21 (9.35)	69.36 (9.76)	68.96(8.72)	39.27 (8.16)	39.66 (8.58)	38.77 (7.57)
3	70.66 (8.44)	69.98 (8.68)	71.53(8.16)	40.43 (7.73)	40.02 (7.79)	40.95 (7.70)
4	71.47 (10.57)	70.81 (11.46)	72.13(9.41)	41.97 (9.07)	41.87 (9.64)	42.08 (8.42)
5	72.81(9.05)	73 (9.55)	72.62(8.52)	42.05 (8.64)	42.86 (9.18)	41.17 (7.91)
6	76.11 (48.42)	73.99 (9.4)	78.77 (71.87)	42.33 (8.28)	43.08 (8.74)	41.36 (7.68)
7	73.05 (9.28)	72.73 (9.08)	72.93 (9.07)	41.53 (9.20)	41.38 (7.57)	41.30 (10.65)
8	73.80(10.85)	72.09 (10.56)	73.79 (10.91)	41.63 (8.96)	41.09 (8.71)	42.06 (9.3)
9	73.32 (10.17)	72.16 (10.9)	74.21 (8.94)	41.37 (8.88)	41.05 (9.54)	41.41 (7.85)
10	73.79 (11.56)	71.93 (9.42)	75.05 (13.15)	41.67 (9.30)	40.53 (7.43)	42.05 (10.54)
11	71.53 (10.38)	69.87 (10.22)	72.62 (9.77)	40.32 (8.13)	39.54 (8.12)	40.50 (7.44)
12	71.03 (10.75)	69.13 (10.59)	72.53 (10.51)	40.15 (8.87)	40.08 (10.03)	39.91 (7.61)
13	71.05 (9.23)	70.28 (9.06)	71.64 (9.42)	39.50 (7.87)	39.49 (7.52)	39.18 (8.22)
14	72.43 (9.25)	71.49 (8.66)	73.20 (9.90)	39.80 (8.09)	38.81 (7.13)	40.60 (8.98)
21	71.81 (10.87)	72.85 (12.49)	69.84 (8.29)	41.38 (11.56)	41.03 (13.07)	42 (9.81)
28	68.56 (12.63)	69.15 (13.49)	67.48 (12.34)	38.35 (10.65)	38.74 (12.39)	38.73 (6.96)

Table 4. Distribution of abnormal BP values using the cut-off

Day	Percentile values (SBP (mmHg))	SBP (mmHg) 5th	SBP (mmHg) ≥ 95th	Percentile values (DBP (mmHg))	DBP (mmHg) 5th	DBP (mmHg) ≥ 95th
	(5th- 95th)	N (%)	N (%)	(5th- 95th)	N (%)	N(%)
1	(50.26-83.05)	14 (4.70)	14 (4.70)	(24-53.13)	15 (5.10)	14 (4.70)
2	(54.70-85.30)	12 (3.90)	15 (4.90)	(27.39-52.65)	15 (4.90)	15 (4.90)
3	(55.85-83.80)	14 (4.90)	14 (4.90)	(28.60-54.25)	14 (4.90)	15 (5.20)
4	(53.69-88.81)	12 (4.80)	12 (4.80)	(28-55.04)	14 (5.60)	12 (4.80)
5	(57.53-89.61)	11 (4.90)	11 (4.90)	(30.19-57.26)	11 (4.90)	11 (4.90)
6	(56-89.06)	11 (5.60)	9 (4.60)	(29.90-56.66)	9 (4.60)	9 (4.60)
7	(57.65-89.35)	8 (4.60)	8 (4.60)	(28.25-56.13)	9 (5.10)	8 (4.60)
8	(54.80-90.80)	7 (4.60)	7 (4.60)	(28.90-57.30)	7 (4.60)	7 (4.60)
9	(54.61-89)	6 (4.70)	8 (6.30)	(27.65-57.82)	6 (4.70)	6 (4.70)
10	(56.27-92.52)	5 (4.50)	5 (4.50)	(28.65-56.33)	5 (4.50)	5 (4.50)
11	(56.03-91.40)	5 (5)	5 (5)	(29.05-55.09)	5 (5)	5 (5)
12	(52.47-95.40)	4 (4.40)	4 (4.40)	(26.88-54.45)	4 (4.40)	4 (4.40)
13	(57.25-86.83)	4 (4.8)	4 (4.80)	(26.25-55.12)	4 (4.80)	4 (4.8)
14	(58.06-90.46)	3 (4)	3 (4)	(29.47-56.11)	3 (4)	3 (4)
21	(53.02-89.37)	2 (5)	2 (5)	(24.02-63.95)	2 (5)	2 (5)
28	(36.28-91.15)	1 (3.70)	1 (3.70)	(16.40-61-81)	1 (3.70)	1 (3.70)

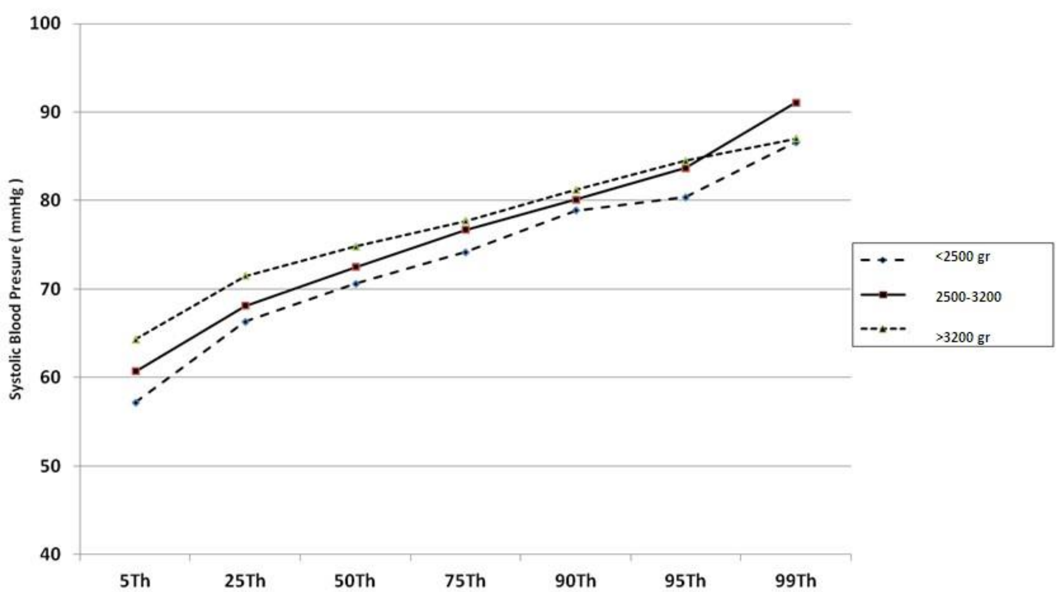

Figure 2. 5th, 25th, 50th, 75th, 90th, 95th, 99th percentiles of systolic blood pressure (BP) plotted based on birth weight

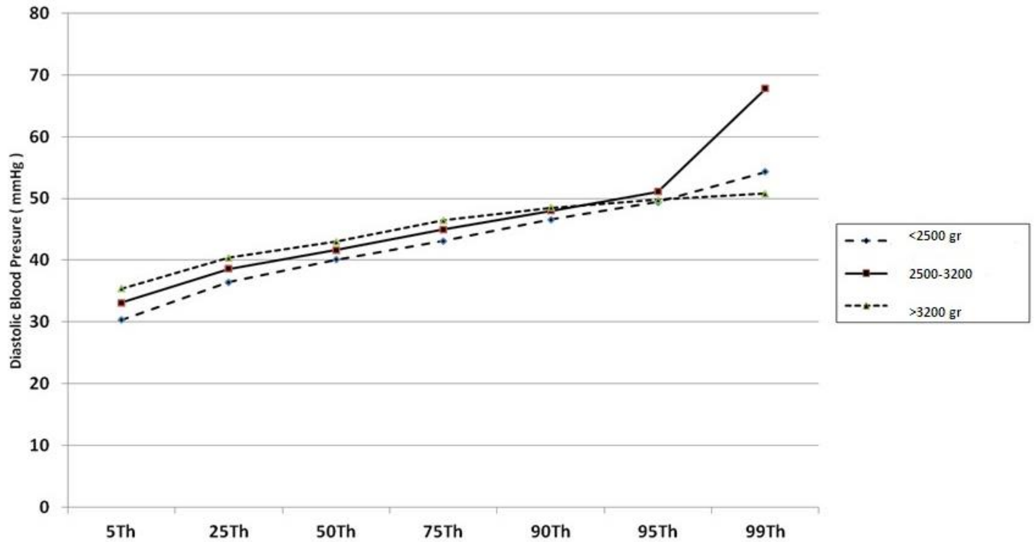

Figure 3. 5th, 25th, 50th, 75th, 90th, 95th, 99th percentiles of diastolic blood pressure (BP) plotted based on birth weight

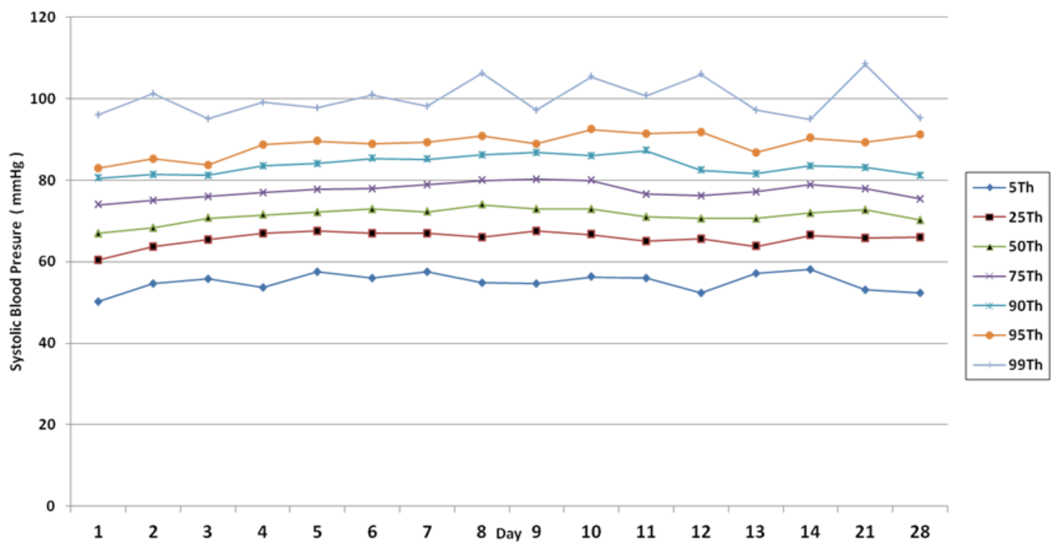

Figure 4. 5th, 25th, 50th, 75th, 90th, 95th, 99th percentiles of systolic blood pressure (BP) plotted based on neonatal age

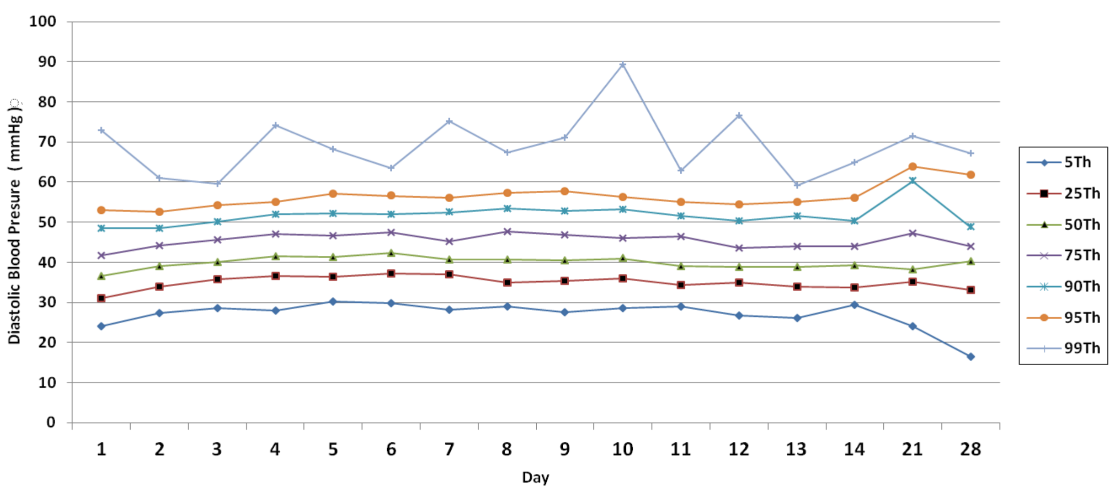

Figure 5. 5th,25th, 50th, 75th, 90th, 95th, 99th percentiles of diastolic blood pressure (BP) plotted based on neonatal age

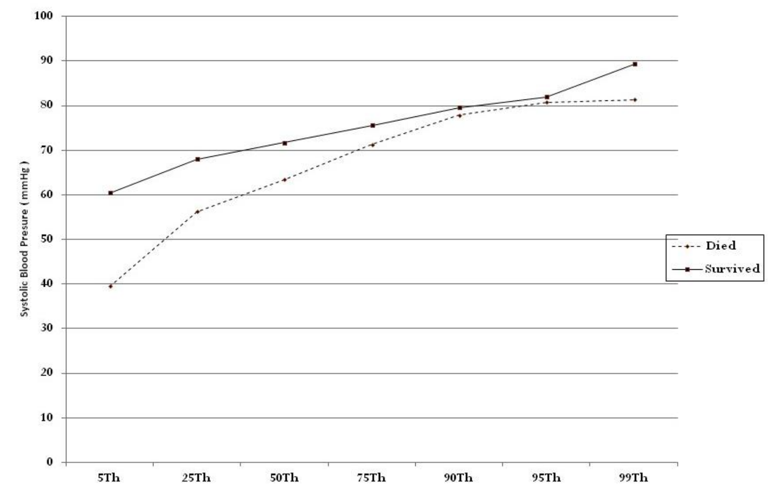

Figure 6. 5th,25th, 50th, 75th, 90th, 95th, 99th percentiles of systolic blood pressure (BP) plotted based on neonatal outcome

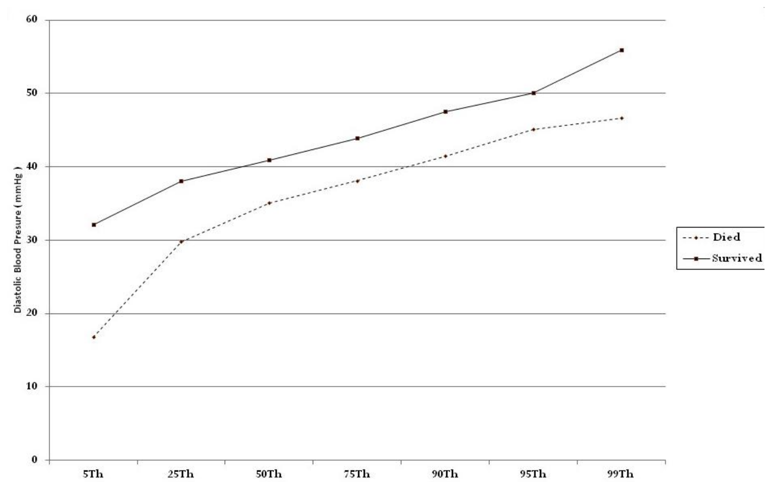

Figure 7. 5th,25th, 50th, 75th, 90th, 95th, 99th percentiles of diastolic blood pressure (BP) plotted based on neonatal outcome

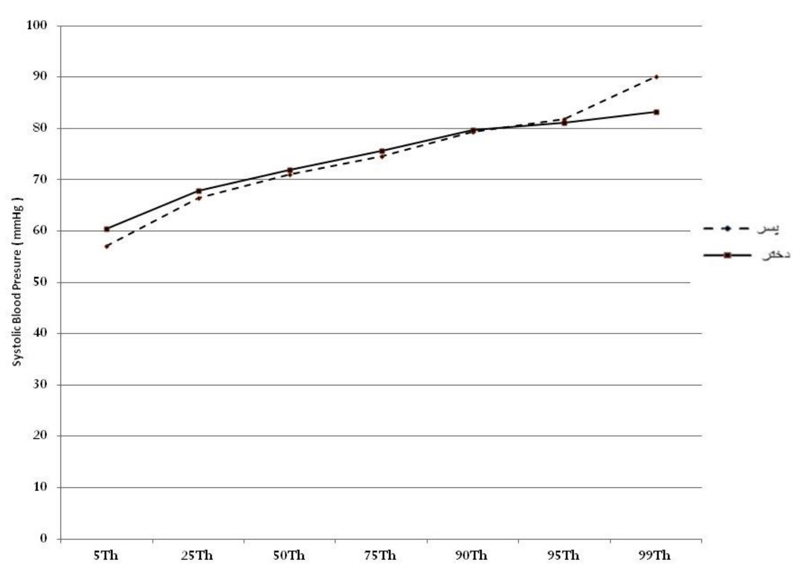

Figure 8. 5th,25th, 50th, 75th, 90th, 95th, 99th percentiles of systolic blood pressure (BP) plotted based on neonatal gender

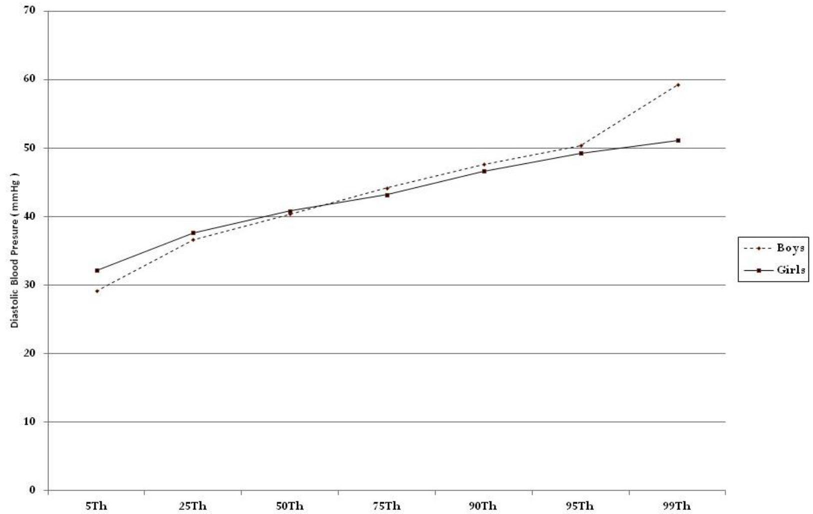

Figure 9. 5th, 25th, 50th, 75th, 90th, 95th, 99th percentiles of diastolic blood pressure (BP) plotted based on neonatal gender

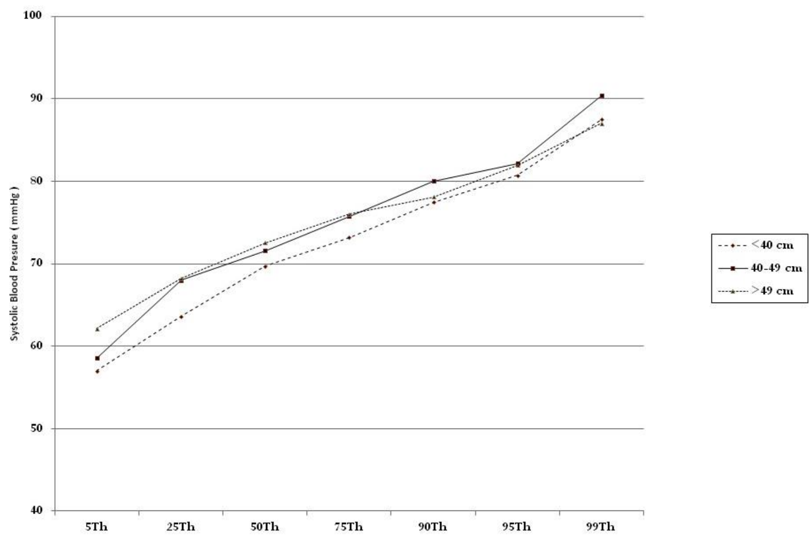

Figure 10. 5th,25th, 50th, 75th, 90th, 95th, 99th percentiles of systolic blood pressure (BP) plotted based on neonatal height

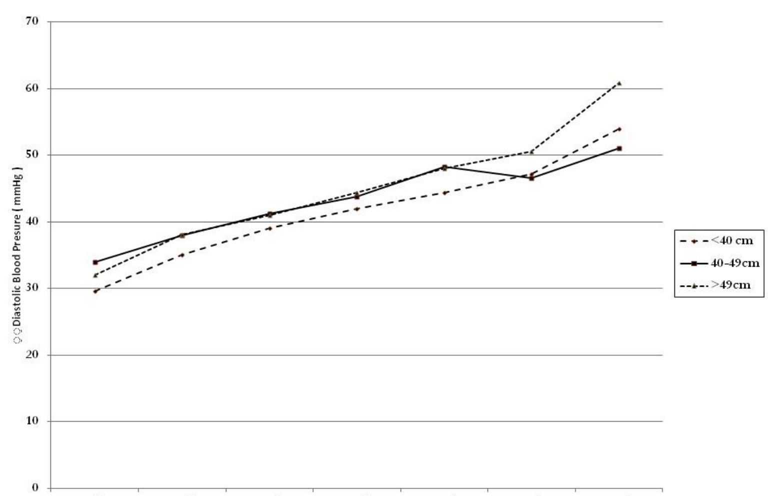

Figure11. 5th, 25th, 50th, 75th, 90th, 95th, 99th percentiles of diastolic blood pressure (BP) plotted based on neonatal height

Discussion

The present study provided normative mean SBP and DBP data on neonates born at 26-42 weeks of gestation during the first month of life. The oscillometric method which was used in our assessment is a non-invasive tool for BP magnitude which eliminates arterial line requirements and widely utilized in neonatal intensive care units in Iran. In this setting, a nomogram prerequisite is indisputable. The generation of regional BP nomograms is not feasible due to racial, geographical, and methodological diversities. Blood pressure in healthy neonates becomes stronger or amplified with body weight, gestational age, and postnatal age (5).

Consequently, this plotted nomogram is applicable for the diagnosis of hypotensive or hypertensive neonates. Hegyi et al. studied the blood pressure of over 1000 preterm neonates weighed 0.5-2 kg in the first hours of life. They reported that BP in healthy premature newborns was independent of birth weight and gestational age. On the contrary, low Apgar score and maternal hypertension directly influenced neonatal pressure (8).

The present study revealed that birth weight exerted a substantial impact on neonatal BP in early life, and a significant positive reciprocal action was observed between BPs and birth weight. This correlation was more obvious in 5^{Th} to 75^{Th} beyond which a plateau was observed in the curve. Park et al. measured BP in both arm and calf of 215 healthy neonates in the first 36 h after birth. They found similar BP in both arm and calf using the same sized cuff; consequently, arm BPs over 75.49 mmHg or calf BPs 6-9 mmHg less than arm should be considered abnormal (10).

Our study group had higher 95^{th} figures, in comparison to disclosing cut point by Park et al. Sadoh et al. evaluated the predictors of BP in 473 mother-newborn pairs. They suggested that neonatal BP was correlated with birth weights and maternal body mass index over 30 (11). This association of birth weight was in agreement with the findings of the current study. Alves et al. studied the effect of fetal factors on BPs of 641 neonates and recognized that the birth weight was the most single influential factor affecting higher neonatal BP (12).

In another study, the SBPs of 257 full-term neonates in the first 4 days were correlated with birth weight (13). In a research conducted by Hans et al. (10), the lower limits of normal mean BP had a direct relationship with birth weight in 16 clinically stable neonates weighed 610-980 gram by aortic blood pressure measurement (14). Term neonates had higher BP, compared to their preterm counterparts. Hulman et al. notified a gradual elevation in BP in the first 72 h of life (1).

Tan et al. observed the same increment in BP during the first few days of life reaching the peak at the age of 4-5 days and declining a little at the age of 6 days (15). One more assessment in Nigeria by Nwokoye et al. on BPs in 310 term newborns confirmed the same observation in line with our study (16). There is a paucity of data on PBs in premature neonates. Alison et al. measured BPs in stable non-ventilated premature neonates at 28-36 weeks of gestational age. Premature neonates stabilize their BP after 14 days of life and adapted to full-term newborns (6). Despite higher SBP values in female neonates, this difference in BP values was not statistically significant between the two groups.

This finding was consistent with other investigations (17, 18) implying that gender has no influential impact on BP during the first two weeks of life. In accordance with the results of a study performed by Holland and Young (19), we found that the mode of delivery was correlated with BP value which was higher in vaginally delivered neonates. On the contrary, Nascimento et al. (20), and Earley et al. (21) reported that BP was not affected by the mode of delivery. Moreover, in line with the studies carried out by Salihoglu et al. (22) and Kent et al. (23), there was no correlation between BPs values and the length of newborns. The limitation of the current study included the small sample size, absence of measurement in daily care neonates, and termination of measurements in the 21^{st} and 24^{th} days of life.

Limitations

The limitation of the current study included parents' poor compliance in follow up and equipment diversity, which is a restriction on multi-center studies.

Conclusion

As evidenced by the obtained results, BP monitoring is an essential part of neonatal care in the hospital setting. The current study produced normal values of BP in the neonatal group using the oscillometric method in the first two weeks of life. The obtained data of the present study can be used as a valuable reference for specialists in the management of newborns.

Acknowledgments

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Conflicts of interest

The authors declare that they have no conflict of interest regarding the publication of the present article.

References

1. Hulman S, Edwards R, Chen YQ, Polansky M, Falkner B. Blood pressure patterns in the first three days of life. J Perinatol. 1991; 11(3):231-4.
2. Dasgupta SJ, Gill AB. Hypotension in the very low birthweight infant: the old, the new, and the uncertain. Arch Dis Child Fetal Neonatal Ed. 2003; 88(6):F450-4.
3. Skalina ME, Annable WL, Kliegman RM, Fanaroff AA. Hypertensive retinopathy in the newborn infant. J Pediatr. 1983; 103(5):781-6.
4. Cachat F, Bogaru A, Micheli JL, Lepori D, Guignard JP. Severe hypertension and massive proteinuria in a newborn with renal artery stenosis. Pediatr Nephrol. 2004; 19(5):544-6.
5. Chen X, Wang Y. Tracking of blood pressure from childhood to adulthood: a systematic review and meta-regression analysis. Circulation. 2008; 117(25):3171-80.
6. Kent AL, Meskell S, Falk MC, Shadbolt B. Normative blood pressure data in non-ventilated premature neonates from 28–36 weeks gestation. Pediatr Nephrol. 2009; 24(1):141-6.
7. Jones JE, Jose PA. Neonatal blood pressure regulation. Semin Perinatol. 2004; 28(2):141-8.
8. Hegyi T, Carbone MT, Anwar M, Ostfeld B, Hiatt M, Koons A, et al. Blood pressure ranges in premature infants. I. The first hours of life. J Pediatr. 1994; 124(4):627-33.
9. Cantinotti M, Giordano R, Scalese M, Molinaro S, Murzi B, Assanta N, et al. Strengths and limitations of current pediatric blood pressure nomograms: a global overview with a special emphasis on regional differences in neonates and infants. Hypertens Res. 2015; 38(9):577-87.
10. Park MK, Lee DH. Normative arm and calf blood pressure values in the newborn. Pediatrics. 1989; 83(2):240-3.
11. Sadoh WE, Ibhanesehbor SE, Monguno AM, Gubler DJ. Predictors of newborn systolic blood pressure. West Afr J Med. 2010; 29(2):86-90.
12. Alves JG, Vilarim JN, Figueiroa JN. Fetal influences on neonatal blood pressure. J Perinatol. 1999; 19(8 Pt 1):593-5.
13. Lee YH, Rosner B, Gould JB, Lowe EW, Kass EH. Familial aggregation of blood pressures of newborn infants and their mothers. Pediatrics. 1976; 58(5):722-9.
14. Versmold HT, Kitterman JA, Phibbs RH, Gregory GA, Tooley WH. Aortic blood pressure during the first 12 hours of life in infants with birth weight 610 to 4,220 grams. Pediatrics. 1981; 67(5):607-13.
15. Tan KL. Blood pressure in full-term healthy neonates. Clin Pediatr (Phila). 1987; 26(1):21-4.
16. Nwokoye IC, Uleanya ND, Ibeziako NS, Ikefuna AN, Eze JC, Ibe JC. Blood pressure values in healthy term newborns at a tertiary health facility in Enugu, Nigeria. Niger J Clin Pract. 2015; 18(5):584-8.
17. Sadoh WE, Ibhanesebhor SE. Oscillometric blood pressure reference values of African full-term neonates in their first days postpartum. Cardiovasc J Afr. 2009; 20(6):344-7.
18. Gemelli M, Manganaro R, Mami C, De Luca F. Longitudinal study of blood pressure during the 1st year of life. Eur J Pediatr. 1990; 149(5):318-20.
19. Holland WW, Young IM. Neonatal blood pressure in relation to maturity, mode of delivery, and condition at birth. Br Med J. 1956; 2(5005):1331-3.
20. Nascimento MC, Xavier CC, Goulart EM. Arterial blood pressure of term newborns during the first week of life. Braz J Med Biol Res. 2002; 35(8):905-11.
21. Earley A, Fayers P, Ng S, Shinebourne EA, de Swiet M. Blood pressure in the first 6 weeks of life. Arch Dis Child. 1980; 55(10):755-7.
22. Salihoğlu Ö, Can E, Beşkardeş A, Koç BŞ, Tan İ, Can G, et al. Delivery room blood pressure percentiles of healthy, singleton, liveborn neonates. Pediatr Int. 2012; 54(2):182-9.
23. Kent AL, Kecskes Z, Shadbolt B, Falk MC. Blood pressure in the first year of life in healthy infants born at term. Pediatr Nephrol. 2007; 22(10):1743-9.