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Effect of body mass index on pregnancy outcomes: a prospective observational study from a rural South Indian tertiary care setting

Rajesh **Venkataraman** [1], Shiv Kumar **Yadav** [1,*], Ravindra **S. Pukal** [2]

[1] Department of Pharmacy Practice, Sri Adichunchanagiri College of Pharmacy, Adichunchanagiri University, BG Nagara, Mandya, Karnataka, India.

[2] Department of Obstetrics and Gynaecology, Sri Adichunchanagiri Institute of Medical Science and Research Centre, Adichunchanagiri University, BG Nagara, Mandya, Karnataka, India.

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***Corresponding author:** Shiv Kumar **Yadav**, Dr., Research Scholar. Department of Pharmacy Practice, Sri Adichunchanagiri College of Pharmacy, Adichunchanagiri University, BG Nagara, Mandya – 571448, Mangalore Road, Karnataka, India.
Email: yadavshiv1222@gmail.com.
ORCID: 0000-0003-2641-6605.

ABSTRACT

Objective. The effect of body mass index (BMI) on pregnancy outcome is not well established especially in a South Indian population. This study aimed to assess the link between maternal BMI and pregnancy outcomes.

Materials and Methods. A prospective observational study was conducted among 150 pregnant women subjects in a South Indian tertiary care centre for a period of 6 months after obtaining ethical approval. Pregnant women aged 18 or above who were accepted and willing to provide written informed consent were included in the study. The relevant data were collected from patients and analysed using SPSS version 16.

Results. A higher proportion of participants (65.3%) had normal BMI, followed by overweight or obese (32%) and only 2.7% were underweight, during the pregnancy. Being overweight was significantly associated with depression ($p = 0.032$) and gestational diabetes ($p = 0.000$), but not with gestational hypertension and pre-eclampsia ($p > 0.05$) in the pregnant woman.

Conclusions. The overweight and obesity were significantly associated with gestational diabetes and depression among pregnant women.

INTRODUCTION

Obesity has negative repercussions during pregnancy, and obesity-related problems possess a significant burden for obstetrical care providers and increased pre-natal risks [1].

Heavy, bigger, thicker, and less efficient placentas have been linked to pre-gestational obesity and overweight, as well as excessive gestational weight increase [2]. The pregnancy outcome study provides a once-in-a-lifetime chance to investigate the independent correlations of gestation diabetes mellitus (GDM) and obesity with unfavourable pregnancy outcomes, both alone and in combination [3]. The pre-pregnancy BMI as well as gestational weight gain is correlated with maternal and newborn outcomes along with long-term complications [4]. Poor pre-preg-

nancy sleep, maternal emotional disturbances (depression, anxiety, and stress), body image, obesity, and pregnancy-related weight gain poses a risk for physiological changes such as decreased oesophageal sphincter tone, hormonal changes, increased uterine size, and increased micturition [5].

An increased risk of GDM and gestational hypertension (GHT) is dangerous among them. Obese women and their newborns appear to have more occurrences of miscarriage, pregnancy and labour difficulties, postnatal morbidity, and short and long-term negative health effects on their offspring than childbearing women of normal weight [6, 7].

The traditional treatment for GDM is mostly based on maternal blood glucose levels and stringent blood glucose control along with strict monitoring is essential to avoid negative pregnancy outcomes [8, 9]. Insulin resistance increases with gestational age in normal pregnancy, and it is identified as a major contributor to GDM along with B-cell dysfunctions [10, 11].

The literature provides evidences on the effect of BMI on pregnancy outcomes lacking with respect to the homogenous conclusion, limited sample size and non-generalizability of findings. The disorder that exists as an undiagnosed form before pregnancy may begin concurrently with pregnancy and may continue after delivery in some situations which affects both mother and newborn [12, 13]. Women with a history of maternal pregnancy problems such as preeclampsia, GHT, or GDM were observed to have an elevated risk of cardiovascular disease [14, 15].

The literature evidence from the lower and middle countries are very less, especially from Indian setting. There are not many evidences from India that assessed the maternal and pregnancy complication associated with BMI or obesity among pregnant woman.

Moreover, the uncontrolled food habits and inadequate monitoring among the rural population necessitate the need of conducting this study in this set of population.

Objective

This study aimed to assess the effect of BMI on pregnancy outcomes such as depression, GDM, GHT, and preeclampsia in a rural tertiary care South Indian Hospital.

MATERIALS AND METHODS

Ethical considerations

An experienced consultant physician and practicing clinical pharmacists were directly involved in conducting the study by utilizing their knowledge and expertise in the field at the Research Centre. All study procedures were carried out according to the Declaration of Helsinki. The study was reviewed by the institutional Ethical Committee (IEC/029/2021) and the study was commenced only after the approval from the institutional Ethical Committee. Written informed consent was obtained from all the participants before enrolling to the study.

Study design and study setting

A prospective observational study was conducted for a period of 6 months among pregnant women from a tertiary care teaching hospital located in a rural area of South India. Those who were accepted and willing to provide written informed consent after receiving an explanation of all the detailed procedures of the study were included for our purpose.

Participants

Only adult women with an aged 18 years or above were only considered. Any participants with a history of psychological disorders during the enrolment were excluded.

Patients who were not interested to take part in the study were given the right to withdraw at any point of the study. Those patients who did not reach to the third trimester were excluded from the study.

Variables and data sources

A detailed data collection form which included the patients' demographics, diagnosis, pregnancy details, stage of pregnancy, comorbidities, drugs used, and clinical outcome, was designed to collect the data from patients. The BMI were calculated at admission or in the first month as per the data from the patient record. The status of depression, GDM, GHT, and pre-eclampsia were measured during the third trimester of pregnancy. The Edinburgh Postnatal Depression Scale [16]

was used to assess depression among the included participants.

Efforts to address the bias

A detailed data collection form was prepared and validated before the data collection. The statistician involved in this study was not involved in any part of the study. The non-masking of the participants and personals are less likely to contribute to the bias in the study.

Sample size

A prospective random sampling technique was adapted in this study. We estimated a minimum sample size of 148 participants with a margin of error of 5%, power of 80%, precision of 0.05, at confidence interval of 95% and a prevalence of 24% in Indian studies. Hence, a total of 150 participants were considered in this study.

Quantitative variables and statistical analysis

All collected data were entered into Microsoft Excel, and statistical analysis was done with the help of a computer with Statistical Package for the Social Sciences version 16.0 developed by IBM [17].
The descriptive statistics were computed, and data were presented as frequencies and percentages in case of categorical outcomes. A Chi-square test was used to assess the effect of BMI on the dependent variables (depression, GDM, GHT, and pre-eclampsia). A P-value less than 0.05 is considered to be significant.

RESULTS

Participants and their demographics

A total of 150 subjects were included in this study as per the above-specified criteria. Among the included participants, 96.7% (n = 145) were aged 18-35 years, and the remaining 3.3% (n = 145) were aged to be 36-60 years. The mean age was observed to be 25.05 ± 5.5 years. Among the included subjects, 65.3% (n = 98) had normal BMI, followed by 32% (n = 48) overweight.
Only 2.7% (n = 4) had underweight (**Figure 1** and **Table 1**).

Table 1. *Demographic details and pregnancy outcomes in the included participants.*

Demographic character	Frequency (%)
Age	
Mean age	25.05 ± 5.5 years
18-35	145 (96.7)
36-60	5 (3.3)
BMI	
Underweight	4 (2.7)
Normal	98 (65.3)
Overweight	48 (32)
Education	
Illiterate	7 (4.7)
High school	65 (43.3)
Higher secondary and above	78 (52)
Diet	
Mixed	107 (71.3)
Vegetarian	43 (28.7)
Occupation	
Private	30 (20)
Housewife	104 (69.3)
Government	16 (10.7)
Annual Income (INR)	
Below 1 Lakh	99 (66)
Above 1 Lakh	51 (34)
GDM	
No	91 (60.7)
Yes	59 (39.3)
GHT	
No	137 (91.3)
Yes	13 (8.7)
Pre-eclampsia	
No	142 (94.7)
Yes	8 (5.3)
Depression as per EPDS scale	
No abnormality	78 (52)
Possible depression	72 (48)
BP at 3 months	
Normal	129 (86)
High	21 (14)
BP at 6 months	
Normal	140 (93.3)
High	10 (6.7)
BP at 8 months	
Normal	141 (94)
High	9 (6)

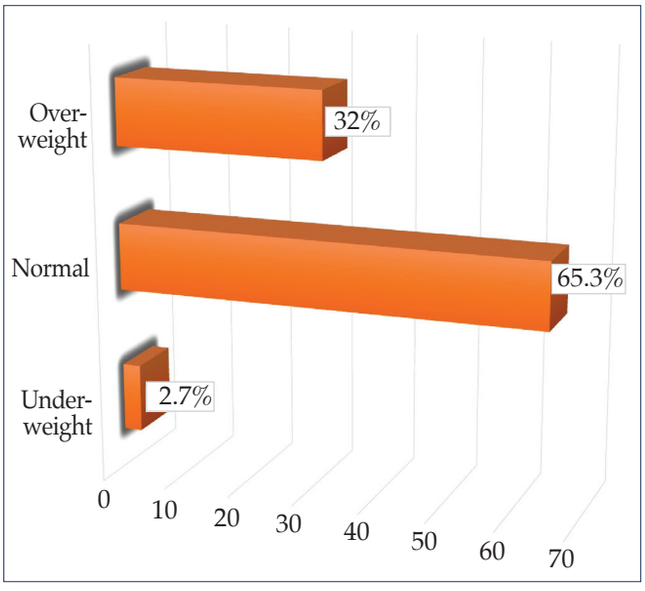

Figure 1. *BMI distribution among the participants.*

Characteristics of the included participants

A high proportion (52%, n = 78) had an education of higher secondary and above and only 7 (4.7%) were illiterate. A majority of the population were housewives (69.3%, n = 104) and consumes mixed diets (71.3%, n = 107). Concerning the annual income, 66% (n = 99) had below 1 Lakh and 34% (n = 51) had above 1 Lakh. Detailed demographic characters are provided in **Table 1**.

Outcome data

Pregnancy outcomes among the included participants
Among the included participants, 59 (39.3%), 13 (8.7%), 8 (5.3%) and 52% had GDM, GHT, pre-eclampsia, and depression respectively. The BP at 3 months, 6 months, and 8 months were high among the 21 (14%), 10 (6.7%), and 9 (6%) of the included participants. Detailed outcomes are presented in **Table 1**.

Effect of BMI on pregnancy outcomes
The high BMI was significantly associated with depression (p = 0.020) and GDM (p = 0.000). However, it was not significantly associated with GHT and pre-eclampsia. Detailed analysis findings are presented in **Table 2**.

DISCUSSION

Comprehensive maternal care is very important in ensuring the safety, and well-being of pregnant women and newborns. Obtaining appropriate health-care advice and monitoring is a safeguarded method to control the risks associated with pregnancy. Health care-seeking behaviour involves actions undertaken to seek initial and continued care for perceived health status, to find an appropriate solution. On average, approximately 830 fatalities of women daily happen across the world as a result of preventable causes related to pregnancy, out of which 99% happen in developing countries with a high prevalence from rural areas. It is estimated that each year throughout the world, approximately 8 million women are suffering pregnancy-related complications [18]. The current study indicates that being overweight was significantly associated with depression and gestational diabetes, but not with gestational hypertension and pre-eclampsia in the pregnant woman.

Table 2. *Effect of BMI and pregnancy outcomes.*

	BMI	Presence of effects		P- value
		No	Yes	
Depression	Underweight	1	3	Ref
	Normal	45	53	0.134
	Overweight	32	16	0.020
Gestational DM	Underweight	4	0	Ref
	Normal	80	18	0.999
	Overweight	7	41	0.000
Gestational HTN	Underweight	4	0	Ref
	Normal	91	7	0.999
	Overweight	42	6	0.291
Pre-eclampsia	Underweight	3	1	Ref
	Normal	92	6	0.073
	Overweight	47	1	0.306

The previous literature indicates that obesity can be correlated with a higher occurrence of unintended outcomes such as GHT, GDM, pre-eclampsia, and delivery of large infants than the women with normal BMI [19]. However, there are no much evidence from India. This study aimed to assess the effect of BMI on untoward maternal outcomes among the pregnant woman in a South Indian rural setting.

The mean age was observed to be 25.05 ± 5.5 years in our population with a majority of the population aged from 18 to 35. This was comparable with the findings by Al-Hakmani *et al.* [20]. They reported a mean age of 27.2 ± 5.3, 29.7 ± 5.6, and 30.1 ± 5.4 among the pregnant woman who is normal, overweight, and obese, respectively. Among our population, 65.3% had normal weight, 32% had overweight and only 2.7% had underweight. The study conducted by Al-Hakmani *et al.* [20] also observed 31% of their participants to have overweight. Among our study group, 52% had higher secondary education and above, 43.3% had secondary-level education and 4.7% were illiterate. This was in line with the study conducted by Al-Hakmani *et al.* [20]. They recorded that half of the women (50.8%, n = 337) were educated to a secondary school level, 31.5% (n = 209) had a college degree, 14.5% (n = 96) had primary education, and 3.2% (n = 21) were illiterate among their population.

Our study recorded that, being overweight was significant for the depression (p = 0.020) and GDM (p = 0.000). The study by Sun *et al.* [21] recorded that being overweight (OR 2.01) and inadequate weight (OR 1.60) were risk factors for GDM. Other recent studies also recorded a significant association between overweight and GDM [22-24]. The exact pathophysiology is unknown concerning the pregnancy though many physiological and pathological changes contribute to it. The events such as low levels of insulin receptors due to high levels of adipose tissue and increased BMI, and reduced glucose tolerance due to changes in the pattern of glucose metabolism during pregnancy, will attenuate the risk of GDM in an obese pregnant woman. However, all these factors may contribute to DM regardless of pregnancy in people with high BMI [21].

The study by Sun *et al.* [21] also recorded that, overweight (OR 2.80) and obese (OR 5.42) were risk factors for GHT. However, we could not observe a significant relationship between overweight and GHT, which might be due to a lesser sample size. The pathophysiological changes including the accumulation of fat and estrogen, aldosterone secretion associated sodium retention, and abnormal blood lipid metabolism can contribute to GDM and GHT [21].

We observed a significant association between depression and BMI. Overweight was significantly (p = 0.020) compared to those with low BMI. This was in line with the findings by Jani *et al.* [25], where they reported that obese early-pregnancy BMI was associated with increased odds of perinatal depression (OR 1.421; 95%CI 1.91-1.696). Similarly, a study conducted by Kumpulainen *et al.* [26] recorded that maternal obesity was associated with a 1.43-fold increase in odds of having depressive symptoms throughout pregnancy (95%CI 1.15-1.77; p < 0.001) and a 1.36-fold increase in odds of depressive symptoms postpartum (95%CI 1.07-1.71; p = 0.01). Not involved in any activities and lack of regular exercise can contribute to a high rate of weight gain in pregnant woman and their turn back to regular sports activities are very less [27]. Recently, the COVID-19 lockdown contributed to a higher proportion of weight gain than in previous years [28]. The BMI can contribute to many other pregnancy complications such as increased risk of stillbirth, altered glucose tolerance, endocrine dysfunctions and its associated gynaecological and obstetric outcomes during pregnancy [29, 30].

There is no much evidence from the rural population of the studies, and this study's results are generated from a rural population-based cohort and outcomes were measured prospectively. The BMI was collected from authentic hospital records instead of relying on the memory recall of the patients, hence recall bias will be less. However, these limitations should be taken into consideration. First, the sample size was less, which may affect the power of the study. Second, the weight and height were measured during the initial prenatal examination which may vary throughout pregnancy. Third, there were no details about potential confounding factors such as clinical complications or lifestyle changes during pregnancy. Future studies should be planned to address the effect of these confounding factors on the overweight and its effect on the pregnancy outcomes especially from diverse cultures like in lower- and middle-income countries. The BMI and weight control during the pregnancy is very crucial in order to avoid the further pregnancy and maternal complications.

CONCLUSIONS

The current findings indicate that the body mass index or overweight was significantly associated with gestational diabetes and depression among pregnant women. Further studies are warranted to confirm this association with a large population.

COMPLIANCE WITH ETHICAL STANDARDS

Authors contributions

R.P., R.V.: Conceptualization, project administration, writing - original draft. S.KY.: Data curation. S.K.Y., R.V., R.P.: Writing - review & editing.

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Study registration

N/A.

Disclosure of interests

The authors declare that they have no conflict of interests.

Ethical approval

All study procedures were carried out according to the Declaration of Helsinki. The study was reviewed by the institutional Ethical Committee (IEC/029/2021) and the study was commenced only after the approval from the institutional Ethical Committee.

Informed consent

Written informed consent was obtained from all the participants before enrolling to the study.

Data sharing

Data are available under reasonable request to the corresponding author.

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