



## RESEARCH ARTICLE

# Sociodemographic, obstetric and psychological determinants of obesity among women in early to mid-pregnancy in South India [version 1; peer review: 2 approved with reservations]

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## Abstract

**Background:** Worldwide, the occurrence of obesity has markedly increased over the past decades with serious public health consequences. Obese pregnant women are more likely to develop hypertension, pre-eclampsia and gestational diabetes, resulting in obstetric complications which in turn may contribute to an increase in adverse child outcomes and maternal mortality. The present study was done to determine the prevalence of obesity and its association with socio-demographic variables, obstetric history and mental health.

**Methods:** This study was nested within an ongoing cohort study, CASCADE, in a public hospital in Bangalore. The study participants comprised of 280 pregnant women who were 18 years of age and above, with a gestational age of less than 24 weeks, enrolled between a period of August 1<sup>st</sup>, 2017 until April 30<sup>th</sup>, 2018. Weight and height were measured using calibrated devices to calculate the body mass index.

**Results:** The prevalence of obesity was observed to be 33.9% among the pregnant mothers. Obesity was found to be significantly associated with age, history of abortion, gravidity on multivariate logistic regression. No association was found with depression and anxiety.

**Conclusions:** Obesity is an important health concern among urban pregnant women in the region of South India. The prevalence is much higher than that reported in other studies. Increasing age, multigravidity and past history of abortion were significantly associated with maternal obesity.

## Keywords

Obesity, pregnancy, prevalence, risk factors, India

## Open Peer Review

Reviewer Status ? ?

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This article is included in the [Wellcome Trust/DBT India Alliance](#) gateway.

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## Introduction

Worldwide, the occurrence of obesity has markedly increased over the past decade, and the World Health Organization (WHO) has termed it as a “global epidemic” with serious public health consequences<sup>1</sup>. According to a recent estimate, about 13% of the world’s adult population (11% of men and 15% of women) were obese in 2016<sup>1</sup>. Using the WHO classification, body mass index (BMI) is estimated by dividing a person’s weight in kilograms by the square of height in meters ( $\text{kg}/\text{m}^2$ ) and is used to classify an individual as being underweight, normal overweight or obese; accordingly, obesity is defined as having a BMI greater than or equal to 30<sup>2</sup>.

In low- and middle-income countries (LMIC), the prevalence of obesity ranges from being as low as 3.4 % to as high as 73.7% among women in the reproductive age group<sup>3,4</sup>. With the improving economy and better standard of living, the prevalence of overweight and obesity surpass that of underweight on a global scale<sup>5</sup>. In India, according to the National Family Survey-4 (NFHS-4), the prevalence of obesity is shown to be in the range of 13–50 % in an urban population while the range for rural areas is slightly less in the range of 8–38%<sup>6</sup>. This, in turn has resulted in a steep incline in the burden of non-communicable diseases (NCD’s)<sup>7</sup>.

Obese pregnant women are more likely to develop hypertension, pre-eclampsia and gestational diabetes<sup>8,9</sup>, resulting in obstetric complications which in turn may contribute to an increase in the maternal mortality<sup>10,11</sup>. Moreover, the offspring of obese women tend to be large for gestational age and have a higher incidence of birth injuries and congenital abnormalities<sup>12</sup>.

As obesity is a modifiable risk factor, it is imperative to identify this early so as to avoid any adverse consequence. While it is known that intake of calorie rich diet is an important risk factor for obesity, it is important to explore the ecological risk factors that could be of regional interest. The present study was done to determine the prevalence of obesity and its association with socio-demographic variables, obstetric history and mental health.

## Methods

### Study setting and participants

This study was nested within the ongoing ‘CASCADE’ cohort study, which is analyzing the effect of prenatal exposure to maternal cortisol, depression and anxiety on infant development in Bangalore, the protocol of which has already been published<sup>13,14</sup>. The cohort study is being conducted at Jayanagar General Hospital in Bangalore, which is a sub-district hospital. The study participants comprised of pregnant women, 18 years of age and above, with a gestational age of less than 24 weeks. High-risk pregnancies and women with a history of intake of steroidal drugs over the past year were not eligible to participate according to the study protocol’s eligibility criteria. Data was analyzed for a study period of 9 months from August 1<sup>st</sup> 2017 until April 30<sup>th</sup> 2018, for those women who had completed their baseline visit; the number of these amounted to 280.

Electronic data capture was done using an Android-based application (CASCADE App version- 6). Data pertaining to socio-demographic factors and obstetric history was obtained. The socio-demographic variables included age, religion, education, occupation and socio-economic status of the study respondents.

The study participants were screened for depression using the Edinburg Postnatal Depression Scale (EPDS), the scores of which range from 0 to 30 points<sup>15</sup>. The 10-item Pregnancy Related Anxiety (PRAQ) scale was used to measure anxiety<sup>16</sup>. The data collected was uploaded and stored in a cloud server.

### Calculation and categorization of BMI

Weight was recorded in kg using a TANITA HD 318, Class III electronic weighing scale, which was calibrated using standard weights from time-to-time. The scale was placed on a stable part of the ground. The digital display was checked for ‘zero’ reading. The women were asked to stand bare-feet on the scale with minimal clothing and look straight ahead. One reading to the nearest 100 g was taken.

Height was measured in cm using a stadiometer. The participant was asked to remove her shoes and stand as tall and straight as possible with feet together, arms held loosely by the side and shoulders relaxed with her back, including the posterior surface of the head and heels applied to the wall. The head was positioned in the Frankfurt plane, such that an imaginary line joining the upper margin of the external auditory meatus and lower border of the orbit of the eye was placed horizontal. The head plate of the stadiometer, fixed to the wall, was pulled down and placed horizontal. Height was recorded to the nearest 0.1cm.

BMI was estimated by dividing the recorded weight in kg by the height in  $\text{m}^2$ , and classified using the WHO criteria<sup>2</sup>.

### Data analysis

Data were downloaded from the cloud server and cleaned before analysis. Statistical analysis was done using SPSS version 23. The prevalence of obesity was calculated by means of descriptive statistics in terms of proportion. The association between independent variables and obesity (dependent variable) was determined using bivariate analysis and reported in terms of crude odd’s ratio (COR). The independent variables were dichotomized into two categories for the purpose of analysis. Those variables with P-value of  $\leq 0.2$  on the univariate analysis were entered into multivariate logistic regression model to calculate the adjusted odd’s ratio and to eliminate the effect of confounding. Those variables with  $p < 0.05$  in the multivariate analysis were considered to be significant.

### Ethical approval

Ethics committee approval was taken from the Institutional Ethics Committee of Indian Institute of Public Health-Bangalore [IIPHBB/TRCIEC/118/2017] and permission from the study hospital was taken prior to start of the study. Written informed consent was taken from all the respondents and they were assured of privacy and confidentiality of their data.

## Results

Raw data for this study are available on OSF<sup>17</sup>.

### Socioeconomic profile

The socioeconomic profile of the study respondents is shown in [Table 1](#). Most of the respondents were more than 20 years of age (72.9%). More than 90% were housewives. A total of 57.5% of subjects belonged to upper lower class and 72.1% were Muslims.

### Prevalence of obesity

The prevalence of obesity was observed to be 33.9% among the pregnant mothers, with a mean BMI of  $23.8 \pm 4.8$  (kg/m<sup>2</sup>) ([Figure 1](#); [Table 1](#)).

### Association of socio demographic variables with obesity

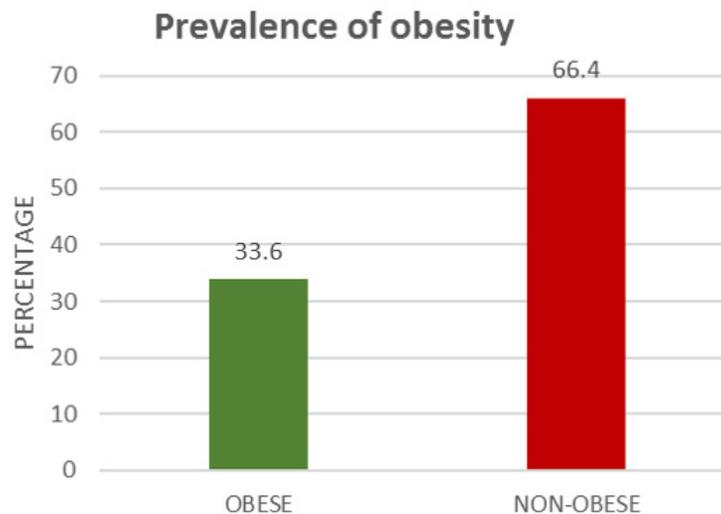
Association between sociodemographic variables with obesity showed that respondents who were more than 20 years of age were prone to obesity during pregnancy (adjusted odd's ratio: 2.412 (1.091-5.333);  $p=0.030$ ) than those who were less than 20 years of age ([Table 2](#)).

### Association of obstetric variables with obesity

In total, 41.7% of the multigravida women were obese ([Figure 2](#)). [Table 3](#) shows the association between the obstetric variables with obesity. We found that gravidity and obesity were significantly associated wherein multigravida women were four times more likely to be obese (adjusted odd's ratio: 4.375 (1.184-16.161);  $p=0.027$ ); The strength of association with other

**Table 1. Sociodemographic profile of study participants.**

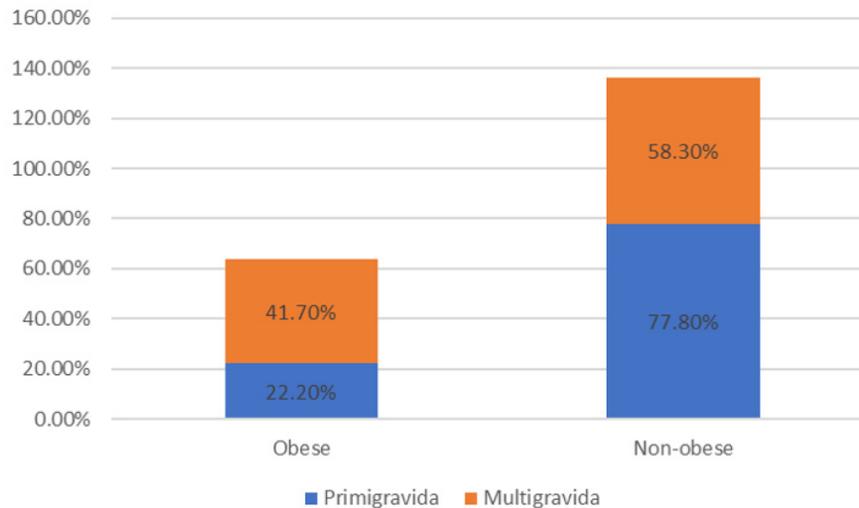
Sociodemographic variable		N (%)
Age, years	≤ 20	76 (27.1%)
	≥ 20	204 (72.9%)
Religion	Hindu	73 (26.1%)
	Muslim	202 (72.1%)
	Christian	5 (1.8%)
Respondent education	≤ high school	203 (72.5%)
	≥ high school	77 (27.5%)
Respondent occupation	Working	23 (8.2%)
	Housewife	257 (91.8%)
Socio-economic status	Upper-middle class	36 (12.9%)
	Lower-middle class	83 (29.6%)
	Upper-lower class	161 (57.5%)



**Figure 1. Prevalence of obesity.**

**Table 2. Association of socio-demographic variables with obesity.**

Variables		Non-obese, n (%)	Obese, n (%)	Crude odds ratio (CI)	p-value	Adjusted odds ratio (CI)	p-value
Total		186 (100)	94 (100)				
Age	≤ 20 years (total, n=76)	59 (77.6)	17 (22.4)	1		1	
	≥ 20 (total, n=204)	127 (62.3)	77 (37.7)	2.069 (1.007-4.252)	0.048	2.412 (1.091-5.333)	0.030
Respondent's years of schooling	≤ 10 years (total, n=203)	133 (65.5)	70 (34.5)	1			
	≥ 10 years (total, n=77)	53 (68.8)	24 (31.2)	0.929 (0.444-1.945)	0.846		
Respondent's occupation	Working (total, n=23)	16 (69.6)	7 (30.4)	1			
	Housewife (total, n=257)	170 (66.1)	87 (33.9)	1.170 (0.464-2.950)	0.740		
Socioeconomic class	Upper middle class (total, n=36)	22 (61.1)	14 (38.9)	1			
	Lower middle class (total, n=83)	59 (71.1)	24 (28.9)	0.45 (0.163-1.278)	0.135	0.533 (0.223-1.275)	0.157
	Upper lower class (total, n=161)	105 (65.2)	56 (34.8)	0.528 (0.197-1.417)	0.205	0.671 (0.303-1.483)	0.324

**Figure 2. Distribution of obesity with gravida status.**

variables such as history of abortions, parity and number of children was rather weak.

#### Association of psychological variables with obesity

No association was found between obesity with either depression (crude odds ratio: 0.933 (0.499-1.741);  $p=0.826$ ) or with anxiety [crude odds ratio: 0.653 (0.309-1.377);  $p=0.263$ ] during pregnancy (Table 4).

#### Discussion

In this study we estimated the prevalence of obesity among women during early to mid-pregnancy and its association with

socio-demographic, obstetric and psychological variables. The prevalence of obesity among these women was 33.6%. Vittal *et al.* observed much lower prevalence rate of 8.2% in their study done among pregnant women in Hyderabad<sup>18</sup>. Likewise, about 11.7% of the pregnant women in Kozhikode were found to be obese<sup>19</sup>. In western countries, the prevalence of maternal obesity is found to range from 1.8% to 25.3%<sup>20</sup>. The higher prevalence of obesity in our study could be attributed to higher pre-pregnancy values of BMI, which was not estimated in this study. Women with higher pre-pregnancy BMI are at a higher risk of obesity during pregnancy<sup>21,22</sup>. According to an estimate from the year 2014, about 20 million women were reported

**Table 3. Association of obstetric variables with obesity.**

Variables		Non-obese, n (%)	Obese, n (%)	Crude odds ratio (CI)	p-value	Adjusted odds ratio (95% CI)	p-value
Total		186 (100)	94 (100)				
Unplanned pregnancy	No (total, n=154)	97 (63)	57 (37)	1			
	Yes (total, n=126)	89 (70.6)	37 (29.4)	0.551 (0.296-1.026)	0.060	0.531 (0.277-1.019)	0.115
Gravida	Primigravida (total, n=117)	91 (77.8)	26 (22.2)	1			
	Multigravida (total, n=163)	95 (58.3)	68 (41.7)	4.675 (1.367-15.987)	0.014	4.375 (1.184-16.161)	0.027
Parity	Nullipara (total, n=129)	97 (75.2)	32 (24.8)	1			
	Para (total, n=151)	89 (58.9)	62 (41.1)	0.606 (0.162-2.276)	0.452		
H/O Abortion	No abortion (total, n=218)	147 (67.4)	71 (32.6)	1			
	Abortion (total, n=62)	39 (62.9)	23 (37.1)	0.498 (0.212-1.169)	0.109	0.388 (0.94-1.447)	0.36
Number of living children	None (total, n=144)	106 (73.6)	38 (26.4)	1			
	1 or more (total, n=136)	80 (58.8)	56 (41.2)	0.611 (0.173-2.155)	0.444		

**Table 4. Association of psychological variables with obesity.**

Variables		Non-Obese, n (%)	Obese	Crude odds ratio (CI)	p-value
Total		186 (100)	94 (100)	N/A	N/A
Depression	Depressed (total, n=100)	69 (69)	31 (31)	0.933 (0.499-1.741)	0.826
	Not depressed (total, n=180)	117 (65)	63 (35)	1	
Pregnancy-related Anxiety	Anxious (total, n=124)	82 (66.1)	42 (33.9)	0.653 (0.309-1.377)	0.263
	Non-anxious (total, n=156)	104 (66.7)	52 (33.3)	1	

to be obese in India<sup>23</sup>. This is mostly ascribed to the changing lifestyles, with particular reference to dietary habits comprising of high intake of processed foods and poor intake of essential micronutrients and fiber, known as 'nutritional transition'<sup>24</sup>. Moreover, obesity tends to be concentrated in urban women, largely from better socio-economic background<sup>25</sup>. However, in our study, lower income appeared to increase the risk; this finding has been corroborated by other studies<sup>21</sup>.

In our study, among the socio-demographic variables, only age appeared to be significantly associated with obesity wherein women above the age of 20 years were more likely to be obese. Misra *et al.* also observed that increasing age contributed to a rise in the prevalence of obesity<sup>7</sup>. Analysis of NFHS data also indicates a similar trend<sup>26</sup>. Among the obstetric variables' gravidity appeared to have a significant relationship with obesity. The likelihood of multigravida women being obese was significantly higher in our study; other studies have also cited

synonymous findings<sup>21,27</sup>. While other studies have shown that obese women were at a greater risk of pregnancy loss<sup>28,29</sup>, in the present study, the strength of association between past history of abortion and obesity was found to be weak.

We did not observe any link between mental morbidities such as anxiety, depression and obesity. Anxiety and depression may result in weight gain in some instances<sup>30</sup> and some studies have shown the existence of a modest association<sup>31,32</sup>.

Obesity is a multifactorial health-related condition. Since the present study was nested within an ongoing cohort study, as described in the study section, we could collect data pertaining to a few selected risk factors relevant to obesity from the baseline study tool. Also, we could not analyze gestational weight gain as the pre-pregnancy BMI value was not available. Moreover, in lower-income settings, majority of the pregnant women report to the antenatal clinic later in pregnancy and hence

the BMI during early pregnancy may not always be obtained. As a part of the study protocol, women with severe obstetric complications and those with a history of recent intake of steroidal medication were excluded from the study which could have impacted our study findings and limited the generatability of the study results.

The present study highlights obesity as an important health concern among urban pregnant women of this region of South India. The prevalence is much higher than that reported in other studies. Increasing age, multigravidity and past history of abortion were significantly associated with maternal obesity.

### Data availability

Raw data for this study, including answers to the questionnaire, the BMI and EPDS and PRAQ scores, are available on OSF. DOI: <https://doi.org/10.17605/OSF.IO/FB5MS><sup>17</sup>.

Data are available under the terms of the [Creative Commons Zero “No rights reserved” data waiver](#) (CC0 1.0 Public domain dedication).

### Grant information

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*The funders had no role in study design, data collection and analysis, decisions to publish, or preparation of the manuscript.*

### Acknowledgments

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[PubMed Abstract](#)

# Open Peer Review

Current Peer Review Status: ? ?

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## Version 1

Reviewer Report 15 May 2019

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### Hasse Karlsson

FinnBrain Birth Cohort Study, Turku Brain and Mind Center, Institute of Clinical Medicine, University of Turku, Turku, Finland

This is a study from India reporting on some determinants of obesity among Indian pregnant women. The paper is clearly written and adds knowledge to this increasingly common phenomenon. I have some questions and comments:

1. Firstly, in the methods section no information is given about how consent was obtained, if an ethics committee statement was requested or how many women declined to participate.
2. Secondly, the numbers in the text and Figure 1 do not match. In the text the prevalence of obesity is 33.9% and in the table it is 33.6%.
3. Thirdly, reference 14 is deficient as the journal is lacking.
4. Altogether I would expect a more thorough discussion of the results. It is known that the prevalence of obesity among pregnant women is highest in the world in India (Chen *et al.*, 2018<sup>1</sup>). Why is this so? Why was education not measured, as in previous studies it has had a clear association with obesity? Why did the authors not find an association between psychiatric symptoms and obesity, as has been found in many previous studies?

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**Is the work clearly and accurately presented and does it cite the current literature?**

Partly

**Is the study design appropriate and is the work technically sound?**

Yes

**Are sufficient details of methods and analysis provided to allow replication by others?**

Partly

**If applicable, is the statistical analysis and its interpretation appropriate?**

Yes

**Are all the source data underlying the results available to ensure full reproducibility?**

Partly

**Are the conclusions drawn adequately supported by the results?**

Yes

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Pregnancy cohort, prenatal stress

**I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.**

Reviewer Report 25 April 2019

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**Bani T. Aeri**

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The authors have meticulously documented the work done and have clarified that the results presented are part of a larger on-going project.

Some observations:

1. In the discussions the authors have mentioned that pre-pregnancy weight was not known and hence the classification of pregnant women being overweight and obese was done on weight taken during the course of their pregnancy (most likely well into the 2<sup>nd</sup> trimester). However, it is expected that pregnant women gain some weight by their 24<sup>th</sup> week of gestation. So, on the basis of their current weight, classifying them as obese seems a bit too simple a process. Is it possible for the authors to segregate them on the basis of their gestational period? If many are before 20 weeks of gestation, then, as per the literature, the weight can be taken as pre-pregnancy weight.
2. The age has been stratified as below 20 years and above 20 years. Below 20 years would in fact mean cases of teenage pregnancy. These young women are anyway undernourished. The numbers in this group are also less (27%). Anyone above 20 years, up to the maximum age of the subjects of the study, has been grouped together. This too seems like a very simplistic and basic

analysis, which would give some co-relation, but does not add to the understanding. The increase in weight with age is well known.

3. Similarly, for gravidity the analysis is either primigravida or multi. It can be assumed that the women who have more than 1 child would be also older in age.
4. The data showed that women belonging to lower SES were in fact more obese. This could be highlighted that even the LSES has the problem of overweight and obesity. The authors can also provide the criteria/basis/classification of division of the SES.

### References

1. Arora P, Tamber Aeri B: Gestational Weight Gain among Healthy Pregnant Women from Asia in Comparison with Institute of Medicine (IOM) Guidelines-2009: A Systematic Review. *J Pregnancy*. 2019; **2019**: 3849596 [PubMed Abstract](#) | [Publisher Full Text](#)

**Is the work clearly and accurately presented and does it cite the current literature?**

Yes

**Is the study design appropriate and is the work technically sound?**

Yes

**Are sufficient details of methods and analysis provided to allow replication by others?**

Partly

**If applicable, is the statistical analysis and its interpretation appropriate?**

Partly

**Are all the source data underlying the results available to ensure full reproducibility?**

Yes

**Are the conclusions drawn adequately supported by the results?**

Yes

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Maternal nutrition, NCD management, Diet and health, adolescent health

**I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.**

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