http:// ijp.mums.ac.ir
Original Article (Pages: 14307-14318)

Certain prenatal problems and their relationship with neonate's anthropometric indices at birth: a cross-sectional descriptive study in Iran

Sedigheh Keshavarz[1], Maryam Chananeh[2], Khatoon Samsami[3], Nadieh Pakari[4], * Razieh Bagherzadeh[5]

[1] Department of Midwifery, School of Nursing and Midwifery, Bushehr University of Medical Sciences, Iran.
[2] Department of midwifery, faculty of nursing midwifery, Bushehr University of medical sciences, Iran.
[3] Department of Midwifery, School of Nursing and Midwifery, Bushehr University of Medical Sciences, Iran.
[4] Department of midwifery, faculty of nursing midwifery, Bushehr University of medical sciences, Iran.
[5] Corresponding author: PhD of Reproductive Health, Assistant Professor, Department of Midwifery, School of Nursing and Midwifery, Bushehr University of Medical Sciences, Iran.

Abstract

Background: Fetal development is a strong predictor of neonate's survival after birth and poor fetal development is a health risk factor in infancy and adulthood. The frequency of factors that may affect fetal development is different from one society to another; therefore, the present study was conducted to investigate certain prenatal problems and their relationship with neonate's anthropometric indices at birth.

Methods: The present cross-sectional descriptive-analytical study was conducted using the records registered in Iran's Integrated Health System (locally known as SIB). They comprised of the records of 616 pregnant mothers who had given birth during 2017-18 in Bushehr city (Iran). The registered details of the mothers and infants were reviewed from the first prenatal visit to the first postpartum visit. A checklist was prepared to cumulate the information in their records. The collected data were analyzed in SPSS-19 through the appropriate statistical tests at a significance level of $p<0.05$.

Results: The mothers' mean age was 30.84±5.30 years. 3.9% of the infants weighed under 2500 g and were, therefore, in LBW group. The frequency of anemia was 16.25% and 22.5% respectively in the first and second trimesters. It was revealed that Gestational age (β=157, P<0.001) and the infant's male gender (β=117, P=0.004) has a direct and significant relationship, and vaginal childbirth an inverse and significant relationship (β=-122, P=0.003) with the infant's head circumference. Gestational age at birth (β=195, P>0.001). The mothers' body mass Index (BMI) (β=241, P>0.001) in the first prenatal visit was also shown to have a significant relationship with the infant's weight-for-age Z-score. Moreover, GA (β=229, P>0.001) and mother's BMI (β=242, P>0.001) in the first prenatal visit had a significant relationship with the infant's length-for-age Z-score. The infant's anthropometric indices had no significant relationships with perinatal complications such as anemia, controlled diabetes, and urinary tract infections.

Conclusion: Prenatal complications such as anemia were prevalent in the study population, and required particular attention. The mother's BMI can predict fetal development and should be the focus of greater attention in prenatal clinics.

Key Words: Anthropometric Indices, Neonate, Prenatal Problems.

Keshavarz S, Chananeh M, Samsami K, Pakari N, Bagherzadeh R. Certain prenatal problems and their relationship with neonate's anthropometric indices at birth: a cross-sectional descriptive study in Iran. Int J Pediatr 2021; 9 (9):14307-14318.DOI: **10.22038/ijp.2020.49906.3983**

****Corresponding Author:***
Razieh Bagherzadeh, Address for correspondence: PhD of Reproductive Health, Assistant Professor, Department of Midwifery, School of Nursing and Midwifery, Bushehr University of Medical Sciences, Iran.
E-mail: r.bagherzadeh@bpums.ac.ir.
Received date: Jun. 26, 2020; Accepted date: Aug. 03, 2020

1- INTRODUCTION

Fetal development in the uterus is a strong predictor of the neonate's survival after birth and poor fetal development is a health risk factor in infancy and adulthood. In addition to reduced neonatal survival, poor fetal development is associated with complications in adulthood, including chronic diseases such as cardiovascular disorders, diabetes, hypertension, and dyslipidemia, and growth-developmental and psychological disorders [1]. The anthropometric indices are considered as the least expensive and most applicable non-invasive method for measuring fetal development. Birth weight is the most used anthropometric index at birth. Head circumference (HC) and length can also be helpful in determining fetal development. Infant's reduced HC and Chest Circumference (CC) and length affect their weight and cause Low Birth Weight (LBW) [2]. LBW is regarded as the leading cause of infant mortality. The high mortality rate in LBW infants is mainly caused by the increased incidence of infection, asphyxia, and emergency surgeries [3]. Other complications of LBW include increased rate of neonatal jaundice, respiratory distress syndrome, hypothermia, hypoglycemia, necrotizing enterocolitis (NEC), and intraventricular hemorrhage (IVH) [4]. LBW may be either caused by preterm delivery or the infant being small for gestational age (SGA), or a combination of both. However, LBW as well as abnormality of other anthropometric indices have also been seen in term pregnancies, which indicates unfavorable uterine conditions for fetal development [5 and 6]. Reducing LBW by 30% between 2012 and 2025 is among the goals of the World Health Organization, but its descending trend has been much slower than expected (1% annually instead of 3%) [7]. Acquiring the knowledge of factors associated with fetal development can be the first step in initiating research and interventions to improve the fetal status, including reducing LBW. Among the important factors that may affect fetal development is the maternal condition during pregnancy, which in other words can be referred to as prenatal factors. Study results do not concur in terms of the role of prenatal factors in fetal development. For example, some studies have revealed the relationship of fetal development with maternal nutrition as measured by two indicators of anemia and BMI [8-11]. The results of a study by Mahmood et al. (2019) showed that maternal anemia in the third trimester is associated with all perinatal complications including LBW, SGA, preterm childbirth, and fetal and neonatal death [12]. In another study by Naoko et al. (2012), the relationship between LBW and maternal anemia was observed only in mothers with severe anemia [13]. However, some other articles rejected the relationship between maternal anemia and LBW, and argued that other maternal factors occurring besides anemia can affect the fetal development parameters; therefore, they recommended that other influential maternal factors such as BMI, parity, chronic diseases, and lifestyle be investigated along with anemia [10 and 14]. Fetal development has been shown to have relationships with other factors, including prenatal chronic diseases such as thyroid problems, diabetes, as well as prenatal complications such as blood pressure disorders and urinary tract problems [10 and 15]. Furthermore, research has shown that maternal BMI can have a role in the intensity of LBW, preterm childbirth, and IUGR [16 and 17]. A meta-analysis by Zhen Han assessed the relationship between maternal BMI and LBW, and reported a direct relationship between them; this result was observed in both developed and developing countries [18]. Although this index is measured and recorded for all pregnant mothers in all clinics and health centers, it is not much considered in predicting the pregnancy outcomes, and its effect on LBW is ignored [17]. We know that the frequency of factors which may affect fetal growth differs from one society to another. Furthermore, the results about the relationship of prenatal problems with fetal development indices are contradictory, and no study has yet been conducted in the city of Bushehr on the frequency of prenatal problems and their relationships with neonatal anthropometric indices. The present study, therefore, aimed at investigating certain prenatal problems and their relationship with neonatal anthropometric indices at birth.

2- MATERIALS AND MEDODS

The present cross-sectional descriptive-analytical study was conducted using registered records in Iran's Integrated Health System, locally known as SIB. SIB was launched in 2016 to register all healthcare services. The records of 616 pregnant mothers who had given birth during 2017-18 in the city of Bushehr (Iran), with SIB-registered details of them and their infants from the first prenatal visit to the first postpartum visit were reviewed. Out of the comprehensive healthcare centers, five were randomly selected, and all records of eligible mothers were reviewed. The available records exceeded the sample size needed for regression analysis (10 to 30 subjects per predictor variable). The study inclusion criteria were having registered records during 2017-18, mother's age of 18-40 years, and singleton pregnancy. The exclusion criteria were mother's use of tobacco or cigarettes, gestational age of <37 weeks at birth based on the first day of the last menstruation or the first trimester ultrasound, neonatal abnormality or disease, perinatal fetal death, or neonatal death at birth or before the first visit to comprehensive healthcare centers. A checklist was prepared to record the data, including mother's age, education, occupation, BMI at first perinatal visit, hemoglobin concentration (Hb) in the first and second trimester, mode of childbirth, neonatal gender, gestational age at childbirth, presence or absence of diabetes, blood pressure disorders, disorders in urinalysis (bacteriuria or pyuria, or both), and thyroid disorders, weight, and neonatal HC and length at birth. Prior to data collection, the project was approved in the Student Research Committee of Bushehr University of Medical Sciences, and received the Ethics Code (IR.BPUMS. REC.1398.143). In addition, permissions from research and health deputies to use the SIB were obtained. The checklists were completed anonymously to maintain confidentiality. Hb<11 g/dl in the first trimester and Hb<10.5 g/dl in the second trimester were considered anemia. Weight<2500 g at birth was taken as LBW. Weight-for-age Z-score and length-for-age Z-score were used in statistical analysis instead of their crude scores. AnthroPlus-1.04 software recommended by WHO was used to convert crude score to Z-scores. The presence of pyuria or bacteriuria was based on the SIB records. Thyroid disorders and their control using TSH level were also based on the SIB records, which showed few reported cases of maternal hyperthyroidism, and therefore only hypothyroidism was taken as a disorder and included in the analysis. Diabetes controlled with diet or insulin were also included based on the SIB records.

The collected data were analyzed in SPSS-19 using appropriate statistical tests. Table of frequency, median, mode, mean, and standard deviation were used to describe data. Data were analyzed using univariate followed by multivariate regression analyses. The linear regression assumptions included normal distribution of the residual, independence of the residual, no independent or dependent outlier data, and no multicollinearity. The significance level was taken as 0.05 in all cases.

3-RESULTS

Mothers' mean age was 30.84±5.30 years, mean gestational age at childbirth was 38.87±1.16 weeks, and mean BMI in the first perinatal visit was 26.04±4.95. Median and mode of both gravida and parity were 2 and 1, respectively. Frequency of anemia was 16.2% in the first trimester and 22.5% in the second. The participants' frequency distribution of demographic details as well as prenatal disorders are presented in **Table 1**. Among the neonates, 3.9% weighed under 2500 g; and were, therefore, in the LBW group. The neonates' mean weight, length, and HC, as well as maternal Hb in the first and the second trimester and maternal BMI in the first perinatal visit are shown in **Table 2**. The results of univariate and multivariate regression analyses are shown in **Tables 3 and 4**. Based on the multivariate regression analysis, multiparity, gestational age, and neonatal male gender had direct relationships and vaginal childbirth an inverse and significant relationship with the neonate's HC. Mother's BMI in the first perinatal visit and gestational age had direct and significant relationships with weight-for-age Z-score and length-for-age Z-score. Furthermore, neonatal gender (male) had an inverse and significant relationship with length-for-age Z-score.

Table-1: Distribution of demographic variables and important pregnancy disorders

Variable (N)	Variable levels	Number	Percentage (%)
Education Level (616)	High school	82	14.5
	Diploma	165	29.2
	College Graduate	318	56.3
Job (562)	Housewife	445	79.2
	Employed	117	20.8
Type of delivery (611)	NVD	338	55.3
	C/S	273	44.7
Gender (608)	Girl	274	45.1
	Boy	334	54.9
UTI in First Trimester (582)	No	449	77.1
	Yes	133	22.9
UTI in Second Trimester (531)	No	418	78.7
	Yes	113	21.3
Hypothyroidism (583)	No	501	85.9
	Yes	82	14.1
Diabetes controlled by diet (612)	No	601	98.2
	Yes	11	1.8
Diabetes controlled by Insulin (612)	No	601	98.2
	Yes	11	1.8
Anemia in First Trimester (586)	No	491	83.8
	Yes	95	16.2
Anemia in Second Trimester (537)	No	416	77.5
	Yes	121	22.5

NVD: Normal Vaginal Delivery, C/S: Caesarean Section, UTI: Urinary Tract Infection.

Table-2: Mean and SD of neonatal anthropometric characteristics, maternal Hb & BMI

Variables	*Total* *N= 616(100%)*	*NBW* *N= 592 (96.1)*	*LBW* *N=24 (3.9%)*
	Mean (SD)	Mean (SD)	Mean (SD)
Birth Weight (gr)	3277.78 (±410.60)	3314.98 (±372.91)	2360.00 (±141.45)
Birth Length (cm)	50.00 (±2.17)	50.11 (±2.10)	47.10 (±2.09)
Birth HC (cm)	34.57 (±1.24)	34.64 (±1.19)	32.79 (±1.18)
Hb First Trimester (g/dl) (6-10w)	12.11 (±1.11)	12.10 (±1.11)	12.28 (±1.14)
Hb Second Trimester (g/dl) (24-30w)	11.26 (±1.06)	11.25 (±1.07)	11.30 (±.91)
Maternal BMI	26.04 (±4.96)	26.03 (±4.97)	26.28 (±4.79)

Hb: Hemoglobin concentration, BMI: Body Mass Index, NBW: Normal Birth Weight, LBW: Low Birth Weight, HC: Head Circumference

Table-3: Univariate regression analysis to investigate factors related to neonatal anthropometric characteristics at birth

Independent Variable		Birth HC		Birth weight score		Birth Length score	
		β	P	β	P	β	P
Maternal Age		.025	.541	.015	.716		
Multiparity		.114	.005	.106	.009	.077	.059
Education Level	Diploma	.007	.879	.054	.215	.062	.132
	College Graduate	-.009	.845	-.087	.057	-.060	.172
Job (Housewife)		.018	.678	-.035	.412	-.055	.212
Type of delivery (NVD)		-.113	.005	0.73	.074	-.121	.003
Gender (male)		.133	.001	-.061	.138	-.110	.007
Maternal BMI (in first prenatal visit)		.060	.166	.221	.000	.235	.000
Gestational age (week)		.123	.002	.207	.000	0.259	.000
UTI in First Trimester		-.041	.321	-.062	.138	-.043	.303
UTI in Second Trimester		-.006	.884	-.040	.364	-.030	.489
Hypothyroidism		-.021	.609	-.052	.199	-.067	.101
Diabetes controlled by diet		.096	.018	.019	.637	.041	.321
Diabetes controlled by Insulin		-.034	.408	.036	.380	.036	.377
Anemia in First Trimester		.022	.600	-.044	.295	-.008	.852
Anemia in Second Trimester		.082	.06	.084	.275	.037	.402

HC: Head Circumference, NVD: Normal Vaginal Delivery, BMI: Body Mass Index, UTI: Urinary Tract Infection

Table-4: Multivariate regression analysis to predict factors affecting infant anthropometric indicators at birth

independent variable	Birth HC			Birth weight score			Birth Length score		
	β	P	95% Confidence Interval for B	β	P	95% Confidence Interval for B	β	P	95% Confidence Interval for B
Multiparity	.112	.005	.044_.250	.069	.108	-.014_.141			
Type of delivery (NVD)	-.122	.003	-.503_-.106	-	-	-	.077	.052	-.007_.388
Gender (boy)	.117	.004	.095_.489	-	-	-	-.102	.016	-.420_-.044
Maternal BMI (in first prenatal visit)	-	-	-	.241	.000	.003_.037	.242	.000	.015_.058
Gestational age (week)	.157	.000	.083_.253	.195	.000	.083_.210	.229	.000	.142_.306
Diabetes controlled by diet	.070	.085	-.088_1.369	-	-	-			
Adjusted R^2	0.220			.24			.26		
F	10.608			10.902			14.675		
P value for model	0.000			0.000			0.000		

HC: Head Circumference, NVD: Normal Vaginal Delivery, BMI: Body Mass Index.

4-DISCUSSION

Fetal development and its related factors can provide a basis for prenatal planning to reduce fetal development retardation and its consequences. The present study was conducted in the city of Bushehr to investigate prenatal factors and their relationships with the infant's anthropometric indices at birth.

Based on the data analysis results, LBW was 4% in the present study, while it has been reported 7% in the neighboring province: Fars province [19]. This difference can be attributed to the study target groups. In the study conducted in Fars province, LBW included term and preterm childbirths, but in the present study, only term infants were considered. Different studies have reported different LBW rates, for example, a study in Tabriz reported the prevalence of LBW 5.1%, which is closer to that of the present study [20]. Studies conducted in Lebanon, Bangladesh, and Nigeria reported LBW as 2.5%, 11.6%, and 7.3%, respectively [8, 21, and 22], which are not in agreement with the results of the present study. This difference can be partly attributed to the study method, including definition of LBW, and inclusion or exclusion of preterm childbirth, and partly to the difference in communities, since fetal development differs from one population to another [23]. In the present study, anemia was observed in 16.2% of the cases in the first trimester and in 22.5% during the second. A study conducted in another city in Bushehr province reported the prevalence of anemia as18% in the first trimester and close to 31% in the second [24], which is close to the present study results in relation to the first trimester anemia. However, the prevalence of anemia reported in that study exceeded that in the present study for the second trimester. This difference is supposed to be due to the definition of anemia. In the mentioned study, anemia was defined as Hb<11 g/dl for both first and second trimester. However, in the present study, anemia was defined as Hb<10.5 g/dl in the second trimester. Another possible reason for this difference could be better care taking for mothers, resulting in better maternal status in terms of anemia during 2017-18 compared to 2013. The study population could have also caused this difference, because the provincial capitals are in a better state than smaller towns in terms of health status. A study conducted in Urmia reported prenatal anemia of 20%, which is close to that in the present study [25]. However, this study did not report anemia by trimesters, so we cannot compare the results by trimester. Two studies conducted in Turkey reported anemia 20% and 26.1% [26 and 27], which is close to or slightly higher than the present study results. An article from Greece reported the prevalence of prenatal anemia as 40% [28]. The difference between these studies can be due to the definition of anemia, considering anemia in general or by different trimesters, and the iron supplement taken during pregnancy. One reason for lower prevalence of anemia in the present study is probably due to the fact that the data were extracted from records; i.e. mothers visiting to receive care and consequently receiving iron supplements. However, generally, the prevalence of anemia was remarkable even in the present study, indicating the mothers' need for better cares. Premarital and pre-pregnancy cares can help in correcting anemia before pregnancy. Although all strata including the above two groups have been included in the care program of the new approach of Iran’s Ministry of Health, i.e., integrated health care, these cares have not been adequately acknowledged. Therefore, further follow-up, emphasis, and promotion in using these cares and also providing community-based cares can help improve women's health before entering the important period of pregnancy.

Moreover, findings revealed that the first and the second trimester anemia had no relationship with any of the anthropometric indices. However, the infant's length and weight were correlated with gestational age and maternal BMI. Anthropometric indices had no relationship with other prenatal problems such as urinary tract infection, hypothyroidism, and diabetes. Various studies have reported conflicting results with regard to the relationship of anemia with neonatal HC and its lack of a relationship with other indices. In agreement with the present study, Saraswathi et al. (2019) reported that maternal Hb has no relationship with neonatal HC and length [11]. However, a relationship between maternal anemia in the first trimester and IUGR was shown in a meta-analysis [29]. Srinivas et al. (2015) reported no relationship between anemia and LBW [30]. The discrepancy in results related to the relationship between anemia and anthropometric indices can be attributed to different study methods, different definition of anemia, neglecting duration of suffering anemia, neglecting confounding factors, and even type of statistical analysis, and especially genetic differences. It seems that further prospective studies can find more accurate results in terms of the effect of anemia on the fetal status. In the present study, duration of suffering anemia was not available, and the third trimester anemia was not investigated. The results of some studies suggest that anemia in the second and the third trimesters, and not in the first trimester, can increase LBW and even cause preterm childbirth [27]. In the present study, mean Hb was not very low, even in those with anemia, suggesting mild anemia. Study results suggest that reduction in infant's anthropometric indices happens in mothers with severe anemia [28 and 31]. It has been argued that Hb between 9-9.5g/dl does not cause any neonatal LBW, and women with Hb<9 g/dl will suffer neonatal complications such as LBW and SGA. Accordingly, it is recommended that lower levels of Hb be taken as the cut-off point for more accurate prediction of neonatal outcomes [13]. In most of the studies which reported a relationship between Hb, fetal weight and other anthropometric indices, firstly, measurements were carried out in the third trimester, and secondly, Hb<10 g/dl was considered as the cut-off point [12 and 31]. Fetal needs for iron and micronutrients increase in the third trimester, and this increase may explain the relationship between third trimester anemia and LBW [9]. Inclusion of maternal examination for anemia in the third trimester appears to help management of anemia and its consequences.

In the present study, no significant difference was found in anthropometric indices between the mothers with insulin-dependent diabetes, gestational diabetes or hypothyroidism or abnormal urinary analysis in the first or the second trimester and the mothers who did not suffer any of these disorders.

Though a meta-analysis had shown a correlation between maternal diabetes and increased neonatal fat mass [32], the fat mass, free fat and thickness of scapular skin fold were identified as fat indicators in the present study. Furthermore, controlled or uncontrolled diabetes was not discussed. Au et al. argued that by controlling diabetes in diabetic mothers, fat mass in their infants would not be different from that in non-diabetic mothers. The fetal fat accumulation can be corrected by correcting maternal glucose and normal glucose (gestational diabetes control) [33]. In the present study, the participants' blood glucose had been controlled with insulin or diet.

In the present study, no relationship was found between controlled hypothyroidism and anthropometric indices. In a meta-analysis investigating thyroid function, measurement of iodine (a precursor to thyroid hormones) was used, and no linear or non-linear relationship was observed between iodine level and neonatal anthropometric indices [34]. A similar study also reached the same result [35]. A study showed that neonatal serum TSH had a relationship with growth parameters at birth [36], and accordingly, the difference may be due to hypothyroidism being controlled or uncontrolled and acquiring hypothyroidism, i.e., if hypothyroidism is severe enough to affect neonatal TSH, it can affect neonatal parameters.

Regarding abnormal urinalysis and its lack of relationship with anthropometric indices, the present study results confirm those obtained by Alijahan et al. (2013), who found no significant relationship between urinary tract infection and LBW [37]. In another study, mother's urinary tract infection was not different between term and late preterm infants [38]. In contrast, most studies have shown that mother's urinary tract infection, especially pyelonephritis can cause premature rupture of membrane/ preterm labor, and IUGR [39-41]. In the present study, all infants were term, and it was not possible to investigate the effect of urinary problems on preterm childbirth, which may explain the lack of a relationship between urinary tract infection and LBW. Given the previous studies results, positive urinary culture, especially the presence of pyelonephritis appears to be a factor for adverse pregnancy and neonatal outcomes rather than abnormal urinalysis. In the present study, abnormal urinalysis included bacteriuria and pyuria. In most cases in the present study, the results of urine culture were not available; there were only a handful of results showing positive cultures, which could not be included in the analysis, due to their limited number. Moreover, their records did not contain information on whether those with abnormal urinalysis had asymptomatic or symptomatic bacteriuria. Accurate recordings of urinalysis including whether they had a culture, the results of culture, microorganisms reported in the culture, and patient follow-up outcomes can help assess and manage the effects of urinary tract infections.

Other factors affecting anthropometric indices including BMI and GA, which were found in this study to have a relationship with neonatal weight and length, were similar to those found in other studies [2, 16, and 42]. With regard to GA, although all mothers had term pregnancies and preterm infants were excluded, that range of term pregnancy can itself affect neonatal weight. Maternal BMI is associated with neonatal weight, which is not surprising, because fetal development is a function of maternal nutrition. The mother's anthropometric features can be a good indicator of the fetus growth [17].

Multiparity was found to have a positive correlation with neonatal HC; and vaginal childbirth was negatively correlated with it, which is not odd. Other studies have also shown bigger HC in multiparous women [43-45]. Childbirth is faster in multiparous women, and changes in the fetal head that reduce HC do not happen. Besides, multiparous mothers have larger fetuses. Moreover, HC is smaller in vaginal childbirths compared to cesarean; despite a large head is probably a reason for cesarean section rather than type of childbirth affecting the head. Studies have shown that large biparietal diameter is associated with increased odds of cesarean section and instrumental childbirth [46 and 47]. However, vaginal childbirth and the fetal head passing through the birth canal causes a series of changes on the fetal head, including molding, which changes the size of HC.

Interestingly, in the present study, an inverse relationship was observed between the infant's male gender and length-for-age Z-score. Meanwhile, previous studies have shown bigger length, weight and HC in male compared to female infants [48]. In the present study, the length-for-age Z-score was used, which adjusts length to gender; and, therefore, there should be no difference between boys and girls, and this inverse relationship probably shows that standardization in any society should be in accordance with that society's attributes, and standardizing based on infants in one country cannot be generalized to another.

5- CONCLUSION

Generally, the present study showed a prevalence of prenatal complications such as anemia among the study population, although it was mostly mild anemia. The prenatal complications had no relationship with anthropometric indices, which were mostly due to the complications being controlled or mild. Moreover, some of the results require further investigations to be accepted or rejected. The mother's BMI can be a predictor of fetal growth and should be addressed more in prenatal clinics. The inverse relationship of male gender with length-for-age Z-score indicates the need for standardization of anthropometric indices in each society.

6- SUGGESTIONS & LIMITATIONS

The present paper, being the first research addressing the relationship between the prenatal complications and anthropometric indices in the city of Bushehr, undergoes certain limitations. Firstly, this study was a retrospective one based on the registered records, and some indices needed for better analysis and outcomes had not been registered. Longitudinal studies to obtain more accurate results are recommended. Secondly, With regard to some complications such as thyroid disorder, there were only a handful of cases showing one end of the complication, namely hyperthyroidism, which could not be included in the analysis. So, the few records in which mothers had hyperthyroidism were excluded. A study with a larger sample size can help assess less prevalent complications. Another important limitation was the difference between the accuracy levels of the measurement tools applied in different centers, which might have affected the registered infant's anthropometric indices and the prenatal disorders used in this study.

7- ACKNOWLEDGEMENTS

The authors wish to thank the research deputy and student research committee of Bushehr University of Medical Sciences for funding this research project, and all professors for their ongoing cooperation in this study.

8- CONFLICT OF INTEREST: No conflict interest

9- ABBREVIATIONS

LBW: Low Birth Weight

NEC: Necrotizing Enterocolitis

IVH: Intraventricular Hemorrhage

BMI: Body Mass Index

SGA: Small for Gestational Age

IUGR: Intrauterine Growth Restriction

Hb: Hemoglobin Concentration

TSH: Thyroid Stimulating Hormone

PROM: Premature Rupture of Membranes

PTL: Preterm Labor

10- REFERENCES

1. Alemu, B. and D. Gashu, Association of maternal anthropometry, hemoglobin and serum zinc concentration during pregnancy with birth weight. Early Human Development, 2020. 142: p. 104949.
2. Ba-Saddik, I.A. and T.O. Al-Asbahi, Anthropometric measurements of singleton live full-term newborns in Aden, Yemen. International Journal of Pediatrics and Adolescent Medicine, 2019.
3. Um, S.S.N., et al., Mortality of Low Birth Weight Neonates in a Tertiary Care Centre of Yaounde (Cameroon).Health Sciences and Desease, 2020. 21(2).
4. Shaikh, F., et al., Complications of low birth weight babies during first 72 hours of life. Medical Channel, 2016. 22(1).
5. Singh, L., et al., Correlation of low birth weight of neonates to placental levels of zinc, copper, iron, lipid peroxidation and glutathione. Toxicology International (Formerly Indian Journal of Toxicology), 2017. 24(2): p. 220-124.
6. Kazemeini, H., H.R. Lornezhad, and A. Banar, Low Birth Weight in Neonates of Iran 2015. Open Journal of Preventive Medicine, 2017. 7(10): p. 202.
7. UNICEF and WHO. UNICEF, WHO, UNICEF-WHO low birth weight estimates: levels and trends 2000–2015. 2019 [cited 2019 20-11-2019]; Available from: https://www.unicef.org/reports/UNICEF-WHO-low-birthweight-estimates-2019.
8. Aboye, W., et al., Prevalence and associated factors of low birth weight in Axum town, Tigray, North Ethiopia. BMC research notes, 2018. 11(1): p. 1-6.
9. Patel, A., et al., Maternal anemia and underweight as determinants of pregnancy outcomes: cohort study in eastern rural Maharashtra, India. BMJ open, 2018. 8(8): p. e021623.
10. Al-Hajjiah, N.N. and M.A. Almkhadree, The effect of maternal anaemia on the anthropometric measurements in full-term neonates. Asian J Pharm Clin Res, 2018. 11(4): p. 3680-3681.
11. Saraswathi, K. and R. Bawa, Evaluation of Anemia in Pregnant Mothers in Correlation with Anthropometry Measures in Tertiary Care Hospital. Indian Journal of Public Health Research & Development, 2019. 10(11).
12. Mahmood, T., et al., The Association between Iron-deficiency Anemia and Adverse Pregnancy Outcomes: A Retrospective Report from Pakistan. Cureus, 2019. 11(10).
13. Naoko, K., L.A. C, and J. katz, Moderate to severe, but not mild, maternal anemia is associated with increased risk of small-for-gestational-age outcomes. The Journal of nutrition, 2012. 142(2): p. 358-362.

14. Giovanni, M., G.I. Prabowo, and W. Fatmaningrum, Infant Birth Weight in Mothers with Maternal Anemia at Dupak Public Health Center Surabaya Working Area in 2017. Biomolecular and Health Science Journal, 2019. 2(1): p. 53-56.
15. Nehab, S.R.G., et al., Influence of gestational and perinatal factors on body composition of full-term newborns. Jornal de pediatria, 2019.
16. Khan, F., et al., Association of Maternel BMI with Fetal Birth Weight and Maternal Height with Fetal Crown Heel Length. Gomal Journal of Medical Sciences, 2017. 15(3).
17. Onubogu, C., et al., The influence of maternal anthropometric characteristics on the birth size of term singleton South-East Nigerian newborn infants. Nigerian journal of clinical practice, 2017. 20(7): p. 852-859.
18. Han, Z., et al., Maternal underweight and the risk of preterm birth and low birth weight: a systematic review and meta-analyses. International journal of epidemiology, 2011. 40(1): p. 65-101.
19. Nikbakht, H., et al., Evaluation of Anthropometric Indices at Birth and their Related Factors among Newborn Infants in Fars Province, South of Iran. Iranian Journal of Epidemiology, 2019. 15(3): p. 269-278.
20. Kheirouri, S. and M. Alizadeh, Impact of prenatal maternal factors and birth order on the anthropometric status of newborns in Iran. Journal of biosocial science, 2017. 49(2): p. 251-264.
21. Bhowmik, B., et al., Maternal BMI and nutritional status in early pregnancy and its impact on neonatal outcomes at birth in Bangladesh. BMC pregnancy and childbirth, 2019. 19(1): p. 413.
22. Papazian, T., et al., Impact of maternal body mass index and gestational weight gain on neonatal outcomes among healthy Middle-Eastern females. PLoS One, 2017. 12(7).
23. Patel, S.A., et al., To Study the Anthropometric Measurements of the Neonates between 28 to 42 Weeks of Gestational Age at the Tertiary Health Care Center, Bhavnagar, Gujarat. Asian Journal of Pediatric Research, 2020: p. 1-16.
24. Mohammadi, M., et al., Serum level of Zinc and Copper among pregnant women of Jam area referred to Towhid Hospital, southern part of Bushehr. ISMJ, 2015. 18(2): p. 344-352.
25. Tabrizi, F.M. and S. Barjasteh, Maternal hemoglobin levels during pregnancy and their association with birth weight of neonates. Iranian journal of pediatric hematology and oncology, 2015. 5(4): p. 211.
26. Öztürk, M., et al., Anemia prevalence at the time of pregnancy detection. Turkish journal of obstetrics and gynecology, 2017. 14(3): p. 176.
27. Vural, T., et al., Can anemia predict perinatal outcomes in different stages of pregnancy? Pakistan journal of medical sciences, 2016. 32(6): p. 1354.
28. Youssry, M.A., et al., Prevalence of maternal anemia in pregnancy: the effect of maternal hemoglobin level on pregnancy and neonatal outcome. Open Journal of Obstetrics and Gynecology, 2018. 8(7): p. 676-687.
29. Badfar, G., et al., Maternal anemia during pregnancy and small for gestational age: a systematic review and meta-analysis. The Journal of Maternal-Fetal & Neonatal Medicine, 2019. 32(10): p. 1728-1734.
30. Srinivas, P. and P. Srinivasan, The relationship between maternal anemia and birth weight in new born. IOSR J Dent Med Sci, 2015. 14(12): p. 9-11.
31. Behal, M., R. Vinayak, and A. Sharma, Maternal anaemia and its effects on neonatal anthropometric parameters in patients attending a tertiary care institute of Solan, Himachal Pradesh, India. International Journal of Reproduction, Contraception, Obstetrics and Gynecology, 2018. 7(2): p. 553.

32. Logan, K.M., et al., Diabetes in pregnancy and infant adiposity: systematic review and meta-analysis. Archives of Disease in Childhood-Fetal and Neonatal Edition, 2017. 102(1): p. F65-F72.
33. Au, C.P., et al., Body composition is normal in term infants born to mothers with well-controlled gestational diabetes mellitus. Diabetes Care, 2013. 36(3): p. 562-4.
34. Nazeri, P., et al., Do maternal urinary iodine concentration or thyroid hormones within the normal range during pregnancy affect growth parameters at birth? A systematic review and meta-analysis. Nutrition Reviews, 2020.
35. Olivares, J.L., et al., Low iodine intake during pregnancy: relationship to placental development and head circumference in newborn. Endocrinología y Nutrición (English Edition), 2012. 59(5): p. 326-330.
36. Nazeri, P., et al., Is there an association between thyrotropin levels within the normal range and birth growth parameters in full-term newborns? Journal of Pediatric Endocrinology and Metabolism, 2018. 31(9): p. 1001-1007.
37. AliJahan, R., et al., The Relation between Treated Maternal Urinary Tract Infection and Adverse Maternal, Prenatal Outcomes in Pregnant Women of Ardabil, Iran. Journal of Research Development in Nursing & Midwifery, 2013. 10(1): p. 43-51.
38. Machado Jr, L.C., et al., Neonatal outcomes of late preterm and early term birth. European Journal of Obstetrics & Gynecology and Reproductive Biology, 2014. 179: p. 204-208.
39. Lai, Y.-J., et al., Asymptomatic pyuria in pregnant women during the first trimester is associated with an increased risk of adverse obstetrical outcomes. Taiwanese Journal of Obstetrics and Gynecology, 2017. 56(2): p. 192-195.
40. Kalinderi, K., et al., Urinary tract infection during pregnancy: current concepts on a common multifaceted problem. Journal of Obstetrics and Gynaecology, 2018. 38(4): p. 448-453.
41. Kessous, R., et al., Bacteruria with group-B streptococcus: is it a risk factor for adverse pregnancy outcomes? The Journal of Maternal-Fetal & Neonatal Medicine, 2012. 25(10): p. 1983-1986.
42. Villar, J., et al., Body composition at birth and its relationship with neonatal anthropometric ratios: the newborn body composition study of the INTERGROWTH-21 st project. Pediatric research, 2017. 82(2): p. 305-316.
43. Datti, S., et al., Evaluation of the influence of maternal parity on neonatal anthropometric parameters among Hausas in Kano state. Bayero Journal of Pure and Applied Sciences, 2016. 9(2): p. 90-94.
44. Meirelles, M.G., et al., Influence of maternal age and parity on placental structure and foal characteristics from birth up to 2 years of age. Journal of Equine Veterinary Science, 2017. 56: p. 68-79.
45. Shajari, H., et al., The effect of maternal age, gestational age and parity on the size of the newborn. Acta Medica Iranica, 2006: p. 400-404.
46. Aviram, A., et al., Association between sonographic measurement of fetal head circumference and labor outcome. International Journal of Gynecology & Obstetrics, 2016. 132(1): p. 72-76.
47. Amorim, M.d.S.T. and A.N.d. Melo, Revisiting head circumference of Brazilian newborns in public and private maternity hospitals. Arquivos de neuro-psiquiatria, 2017. 75(6): p. 372-380.
48. Kurtoğlu, S., et al., Body weight, length and head circumference at birth in a cohort of Turkish newborns. Journal of clinical research in pediatric endocrinology, 2012. 4(3): p. 132.