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Research Article

# DOUBLE BURDEN OFMALNUTRITION IN SINGLETON PREGNANCIES AT A TERTIARY CARE TEACHING INSTITUTION IN NORTH KERALA, INDIA OUR EXPERIENCE

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**ABSTRACT**

**Objectives:** This research was aimed at analyzing the dual burden of maternal pre-pregnancy body mass index (BMI) and their effects on the pregnancy outcomes in a tertiary care center in North Kerala.

**Methods:** Based on maternal BMI calculated from the pregnant women's height and pre-pregnancy weight, 299 pregnant women with singleton pregnancies were divided into four groups and morbidities compared.

**Results:** Underweight women had two fold more chances of delivering an LBW infant. Maternal age in overweight or obese was slightly more and had longer operative time compared to those with normal weight. Maternal height and mean gestational age were comparable across the groups. Slightly heavier babies were born to mothers with increasing BMI. Mean hospital stay was 4.34–4.85 days in all the groups irrespective of body weight.

**Conclusion:** The results re-iterated the existence of a double burden of malnutrition in rural mothers in Kozhikode district of North Kerala which can help policy makers the need to adopt appropriate pre-natal planning and counselling tailored to improve women's nutritional status and thereby prevent possible adverse health outcomes in their reproductive career by achieving BMI to be between 18.5 and 22.9.

**Keywords:** Pregnancy, Underweight, Obese, Overweight, Body mass index, Neonatal, Maternal, Gestational, Outcomes.

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## INTRODUCTION

One of the most influential factors affecting the health of mother and the new-born is her Nutrition [1,2]. In population-based studies, nutrition status is commonly assessed by body mass index (BMI) that is calculated by weight in kilograms divided by the square of the height in meters (kg/m$^2$). Pre-pregnancy BMI was categorized as underweight (BMI <18.5 kg/m$^2$), normal (18.5 kg/m$^2$ - BMI-22.9 kg/m$^2$), overweight (22.9–24.9 kg/m$^2$), or obese (BMI >25 kg/m$^2$) using the Asian Indian specific guidelines BMI Classification [3,4].

India is a low middle income country and is unique as it suffers from a dual burden of malnutritionas higher number of underweight women reside in Chhattisgarh, Bihar, and Jharkhand and Punjab, Delhi, Kerala and Sikkim being home to the other end of the spectrum, that is, obesity [5]. More than 20% of females aged 20 years and older in India and more than one-third of females in Pakistan were overweight or obese [6]. Undernutrition is more prevalent in rural areas, whereas obesity is 3 times higher in urban area. Globally, half of the underweight women live in South Asia, particularly in Bangladesh, India, and Pakistan [7,8]. At the other end of spectrum, many low-income countries are now in a phase of nutrition and epidemiologic transitions that have led to an increase in overweight/obesity in women of reproductive age at a population level with high risk of pregnancy-induced hypertension, and cesarean delivery, depression and anxiety during pregnancy [9,10]. Neonatal complications includes large for gestational age babies and low Apgar scores at birth and extended NICU stay. Long-term risks include childhood obesity, type 2 diabetes mellitus and metabolic syndrome [11-13].

### Objectives

The objectives of the study are as follows:
1. To estimate the prevalence of double burden of BMI in a cohort of 299 mothers
2. To determine the adverse maternal and perinatal outcomes in mothers associated with both extremes of malnutrition.

## METHODS

Informed consent of the pregnant women was taken. Study approval was obtained from Institutional Ethical Committee and Institutional Research Committee, for formal review and approval of the study conduct. A pre-designed case record form was used for data collection. Information on maternal demographic data, socioeconomic status, education was taken. Maternal age was defined as the completed age in years at conception. Obstetric score and details regarding exact gestational age, medical comorbidities, maternal anxiety were noted. Labor-related variables like induction of labor, outcomes, and gestational age at delivery were highlighted. Birth weight of new-born, NICU admission, and the length of hospital stay were recorded to assess neonatal morbidity. Maternal height and weight were measured by standard protocol and calibrated instruments. BMI was calculated as weight (kg) divided by height (m$^2$). BMI at first booking (early pregnancy) was classified according to the WHO Asia Pacific BMI cut points [14].

| WHO Asia Pacific | BMI - <18.5 | BMI 18.5–22.9 | BMI 23–24.9 | BMI>25 |
|---|---|---|---|---|
| BMI (16) | Underweight | Normal | Overweight | Obese |

Random selection of 299 antenatal patients with singleton pregnancies within the first 12 weeks of gestation attending Outpatient department of KMCT Medical College, Kozhikode and were willing to be a part of this research constituted the study sample during September 2021–March 2022.

**Inclusion criteria**

The following criteria were included in the study:
1. Singleton pregnancy
2. Documented pre-pregnancy weight and first trimester height.

**Exclusion criteria**

The following criteria were excluded from the study:

Included pre-term delivery before 24 completed weeks of gestation, multifetal gestation, previous cesarean pregnancy.

Based on maternal BMI calculated from the pregnant women's reported height and pre-pregnancy weight, all pregnant women were divided into four groups:
1. Underweight pregnant women with a BMI <18.5 kg/m$^2$ at the time of conception formed group A (n=44),
2. Women with a normal weight at conception (BMI between 18.5 and 22.9 kg/m$^2$) formed group B (n=121)
3. Overweight, [BMI 22.9–24.9] (n=34) formed group C,
4. Obese [BMI ≥25] which is group D of (n= 100 mothers).

New-born weight (in grams) was measured conventionally immediately after delivery using an automatic device. Neonatal SGA and LGA identification (90$^{th}$ percentile) were identified. All statistical analyses were performed with Prism 5.0 for Windows (GraphPad Software, 2007, San Diego, CA, USA). Analysis included the Mann–Whitney test for continuous data, Chi-square test and Fisher's exact test for categorical data. The results were considered statistically significant when two-sided analysis yielded p≤0.05.

**Ethical considerations**

The ethical approval for the research was provided by the following institutions, KMCT Medical College and conducted according to the principles of Helsinki Declaration.

**RESULTS**

1. Underweight/BMI <18.5 kg/m$^2$ at the time of conception formed group A (n=44), women with a normal weight at conception (BMI between 18.5 and 22.9 kg/m$^2$) formed group B (n=121), Overweight [BMI 22.9–24.9 kg/m$^2$] (n=34) formed group C, Obese [BMI ≥25kg/m$^2$] which is group D of (n=100 mothers.) (Table 1).

71 had BMI of 25–29.9, which one fifth of obese had BMI 0f 30–34.9.There were 8% with morbid obesity with BMI>35 (Table 2).

Mothers who were overweight or obese before pregnancy were older, and had longer operative time compared with mothers with pre-pregnancy normal weight. Maternal height was comparable with mean gestational age being similar across groups. Slightly heavier babies were born to mothers with increasing BMI. Hospital stay was 4.34–4.85 days, not affected by increasing body weight (Table 3).

Age and occupation was similar across all these categories (Table 4).

Anemia was comparable across all the groups. Hypertension of pregnancy was only 9.1% in underweight, while almost doubled in obese mothers. Similarly, twice the babies needed surveillance for fetal growth restriction in underweight category there were 28 obese mothers with GDM, while only six underweight mothers needed insulin for glycemic control compared to overweight and obese. SSI was more frequent in obese and overweight mothers than lean ones. Antepartum anxiety was higher in obese mothers followed by underweight mothers (Table 5).

There were relatively more number of 1$^{st}$ time mothers who were underweight compared to normal BMI mothers. Multigravida predominated overweight and obese group BMI Mothers. Gestational age was similar across all the groups. New-born of undernourished mothers were Low birth weight (25%) compared to babies born to obese mothers. There was no difference in the number of NICU admission and extended hospital stay (Table 6).

**Table 1: Distribution of body mass index in the study population by WHO Asia Pacific BMI cut points**

| Asian criteria | BMI-<18.5 | BMI 18.5–22.9 | BMI 23–24.9 | BMI>25 |
|---|---|---|---|---|
| Number | 44 (14.7%) | 121 (40.5%) | 34 (11.4%) | 100 (33.4%) |

**Table 2: Distribution of 100 obese antenatal mothers according to body mass index and severity**

| Obese ranges | n=100 |
|---|---|
| BMI-25–29.9 | 71 (71.0) |
| BMI-30–34.9 | 21 (21.0) |
| BMI>35 | 8 (8.0) |

Slightly heavier babies were born to mothers with increasing BMI (Table 7).

**DISCUSSION**

**Age and maternal medical morbidity**

Mothers who were overweight or obese before pregnancy were older as the obesity prevalence increases with age as seen in Menon and Sivaprasad [15] Obese pregnant women have been shown to have high likelihood, two to eleven-fold, of developing gestational diabetes mellitus (GDM) [14,16] as in our observation that there were 28 obese mothers with GDM, while only 6 underweight mothers needed insulin for glycaemic control. About 17% of obese women show GDM in pregnancy compared to 1–3% women in normal BMI [17].

Hypertensive disorders of pregnancy are significantly higher among obese women. O'Brien *et a*l. [18] demonstrated that the risk of pre-eclampsia is typically doubled with every 5–7 kg/m$^2$ increase in pre-pregnancy BMI [19]. Frederick *et al*. found that every 1 kg/m$^2$ increase in pre-pregnancy BMI resulted in an 8% increased risk of preeclampsia [19].

FGR: Twice the babies needed surveillance for fetal growth restriction in underweight category while the same was seen in obese mothers in study by Dasgupta *et al*. [20,21].

**Gestational age at birth**

Hendler had predicted fewer total and spontaneous preterm births with maternal pre-pregnancy BMI ≥30 Kg/m$^2$ [22]. It was marginally earlier in the study group compared to the controls 37.11±2.34 versus 37.87±2.28 in Menon and Sivaprasad and Leddy *et al*.[23] with more preterm deliveries while in the present study, gestational age was 38.4–38.6 across increasing BMI groups with 6.8% underweight preterm deliveries born preterm and only 4% in obese.

**Operative time**

With escalating trend in BMI, authors noted longer operative time compared with mothers with pre-pregnancy normal weight. Underweight caesarean had a mean operating time of 57 min while it needed another 15 min to complete the caesarean delivery due to technical reasons similar to Jain *et al*. [24].

**Maternal height**

Was comparable with mean gestational age being similar across groups.

**Birth weight of new-born**

Pre-pregnancy BMI was positively associated with infant birth weight. Slightly heavier babies were born to mothers with increasing BMI.

Table 3: Mean of significant variables

| Variable | BMI<18.5 | BMI 18.5–22.9 | BMI 23–24.9 | BMI>25 |
|---|---|---|---|---|
| Maternal age in years | 24.20 | 25.42 | 26.53 | 26.74 |
| Maternal weight in kg | 46.61 | 58.09 | 66.31 | 77.63 |
| Gestational age in weeks | 38.41 | 38.64 | 38.43 | 38.43 |
| Maternal height in cm | 154.15 | 156.41 | 156.64 | 153.54 |
| Operating time in minutes | 57.78 | 66.65 | 71.50 | 72.38 |
| Birth weight-baby in gm | 2726.93 | 2917.20 | 2937.71 | 3049.01 |
| Hospital stay in days | 4.34 | 4.60 | 4.85 | 4.82 |
| Weight gain in kg | 8.41 | 8.50 | 7.64 | 9.13 |

Table 4: Demographic variables age and occupation

| Variable | BMI<18.5 | BMI 18.5–22.9 | BMI-23–24.9 | BMI>25 |
|---|---|---|---|---|
| | n=44 (%) | n=121 (%) | n=34 (%) | n=100 (%) |
| Maternal age | | | | |
| >35 years | 1 (2.3) | 6 (5.0) | 3 (8.8) | 6 (6.0) |
| <35 years | 43 (97.7) | 115 (95.0) | 31 (91.2) | 94 (94.0) |
| Occupation -mother | | | | |
| Yes | 25 (56.8) | 76 (62.8) | 17 (50.0) | 58 (58.0) |
| No | 19 (43.2) | 45 (37.2) | 17 (50.0) | 42 (42.0) |

Table 5: Obstetric medical variables

| Variable | BMI<18.5 | BMI 18.5–22.9 | BMI-23–24.9 | BMI>25 |
|---|---|---|---|---|
| | n=44 (%) | n=121 (%) | n=34 (%) | n=100 (%) |
| Anemia | | | | |
| Yes | 8 (18.2) | 23 (19.0) | 6 (17.6) | 17 (17.0) |
| No | 36 (81.8) | 98 (81.0) | 28 (82.4) | 83 (83.0) |
| Hypertension in PREG | | | | |
| Yes | 4 (9.1) | 10 (8.3) | 5 (14.7) | 17 (17.0) |
| No | 40 (90.9) | 111 (91.7) | 29 (85.3) | 83 (83.0) |
| GDM | | | | |
| Yes | 6 (13.6) | 26 (21.5) | 8 (23.5) | 28 (28.0) |
| No | 38 (86.4) | 95 (78.5) | 26 (76.5) | 72 (72.0) |
| Antepartum anxiety | | | | |
| Yes | 20 (45.5) | 23 (19) | 8 (23.5) | 49 (49) |
| No | 24 (54.5) | 98 (81) | 26 (76.5) | 51 (51) |
| Surgical site infection | | | | |
| Yes | 2 (4.5) | 12 (9.9) | 3 (8.8) | 9 (9.0) |
| No | 42 (95.5) | 109 (90.1) | 31 (91.2) | 91 (91.0) |
| Fetal growth restriction | | | | |
| Yes | 20 (45.5) | 34 (28.1) | 8 (23.5) | 25 (25.0) |
| No | 24 (54.5) | 87 (71.9) | 26 (76.5) | 75 (75.0) |

Table 6: Obstetric variables associated with dual burden

| Variable | BMI<18.5 | BMI 18.5–22.9 | BMI-23–24.9 | BMI>25 |
|---|---|---|---|---|
| | n=44 (%) | n=121 (%) | n=34 (%) | n=100 (%) |
| Obstetric score | | | | |
| 1st time mothers | 25 (56.8) | 60 (49.6) | 14 (41.2) | 43 (43.0) |
| G2 | 12 (27.3) | 30 (24.8) | 7 (20.6) | 25 (25.0) |
| G3 | 4 (9.1) | 23 (19.0) | 11 (32.4) | 13 (13.0) |
| G>4 | 3 (6.8) | 8 (6.6) | 2 (5.9) | 19 (14.0) |
| Gestational age at delivery | | | | |
| Preterm | 3 (6.8) | 5 (4.1) | 2 (5.9) | 4 (4.0) |
| Term | 41 (93.2) | 116 (95.9) | 32 (94.1) | 96 (96.0) |
| Birthweight in grams | | | | |
| <2499 | 11 (25.0) | 19 (15.7) | 6 (17.6) | 10 (10.0) |
| >2500 | 33 (75.0) | 102 (84.3) | 28 (82.4) | 90 (90.0) |
| NICU admission | | | | |
| Yes | 12 (27.3) | 32 (26.4) | 11 (32.4) | 29 (29.0) |
| No | 32 (72.7) | 89 (73.6) | 23 (67.6) | 71 (71.0) |

**Table 7: Weight of new-born associated with dual burden of BMI**

| Birth weight | BMI<18.5 | BMI 18–22.9 | BMI 23–24.9 | BMI>25 |
|---|---|---|---|---|
| Category | Underweight (%) | Normal (%) | Overweight (%) | Obese (%) |
| In grams | n=44 | n=121 | n=34 | n=100 |
| <1499 | 0 (0.0) | 0 (0.0) | 1 (2.94) | 1 (1.0) |
| 1.5–2499 | 11 (25.0) | 19 (15.7) | 5 (14.71) | 9 (9.0) |
| >2.5–3499 | 32 (72.7) | 92 (76) | 26 (76.47) | 74 (74.0) |
| >3.5–3999 | 1 (2.3) | 09 (7.43) | 2 (5.88) | 14 (14.0) |
| >4000 | 0 (0.0) | 1 (0.83) | 0 (0.0) | 2 (2.0) |

### Wound sepsis

SSI was more frequent in obese (9%) and overweight mothers than lean ones (4.5%) which was higher than Kiran *et al.* (1.6%), and Sebire *et al.* (1.34%) in the obese population and lower than Jain *et al.* [24-26].

### Hospital stay

It was 4.34–4.85 days, not affected by increasing body weight. Increased maternal morbidity resulted in prolonged hospital stay in obese mothers than normal weight mothers in authors including Pillai and Menon and Sivaprasad [14, 27]

## CONCLUSION

The WHO Asia Pacific BMI was found to be an essential risk stratification tool in obstetrics because it re-iterated the existence of a double burden of malnutrition in rural mothers in Kozhikode district of North Kerala which reinforces the need to adopt appropriate pre-natal planning and counselling tailored to women's nutritional status to prevent possible adverse health outcomes in their reproductive career.

## AUTHORS' CONTRIBUTIONS

All authors read and agreed to the final version of this manuscript.

## CONFLICTS OF INTEREST

None declared.

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Nil.

## ETHICAL APPROVAL

The ethical approval for the research was provided by the following institutions -KMCT Medical College and research conducted according to the principles of Helsinki Declaration.

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