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Research Article

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Study of Impact of Maternal Body Mass Index (BMI) on Neonatal outcome at BPKIHS

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Introduction

Poor maternal, newborn and child health remains a significant problem in developing countries. Worldwide, 358,000 women die during pregnancy and childbirth every year and an estimated 7.6 million children die under the age of five [1,2]. while maternal and child mortality has declined in the last two decades, progress remains insufficient to achieve Millennium Development Goals 4 and 5, particularly in Sub-Saharan Africa and South Asia. A child's risk of dying is highest during the first 28 days of life when about 40% of under-five deaths take place, translating into three million deaths [2]. Up to one half of all newborn deaths occur within the first 24 hours of life and 75% occur in the first week. Globally, the main causes of neonatal death are preterm birth, severe infections and asphyxia. Children in low-income countries are nearly 18 times more likely to die before the age of five than children in high-income countries [3].

Low birth weight (LBW) is defined as birth weight (BW) of less than 2,500g. Newborns with Low birth weight are at higher risk for prenatal and infant mortality and other health complications [4-7]. According to WHO, about 20 million or approximately 15.5 percent of births worldwide are low birth weight and 96% of these are from developing countries .LBW together with preterm delivery has also been recognized as a strong biological predictor of unfavorable developmental outcomes low birth weight is a consequence of either preterm (<37weeks of gestation) delivery or intrauterine growth restriction or of both [4, 7-10]. In full term pregnancy, birth weight is greatly influenced by the fetal growth, which is closely linked to nutritional status during the pregnancy period and after birth nutritional status linked with next pregnancy [4,11]. Maternal under nutrition contributes to 800 000 neonatal deaths annually through small for gestational age births; stunting, wasting, and micronutrient deficiencies are estimated to underlie nearly 3.1 million child deaths annually [12].

Body mass index (BMI) is considered a measure of body composition/ nutritional status and in women, low pre-pregnancy BMI has been considered as a marker of minimal tissue nutrient reserve [13,14]. The impact of maternal pregnancy weight and weight gain during pregnancy on pregnancy outcomes has been reported. For example, weight gain in excess of 12 kg and between 6 -11 kg for underweight and overweight women, respectively, has been associated with best pregnancy outcomes [15]. Also the risk of spontaneous preterm delivery has been found to be associated with a low 2nd and 3rd trimester weight gain (BMI < 19.5kg/m2).

The Global Safe Motherhood Initiative, launched in 1987, is designed to improve antenatal care and counseling throughout the world. Nutrient intake and weight gain during pregnancy are the two main modifiable factors influencing maternal and infant outcomes [16].

It has been reported that obesity carries significant risks for the mother and fetus with the risk increasing with the degree of obesity and persists after accounting for other confounding demographic factors [17]. Maternal obesity has been associated with increased risk of structural anomalies caesarean delivery pre-term delivery, particularly if women were underweight or of average weight before of pregnancy [14,18-20]. While low maternal BMI is associated with preterm delivery and low birth weight, especially if weight gain during pregnancy is inadequate, low pre-pregnancy BMI alone has been independently implicated as a risk factor for preterm delivery [14]. However, in women with low BMI, the overall outcome is favorable and several adverse outcomes are less common [21]. Indeed, a low body mass index (BMI) and suboptimal weight gain during pregnancy are long recognized risk factors for the delivery of infants to small for gestational age [22].

Maternal anthropometry differs across populations women belonging to ethnic groups characterized by a small body size have been reported to gain less weight on average during pregnancy than larger women. In less-developed Asian countries, including Vietnam, women generally have a lower BMI and/or a smaller gestational weight gain than in developed countries [23-25]. In the United States of America, for example, 2% of pregnant women have a BMI < 18.5 and more than 50% have a BMI > 25 [26]. There is a need to assess whether the current anthropometric recommendations for pregnant women of the United States National Academy of Sciences Institute of Medicine (IOM), which are based on data from western countries, are appropriate for preventing adverse pregnancy outcomes across populations everywhere, including south-east Asia [16].

The Body Mass Index (BMI), or Quetelet Index, is for estimation of human body Fat based on an individual's Weight and Height. It was

devised between 1830 AD and 1850 AD by the Belgian polymath Adolphe Quetelet.

BMI is defined as individual's body mass (kg) divided by the height square. The Formula universally used in medical practice is a measure of kg/m2. BMI<18.5Underweight,18.5-24.9 Normal weight,25-29.9 Over weight,30-34.9 Obese class 1,35-39.9 Obese class 2, 40 & above Obese class 3.

Average BMI of Nepalese Population is 20.55.Average BMI of male being 20.82, and for Female BMI is 20 [27]. (WHO Global Statistics) [27]. Low maternal BMI i.e. BMI of <18.5 has been associated with low birth weight, preterm delivery, small for gestational age, vision and hearing problems, mental retardations cerebral palsy and increases neonatal mortality. Whereas BMI of women > 25 or above is known to be associated with large for Gestational age and macrosomia [28].

Birth weight (BW) is an important determinant of infant'swellbeing [29]. Low birth weight (%) 2008-2012, 17.8%.(UNICEF). Several factors such as mothers' genetic characteristics, socio-cultural, demographic, behavioral factors, pre-pregnancy body mass index (BMI), gestational weight gain (GWG) etc. contribute to birth weight [30]. The gestational period determine the quality of human resources and depend on the intrauterine condition. Healthy pregnant women with a good nutritional status certainly improves the outcome of baby. Low birth weight rate in developing countries were higher four times than developed countries. More than 9 million babies die each year, 98% occur in developing countries and most of them caused by low birth weight. Therefore, optimal maternal weight gain is essential for better outcome [31].

Although there is some data that maternal short stature is associated with LBW in Caucasians there is limited information on such association among South Asian population [32-34]. Maternal short stature in itself is recognized to increase the risk of obstetric complications such as cephalopelvic disproportion, arrest of labor, higher rates of cesarean sections, intrauterine asphyxia, intrauterine growth retardation and low APGAR scores.

Being born small for gestational age is a major predictor of neonatal mortality and morbidity, failure to grow, slow cognitive development and chronic diseases in adulthood [22,35]. Infants too large for gestational age also experience higher perinatal and long-term health risks [36-39]. In addition, both groups of infants are more likely to be delivered by Caesarean section. Thus, reducing the delivery of excessively small or large infants translates into fewer surgical risks for women [40]. Appropriate antenatal management of maternal nutrition, as dictated by scientific evidence, is critical in reducing the delivery of these babies for whom both the intrauterine environment and the birth process can be life-threatening [40,41].

The neonatal mortality rate in the past five years is 23 deaths per 1,000 livebirths, which is two and a half times the post neonatal rate.In Nepal, three most common causes of neonatal admission in the NICU unit are birth asphyxia, neonatal sepsis and prematurity and are also the leading causes of death.A study previously done in Nepal shows asphyxia as a leading cause of hospital admission (22%) followed by prematurity (20%) and neonatal sepsis (17%) with mortality due to these three causes being 7%, 3% and 5% respectively [42].

Neonatal outcomes included preterm deliveries (before 37 week gestation), Low birth weight (less than 2500g), small for gestational age (SGA) birth weight below the 10th percentile for gestational age (2800g for examine population),large for gestational age (LGA) birth weight above 90th percentile for gestational age (4000g for examine population) and macrosomia (maximum than 4500g) [43].

Women's nutrition, before and during pregnancy, may play a key role in reproductive health and is recognized as being important for optimizing pregnancy out – comes [44,45]. The availability and supply of nutrients to the developing fetus depends on maternal nutritional status which in turn depends on her nutrient stores, dietary intake and obligatory requirements. Most of the studies that have examined the importance of nutrition during pregnancy typically focus on the second and/or the third trimester by which time key processes such as organogenesis have been completed [46]. Women's nutritional status just before conception and/or during early pregnancy (<12 weeks gestation), when women are typically unaware of their pregnancy status, may influence pregnancy outcomes by affecting critical developmental processes that begin early in pregnancy as well as the availability of nutrients. Animal studies suggest that periconceptionalundernutrition may influence the hypothalamic-pituitary-adrenal axis which in turn influences outcomes such as preeclampsia and preterm delivery(PTD).Various nutrients may influence pregnancy outcomes by altering both maternal and fetal metabolism due to their roles in modulating oxidative stress, enzyme function, signal transduction and transcription pathways that occur early in pregnancy namely during the critical periods of preconception, conception, implantation, placentation and embryo- or organogenesis [46-48]. Nutrients such as iron, zinc, iodine and long chain n-3polyunsaturated fatty acids (LCPUFA) play critical roles in development of the brain and nervous system, whereas vitamins A,B-6, B-12 and folic acid influence oxidative pathways and methylation.

Nutrition during early pregnancy may affect placental function, which has been associated with adverse pregnancy outcomes such as preeclampsia, PTD and fetal growth restriction. Proposed mechanisms include lowered number and surface area of arterioles in tertiary villi and reduction in spiral artery formation as a result of impaired function of trophoblasts due to oxidative stress and/or inflammation [49-51]. Many policymakers and health professionals are unaware that more than 10000 newborn babies die every day, mostly from preventablecauses. The Millennium Development Goal for child survival (MDG -4)-to reduce childhood mortality by two-thirds between 1990 and 2015—will not be met without substantial reductions in neonatal mortality [52]. Low-cost interventions could reduce neonatal mortality by up to 70% if provided universally [53].

Aims and Objectives

General Objective:

- Study of impact of maternal BMI on neonatal outcome at BPKIHS.

Specific Objectives:

- Study of Impact of maternal BMI on Neonatal Anthropometry
- To find out the Correlation between BMI of mothers and Gestational age of the newborns.
- To find out the association of maternal BMI with mode of delivery andneonate needs for NICU care

Materials and Methods

This was a hospital-based study conducted in the Department of Pediatrics and Adolescent Medicines in collaboration with the Department of Obstetrics and Gynecology at BPKIHS, Dharan .The study was conducted over a period of one year. Ethical clearance was obtained from The Institute Ethical Review Board of BPKIHS, Dharan.

Study period:-15TH JUNE 2013-14TH JUNE 2014. (ONE YEAR)

Study design:- Cross-sectional Descriptive study.

Population of study

All live born babies at BPKIHS during the period of one year were included in the study.calculated sample size is 500.

Sampling Technique: For study, sampling technique included approx-10 babies delivered per week or every 3 babies delivered on alternate days (Systemic Sampling).

Inclusion Criteria

1. Women of reproductive age group 15-49 years age visiting The Department of Obstetricsand Gynecology for Antenatal checkups (ANC) and delivery at BPKIHS.
2. Neonates Delivered by these pregnant women followed up at BPKIHS were included.

Exclusion Criteria

1. Intrauterine fetal death (IUD)
2. Pregnancy complicated by Hypertension, Diabetes, Thyroid dysfunctions,Epilepsy
3. Heart diseases
4. Metabolic disorders
5. Alcoholic and smokers
6. Twins
7. Drug abusers

Initial data collection: Baseline

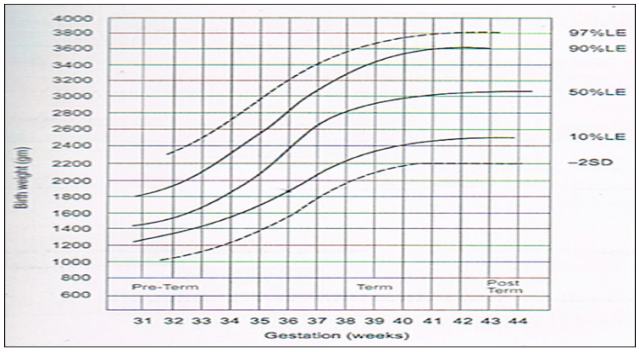
Maternal data was recorded according to the enclosed proforma (Annexure-).This include name, age, sex, address, religion, education, occupation, parity, past Obstetrics history, family income, Gestationalage calculated by LMP

Maternal Anthropometry

Present Maternal weight was recorded on a standardized weighing scale (Libra) with reading to nearest 0.5kg and previous weights were obtained from the ANC card during the visit. Height was measured by the fibre glass tape to nearest 0.1cm without shoes and heels against wall with head straight forward. Body mass index (BMI) was calculated by dividing body weight (Kg) by square of height (m) according to WHO.BMI = Weight (kg)/Height (meter)^2.

Neonatal characteristics

Neonatal details included a record of gestational age calculated by New Ballard's score. Apgar scores at birth were recorded while attending the delivery of the Newborns.The Newborn was labeled as term (37-41weeks), pre-term<37weeks, or post term >42weeks according to the gestational age. The birth weight of the baby was taken within 1 hour of birth in the labor room and operation theatre. A weighing scale (Seca) was used to record weight (minimum 0.5gms). Neonatal crown to heel length was measured to nearest 0.1cm, using Infantometer, with baby supine, neck fully extended and soles of feet held firmly against the foot board and head touching fix-board. Mid upper arm circumferences was taken to nearest 0.1 cm in the left upper arm midway between acromion and olecranon process. Occipitofrontal head circumference was measured to nearest 0.1cm encircling around glabelianteriioly, opisthocranion on the occiput posteriorly and just above ears laterally. Chest circumference was measured to nearest 0.1cm at the level of nipples. A standardized fibre glass tape was used for recording all body circumferences. All newborns were classified for their weight for gestational and classified being small for appropriates or large for gestational age. The aberrant growth was assessed by plotting the weight against the gestational age on standard Intrauterine Growth Curve.



Apgar score

	0	1	2
HEART RATE	ABSENT	SLOW(<100)	NORMAL(>100)
RESPIRATIONS	ABSENT	WEAK CRY	GOOD STRONG CRY
MUSLE TONE	LIMP	SOME REFLEX	ACTIVE MOVEMENT
REFLEX IRRITABILITY	NO RESPONSE	GRIMACE	COUGH OR SNEEZE
COLOR	BLUE OR PALE	BODY PINK,	COMPLETELY PINK
		EXTREMITIES BLUE	

Ponderal index (weight in gram /cube of length in cm) was calculated and infants with Ponderal index < 2 labeled as being asymmetrical IUGR AND >2 as symmetrical IUGR.

Calculated by; Weight (gm.) ×100/Length (cm)^3

After delivery of the baby, regular follow up of neonate was done in ward, postnatal nursery and NICU till the baby was discharged from the hospital.

Statistical Analysis

For Descriptive statistics mean, median, standard deviation (SD), percentage, proportion will be calculated.For inferential statistics Chi-square test and Pearson coefficient's was used for the study. Correlations were studied to find out the significant difference between maternal BMI and Neonatal anthropometry and related variables at 95% confidential interval where p=0.05 was taken as significant.

Results

This study **"STUDY OF IMPACT OF MATERNAL BODY MASS INDEX (BMI) ON NEONATAL OUTCOME AT BPKIHS"** was conducted in BPKIHS, Dharan, Nepal. Total of 500 pregnant women attending to the antenatal clinic at BPKIHS from 15th June 2013 to 14th June 2014 were included

For the sake of convenience, observation was divided into following groups

- Study of Impact of maternal BMI on Neonatal Anthropometry
- To find out the Correlation between BMI of mothers and Gestational age of the newborns.
- To find out the association of maternal BMI with mode of delivery and neonate needs for NICU care.

Objectives Results

1. Study of Impact of maternal BMI on Neonatal Anthropometry

Table 1: Maternal BMI with Neonatal Anthropometry

Variables	Pearson'scoefficient(r)	P-value	Remark
Birth weight (gm.)	0.109	0.015	S
Length (cm)	0.035	0.434	NS
Head circumference(cm)	0.104	0.020	S
MUAC(cm)	0.028	0.528	NS
APGAR @ 10 MINS	0.003	0.945	NS

Correlation is significant at the 0.05 level

The Table above shows the correlation of Maternal BMI with neonatal anthropometry. The correlation with Birth weight and Head circumference of Newborns was found to be significant with P-value of 0.015 and 0.02 respectively. Thecorrelation of maternal BMI with Apgar score at 10 minutes, MUAC and Length was found not to be significant as shown in Table No.20

2. To find out the Correlation between BMI of mothers and Gestational age of the newborns.

Table 2: Maternal BMI and Gestational age of the newborns.

Variables	Pearson's coefficient(r)	P-value	Remark
Gestational Age of Newborns	0.06	0.184	NS

The above table shows that the correlation of Maternal BMI and Gestational age of Newborns was found not to be significant. However low BMI are not associated with preterm delivery in this study

3. To find out the association of maternal BMI with mode of delivery and neonate needs for NICU care.

Table 3: Maternal BMI and mode of delivery (Chi square test)

Maternal BMI	Mode of Delivery			Total	P-value
	ND	ELEC LSCS	EMG LSCS		
Under weight	12(2.4%)	0	0	12(2.4%)	
Normal weight	282(56.4%)	24(4.8%)	62(12.4%)	368(73.6%)	
Over weight	72(14.4%)	12(2.4%)	33(6.6%)	117 (23.4%)	0.004
Obese	1(0.2%)	0	2(0.4%)	3 (0.6%)	
	367(73.4%)	36(7.2%)	97(19.4%)	500	

Table 4: Maternal BMI and Need for NICU

Maternal BMI	Need for NICU		Total	P-value
	Discharge	Admitted		
Under weight	12	0	12	0.16
Normal weight	354	14	368	
Over weight	107	10	117	
Obese	3	0	3	

The above tables shows that the association between maternal BMI with mode of delivery was found to be (P=0.004) significant. Although the association between maternal BMI with neonates requiring NICU care was found not to be significant statistically, but 4.8% of Newborns required NICU care.

Discussion

This is a hospital-based, cross-sectional, prospective study conducted over a period of one year in the Department of Pediatrics and Adolescent Medicine at BPKIHS, Dharan. This study was done to find out the correlation of the BMI in the pregnant women of Nepalese mothers on neonatal outcome. In this study, we analyzed the correlation of maternal BMI with the neonatal outcome such as neonatal anthropometry (birth weight, length, head circumferences, MUAC), and also the associations of maternal BMI with the mode of delivery and the neonatal needs for NICU care.

In our study, Mean age of the pregnant women was 25.30 ±4.6 (SD), which is similar to the study of Ota E et al, in which the mean age of the Vietnamese women was found to be 27. 9 ± 5. 3 SD [53]. A similar study was conducted in Europe, by Kalk P et al, in which the mean age of healthy women was observed to be 30.2±5.4 [52] .

Mean height of mothers in this study was 155.49 ±3.9 SD. A similar study conducted at our institute showed the mean height to be 153 cm (SD 0.0005). The study conducted in Vietnam by Ota E et al showed the average mean height to be 154. 2 ± 4. 8cm, which is similar to our study [53]. An anthropometric study done in pregnant women in Nepal conducted by Manandhar D S et al. found that the mean height of women was 149 cm [54]. The result showed that the height of Nepalese women are increasing and that is a healthy sign showing that girls in Nepal are being nourished and cared well than found in earlier studies from Nepal.

Out of 500 delivered babies in our hospital, 232 (46.4%) babies were Male and 268 (53.6%) were Female. Hence Male : Female ratio was 0.86:1. In a retrospective study done at BPKIHS earlier found the male: female ratio to be 1.1:1, which was almost equal. In which the ratio was almost equal. The Mean birth weight of newborns observed in this study was 3190± 2.041(SD) gm. In the study done by S Upadhyay et al, mean birth weight was 2960 gm [55]. But in a study done earlier by Singh R et al. showed the average birth weight at BPKIHS was 2680 gm [56]. This is again a very encouraging finding as our mean birth weight in this institute has increased significantly after almost 18 years.

A study conducted in Nepal by S Upadhyay et al, found that there is a variation in birth weight of Newborns in Ethnic Group between the Brahmins/Chhetri which was found to be 2960±0.340 gm, whereas amongst the Sherpa/Tamang/Gurung it was found to be 3460±0.410 gm [55]. This study showed a great variation of birth weight between

the ethnic groups.

Another study by S. Lumbanraja et al. in Indonesia showed that the birth weight of newborns ranged at 2500 – 4000 gm [31]. (Mean 3119±399.86) which is similar to the birth weight found in our study. A study by Athukorala et al. showed that the birth weight of Newborn was 3376±573.7gm [57]. In the study of Ugwuja et al, conducted in Nigeria, showed that Mean Birth weight was 3.01±0.37 kg and in a study conducted in Kolkata, India showed the mean birth weight of Neonates to be 2.47±409 kg [58].

In this study the Mean Length of the Newborns was found to be 51 cm (Mean 51.11 ±2.04SD) which is a standard requirement for newborn. In other studies by Kalk P et al, Ota E et al, Athukorala et al and Ugwuja et al, showed that the average (mean) length of neonates was 50 cm which is similar to the length of the newborns observed in our study. But in the studies of Bisai S and Godhia et al, it was found that the Mean length of neonates was (47.3±2.1cm) and (48.72±2.48cm) respectively [52,53,57-60].

The Mean Head circumference (HC) of the neonates in this study was found to be 34.37cm, which again shows that the Mean Head circumference observed in our study is similar to the studies conducted by Athukorala et al and Kalk P et al, with average Mean head circumference being 34cm [52,57]. whereas the Godhia et al, and Ugwuja et al. found lower mean head circumference in their study [58,60].

In our study Mean MUAC of newborns was found to be 12cm (12.09±1.646). A study conducted in India by Godhia et al, found that the Mean MUAC of Neonates was 9.67±1.14cm.This shows that the nutritional status of our newborns was comparatively much better than the study group of Godhia et al [60].

Out of 500 Neonates delivered in our institution during the study period, this study showed that numbers of preterm were 52 (10.4%) which closely resembles to Ugwuja et al study in which numbers of preterm were 9.2% [58]. Other studies by Kalk P et al, showed 7.6% and Athukorala et al, showed 59 (6.3%) preterms delivered during their study period [52,57]. In this study, we observed that post term delivered babies were very less with only 0.6% in number. But Ugwuja et al showed 4.2% post term delivered in their study [58].

In this study, conducted at BPKIHS, Dharan, showed that there is least number of LGA 6(1.2%) while SGA was 26(5.2%) in number and almost 468(93.6%) newborns delivered were AGA. Studies of Athukorala et al. and P KAlk P et al, showed more numbers of SGA and LGA delivered as compared to our study [52,57].

Table 5

	SGA (%)	LGA (%)
Kalk P et al. (2009)	21.5	13.4
W M Kanadys (2007)	8.0	8.9
Athukorala et al. (2010)	9.8	8.1

In this study, evaluation of Apgar score was done at 1minute, 5 minutes and 10minutes after the delivery of the babies. Thus, in this study out of 500 delivered babies, about 10 (2%) of babies had Apgar less than 7 at 1 minute and 1% babieshad Apgar less than 7 at 5 minutes respectively. Maximum numbers of babies i.e., about 487 (97.4%) newborns had Apgar score between7 to 8, and only 1.6%Newborns had Apgar score greater than 8.

Maximum numbers of newborns, i.e. 484 (96.8%) were found to have Apgar greater than 8 and least numbers 16 (3.2%) neonates had Apgar score in between 7 to 8 at 10 minutes after birth. Comparing the Apgar score at 10 minutes, in this study Mean±SD found to be 9.12±4.018 which is closely similar to the study Kalk P et al. with Mean±SD Apgar at 10 minutes observed to be9.7±0.6

In this study out of 500 delivered babies, 476 (95.2%) neonates were discharged within 48 hours and only 24 (4.8%) newborns requiring NICU care were admitted .The finding of our study is similar to the study of Athukorala et al, in which about 29 (3.1%) were admitted in NICU [57]. Our study finding of NICU admission is in contrast to the study of Kalk P et al, in which 22.9% where newborns needed NICU care [52].

Table: 6

	Birth weight	Length	HC	MUAC	APGAR	NICU
KalkPet al(2009)	3347.1±607.8	50.8±3.0	34.7±2.0		9.7±0.6	22.9%
Ota E et al (2011)	3227±423	50.4±1.8				
Godhia M et al (2012)	2849±462.28	48.72±2.48	33.81±1.47	9.67±1.14		
Chiba et al [61]	3219±371.5	49.7±1.8	33.3±1.5			
Athukorala et al (2010)	3376±573.7	50.4±3.1	34.4±1.9			3.1%
WM Kanadys (2007)	3396±503					
KabirAlamir et al (2014)	2440±420	46.43±2.41	32.36±1.63	9.31±0.84		
M Thame et al (1997)	3190.6±527.3	52.61±4.0	34.4±1.8			
BPKIHS study (2013)	3190±204.1	51.11±2.04	34.37±0.903	12.09±1.646	9.12±4.038	4.8%

In this study the Mean age of Mothers was found to be 25 years. Maximum number mothers 383 (76.6%) were between the age group of 20-30 years and minimum number of mothers found in this study were more than 40 years i.e. about 0.4%. The Mean age of the mother in this study is similar to the study of Ugwuja et al. which showed that the Mean age of the mother was 25.2±4.2 [58]. Where as in the study of M Thame et al, Godhia et al, and Athu korala et al, the mean age of pregnant women was found to be 26.4±5.3, 27.88±3.922, and 26.7±5.9 respectively [57,60,62].

This study showed that maximum number of mothers 76.6% were between 20- 30 years of age groups, which is similar to the study of M V Kanadys and S. Lumbanraja et al, where maximum number of mothers were in the age group between 20-29 years (69.5%) and 20 -35 years (80.8%) respectively [31, 63]. This study also shows that young mothers less than 20 years of was only 39 (7.8%). The marriageable age of Nepalese women is 18 years hence this study shows that age of marriage of Nepalese women is also increasing.

This study showed that out of 500 pregnant women, majority were primigravida 261 (52.2%) and rest of them were multigravida 47.8%, which is similar to the study of W M Kanadys study in which 53% were primigravida [63]. The study of Kalk P et al. and Ota E et al. showed that majority of mother were primigravida with 64.8% and 50.1% respectively [52,53]. But study of S. Lumbanraja et al, showed maximum number of mothers to be multigravida [31].

In this study the Mean Height of the mother is found to be 155.49±3.0 (SD) cm, which is similar to the study of S. Lumbanraja et al [31]. In our study, maximum number of mothers were between 150- 159 cm (76%), and with minimum numbers of mothers (8.2%) between 145-149cm. whereas the studies of Ota E et al. and Godhia M et al. showed the maternal Height to be 154.2±4.8 (Mean±SD)cm and 154.67±07.53cm respectively, which is closely similar to our study [53, 60]. But in the study of W M Kanadys and M Thame et al, mean height of the mother were found to be higher than in our study [62,63].

Table: 7

	Age (Mean±SD)	Parity %	Height (Mean±SD)
Kalk P et al (2009)	30.2±5.4	PGR-64	
Ota E et al (2011)	27.9±5.3	PGR-50. MGR-49.9	154.2±48
Godhia M et al (2012)	27.88±3.92		154.67±7.53
Athukorala et al (2010)	26.7±5.9		164.3±5.8
W M Kanadys (2007)	23.4±4.0		
M Thame et al (1997)	26.4±5.3		163±6.7
S. Lumbanraja et al(2013)		PGR-42.3 MGR-56.7	155.85±5.8
BPKIHS study (2013)	25.30±4.6	PGR-52.2 MGR-47.8	155.49±3.9

During the study of one year period, we found that the maximum number of pregnant women 450 (90%) delivered their babies between 37-42 week and mothers who delivered babies after 42 weeks were least in number, i.e. 3 (0.6%). The mothers who delivered babies in less than 37 weeks were only 47(9.4%) in numbers. The finding of our study is similar to the studies of Ota E et al, and S. Lumbanraja et al, in which maximum deliveries took place between 37-42 weeks (>90%) in each studies [31,53].

In this study, the Mean BMI of pregnant women in this study was found to be 24.22±3.5. The BMI of Mothers in this study is similar to the study M Thame et al, which showed mean BMI of mothers to be 24.2±5.0 [62]. But the study conducted in Nepal by S Upadhyay et al, showed that average BMI of Nepalese women among Sherpa/ Tamang was 23.53±2.28 which is closely similar to the mean BMI found in our study [55]. S Upadhyay et al, showed a great variation among Ethnic groups among Sherpa/Tamang and Brahmins/Chettri with a mean BMI of 23.53±2.28 and 21.16±2.32 respectively [55]. In a study conducted by S Upadhyay et al, in Nepal found that mean BMI of Sherpa /Tamang women was 24.92± 1.86, which is similar to our study observed in the pregnant women [55]. In our study too the ethnic groups of Rai, limbu, Tamang, etc. were dominant. Where as in the study of W M Kanadys et al, Mean BMI was 22.3±1.7 which is less than the Mean BMI found in this study done at BPKIHS [63].

Landmann et al, have suggested a BMI cut off point of 23.0 for obesity in Asian countries [64]. In the present study, 368 (73.6%) of pregnant women were found to have normal BMI in the 1st trimester, while the studies of Ota E et al, and Ugwuja et al, also showed that maximum of pregnant women had normal BMI of 65.4% and 40.7% respectively in their studies [53,58].

Table No: 8

BMI	Ota E et al	Kalk P et al
Underweight	17.4±0.8	17.6±o.7
Normal	20.3±1.2	21.4±1.7
Overweight	24.7±1.7	26.9±1.6
Obese		33.9±3.3

Table No: 9

BMI	Ota E et al (%)	Ugwuja et al (%)
Underweight	26.1	1.1
Normal	65.4	40.7
Overweight	8.5	35.5
Obese		17.2
Morbid obese		5.4

The present study at BPKIHS showed that out of 500 delivered neonates , maximum 367 (73.4%) were delivered by normal vaginal delivery and 132 (26.4%) were delivered by caesarean section, out of which 7.2% were delivered by elective LSCS and 19.6% delivered by Emergency LSCS. The number of neonates delivered by LSCS is similar to the Ugwuja et al, about 24.6%.Study of Kalpan –shik et al, showed that 27.5% pregnant women having BMI less than 30 and 14.3% those having BMI greater than 30 underwent LSCS [58,65]. In our studywe found women who were overweight (9%) underwent LSCS, while the study of Kalpan –shik et al, where 14.8% women who were having BMI greater than 30 underwent LSCS [65].

Our study shows that, maximum number of mothers were overweight 117(23.4%) and 3(0.6%) were obese, which is comparatively increased from 1st trimester. Kalk P et al, Ugwuja et al. and Athukorala et al, studies showed that mean weight of baby increases with increase in weight of the mothers during pregnancy and least increase of weight of Newborns were found in mothers who were underweight [52,57,58]. Similarly, it was found that Birth weight and Head circumference of the newborns was higher in the women who were normal and overweight.

In the Table No 1 shows that the correlation of maternal BMI with the Birth weight of Newborns was found to be significant. But when comparing the other anthropometry such as Length (cm) and MUAC (cm) of newborns it was found not to be significant, which shows that as BMI of mothers is higher, the Birth weight and Head

circumference also increased. This shows that higher maternal BMI has significant effect on Birth weight and Head circumference of Newborns.

In our study while looking into the correlation of the Maternal BMI with Mid Upper Arm Circumference of the Newborns, the result was found not to be significant. But the Mean±SD (12.09±1.646cm) in our study was comparable to the study of GodhiaM et al. and Kabir A et al. This reflects that the nutritional status of the pregnant Nepalese women has also been increasing according to our study [60,66].

In the present study we tried to find out the relationship of maternal BMI with the Apgar score finding of Newborns at 10 minutes. Although the result were found not to be significant but it showed that maximum number of mothers with normal BMI delivered the babies who had Apgar score >7 at 10 minutes and did not require NICU admission.

The correlation between the Maternal BMI with Gestational Age of Newborns was found not to be significant. In this study, we found that there is a strong association between Maternal BMI with the Mode of delivery (P value -0.004). Maximum number of women visiting BPKIHS, having Regular Antenatal checkups had normal delivery (73.4%), and only 26.6% underwent caesarean section, out of which 19.4% was Emergency LSCS. Our study shows that maximum number of babies were delivered by Normal vaginal delivery due to the regular ANC visits to our Institute. Again this reinforces the fact that regular ANC visit has significant effect on mode of delivery and may also reduce the complications of delivery.

As we know that underweight or under nutrition during the pregnancy leads to low birth weight, prematurity, IUGR and has poor impact on neonatal outcome. In our study, when analyzing the association between the maternal BMI with needs of Newborns for NICU care, we found the result not to be statistically significant, although 4.8% of newborns required NICU care. The study shows that maximum babies admitted were of the overweight women rather than that of underweight women. This may again be attributed to the Regular antenatal care visits, in which minimum numbers of enrolled women were underweight. Our study finding was similar to the study of Athukorala et al57 i.e. 3.1% requiring NICU care but our finding is in contrast to the study of Kalk P et al, where 22.9% neonates required NICU admission [52].

Summary

This is a Cross-sectional Descriptive hospital-based study conducted in the Department of Pediatrics and Adolescent Medicine in collaboration with the Department of Obstetrics and Gynecology at B.P Koirala Institute of Health Sciences, Dharan, Nepal, involving 500 neonates delivered at BPKIHS.

- In this study, women who were having ANC cards were enrolled and details of maternal datas were obtained from ANC card.
- The mean Age of mother was 25 years, maximum number of mother were primigravida52.2%.
- The mean duration of pregnancy was 38.82 weeks.
- The mean height of mother was 155cm.
- The maximum number of women (94.8%) had weight more than 60 kg.
- The mean BMI of mothers during pregnancy was 24.22.
- The mode of delivery- maximum newborns delivered were by normal vaginal delivery 73.4%.
- Among important maternal complications, edema was seen to be in maximum number of pregnant women 43.8%.
- Out of 500 Newborns, 53.6%were Female and 46.4% were Male.
- The mean birth weight of newborns was 3190 gm.
- The mean length of Newborns was 51cm.
- The mean Head Circumference of Newborns was 34.37 cm.
- The mean MUAC of Newborns was 12cm.
- In this study total number of preterm delivery was 10.4%.
- About 2.6% of newborns had Ponderal index < 2 and 1.4% had Ponderal index >2.
- Maximum number of Newborns delivered were AGA 93.6%
- The mean Apgar score > 8 at 10 minutes was 96.8%
- Number of Newborn admitted i.e. Need for NICU care was 4.8%.
- In this study, significant correlation was found between the Maternal BMI and Birth Weight of Newborns.
- There was significant correlation found between the Maternal BMI with Head circumference of the Newborns.
- The association between Maternal BMI with Mode of delivery was also found to be significant.

Conclusion and Recommendations

This was a Hospital-based study done in 500 pregnant women who were coming for regular ANC visits at our Institute. It showed the impact of regular ANC checkups on Neonatal outcome. We found from our study that the frequency of preterm, LBW, SGA, IUGR deliveries are reduced. Our study also showed if mothers were given good care during pregnancy, maternal BMI also has significant effect on Neonatal Anthropometry with improved birth weight, length and Head circumference. Maternal BMI has significant association on mode of delivery as well, as shown from our results. Newborns requiring NICU care also reduces if the mothers attend ANC clinic regularly and BMI is also improved during pregnancy.

This study **"STUDY OF IMPACT MATERNAL BMI ON NEONATAL OUTCOME"** showed that the regular ANC visits during the pregnancy has a good outcome. So, further multicentric research with larger sample size is required to determine in general, the impact of maternal BMI on neonatal outcome especially in developing countries where low BMI is generally seen in women of reproductive age groups.

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