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Effect of pre-delivery body mass index and gestational weight gain oninfant weight

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Abstract

It is well known that over-weight particularly for pregnant women is an alarming constraint for both mother and child.So, in the present study investigated the impacts of different pre-delivery body mass indexes (BMI) and gestational weight gain (GWG) on the risk of delivering a high birth weight infant in Pakistan. A retrospective cohort study was conducted from 2017 to 2018 in the Civil Hospital of Multan City, Punjab Province and 3433 women who had a singleton birth were included in the study. A logistic regression model and quantile regression model were used to analyze the association. The risk of delivering high birth weight infant increases when the mother's pre-delivery body mass index exceeds 24 kg/m². Compared with women whose pre-delivery body mass index was 21 kg/m², the risk of delivering a high birth weight infant doubled when the mother's pre-delivery body mass index was 29 kg/m², and nearly tripled when the mother's pre-delivery body mass index was 31 kg/m². When the mother experiences a gestational weight gain greater than 27 kg, the risk of delivering a high birth weight infant is greater than that for a mother who has a gestational weight gain of 12.0 kg. Proposed strategies to raise public awareness of the risks to infants posed by high maternal pre-delivery body mass index and gestational weight gain are required. Generally, all clinical recommendations and measures are for all pregnant women, not just overweight and obese pregnant women, which needs to be considered also.

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Introduction

The high commonness of an undesirable body mass index (BMI, kg/m²) and irregular gestational weight gain (GWG, kg) among pregnant ladies is a genuine general wellbeing problem (Kanguru *et al.,* 2017; Shao *et al.,* 2017; Soltani *et al.,* 2017). Pre-pregnancy BMI and GWG have been perceived as free hazard factors for a few newborn child outcomes (Dzakpasu *et al.,* 2015; El Rafei *et al.*, 2016; Metsala *et al.,* 2016). Unhealthy BMI before pregnancy and unseemly GWG are accounted for to expand the danger of unfriendly baby results (e.g., preterm delivery, low/high birth weight, feotal acidosis, and pre-birth mortality) (Manzanares *et al.,* 2012; Li *et al.,* 2013) and ensuing sickness chance for the offspring (Yu *et al.,* 2013).High birth weight babies have a body weight more noteworthy than 4000 g inside 1 hour after birth. High birth weight has not exclusively been connected to incessant infections that happen later in a tyke's life yet additionally influences the soundness of mothers (Alexander *et al.*, 2015). High birth weight newborn children are inclined to hypertension and higher circulatory strain amid childhood (Zhang *et al.,* 2013). A noteworthy pattern was seen in Asian ladies that related expanding baby weight with expanding self-revealed type2 diabetes pervasiveness amid pregnancy (Ryckman *et al.,* 2014) likewise, there is a positive relationship between's high birth weight babies and cancer (Chen *et al.,* 2015). Both maternal pre-pregnancy BMI and GWG have been accounted for to affect the high birth weight newborn child rate (Abubakari *et al.,* 2015). Women who are overweight (25.0 kg/m² ≤ BMI ≤ 29.9 kg/m²) or large (BMI ≥ 30.0 kg/m²) preceding pregnancy face expanded dangers of delivering a baby with high birth weight, macrosomia, or resulting issues with being overweight or obese (Yu *et al.,* 2013). Pre-pregnancy corpulence has been related with expanded posterity issue practices, including disguising practices, externalizing practices, and consideration problems (Pugh *et al.,* 2016). Women with exorbitant GWG increment their baby's danger of macrosomia (Chen *et al.,* 2010) and each extra 1 kg of weight gain extraordinarily builds the gestational age danger of infant (Oza-Frank and Keim, 2013). Maternal stoutness and unreasonable GWG have been related with dangers to a kid's cognizance, contrasted and ordinary weight mothers (Pugh *et al.*, 2015). With the commonness of overweight and fat childbearing-age ladies and multi-supplement supplements amid pregnancy, the dangers of antagonistic maternal and baby results are expanded.

These antagonistic pregnancy results not just influence the physical and psychological wellness of the mother and newborn child, however can likewise convey tremendous monetary weights to the family and society. Along these lines, finding the related hazard factors that may increment unfavorable pregnancy results and taking dynamic measures and strategies to control these components have turned out to be pressing general wellbeing needs. Be that as it may, the nature of the relationship between various dimensions of pre-pregnancy BMI and GWG on high birth weight newborn children has less accessible data. From one perspective, a large portion of the past investigations have utilized pre-pregnancy BMI and GWG as moderately wide arrangement factors, which suggest a consistent hazard inside classes and an expansive bounce in hazard between classifications, which may cover some organic affiliations, particularly for the reference gathering.

Then again, most of past investigations have diverse meanings of high birth weight baby weight, where some are characterized as a birth weight over the 90th percentile as indicated by birth weight graphs, and others are characterized as a birth weight ≥ 4500 g, which we characterized as birth weight ≥ 4000 g as per the World Health Organization (WHO). Furthermore, maternity specialists can exhort ladies about the advantages to herself and her newborn child of keeping up body record.

This thus limits confusions for ladies and newborn children and enhances the odds of an ordinary, sound birth.So, the aim of the present investigation was to explore the relationship among pre-pregnancy BMI and GWG on the event of high birth weight babies in Pakistan.

Materials and methods

Study design

A cross sectional data consisting of 3433pregnant women were taken from Civil Hospital, Multan, Province, Punjab as a case study of Pakistan.

Participants

Our participant's wereall pregnant women of age 17 years and more.

Variables

The data consisted of different variables and they were pregnant women name, age, and history of the disease, education, height, pre-delivery weight, pregnancy complications, and gestational weeks, mode of delivery, gestational age, infant size, infant gender and weight. And the infant weight and size were measured within an hour of birth in hospital.

Data collection

The data consisted of different variables such as; pregnant women name, age, history of the disease, education, height, pre-delivery weight, pregnancy complications, gestational weeks, mode of delivery, gestational age, infant size, infant gender and weight. And the infant weight and size were measured within an hour of birth in hospital using standardized techniques and equipment's from Pakistan.

Patient and public involvement

While collecting data from our participants we facet many hurdles and then solved them for effective data collection. We collect data through a self-administered way from the patients.

Bias

While editing and formatting of data, we exclude some unusual and irrelevant observations to remove the effect of bias.

Study population

A total of 3433women who gave birth to singletons from June 2017 until August 2018 were considered for this retrospective cohort study. All data were collected from the Civil Hospital of Multan City, Punjab Province, Pakistan.

Inclusion criteria and grouping

To be incorporated into this investigation, a pregnant lady must be healthy, with no applicable pregnancy complexities or family ancestry of hereditary malady. We restricted our investigation to pregnant ladies with singleton pregnancies and barred ladies with different pregnancies. Ladies for whom information on pre-delivery BMI or GWG were missing were barred. Eventually, a sample of 3433 ladies was incorporated into this examination. Pre-delivery BMI (kg/m^2) was determined by partitioning the mother's pre-delivery weight by the square of her height which dependent on maternal self-report amid her first examination. The majority of the ladies were arranged by the WHO, BMI criteria order as pursues: for those with a pre-delivery BMI under 18.5 kg/m^2 (underweight); for those with a pre-delivery BMI somewhere in the range of 18.5 and 24.9 kg/m^2 (typical weight); for those with a pre-delivery BMI somewhere in the range of 25 and 29.9 kg/m^2 (overweight); and for the individuals who had a pre-delivery BMI of 30 kg/m2 or increasingly (hefty). BMIs were gathered into 16 classes (≤ 17 kg/m2, 18–31 kg/m^2 in which every BMI point as a solitary classification, and ≥ 32 kg/m^2), every class speaks to a scope of BMI, for example, pre-delivery BMI 18 kg/m^2, which speaks to BMI from 18.0 to 18.9 kg/m^2. Also, in light of quantile regressiongrowth diagrams, a pre-delivery BMI estimation of 21 kg/m^2 was set as the reference classification. Pre-delivery BMI was coded utilizing a confined quantile (RQ) work with five bunches situated at the fifth, 25th, Median, 75th and 95th percentiles of the dispersion of pre-delivery BMI. Gestational weight gain (GWG) was characterized as the distinction between the mother's pre-delivery weight and her weight at the last examination before delivery date. As indicated by the proper weight gain run suggested by the WHO, the pregnant ladies were separated into 2 gatherings: for ladies with deficient weight gain (underneath) and for ladies with over the top weight increase (above). The WHO made the accompanying suggestions for GWG: 12.5–18.0 kg for under-weight ladies, 11.5–16.0 kg for

ladies with ordinary BMI, 7.0–11.5 kg in the overweight ladies, and 5.0–9.0 kg for fat ladies. Also, GWG was assembled into 12 classifications (≤ 6 kg, 7–26 kg in which each two GWG focuses is a solitary class and ≥ 27 kg), a GWG estimation of 11–12 kg was set as the reference, and the normal number of each gathering was utilized as a gathering esteem. Also, GWG was coded utilizing a limited quantile (RQ) work with three bunches situated at the fifth, 25th, Median, 75th and 95th percentiles of the circulation of GWG.

Statistical analysis

The data were entered and analyzed using the SPSS software package (Statistics 19.0, SPSS) and EVIEWS software package (version 7.0). The continuous variables were expressed as the mean± standard deviation to describe women's age, pre-delivery BMI, gestational weeks, weight gain, infant weight, infant size and other variables. We performed analysis of variance for differences between the continuous variables. The chi-square test was used to compare maternal pregnancy outcomes in each category. Multiple logistic regressions were performed to compare the associations of pre-delivery BMI and GWG with high birth weight infants. Risk estimation (OR) statistics and the 95% confidence intervals (CI) were calculated for potential confounding variables. Quantile Regression model was used to estimate the dose-dependent relationship of pre-delivery BMI, GWG, and the occurrence of high birth weight infants. Statistical significance was established when the P-value was less than 0.05.

Results

General information

The general characteristics of the women and infants are presented in Table 1. According to maternal pre-delivery BMI classification, 3433 eligible women were included in this study. The pre-delivery BMIs were as follows: 247 (7.2%) women were underweight, 2403 (70.0%) were of normal weight, 694 (20.2%) were overweight, and 89 (2.6%) were obese. The average age of the pregnant women in this study was 26 years old. The underweight women were younger ($P < 0.001$) and taller ($P < 0.05$), which was significantly different from all of the other groups. Overweight and obese women were heavier ($P < 0.001$) than the women in the other groups, while education did not differ among the groups ($P < 0.05$).

Table 1. Characteristics of Women and Infants.

Characteristics	Underweight	Normal Weight	Overweight	Obesity	Overall	P-value
	n=247, 7.2%	*n*=2403, 70.0%	*n*=694, 20.2%	*n*=89, 2.6%	*n*=3433, 100%	
Age (years)	26.98±4.11	26.17±4.21	26.38±4.68	25.67±4.82	26.18±4.51	<0.05
Height (ft)	5.61±0.21	5.34±0.17	5.11±0.12	4.85±0.07	5.18±0.21	<0.05
Weight (kg)	49.13±2.02	60.63±2.82	62.97±2.77	70.83±2.35	62.01±2.98	<0.05
Education						<0.05
Matriculation	9(3.4%)	147(6.1%)	61(8.8%)	9(9.8%)	223(6.5%)	
Intermediate	131(53.2%)	1242(51.7%)	362(52.2%)	51(57.4%)	1789(52.1%)	
Graduation	107(43.4%)	1014(42.2%)	271(39.0%)	29(32.8%)	1421(41.4%)	
Pre-Delivery BMI	19.9±1.11	23.37±1.03	26.32±1.17	30.51±1.34	25.50±2.39	<0.05
Infant Weight (g)	3018±506	3024±521	3052±507	3132±541	3048±521	<0.05
Infant Gender						<0.05
Male	144(58.3%)	1293(53.8%)	400(57.7%)	47(52.5%)	1888(55%)	
Female	103(41.7%)	1110(46.2%)	294(42.3%)	42(47.5%)	1545(45%)	
Nutrition						<0.05
Yes	73(29.5%)	1048(43.6%)	414(59.7%)	59(65.7%)	1926(56.1%)	
No	174(70.5%)	1355(56.4%)	280(40.3%)	30(34.3%)	1507(43.9%)	

The mean pre-delivery BMI was 25.5 kg/m² (range, 16.9-36.5 kg/m²). The mean maternal GWGs were as follows: 14.6 kg for underweight women, 12.3 kg for normal weight women, 11.6 kg for overweight women and 10.1 kg for obese women. The mean GWG was lower among overweight and obese women (P < 0.001). The mean GWG was statistically different among the groups, most likely because of the different pre-delivery BMIs in each group, that is, in order to have a healthy infant, underweight women gain more weight than those who are overweight and obese during pregnancy. As pre-delivery BMI increased, the amount of GWG decreased (P < 0.001; P < 0.001). The mean infant weight was 3048 g (range, 1500–4200 g). In the overweight and obese group, infant weight was heavier (P < 0.001) than those in the other groups. The gestational weeks of infant were no difference in each group (P<0.05).

There was a difference in the number of gestational age distribution of the infants in each group (P<0.001). Further, 55% of the infants were male, and there was difference in the gender distribution of the infants born to mothers in each group (P < 0.001).

Table 2. Association between pre-delivery BMI and pregnancy outcome.

Pre-delivery BMI	High birth weight infant		
	n(%)	Median (95% CI)	Mean (95% CI)
Underweight	12(3.4%)	23.68 (23.43-23.82)	23.37 (23.24-23.50)
Normal Weight	124(6.6%)	26.17 (25.83-26.24)	26.32 (28.18-28.45)
Overweight and obesity	105(18.3)	30.53 (29.80-30.64)	30.51 (30.14-30.87)

The connection between pre-delivery BMI and high birth weight babies

Utilizing the WHO recommendations of pre-delivery BMI, the rate of high birth weight newborn children in various pre-delivery BMI categories is appeared in Table 2. The danger of delivering a high birth weight newborn child was expanded for overweight and stout ladies contrasted and the ladies who had typical pre-delivery BMI of the babies delivered by overweight and fat ladies, 14.5% were high birth weight newborn children. This was altogether higher than the level of high birth weight newborn children delivered by underweight ladies and ordinary weight ladies (P < 0.001).

Table 3. Association between gestational weight gain and pregnancy outcome.

Gestation gain weight	High birth weight infant		
	n(%)	Median (95% CI)	Mean (95% CI)
Underweight	12(3.4%)	5.10 (5.00-6.00)	5.51 (5.32-5.71)
Normal weight	124(6.6%)	5.30 (5.00-6.00)	5.69 (5.50-5.88)
Overweight and obesity	105(18.3)	5.15 (5.00-6.00)s	5.52 (5.05-5.98)

The underweight ladies had no huge association with high birth weight newborn children; in any case, for potential puzzling elements, there was a negative connection between underweight ladies and high birth weight babies, when contrasted and the ordinary pre-delivery BMI ladies.

The connection between various dimensions of pre-delivery BMI and period of mother amid pregnancy is appeared in Fig. 1. In the wake of modifying for maternal age and GWG, the danger of delivering a high birth weight baby increments with expanding pre-delivery BMI. The danger of delivering a high birth weight baby extraordinarily increments when the pre-delivery BMI is more noteworthy than 24 kg/m². Contrasted and ladies with a pre-pregnancy BMI of 21 kg/m², the danger of delivering a high birth weight newborn child multiplied when the mother's pre-delivery BMI was 29 kg/m², and it about tripled when the pre-delivery BMI was 31 kg/m².

The connection among GWG and high birth weight newborn children

Utilizing WHO GWG proposals, 22.4% of pregnant ladies put on less weight than prescribed, and 39.8% of ladies put on more weight than suggested. The occurrence of high birth weight babies related with every result in various weight gain bunches are appeared Table 3.

Contrasted and the ladies whose GWG was inside the WHO suggested range, the danger of high birth weight newborn child was expanded in ladies whose GWG was over the proposals.

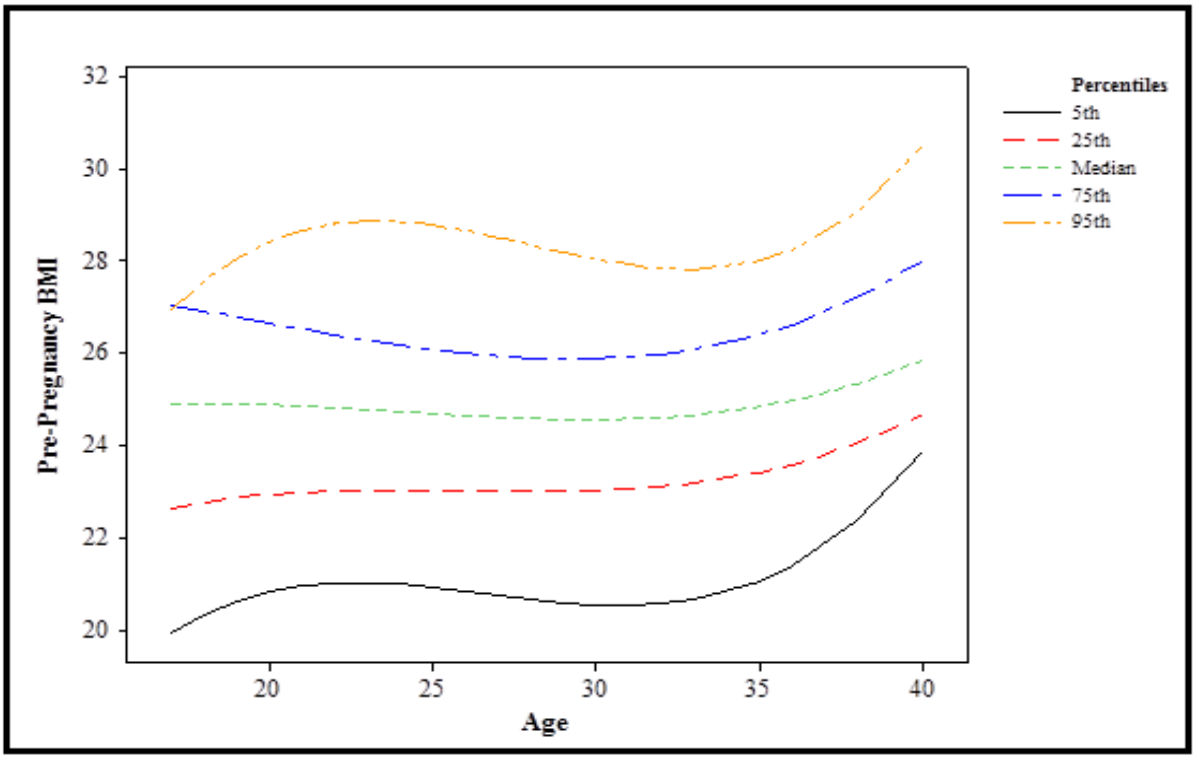

Fig. 1. Growth chart of pre-delivery BMI percentiles.

The rate of delivering a high birth weight newborn child in these ladies was 14.5%. In any case, for ladies whose GWG was underneath the suggested sum, the relationship was not noteworthy.

The danger of delivering a high birth weight baby likewise expanded with expanding GWG, and the expansion remained genuinely consistent through the upper boundaries of GWG, even in the wake of changing for maternal age and pre-delivery BMI.

Contrasted and ladies who had GWG of 12.0 kg, ladies with GWGs of 20.0 kg, 22.0 kg, 26.4 kg had expanded dangers of delivering high birth weight newborn children. At the point when GWG surpasses 27 kg, the danger of delivering a high birth weight newborn child is more noteworthy.

Discussion

Body mass index (BMI) and Gestational Weight Gain (GWG)

In this investigation, predictable with past examinations, we found that the danger of delivering a high birth weight newborn child was expanded in overweight and fat ladies, contrasted and ladies who had a typical pre-delivery BMI, and the danger of delivering a high birth weight baby was expanded in ladies whose GWGs surpassed suggested sums when contrasted and ladies whose GWGs were inside the WHO prescribed range. Further, our discoveries of the portion subordinate relationship of various pre-delivery BMIs and GWGs on the danger of delivering high birth weight newborn children began to increment in ladies with ordinary pre-delivery BMIs and typical GWGs, which were not found in past

investigations. Pre-delivery BMI is an autonomous hazard factor for delivering a high birth weight newborn child, and numerous epidemiological investigations have affirmed this (Athukorala *et al.,* 2010; Crane *et al.,* 2013; Bird *et al.,* 2016).

Survey analyses

A precise survey of 45 examines demonstrated that moms who are overweight or stout preceding pregnancy have an expanded danger of delivering a high birth weight infant (Yu *et al.,* 2013). This finding is predictable with our examination, which shows that the danger of delivering a high birth weight baby has expanded inside pre-delivery BMI classes. Despite the fact that we watched a multiplying and tripling of the danger of delivering a high birth weight baby when a mother's pre-delivery BMI showed that she was overweight or hefty, contrasted and moms whose pre-delivery BMI was 21 kg/m², there were contrasts in dangers at what are commonly seen as ordinary pre-delivery BMI esteems. Ladies with a pre-pregnancy BMI of 24 kg/m², generally delegated ordinary weight, were additionally prone to bring forth a high birth weight newborn child. Along these lines, in addition to the fact that we need to focus on ladies who were overweight or large preceding pregnancy, however we ought to reinforce the board of typical weight ladies, who are bound to be disregarded. The rate of GWG amid pregnancy is altogether connected with baby weight (Hanieh *et al*., 2014).

Controlled measures

Women with intemperate GWGs had an improved probability of delivering a high birth weight newborn child contrasted and ladies with ordinary GWG(Li *et al.,* 2015; El Rafei *et al*., 2016). Yang andYang(2012) revealed that the 2009 IOW GWG suggestions which utilized the WHO criteria may be fitting for Chinese people. Further, if GWGs were inside rules, ladies could lessen their hazard for a few unfriendly results, for example, cesarean birth, macrosomia, LGA, preterm birth, LBW and SGA (Park *et al.,* 2011; Asvanarunat, 2014). This is conflicting with our examination. We demonstrated that increments in GWG are related with an expanded danger of delivering a high birth weight newborn child, paying little respect to the mother's pre-delivery weight. At the end of the day, the more GWG amid pregnancy, the almost certain it is that a mother will bring forth a high birth weight newborn child. This warrants further examination supposing that it holds the planned importance extreme GWG could be quickened fetal development. Notwithstanding, maternal muscle to fat ratio statement, extracellular liquid maintenance and other physiological changes amid pregnancy add to GWG, alongside the baby, placenta, and amniotic liquid. The job of GWG on newborn child result should cause extraordinary concern.

Conclusion

Mother pre-delivery BMIs and GWGs were found to be the most important determinants of high birth weight infants. First, our study found that although the risk of high birth weight infants is highest in women with the highest pre-delivery BMIs, a substantial number of women who gave birth to high birth weight infants, had normal BMIs. Second, the risk of giving birth to a high birth weight infant increased as GWG increased, regardless of pre-delivery weight. Our results indicate that we must propose strategies to raise public awareness of the risks posed by high maternal pre-pregnancy BMI and GWG on infants' well-being.

These clinical recommendations and measures are for all pregnant women, not just for overweight and obese pregnant women. In addition, for women who become pregnant, midwives should advise them not only to maintain a normal BMI range before pregnancy and limit their GWG according to the classification of their pre-delivery BMI, but also to change their lifestyle to minimize the risk of complications.

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