Association between maternal body mass index and the birth weight of neonates

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ABSTRACT

Birth weight (BW) is an important determinant of infant's well being. Several factors such as mothers' genetic characteristics, socio-cultural, demographic, behavioral factors, prepregnancy body mass index (BMI), gestational weight gain (GWG) etc contribute to birth weight. This study assesses the anthropometric measurement of ethnic Nepalese women belonging to *Sherpa*/*Tamang* community and *Brahmin*/*Chhetri* community and the neonatal outcome in this population. A retrospective study was done in singleton pregnant women of *Sherpa*/*Tamang* and *Brahmin* /*Chhetri* community who delivered baby in Nepal Medical College and Teaching Hospital from April 2007 to March 2008 to examine the association between the maternal Body Mass Index (BMI) and the gestational weight gain among the two ethnic communities and the birth weight of newborns. Among 206 Sherpa women who met the eligibility criteria, the mean BMI of *Sherpa*/*Tamang* community was 23.53 ± 2.28 which was statistically higher than the *Brahmin*/*Chhetri* community (21.6 ±2.32). Among *Sherpa*/*Tamang* community, the mean gestational weight gain was 12.8 ±3.4 kg and the mean birth weight was 3460 ± 410 grams. Similarly among *Brahmin*/*Chhetri* community, mean gestation weight gain was 10.3±3.1 kg and the mean birth weight was 2960 ± 340 gm. Maternal BMI, gestational weight gain and birth weight of the newborn was significantly higher in *Sherpa*/*Tamang* community and the Increasing BMI and the gestational weight gain was found to have strong association with the birth weight of the newborns among this ethnic community.

Keywords: Birth weight, body mass index, gestational weight gain.

INTRODUCTION

Birth weight (BW) is an important determinant of infant's well being.[1] Several factors such as mothers' genetic characteristics, socio-cultural, demographic, behavioral factors, prepregnancy body mass index (BMI), gestational weight gain (GWG) etc contribute to birth weight.[2] In order to improve the antenatal care and counseling throughout the world, the Global Safe-motherhood was launched in 1987.Nutritional intake and the weight gain during pregnancy are the two main modifiable factors influencing maternal and neonatal outcome.[3] A low body mass index (BMI) and suboptimal weight gain during pregnancy are long recognized risk factors for delivery of infants too small for gestational age.[4]

In Nepal, with a neonatal mortality rate (NMR) of 27 (UNICEF, 2009),[5] being born small for gestational age is a major predictor of neonatal mortality and morbidity.[4] Infants too large for gestational age also experience higher perinatal and a long term health risk.[6-9]

Maternal anthropometry differs across populations.[10] 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 the United States of America, for example, 2% of pregnant women have a BMI < 18.5 and more than 50% have a BMI > 25.[11] The height and weight of women during first trimester as well as the weight before delivery have been systematically logged, thus offering a unique opportunity to study the effect of maternal BMI on neonatal birth weight. This study assesses the anthropometric measurement of Nepalese women belonging to Sherpa/Tamang community and *Brahmin*/ Chhetri community and the neonatal outcome in this population.

The objective of this study is to examine the association between the maternal BMI and gestational weight gain among the two ethnic communities and the birth weight of newborns.

Table-1: Showing maternal BMI, GWG and mean birth weight

Ethnic group	Average maternal BMI	Average gest. weight gain	Average birth weight
Sherpa/Tamang	23.53±2.28	12.8 ±3.4 kg	3460±410 grams
Brahmin/Chhetri	21.16±2.32	9.6 ±3.1 kg	2960±340 grams

Table-2: Maternal BMI in two different ethnic populations

BMI in range	Ethnic group	n	Mean ± SD	P value
Low	*Brahmin/Chhetri*	18	17.58±0.43	
<18.5	*Sherpa/Tamang/Gurung*	1	18.3	
Normal	*Brahmin/Chhetri*	128	20.55±1.14	.000
18.5 – 22.9	*Sherpa/Tamang/Gurung*	85	21.62±1.01	
High	*Brahmin/Chhetri*	42	24.54±1.46	.228
>23	*Sherpa/Tamang/Gurung*	120	24.92±1.86	
BMI	*Brahmin/Chhetri*	188	21.16±2.32	.000
	Sherpa/Tamang/Gurung	206	23.53±2.28	

SUBJECTS AND METHODS

A retrospective study was done in singleton pregnant women of *Sherpa/Tamang* community who delivered baby in Nepal Medical College and Teaching Hospital from April 2007 to March 2008. The obstetric file records age, ethnic background, weight and height during booking and the weight before delivery. Similarly it records the birth weight of a newborn. Data was collected for the analysis.

Samples with incomplete data, women who delivered a still birth, preterm deliveries and pregnancy complicated by hypertension and diabetes and twin deliveries were excluded from the study. Women whose weight and height was not taken during booking were excluded from the study.

Overall, 811 deliveries were conducted from April 2007 to March 2008. Thirty six percent of them did not have antenatal checkups in the hospital. This left a total of 520 recruits, of whom an additional 40 were excluded because other data were found to be missing. Out of 480 participants, 206 (43%) belonged to *Sherpa* Community, 188 (39%) belonged to *Brahmin/Chhetri* community and 86 (18%) belonged to other Ethnic groups (*Newar*, *Madheshi*, *Aadibasi Janajati* etc). Population from two ethnic background (*Sherpa/Tamang* and *Brahmin/Chhetri*) were included in the analysis.

The weight and height of all mothers are measured during first antenatal checkups in first trimester. The study subjects were weighed using spring balance (adult) with minimum clothing after correcting zero error. The weight was recorded to the nearest 50 gm. The height was measured keeping the women standing on level ground, without footwear, against a wall, by using measuring tape to the nearest of 0.5 cm. Similarly, unclothed newborns were weighed immediately after delivery using an electronic baby weighing scale. The maternal weight and height obtained was used to calculate maternal BMI ($kg/m^{2)}$

In western countries, BMI is classified as low if <18.5; normal if 18.5-24.9 and high if e"25. Landmann *et al* have suggested a BMI cut off point of 23.0 for obesity in Asian countries.[12] The World Health Organization (WHO) also recommends using this last criterion for Asian population[13] and this is the cut-off we used. Thus we classified women into low, normal and high BMI group as follows: low, BMI < 18.5; normal, BMI 18.5-22.99 and high, BMI e"23. Gestational weight gain is typically measured by subtracting prepregnancy weight from final pregnancy weight or weight at delivery.

Neonates were classified as small, normal or large for gestational age in accordance with the following criteria, based on gender-specific percentiles for the Asian population[14] as recommended by Clausson *et al*.[15] Small if the birth weight was below the 10th percentile; normal if it was between the 10th and 90th percentile and large if it was above the 90th percentile.[14] Low birth weight and macrosomia were defined as a weight at birth of < 2500 g and > 4000 g, respectively. Exceptionally large baby was defined as a birth weight of 4500 g or more that excluded the syndrome of diabetic mother and the infant of mother with gestational diabetes.[16]

The data was analyzed using statistical package for social sciences (SPSS - Version 16) and independent t test and chi-square test was done to find out test of significance

Table-3: Birth weights of neonates of two ethnic populations

Ethnic group	Growth status	No. of cases	Mean birth weight(kg) ± SD
Sherpa/Tamang	Low birth weight <2.5kg	2(1%)	2.35±0.07
	Normal (2.5-4)kg	183(88.8%)	3.38±0.3
	Large for date> 4kg	21(10.2)	4.28±0.16
Brahmin/Chhetri	Low birth weight <2.5kg	11(5.9%)	2.26±0.02
	Normal (2.5-4)kg	177(94.1%)	3±0.30
	Large for date> 4kg	0	0

Table-4: Mean birth weight in two different ethnic populations

Ethnic Group	n	Mean birth wieght (grams) ± SD
Brahmin/Chhettri	188	2960±0 .340
Sherpa/Tamang/Gurung	206	3460±0.410

between different variables or attributes. P value less than 0.05 was considered as significant.

RESULTS

Among 206 *Sherpa* women who met the eligibility criteria, the mean BMI was 23.53 ± 2.28 which was statistically higher than the *Brahmin/Chherti* mothers (21.6 ±2.32) (Table-1). Among the *Sherpa/Tamang* recruits, low (<18.5), Normal (18.5-22.9) and high (>23) BMI was found in 01 (0.5%), 85 (41.3%) and 120 (58.2%) cases respectively (Table-2). The normal mean BMI was 21.62 ±1.01 and the corresponding mean birth weight among the neonates was 3250±310 gms. The high mean BMI was 24.92 ±1.86 and the corresponding mean birth weight of the neonates was 3610±400 gms. Among this ethnic community the mean gestation weight gain was 12.8 ±3.4 kg and the mean birth weight was 3460 ± 410 grams (Table-1). Similarly, low birth weight was seen in only two (1%) cases, normal weight babies in 183 (88.8%) and large for date (LFD) in 21 cases (10.2%) (Table-3). The mean birth weight among this population was 2350 ±70 gm, 3380 ±300 and 4280 ±160gm respectively. Thirty eight (18.4%) was delivered by caesarean section.

The mean BMI of *Brahmin/Chhetri* mothers was 21.16 ±2.32. (Table-1) Among them, low (<18.5), normal (18.5-22.9), and high (>23) BMI was found in 18(9.6%), 128 (68.1%) and 42 (22.3%) cases respectively (Table-2). The mean low BMI was 17.58 ±0.43 with the corresponding mean birth weight of neonates 2890±240 gm and the mean high BMI was 24.54 ±1.46 with corresponding mean birth weight of neonates 3000±330 gm. Among this ethnic community, mean gestation weight gain was 10.3±3.1 kg and the mean birth weight was 2960 ± 340 gm (Table 1). Similarly, low birth weight was seen in 11 (5.9%) and normal weight baby was seen in 177 cases (94.1%) (Table-3). The mean birth weight among this population was 2260 ±200 gm and 3000 ± 300 gm respectively. Nineteen neonates (10.1%) was delivered by caesarean section.

Table-5: Descriptive statistics of BMI and the birth weight of the neonates in two ethnic groups

Ethnic Group	BMI	Mean ± SD	Birth weight (kg) ± SD
Sherpa/Tamang	Low		
	Normal	21.62± .01	3.25± .031
	High	24.92± 1.86	3.61 ±.040
Brahmin/Chhetri	Low	17.58± 0.43	2.89±0.24
	Normal	20.55±1.14	2.96±0.35
	High	24.54±1.46	3.06±0.33

DISCUSSION

To the best of our knowledge this is the first study to quantify the BMI in pregnant women of different Nepalese ethnic background (*Sherpa/Tamang* vs *Brahmin/Chhetri*) and to see the relationship between their gestational weight gain and the neonatal outcome. The mean BMI was 23.53 ± 2.28 in *Sherpa/Tamang* population which was higher than the mean BMI among *Brahmin/Chhetri* group (21.16 ± 2.32). Although, Landmann *et al* have suggested a BMI cut off point of 23.0 for obesity in Asian countries,[12] it was observed that majority 120 (58.2%) of *Sherpa/Tamang* women had a mean BMI of 24.92±1.86. Among these 2 ethnic populations, the mean gestational weight gain was found to be greater among the *Sherpa/Tamang* community (12.8 ±3.4 kg) than the *Brahmin/Chhetri* community (10.3 ±3.1kg). The mean gestational weight gain among *Sherpa/Tamang* community was comparable to the study done by Ota *et al*[17] in Vietnam. The observed mean birth weight of the neonates in our study for *Sherpa/Tamang* and *Brahmin/Chhetri* group was 3460 ± 410gm and 2960 ± 340 gm respectively. The weight of neonates of *Brahmin/Chhetri* mothers was comparable to the study conducted by Rao *et al*[18] in India. Nevertheless the neonatal weight was significantly higher in *Sherpa/Tamang* groups which was comparable to the study conducted by Thorsdottir *et al*[19] in Iceland where the mean birth weight was 3778 ± 496 gm. This dissimilarity could have been due to different ethnic and cultural background. Among *Sherpa* mothers, Large for dates were seen in 21 cases (10.2%) which probably would have resulted in the higher rates of Caesarean delivery in this community 38 (18.4%) than the *Brahmin/Chhetri* community 19(10.1%). Birth weight was more in

Table-6: Association between BMI and birth weight

BMI range in birth weight (n)				
	Birth weight (kg)			Total
BMI range in pregnant women	Less than 2.5 kg	2.5-4.0kg	Above 4 kg	(n.)
low	0	19	0	19
normal	12	201	0	213
high	1	140	21	162
Total	13	360	21	394

Sherpa/*Tamang* than the *Brahmin*/*Chhetri* group. Chi-square test was done to see the association between BMI and the birth weight (Table-6). With the increasing maternal BMI there was increase in the birth weight of a neonate (Table-5). Since the maternal anthropometry is an important determinant of birth weight, further studies in a larger population with different ethnic background is necessary to establish stronger relationship between the gestational weight gain and birth weight.

Maternal BMI, gestational weight gain and birth weight of the newborn was significantly higher in Sherpa/ Tamang community and the increasing BMI and the gestational weight gain was found to have strong association with the birth weight of the newborns among these ethnic community.

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