



College of Health Sciences

***Department of Obstetrics and
Gynecology***

**Patterns and Determinants of Gestational Weight Gain among
Women Attending ANC in Selected Hospitals in Addis Ababa: A
Cross-sectional Study, 2024**

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Student declaration

I hereby declare that this thesis titled “Patterns and Determinants of Gestational Weight Gain among Women Attending ANC in Selected Hospitals in Addis Ababa” was conducted entirely by me under the supervision of my advisor. I affirm that I have cited all sources of information used in this thesis to the best of my knowledge and effort. Additionally, I confirm that this thesis has not been submitted to any other institution for the purpose of obtaining any degree, certificate, master's, or diploma.

Name of Student: Eyerusalem Mengistu Mamo

Signature.....

Date: October 2, 2024

Supervisors' Declaration

I hereby confirm that I have read and assessed this research thesis on “Patterns and Determinants of Gestational Weight Gain among Women Attending ANC in Selected Hospitals in Addis Ababa.” I have provided guidance throughout its development up to the present format, and I believe it is ready for submission for final approval in partial fulfillment of the Degree of Specialty in Obstetrics & Gynecology

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Signature.....

Date: October 15, 2024

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Abstract

Background: - GWG refers to the weight gained from beginning of pregnancy until delivery. It is crucial for the wellbeing of the mother & the fetus & inadequate weight gain can pose significant risks to both. Inadequate weight gain is linked with LBW & premature delivery. Excessive weight gain is associated with macrosomia & cesarean section among other complications. Therefore, weight monitoring in pregnancy is an essential aspect of preventive care during pregnancy.

Objective: - To evaluate the patterns & factors influencing gestational weight gain in women having ANC in selected hospitals in Addis Ababa.

Research Methods: - A cross-sectional study design was implemented in a study period of 6 months, & 361 partakers were involved making reply rate of 97%. The collected data underwent thorough checks for completeness, consistency, clarity, & missing values. Data entry was performed using SPSS version 25 for data management & statistical analysis.

A 95% confidence intervals was utilized & statistical significance was set at a p-value of less than 0.05 was used to analyze the correlation between outcome & independent variables.

Result: - The average weight gain for underweight women in the pre-pregnancy period was 11.78 kilograms, for those with normal weight was 11.15 kg, for mothers' overweight was 9.41 kg & for obese women was 8.35 kg. Fifty-two percent of them had inadequate weight gain, 22% had excessive weight gain & 26% had normal weight gain. The determinant of normal weight gain were age of ≥ 35 years compared to those of age 18-24 years (AOR=5.1), residence out of Addis Ababa in contrast to those residing inside Addis Ababa (AOR=8.4), having achieved a minimum DDS (AOR=4.1) & normal pre-pregnancy BMI (AOR=0.42).

Keywords: - Pattern of weight gain, Pre-pregnancy weight, BMI

Acronym

AOR Adjusted odd Ratio

BMI Body Mass Index

BMI Large for gestational age

CI Confidence interval

GDM Gestational diabetes

GMH Gandhi Memorial Hospital

GWG Gestational weight gain

IOM Institute of Medicine

OR Odd ratio

TASH Tikur Anbessa Specialized Hospital

ZMH Zewditu Memorial Hospital

1. Introduction

1.1 Background

The weight gained during pregnancy has a crucial part in supporting fetal well-being. It comprises of conception products & maternal tissue buildup (1). It is a vital factor to meet the greater metabolic demand & support positive pregnancy outcomes (2).

GWG refers to the weight gained from conception until delivery. The recommended amount for underweight women with a BMI of less than 18.5 is 13–18 kilograms. For those with a BMI of 18.5-24.9, the suggested range is 11-16 kilograms. Overweight women with a BMI of 25-29.9 are advised to gain 7-11 kilograms, while obese women with a BMI over 30 are recommended to gain 5-9 kilograms (3).

Gaining more or less weight than the recommended amounts is linked to negative perinatal outcomes. (4). A study finding has shown that gaining more weight in pregnancy is associated with asphyxia, birth trauma, hypoglycemia & big babies (5–6). On the other hand, insufficient weight gain is connected with IUGR, premature delivery & LBW (7).

Complying with healthy weight gain guidelines lays the groundwork for achieving favorable pregnancy results & helps prevent excessive gain (8). Obesity is a significant public health concern because it is a widespread occurrence & has heightened risk of complications for both mothers & their babies. Women who have higher weight have an increased risk of diabetes, pregnancy induced hypertension, operative delivery, macrosomic babies. These factors can impact the longstanding cardiovascular health of both (9-11).

Studies have shown that less than one-third of pregnant women have adequate weight gain (12–15) (7–10). A significant proportion of those living in developed countries gain excessive weight during pregnancy (16–17). Conversely, insufficient gestational weight gain is a serious public health issue in low-income countries including Ethiopia (18-19). One review done in Harar revealed 69% of pregnant women had inadequate weight gain (8).

Undue weight gain is increasingly prevalent & is linked to a higher risk of complications, such as macrosomia & cesarean deliveries (20). Conversely, insufficient weight gain during both the third & second trimesters of pregnancy influences outcomes (21).

Achieving the right amount of weight gain supports positive pregnancy outcomes with healthy fetal growth & lowers the risk of pregnancy-related mortality (25).

According to IOM recommendation, women with normal BMI who have singleton pregnancy are recommended to gain 11.5 kg to 16 kg. The weight gain is believed to be 500grams to 2000 grams in the first trimester & around 420 grams in a week in the second & third trimesters. Women who are underweight are encouraged to aim for a higher gain of up to 18 kg (21). Socioeconomic factors, nutrition, comorbidities, multiple pregnancy & genetics influence weight gain. (26)

1.2 Statement of the problem

Monitoring weight gain is a crucial component of preventive care during gestation. Both excessive & inadequate weight gain are associated with various poor outcomes (27). Surviving low birth weight neonates are prone to stunted growth, health issues during childhood, adolescence, & even into adulthood. Moreover, the effects on the mother's health & productivity can lead to stunted growth & increase the chances of having low birthweight children, & perpetuating the cycle (28).

The amount of weight gained during pregnancy is influenced by various factors, such as the mother's age, parity, income status, educational status, social class, & pre-pregnancy weight. Additionally, factors like ANC, physical activity during pregnancy, & perinatal depression can also play a role (18).

GWG is significantly affected by various biological, metabolic & social factors. A few among those could be pre-pregnancy BMI, multiparity, exercise, dietary choices, smoking, educational background & proper counseling regarding weight gain. Research suggests that women with higher BMI during first trimester, who attend ANC regularly & those who consume a varied diet are more likely to achieve adequate weight. Key factors linked to sufficient weight gain include BMI of 25kg/m² & higher at the start of pregnancy, engaging in regular physical exercise, attending at least four antenatal care visits, & consuming fruits, vegetables & meat (8).

Increased weight gain makes women more likely to retain weight after giving birth, regardless of their BMI category. Pre-gestational overweight, a stature <157 cm & ages 25–29 years is associated with inadequate GWG while age <12 years at menarche, & being a former smoker revealed an association with excessive GWG (29). Various factors have been identified as contributing to excessive GWG, including being overweight or obese before pregnancy, younger maternal age, higher maternal birth weight, discontinuing smoking by 14 to 16 weeks, longer nightly sleep duration, a diet high in seafood, restricting certain behaviors, & a reduction in exercise by 14–16 weeks (30).

One research examining the factors influencing pregnancy weight gain in 3,870 women revealed that those with low weight gains are typically younger, shorter, thinner, nescient, smokers, & often black. Meanwhile, those who gain excessive weight tend to be taller, heavier, first-time mothers, hypertensive, & predominantly white. Another study by Hickey et al., described that white women with low scores on psychosocial measures of anxiety, depression, mastery, & self-esteem had increased risk of inadequate weight gain, whereas this was not observed in Black women. Other research has shown that factors such as physical abuse, lack of financial support, alcohol consumption, smoking, poor diet, & inadequate adherence to prenatal care are linked to both low & high weight gain during pregnancy (31).

Sociodemographic & clinical factors linked to GWG greater than 22 kg were similar, but smaller weight patients showed increased risk. Women who are more likely to gain more weight would benefit from early nutritional counseling & education on lifestyle modifications (32).

Higher depressive symptoms on the Edinburgh Postnatal Depression Scale & being overweight or obese, as indicated by the Nancy BMI were linked to excessive weight gain (23).

The occurrence of underweight among urban Ethiopian significantly declined from around 23% to around 14% from 2000 to 2016. Women from wealthier households & those who had never married were less likely to be underweight. Women from affluent backgrounds & those with at least a secondary education were more likely to be overweight or obese. In contrast, women who held informal jobs & listened to the radio were less likely to be overweight or obese compared to their unemployed peers who did not listen to the radio. Additionally, the study found that GWG increased with supplementation of multivitamins during pregnancy.

The aim of this study is to identify patterns of weight gain in pregnant women & analyze the maternal demographic & anthropometric factors that affect weight gain during pregnancy. This research is intended to inform the development of programs that support expectant mothers in achieving the recommended weight gain before & during pregnancy, promoting optimal weight for the health of the baby.

1.3 Significance of the study

The ability to predict GWG plays a crucial role for pregnant women in regulating their weight & achieving a healthy balance. It allows them to enhance underweight gain while preventing excessive weight gain. By understanding the epidemic or pattern of weight gain, appropriate programs can be put in place to minimize the risk of overweight gain.

Studies indicate that women do not meet the recommended weight gain as outlined in guidelines. Furthermore, health professionals often have inadequate awareness of the significance of sufficient weight gain. Pregnant woman should discuss their weight gain goals with their care providers at the start of their pregnancy & continue discussions to achieve their goal.

Observing gestational weight gain aids in identifying & treating complications that can complicate pregnancy, leading to improved well-being for both. Our study aims to specifically assess weight gain patterns & identify factors that influence it.

Efforts to obtain optimal weight gain during pregnancy may have to begin before conception. Additionally, those who are likely to have inadequate gain might profit from mediations targeting adjustable factors.

The findings of this study will play a crucial role in informing public health planners & implementers, guiding them in the planning & design of effective intervention strategies to optimize weight gain. By preventing both insufficient & unnecessary weight gain, these strategies aim to enhance the quality of antenatal care services delivered by healthcare professionals & other stakeholders. Furthermore, the results can provide valuable baseline data for researchers interested in this field.

2. Literature Review

GWG is the weight gained during gestation & is affected by the mother's pre-gestational weight, body mass index & weekly weight gain. This complex biological process is crucial for supporting fetal growth & development. Additionally, these factors have been found to influence the baby's birth weight, weight for length & body fat levels. (35)

2.1 Patterns of Gestational Weight Gain

2.1.1. Recommended gestational weight gain

The Institute of Medicine (IOM) classifies a healthy GWG of 12.5–18 kg, 11.5–16 kg, 7–11 kg, & 5–9 kg for underweight, normal, overweight, & obese women, respectively. Accordingly, weight gains below & above these recommendations are considered inadequate & excessive (36).

2.1.2. Obesity

Obesity is defined as BMI of 30 kilograms per meter square & above. The rate of obesity began to rise in high income countries during the final decades of the 20th century. In the United States, the rate of obesity amid reproductive age women (20-39 years) increased from 28.4% in 1999 to 34.0% in 2010. It's reported that prevalence of obesity among reproductive age women has not changed significantly between 2003 & 2012. However around 7.5% of these women have class 3 Obesity. Globally, age standardized BMI rose from 22.1 in 1975 to 24.4. In Europe around 50% of the population is either overweight or obese, with 23% of women classified as obese. In Southeast Asia, around 14% of the population is overweight & 3% is obese (37).

2.1.3. Malnutrition

Undernourishment during gestation is excessively prevalent in all of Africa. A study showed that the prevalence of malnutrition among pregnant women in Africa was 23.5%. The factors positively associated with maternal malnutrition were rural placement, low literacy of spouses, multifetal pregnancy, & poor nutritional indicators. In contrast, improved financial status showed a negative correlation with maternal malnutrition (38).

A research done in Ethiopia in June 2013 revealed 24% of surveyed mothers were malnourished. The determinants of malnourished women showed that those women with no ANC were 1.83 times more likely to be malnourished as compared to those women who had ANC. Homemakers were less likely to be malnourished compared to those working as pastoralists. Additionally, mothers whose no family member received TSF in the preceding 6 months were less likely to experience acute malnutrition compared to those from families that received TSF (39).

2.1.5. Inadequate Weight Gain

A study done in Bangladesh revealed that more than 50% of pregnant women did not achieve the recommended weight gain during the last trimester. The strongest associated risk factor was being short. BMI was negatively correlated with inadequate weight gain. Older maternal age, multiparity, poverty, illiteracy, consuming arsenic polluted water & conceiving during a dry season were all related with inadequate weight gain (40).

2.1.6. Multivitamin supplementation in pregnancy & weight gain

Addition of vitamins is believed to reduce low birth weight which might be due to its influence on weight gain during gestation. An RCT done on HIV-negative women from Tanzania in this area revealed that women who received multivitamins had around 250 gm higher weight gain & a greater weight gain of 59 gm every month compared to those on the control. Mothers in the first quartile for the total weight gain had infants with a mean birth weight of 3030 gm & those in the fourth quartile had an average birth weight of 3246 gm. This indicates that supplementation with vitamins led to the higher weight gain, which is a significant indication of birth weight (41).

2.1.7. Urbanization & western way of life in pregnancy with weight gain

A longitudinal study done on weight gain during pregnancy found that more than half of the women (57%) had a normal BMI, while one-third (39%) had a pre-pregnancy overweight. The average weight gain recorded in this study was around 11 kg. A third of the women experienced inadequate weight gain (28.7%), half had enough weight gain (49.6%) & around 21.7% had excessive gain (42).

A study done with the aim of assessing the trends of weight gain revealed that a vast number of women had less weight than the recommendation (96.6%). Only about 3% had appropriate gain & 0.3% had excessive weight gain. Around 2% of those who are underweight, 0.2% of those who have a normal weight & around 2.2% of those who are overweight have gained appropriate weight. Around 93% of obese women had the recommended weight; 6.7% gained above the recommendation (44).

A study done on overweight & obese women to assess their risk of delivering big babies identified 4 distinct GWG patterns. The first group included those who had smaller weight gain early in the pregnancy with increased weight gain in late pregnancy. The second group had high weight gain & had larger babies compared to the first group. The third group had lower weight gain initially & who later catch-up & have an increased likelihood of LGA babies. The fourth group had fast weight gain in the first & second trimesters followed by weight control & still had a higher risk of LGA compared to the first group (45).

A longitudinal study done on gestational weight gain revealed that the highest gain occurred between 26 weeks & 30 weeks of pregnancy with an average weight of 2.7 Kg. Approximately 19% of underweight women had weight gain above the recommendation. Around 57% of the normal weight women had normal weight gain. Additionally, 24% of overweight & obese women had inadequate weight & 18% had excessive weight gain. Only around 47% of them had adequate weight gain (46).

A research done in Brazil found that the average weight gain was around 12.3 kg. Obese women had smaller weight gain compared to normal, underweight, overweight or obese women. Less than a third of them had adequate weight gain & half of the women gained above the recommendation (47).

An analysis on Sub-Saharan African women revealed that weight gain had an average increment of 6.6 kilograms from an estimated weight of 57.1 kg prior to conception to 63.7 by the time of delivery.

In Africa, southern regions had highest pre conception weight while the Eastern regions had the lowest. The highest weight gain was observed in the Southern African region & the lowest was seen in western African regions. Low income countries had an average weight gain of 6.4 kg & corresponding level of countries in the middle or upper class was 6.8 kg (48).

A cross-sectional study done in Eastern Ethiopia, Harar regional state, showed that the average weight gain was 8.96 kg. Those who are underweight acquired 9.14 kg & those women who are obese gained 6.44 kg. However, majority of the women had insufficient weight gain & around 2.7% gained excessive weight. Among those who were underweight, 7.7%, among those who had normal BMI around 24%, among those overweight around half & approximately 62% of those who were obese had appropriate weight gain (49).

A study conducted including 369 women who had ANC visit in health centers in Addis Ababa revealed that the average weight gain to be 8.7 kg. Around 67% had insufficient weight gain, about 28% had adequate weight gain & around 4.9% had undue weight gain. Around 75% of those who were underweight had insufficient gain while 43% of those overweight or obese had insufficient gain. Having normal or underweight increased the risk of insufficient gain compared to their counterparts (50).

2.2 Determinant Factors for GWG

A study done to determine predictors of delivery weight in Ghana revealed that maternal diet & weight gain during pregnancy had an effect. Underweight women were at higher risk of delivering low birth weight neonates as are those women who did not achieve the recommended weight gain (43).

An observational study done in Nigeria revealed that adolescents were more likely to gain excessive weight compared to young or mature women. Additionally, pregnant women with higher educational attainment were more likely to experience excessive weight gain than those with lower educational levels. Employed women also had a higher incidence of excessive weight gain compared to their unemployed counterparts. Nonetheless, the rates of excessive weight gain among underweight, normal weight, & overweight women were comparable (44).

A longitudinal study done on the determinants of weight gain revealed that for every 1 kg increment in weight, there's decrement of gestational weight by around 45 grams. Additionally,

an increase in the number of previous pregnancies was associated with an average decrease in gestational weight of 786 grams. Conversely, for each additional week of gestational age, there was an average increase in weight of 310 grams per week (46).

A cross-sectional study done in Eastern Ethiopia revealed that women with a higher BMI in early pregnancy were more likely to achieve adequate weight gain compared to underweight mothers. Women who consumed vegetables, fruits or meat were more likely to gain adequate weight than those who did not. Women who participated in various physical activities had a higher likelihood of achieving adequate weight gain. Similarly, women who delivered at term or had at least 4 ANC visits were more likely to gain adequate weight (49).

2.3 Conceptual framework

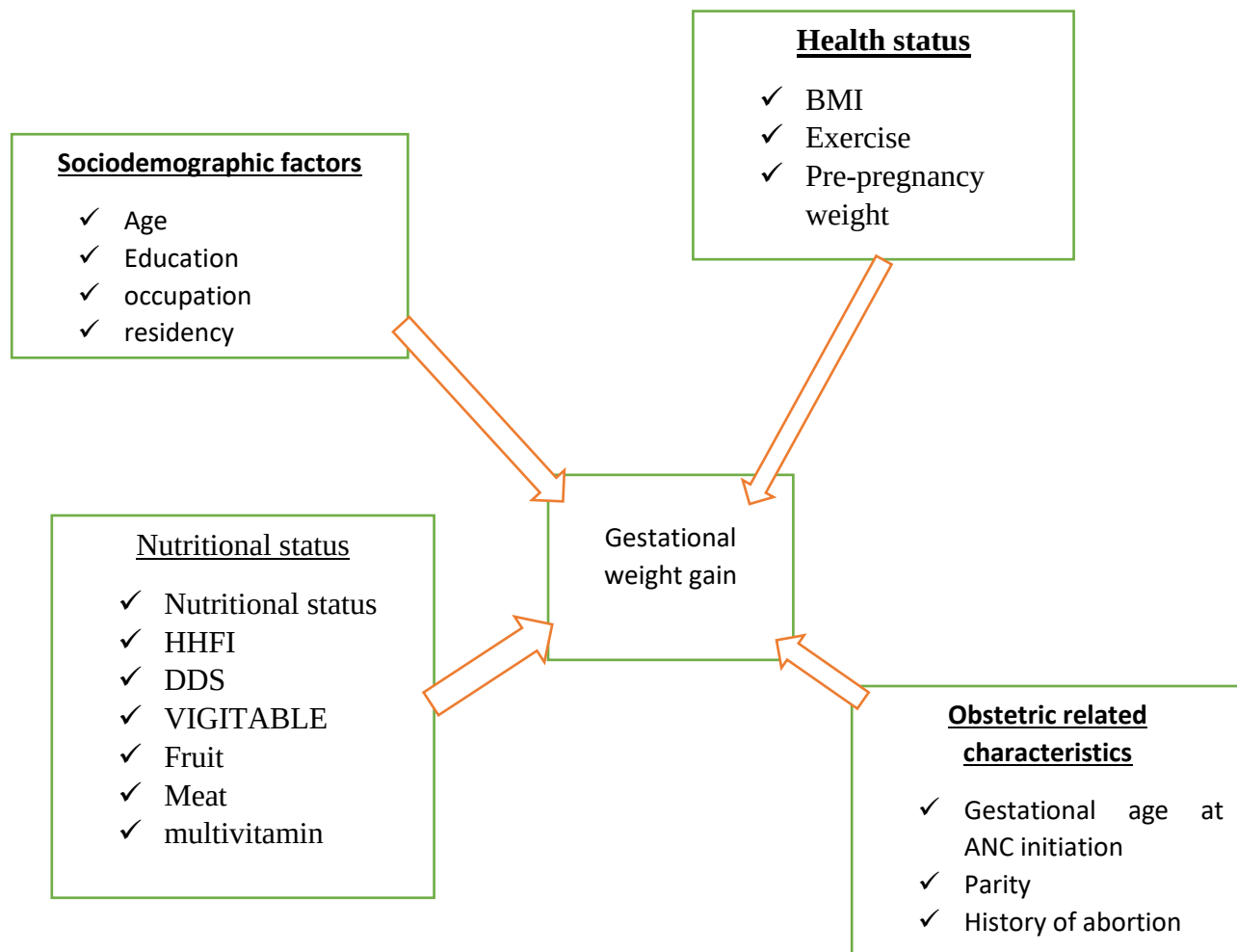


Figure 1: The conceptual framework adopted from the literature by the author

3. OBJECTIVE

3.1 General objective

Assessment of the patterns & determinants of gestational weight gain among women having ANC visits in selected government hospitals in Addis Ababa.

3.2 Specific objectives

- I. To determine the patterns of gestational weight gain among women attending ANC visits in selected hospitals in Addis Ababa.
- II. To identify the determinants of gestational weight gain among women attending antenatal care visits in hospitals in Addis Ababa.

4. Methods

4.1 Study Area & Period

The research was completed in GMH, ZMH, & TASH & the total duration was conducted from December 1, 2023 to May 30, 2024.

4.2 Study Design

A facility-based cross-sectional design was conducted.

4.3 Source Population

All pregnant women who have antenatal visits in GMH, ZMH, & TASH of the three teaching hospitals of AAU.

4.4 Study Population

Pregnant women gestational age ≥ 37 weeks & have antenatal visits in GMH, ZMH, & TASH of three teaching hospitals of AAU.

4.5 Inclusion & Exclusion Criteria

4.5.1 Inclusion criteria

Participants who know pre-pregnancy weight or have recorded weight in the first trimester of pregnancy.

4.5.2 Exclusion criteria

- ✓ Participants who do not give consent
- ✓ Unknown pre-pregnancy or first trimester weight
- ✓ Gestational age < 37 weeks
- ✓ Multifetal Pregnancy
- ✓ Chronic Medical Illness
- ✓ Hyperemesis Gravidarum

4.6 Sample Size Determination

To determine the sample size, single proportion formula was used.

$$n = \frac{(Z_{\alpha/2})^2 p (1-p)}{d^2}$$

Where: n = desired sample size

z = value at 95% confidence interval (CI)

p = pattern of GWG

d = margin of error

The Z value at 95% CI is 1.96 (from significance level $\alpha = 5\%$). Since 67.2% of the study participants had inadequate weight gain (50), the tolerated margin of error is 5%.

Therefore,

$$n = \frac{(1.96)^2 (0.672) (1-0.672)}{(0.05)^2} = 338$$

Adding 10% non-response rate, the total sample size calculated to be 372 participants.

4.7 Sampling technique

The sample size was proportionally allocated to the respected study area based on the patient flow, & after adjusting the sample size in the six-month period, the data was collected using a simple random sampling method.

4.8 Study Variables

4.8.1 Dependent Variable

- Patterns of gestational weight gain

4.8.2 Independent Variables

- Sociodemographic characteristics
- Reproductive characteristics
- Eating habit & physical exercise
- Health-related characteristics

4.9 Data Collection Method

The questionnaire was adapted from the existing literature by the author, & a structured, pretested questionnaire was prepared in English. Potential participants were selected sequentially by the data collectors (trained interns, BSc nurses or residents) after the mother has completed her ANC visit. Once the patient is taken to a separate room, the interviewer obtains oral informed consent to collect the questionnaire & to also review medical records for information such as first trimester weight & hemoglobin & signs the consent form. The data was then collected through interviewer administration.

4.10 Data Quality Control Measures

The questionnaire was pretested on 5% of the study population to ensure clarity, wording, logical sequence, & skip patterns of the questions. Every day the filled questionnaires were checked before a respondent went from the setting by data collectors & a supervisor. The principal investigator controlled the data collection procedure. The data collectors had close supervision & honest communication, & there was on-the-spot decision in the data collection phase.

4.11 Data Processing & Analysis

Collected data were checked for completeness, consistency, clarity, & missed values were entered into EPI-info version 4.6.0.0. Then cleaned & coded data was exported to SPSS version 25 for data management & further statistical analysis. Frequency counts were performed to

assess the completeness of all variables. Ninety-five percent confidence interval was used to correlate outcome variables with independent variables. All tests were two-sided, & statistical significance was set at $p\text{-value} < 0.05$.

4.12 Operational Definitions

- ✓ **BMI** based on WHO cut-off points as underweight ($\text{BMI} \leq 18.5 \text{ kg/m}^2$); normal weight (18.6 to 24.9 kg/m^2); overweight (25.0 to 29.9 kg/m^2); & obese ($\geq 30.0 \text{ kg/m}^2$).
- ✓ **Gestational weight gain according to the IOM** classification a healthy GWG of 12.5–18 kg, 11.5–16 kg, 7–11 kg, & 5–9 kg for underweight, normal, overweight & obese women respectively. Accordingly, weight gains below & above these recommendations are considered inadequate & excessive.
- ✓ **Total weight gain in pregnancy** is estimated by subtracting the prepregnancy weight from the last measured weight before delivery.
- ✓ **Dietary diversity** of the women was assessed using a minimum dietary diversity-women (MDD-W) set from the Food & Agricultural Organization (FAO) & USAID's Food & Nutrition Technical Assistance III Project (FANTA). The food groups assessed in MDD-W include: grains, white roots, tubers & plantains; pulses; nuts & seeds; dairy; meat, poultry & fish; eggs; vegetables; other vitamin A-rich fruits & vegetables; other vegetables; & other fruits. The MDD-W is a dichotomous indicator of whether or not women have consumed at least five out of ten defined food groups the previous day or night. The proportion of women who reach this minimum can be used as a proxy indicator for higher micronutrient adequacy. (53)
- ✓ **Household food insecurity** is a lack of consistent access to enough food for an active, healthy life; Hunger refers to a personal, physical sensation of discomfort, while food insecurity refers to a lack of available financial resources for food at the household level. & household food insecurity will be measured by the nine questions of the Household Food Insecurity Access Scale. (54)

4.13 Ethical Considerations

The proposal was submitted to my advisors for feedback & approval before conducting the study; then ethical approval was requested from DRPC, & an official letter of approval was obtained from the department of obstetrics & gynecology. The significance of the study was communicated to the participants. To facilitate this, a consent letter was included on the cover page of each questionnaire. The oral informed consent was obtained after the objectives of the study.

The benefits & risks of the study were explained to study participants. Participation is voluntary; confidentiality & private information were not requested from the participants. The respondent's right to withdraw from the interview or decline participation was upheld. The information collected from the study subjects was kept confidential & was used only for the study & management of the patient.

4.14 Dissemination Plan & Use of Findings

The result of the study is to be presented to TASH, Department of Obstetrics & Gynecology. The final report will be submitted to the Department of Obstetrics & Gynecology. Moreover, efforts will be made to publish the findings of the study & disseminate them through different journals & scientific publications.

5. Result

5.1 Sociodemographic characteristics of the study participants

In this study, 361 study participants were involved, making a response rate of 97%. The majority (42.7%) of the study participants were in the age group of 25-29 years with a mean & SD of 28.32 ± 4.75 years, respectively. Almost all (94.7%) of the study participants were married, & 90.9% were from Addis Ababa. Thirty-seven percent of the study participants have attended secondary education level, & 58.2% were housewives. Fifty-six percent of the partners were private employees, & 45.4% of them had a household monthly income of >10000 ETB. Regarding their physical activity, 48.5% of the participants were standing for long periods.

Table 1. The sociodemographic characteristics of the study participants among Women Attending ANC in Selected Hospitals in Addis Ababa, 2024

Variable	Frequency	Percent
Age in years		
18-24	75	20.8
25-29	154	42.7
30-34	82	22.7
≥ 35	50	13.9
Marital status		
Single	19	5.3
Married	342	94.7
Residence		
Addis Ababa	328	90.9
Out of Addis Ababa	33	9.1
Educational status		
No formal education	29	8.0
Primary	116	32.1
Secondary	134	37.1
College & above	82	22.7
Partners educational status		
No formal education	18	5.0
Primary	106	29.4
Secondary	137	38.0
College & above	100	27.7
Occupational status		
Unemployed	15	4.2
Housewife	210	58.2
Government/private employee	116	32.1

Merchants	13	3.6
Daily laborer	7	1.9
Partners occupation		
Unemployed	15	4.2
Government employee	63	17.5
Private employee	203	56.2
Merchant	32	8.9
Daily laborer	48	13.3
Household monthly income		
<5000	58	16.1
5000-10000	139	38.5
>10000	164	45.4
Family size in the household		
1-3	208	57.6
≥4	153	42.4
Number of under five children		
None	187	51.8
One	150	41.6
Two	24	6.6

5.2 Physical activity related characteristics of the pregnant women

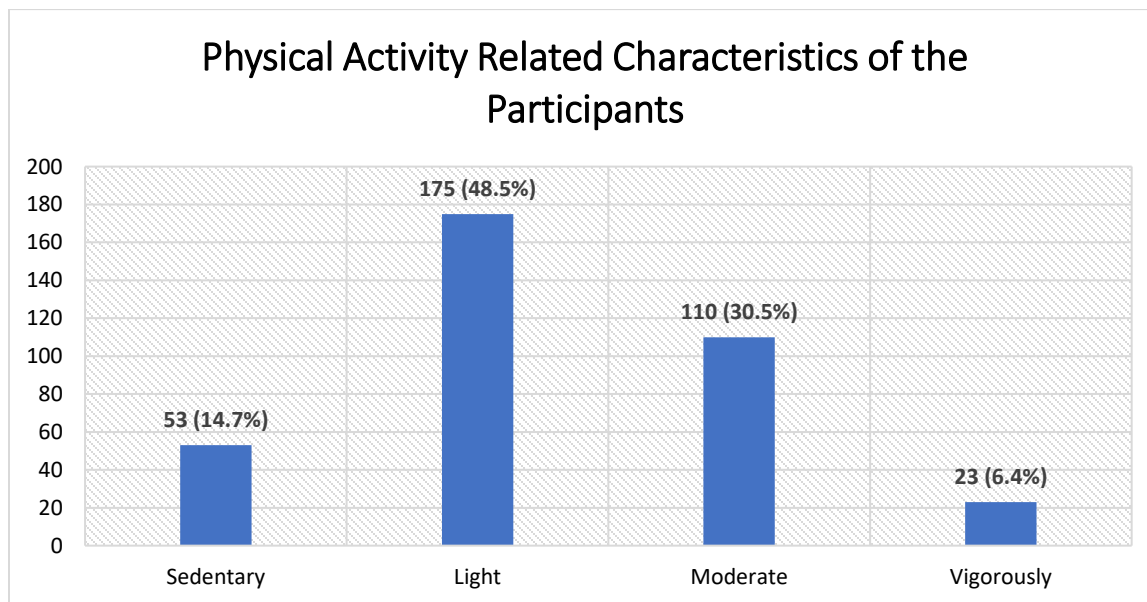


Figure 2. Physical activity related characteristics of the pregnant women

5.2 Obstetric characteristics of the study participants

Sixty-three percent of the study participants were multigravida, & 92% were multiparous. Ten percent of the study participants had a history of abortion, & of those, 86.5% of them had one abortion. Ninety-six percent of the current pregnancies were wanted, 99.7% were supported, & 89.8% were planned. Almost sixty-seven percent of the study participants initiated antenatal care after 12 weeks of gestation, & 6.9% of the participants had a hemoglobin level of <11 mg/dl. The findings of the study also showed that 96.1% of the study participants have received an iron supplement or multivitamin during pregnancy.

Table 2. Obstetric-related characteristics of the study participants

Variable	Frequency	Percent
Gravidity		
Primigravida	112	31.0
Multigravida	228	63.2
Grand multigravida	21	5.8
Parity		
Nulliparous	12	5.1
Multiparous	218	92.0
Grand multiparous	7	3.0
Abortion		
Yes	37	10.2
No	324	89.8
Number of abortion (n = 37)		
1	32	86.5
2	3	8.1
≥ 3	2	5.4
Pregnancy condition		
Wanted	347	96.1
Unwanted	14	3.9
Was the pregnancy supported?		
Yes	360	99.7
No	1	0.3
Types of pregnancy		
Planned	324	89.8
Unplanned	37	10.2
Gestational age at ANC initiated		
≤12	113	31.3
>12	248	68.7
Hemoglobin		
≥11	25	6.9
>11	336	93.1

Received iron or multivitamin during pregnancy		
Yes	347	96.1
No	14	3.9

5.3 Food group consumed in the last 24 hours

Thirty percent of the study participants have achieved the minimum dietary diversity. Eighty-five percent consumed grain; 17.5% of them had white roots, tubers & plantains; 31.3% had eaten pulses; & 36% of them had consumed milk & milk products in the past 24 hours. Around 34% had eaten meat & meat products, 28% had eggs, 23.3% had vegetables, 37.4% had fruits, & 75.3% consumed any food made of oil or fat in the previous day or night.

Table 3. The dietary diversity score of the study participants

Variable	Frequency	Percent
Achieved minimum DDS		
Yes	109	30.2
No	252	69.8
Food from grain		
No	53	14.7
Yes	308	85.3
White roots, tubers & plantains		
No	298	82.5
Yes	63	17.5
Pulses (bean, peas & lentils)		
No	248	68.7
Yes	113	31.3
Milk & Milk products		
No	231	64.0
Yes	130	36.0
Meat & Meat products		
No	238	65.9
Yes	123	34.1
Eggs		
No	260	72.0
Yes	101	28.0
Vegetables		
No	277	76.7
Yes	84	23.3
Fruits		
No	226	62.6
Yes	135	37.4
Any food made with oil & fat		
No	89	24.7

Yes	272	75.3
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5.4 Household food insecurity assessment scale related characteristics of the study participants

Around half (48.8%) of the study participants had household food insecurity. Regarding the specific HHFI assessment score, 17.5% of the study participants would worry about food, 20.2% were unable to eat preferred foods, 34.3% had eaten a limited variety of food, 8% would eat food that really did not want to eat, 24.7% would eat a smaller meal & 16.1% of the participants would consume fewer meals in a day.

Table 4. Household food insecurity assessment scale-related characteristics of the study participants

Variable	frequency	Percent
HHFI		
Yes	176	48.8
No	185	51.2
Worry about food		
No	298	82.5
Yes	63	17.5
Unable to eat preferred foods		
No	288	79.8
Yes	73	20.2
Eat a limited variety of foods		
No	237	65.7
Yes	124	34.3
Eat foods that you really did not want to eat		
No	332	92.0
Yes	29	8.0
Eat a smaller meal		
No	272	75.3
Yes	89	24.7
Eat fewer meals in a day		
No	303	83.9
Yes	58	16.1
No food to eat of any kind in the household		
No	353	97.8
Yes	8	2.2
Go to sleep at night hungry		
No	343	95.0
Yes	18	5.0
Go a whole day & night without eating any thing		
No	343	95.0

Yes	18	5.0
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5.5 Weight-related characteristics of the study participants

The minimum, maximum, & mean pre-pregnancy weight were 38kg, 101kg & 56.5kg respectively & the minimum, maximum & mean weight at term of pregnancy were 46, 113 & 67.17 kg respectively. Almost sixty-eight percent & forty-two percent of the study participants had normal BMI during pre-pregnancy & term pregnancy respectively.

Table 5.Weight related characteristics of the study participants

Variable	frequency	Percent
Pre-pregnancy or First Trimester Weight		
Mean	56.48	
Minimum	38	
Maximum	101	
Weight at Term		
Mean	67.17	
Minimum	46	
Maximum	113	
Pre-pregnancy BMI		
Underweight	41	11.4
Normal	245	67.9
Overweight	58	16.1
Obese	17	4.7
BMI at term		
Normal	153	42.4
Overweight	136	37.7
Obese	72	19.9

5.6 Patterns of weight gain at term of the pregnancy

The findings of the study revealed that 52% of them had inadequate weight gain, 22% had excessive weight gain, & 26% had normal weight gain. The mean, minimum & maximum weight gains were 10.8 kg, 2 kg, & 33kg respectively.

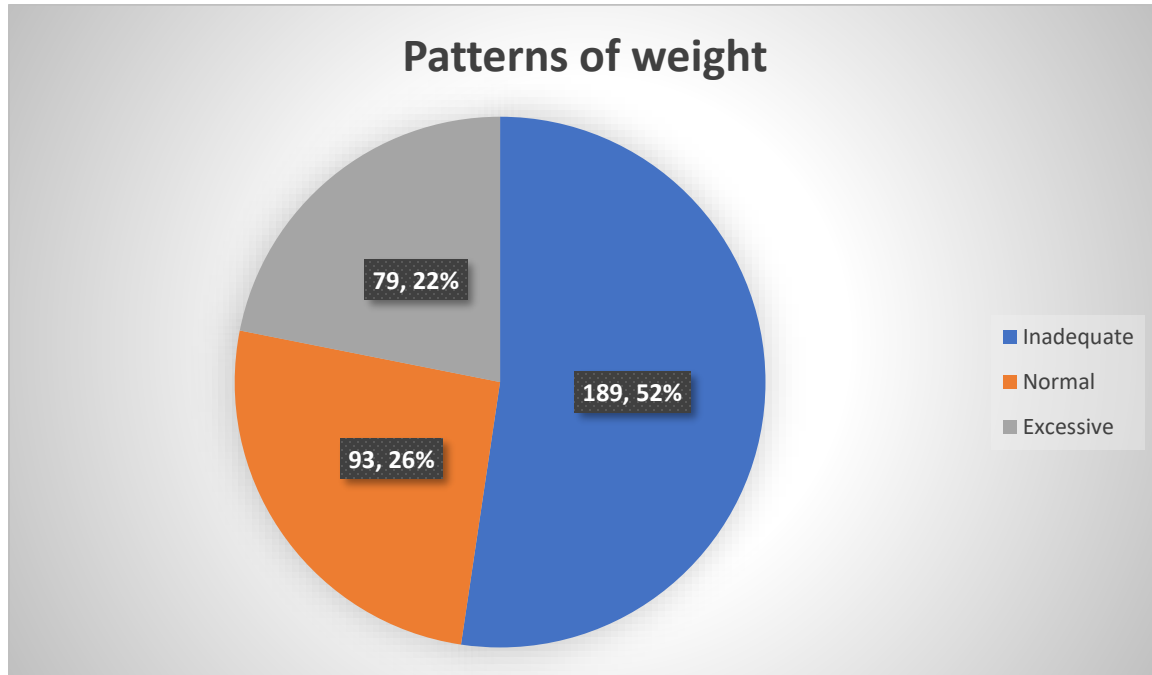


Table 6. The pattern of weight gain of the study participants

5.7 The pre-pregnancy body mass index & its weight gain

Pre-pregnancy body mass index	Average weight gain					
	Mean	Median	Minimum	Maximum	N	Std. Deviation
Underweight	11.78	12.0	4.00	20.0	41	3.81
Normal	11.15	10.0	2.00	33.0	245	5.99
Overweight	9.41	8.50	2.00	21.0	58	5.25
Obese	8.35	9.0	2.00	18.0	17	4.255
Total	10.82	10.0	2.00	33.0	361	5.65

5.8 The relation between patterns of weight gain with pre-pregnancy weight gain

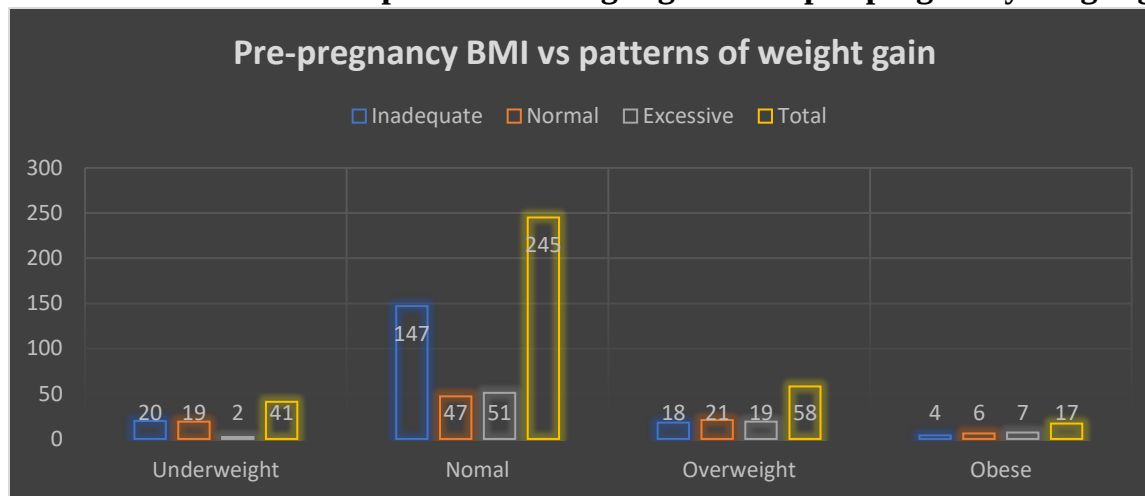


Figure 3. The relation between pre-pregnancy BMI & weight gain

5.9 The determinant factors of normal weight gain during pregnancy

The study finding revealed that age, residency, pregnancy status, DDS, & pre-pregnancy BMI were associated with pregnancy weight gain by bivariate logistic regression. The multivariate logistic regression revealed that study participants whose age was ≥ 35 years were 5.1 folds more likely to have normal weight gain compared to those aged 18-24 years (AOR=5.1, 95% CI=1.92, 13.43) & study participant who resided outside Addis Ababa were 8.4 folds more likely to have normal weight gain compared to those residing inside Addis Ababa (AOR=8.4, 95%CI=3.49, 13.43). Study participant who achieved a minimum DDS were 4.1 folds more likely to have normal weight gain compared to those who haven't achieved a minimum DDS (AOR=4.1, 95% CI=2.22, 7.28) & study participant who had normal pre-pregnancy BMI were 58% less likely to have normal weight gain compared to those who were underweight during pre-pregnancy period (AOR=0.42, 95%CI=0.19, 0.92).

Table 7. The bivariate & multivariate association of weight gain among pregnant women in selected hospitals of Addis Ababa.

Variable	Weight gain		p-value	COR with 95%CI	P-value	AOR with 95%CI
	Normal	abnormal				
Age in years						
18-24	16	59	1		1	
25-29	32	122	0.923	0.97(0.49, 1.90)	0.711	0.86(0.39, 1.88)
30-34	22	60	0.423	1.4(0.65, 2.83)	0.214	1.7(0.73, 4.09)
>=35	23	27	0.004	3.1(1.43, 6.88)	0.001	5.1(1.92, 13.43)
Residence						
Addis Ababa	74	254	1		1	
Out of Addis Ababa	19	14	0.000	4.7(2.23, 9.74)	0.000	8.4(3.49, 20.29)
Education status						
No formal education	6	23	1		1	
Primary	23	93	0.917	0.95(0.35, 2.59)	0.571	0.71(0.22, 2.31)
Secondary	35	99	0.542	1.4(0.51, 3.60)	0.926	1.1(0.33, 3.40)
College & Above	29	53	0.149	2.1(0.77, 5.74)	0.417	1.6(0.49, 5.41)
Types of Pregnancy						
Planned	90	234	0.017	4.4(1.31, 14.55)	0.027	4.2(1.18,14.76)
Unplanned	3	34	1		1	
Initiated ANC in weeks						
≤12	34	79	0.205	1.4(0.84, 2.27)	0.313	1.4(0.75, 2.45)
>12	59	189	1		1	
Achieved minimum dietary diversity						
Yes	45	64	0.000	2.9(1.82, 4.89)	0.000	4.1(2.22, 7.28)
No	48	204	1		1	
Pre-pregnancy BMI						
Under weight	19	22	1		1	
Normal	47	198	0.000	0.28(0.14, 0.55)	0.031	0.42(0.19, 0.92)
Overweight	21	37	0.312	0.66(0.29, 1.48)	0.559	0.76(0.29, 1.92)
Obese	6	11	0.441	0.63(0.19, 2.03)	0.218	0.41(0.09, 1.70)

5.10 The determinants of inadequate & excessive weight gain

The multivariate logistic regression of inadequate weight gain found that study participants whose age is ≥ 35 years were 83% less likely to have inadequate weight gain compared to those in the age range of 18-24 years, & study participants who resided out of Addis Ababa were 89% less likely to have inadequate weight gain compared to those residing in Addis Ababa (AOR=0.11, 95%CI = 0.04, 0.29). Study participants who didn't achieve minimum DDS were 3.8 times more likely to have inadequate weight gain compared to their opposite compartments (AOR=3.8, 95%CI=1.98, 7.46).

On the other hand, multivariate logistic regression of excessive weight gain revealed that study participants who were from out of Addis Ababa were 92% less likely to have excessive weight gain compared to those from Addis Ababa (AOR=0.08, 95%CI=0.01, 0.41) & study participants who had unplanned pregnancy had a 4.1-fold increased likelihood of excessive weight gain compared to their opposite counterparts (AOR=4.1, 95%CI=1.87, 18.64). The study participants who had not achieved minimum DDS had 4.4-fold increase in excessive weight gain compared to those who gained minimum DDS (AOR=4.4, 95%CI=1.88, 10.26). The study participants who were normal weight, overweight, or obese were 6.1, 5.9, & 11.6 times more likely to have excessive weight gain compared to those who were underweight prior to pregnancy.

Table 8. The determinants of gestational weight gain among women who have ANC follow up at the third trimester of pregnancy.

Variable	Inadequate	Normal	Excessive	Inadequate vs adequate			Excessive vs adequate		
				COR	AOR	p-value	COR	AOR	P-value
Age in years									
18-24	44	16	15	1	1		1	1	
25-29	93	32	29	1.1(0.53, 2.23)	1.3(0.55, 2.87)	0.597	0.97(0.41, 2.29)	1.1(0.33, 3.12)	0.984
30-34	34	22	26	0.56(0.26, 1.23)	0.46(0.17, 1.24)	0.124	1.3(0.51, 3.12)	1.1(0.33, 3.13)	0.979
>=35	18	23	9	0.29(0.12, 0.66)	0.17(0.06, 0.51)	0.002	0.42(0.15, 1.19)	0.26(0.06, 1.04)	0.056
Marital									
Single	6	6	7	1	1		1	1	
Married	183	87	72	2.1(0.66, 6.71)	1.9(0.49, 7.52)	0.340	0.71(0.23, 2.21)	0.4(0.09, 1.74)	0.221
residence									
Addis Ababa	177	74	77	1	1		1		
out of Addis Ababa	12	19	2	0.26(0.12, 0.57)	0.11(0.04, 0.29)	0.000	0.1(0.02, 0.45)	0.08(0.01, 0.41)	0.003
Education level									
no formal education	17	6	6	1	1		1	1	
Primary	67	23	26	1.1(0.36, 2.92)	2.4(0.70, 8.41)	0.162	1.1(0.32, 3.99)	0.45(0.09, 2.22)	0.324
Secondary	72	35	27	0.73(0.26, 2.00)	1.7(0.49, 5.61)	0.422	0.77(0.22, 2.66)	0.35(0.07, 1.68)	0.189
College & above	33	29	20	0.40(0.14, 1.16)	0.69(0.19, 2.44)	0.565	0.69(0.19, 2.45)	0.35(0.07, 1.75)	0.203
Types of pregnancy									
Planned	164	90	70	1	1		1	1	
Unplanned	25	3	9	4.6(1.34, 15.57)	3.5(0.90, 13.84)	0.070	3.9(1.0, 14.78)	4.1(1.87, 18.64)	0.034
History of abortion									
Yes	16	8	13	0.98(0.40, 2.39)	1.4(0.45, 4.10)	0.579	2.1(0.82, 5.34)	1.6(0.50, 5.37)	0.410
No	173	85	66	1	1		1	1	
GA of ANC initiated									
≤12	45	34	34	1	1		1	1	
>12	144	59	45	1.8(1.08, 3.16)	1.9(0.96, 3.71)	0.062	0.76(0.41, 1.41)	0.67(0.30, 1.48)	0.323
Achieved minimum DDS									
Yes	46	45	18	1	1		1	1	
No	143	48	61	2.9(1.72, 4.93)	3.8(1.98, 7.46)	0.000	3.2(1.63, 6.18)	4.4(1.88, 10.26)	0.001
Pre-pregnancy BMI									
Underweight	20	19	2	1	1		1	1	
Normal	147	47	51	2.9(1.46, 6.03)	1.5(0.66, 3.57)	0.323	10.3(2.28, 46.6)	6.1(1.16, 32.28)	0.033
Overweight	18	21	19	0.81(0.34, 1.98)	0.63(0.22, 1.82)	0.390	8.6(1.76, 41.88)	5.9(1.06, 35.37)	0.043
Obese	4	6	7	0.63(0.15, 2.60)	1.2(0.23, 5.89)	0.852	11.1(1.79, 68.39)	11.6(1.38, 27.33)	0.024

6. Discussion

In this study only 26% of the study participants had normal weight gain. This finding was similar with the study done in Addis Ababa (27.9%) (50). The finding of the study revealed that 22% had excessive weight gain. This finding was higher than a study done in Addis Ababa (4.9%) (50). The finding of the study showed that 52% of the study participants had inadequate weight gain which is similar with the study done in Bangladesh (54%) (40). This finding is however higher than the study done in Ghana (17.8%), Tamale Metropolis (96.9%), & study done by Wei Zhenga (24%), (43, 44, 46). The finding is also lower than the study done in Eastern Ethiopia, Harar regional state (69.3%), health centers in Addis Ababa (67.2%) (49-50). This difference in weight gain may be due to differences in age, nutritional intake, dietary habits, variations in diet, calorie intake, & nutritional quality that can influence weight gain. The other difference was also due to different levels of physical activity & exercise among pregnant women, genetic predispositions & metabolic rates, pre-existing conditions such as diabetes & hypertension, & the type & frequency of prenatal care & advice provided by healthcare providers.

The finding of the study also revealed that the mean weight gain during pregnancy of women who were underweight during pre-pregnancy was 11.78 kg, for those with normal weight it was 11.15 kg, for those who were overweight it was 9.41 kg, & for obese women it was 8.35 kg. This all-mean weight gain pattern regarding the pre-pregnancy weight was under the category of IOM classification. The finding of the study is also similar to the study done in Eastern Ethiopia, Harar regional state (36, 49). This was due to the caloric & nutritional requirements during pregnancy being well-defined & consistent, leading to similar weight gain patterns when nutritional intake meets these needs.

Study participants whose age was 35 years & above were 5.1 folds more likely to have normal weight gain compared to those who are in the age range of 18-24 years (AOR=5.1, 95%CI=1.92, 13.43). One explanation could be that older women may be more likely to attend prenatal check-ups & adhere to medical advice, which helps in monitoring & maintaining appropriate weight gain.

With age, women might have developed better dietary habits & are more conscious of their nutritional intake, ensuring they meet the dietary requirements necessary for healthy gestational weight gain.

Study participants whose residence is outside of Addis Ababa had an 8.4-fold increase in normal weight gain compared to their opposite compartment (AOR=8.4, 95%CI=3.49, 13.43). This may be due to urban areas often have greater access to a variety of foods, including fresh fruits, vegetables, lean proteins, & whole grains, supporting balanced & nutritious diets.

Study participants who achieved a minimum DDS were 4.1 times more likely to have normal weight gain compared to their opposite counterparts (AOR=4.1, 95%CI=2.22, 7.28). This finding was in line with the study done in Eastern Ethiopia, Harar regional state (49). This may be due to the fact that a diverse diet ensures a wide range of essential nutrients, including vitamins, minerals, proteins, carbohydrates, & fats, which are crucial for healthy weight gain during pregnancy. Consuming a variety of foods helps obtain both macronutrients (carbohydrates, proteins, & fats) & micronutrients (vitamins & minerals) necessary for fetal growth & maternal health.

Study participants who had normal pre-pregnancy BMI were 58% less likely to gain weight compared to those of underweight in pre-pregnancy BMI (AOR=0.42, 95%CI=0.19, 0.92). This finding was in line with the study done in Eastern Ethiopia, Harar regional state (49). Women with a normal BMI might have a higher metabolic rate, requiring more calories to maintain their weight & support pregnancy, & may not meet these increased caloric needs.

Study participants who had unplanned pregnancy were 4.1 times more likely to have excessive weight gain compared to those who had a planned pregnancy (AOR=4.1, 95%CI=1.87, 18.64). This could be due to women with unplanned pregnancies might not have optimized their health or weight before conception, potentially leading to less optimal weight gain patterns. Women with unplanned pregnancies might not be as informed or prepared about the dietary & nutritional needs during pregnancy, leading to overeating or poor food choices.

7. Conclusion

The finding of this study revealed that the mean weight gain of women who are underweight pre-conceptually was 11.78 kg, & for those with normal weight was 11.15 kg. Overweight women had a mean weight gain of 9.41 kg & obese women had a mean weight gain of 8.35 kg. The finding of the study also revealed that 52% of them had inadequate weight gain, 22% had excessive weight gain & 26% had normal weight gain. The mean, minimum & maximum gained of weight were 10.8 kg, 2 kg & 33 kg, respectively. The determinant factors of normal weight gain were age ≥ 35 years compared to those aged 18-24 years (AOR=5.1), residence outside Addis Ababa compared to those residing in Addis Ababa (AOR=8.4), having achieved a minimum DDS (AOR=4.1) & normal pre-pregnancy BMI (AOR=0.42). The determinants of inadequate weight gain were age of ≥ 35 years (AOR=0.17), residency of out of Addis Ababa (AOR=0.11) & didn't achieve minimum DDS (AOR=3.8). On the other h&, determinants of excessive weight gain were unplanned pregnancy (AOR=4.1), had not achieved minimum DDS (AOR=4.4). Women who had normal weight, overweight, & obese Pre-pregnancy were 6.1, 5.9 & 11.6 times more likely to have excessive weight gain compared to those who were underweight in pre-pregnancy.

9. Recommendations

The finding of the study indicates that the level of normal gestational weight gain was low (26%). Thus, ensuring adequate gestational weight gain is crucial for the health of both the mother & the baby. Therefore, the recommendation of this study was goes to

- Younger women: To schedule & attend regular prenatal visits to monitor weight gain & overall health.
- For those women who live in urban areas: - incorporate cultural dietary preferences while ensuring nutritional balance during pregnancy. Discuss any traditional practices related to pregnancy with healthcare providers for guidance & support.
- For those who do not achieve DDS: - I recommend to the government, non-governmental organizations, & other concerned to support those pregnant women who didn't afford to get the minimum dietary diversity.

References

1. Institute of Medicine. Weight gain during pregnancy: reexamining the guidelines. Washington DC: National Academy Press; 2009.
2. Paatikainen K, Heiskanen N, Heinonen S. Transition from overweight to obesity worsens pregnancy outcome in a BMI-dependent manner. *Obesity*.2006;14:165–71.
3. Cunningham, F., Leveno, K., Bloom, S., Spong, C. Y. & Dashe, J. (2014). *Williams obstetrics*, 24e. Mcgraw-hill, 254.
4. Brawarsky, P., Stotland, N., Jackson, R., Fuentes-Afflick, E., Escobar, G., Rubashkin, N., & Haas, J. (2005). Pre-pregnancy & pregnancy-related factors & the risk of excessive or inadequate gestational weight gain. *International Journal of Gynecology & Obstetrics*, 91(2), 125–131. <https://doi.org/10.1016/j.ijgo.2005.08.008>.
5. Asvanarunat, E. (2014). Outcomes of gestational weight gain outside the Institute of Medicine Guidelines. *Journal of the Medical Association of Thailand*, 97(11), 1119–1125
6. Catalano, P. M., & Shankar, K. (2017). Obesity & pregnancy. *BMJ*, 281, j1.
7. Rooney, B. L., & Schauburger, C. W. (2002). Excess pregnancy weight gain & long-term obesity: One decade later. *Obstetrics & Gynecology*, 100(2), 245–252. <https://doi.org/10.1097/00006250-200208000-00008>.
8. Council NR. Weight gain during pregnancy: reexamining the guidelines: NAP; 2010.
9. Rasmussen T, Stene LC, Samuelson SO, Cinek O, Wetlesen T, Torjesen PA, et al. Maternal BMI before pregnancy, maternal weight gain during pregnancy, & risk of persistent positivity for multiple diabetes-associated autoantibodies in children with the high-risk HLA genotype: the MIDIA study. *Diabetes Care* 2009;32(10):1904–6.
10. Tsai IH, Chen CP, Sun FJ, Wu CH, Yeh SL. Associations of the pre-pregnancy body mass index & gestational weight gain with pregnancy outcomes in Taiwanese women. *Asia Pac J Clin Nutr*. 2012;21(1):82–7.
11. Kim SY, Sharma AJ, Sappenfield W, Wilson HG, Salihu HM. Association of maternal body mass index, excess weight gain, & gestational diabetes mellitus with large-for-gestational-age births. *Obstet Gynecol*. 2014 Apr;123(4):737–44.
12. [Ashley-Martin J, Woolcott C. Gestational weight gain & postpartum weight retention in a cohort of Nova Scotian Women. *Matern Child Health J*. 2014;18(8):1927–35.

13. Asefa F, Nemomsa D. Gestational weight gain & its associated factors in Harari Regional State: Institution based cross-sectional study, Eastern Ethiopia. *BMC Reprod Health*. 2016;13(1):1–7.
14. Begum F, Colman I, McCargar LJ, Bell RC. Gestational weight gain & early postpartum weight retention in a prospective cohort of alberta women. *J Obstet Gynaecol Can*. 2012;34(7):637–47.
15. Restall A, Taylor RS, Thompson JD, Flower D, Dekker GA, Kenny LC, Poston L, McCowan LE. Risk factors for excessive gestational weight gain in a healthy, Nulliparous Cohort. *J Obes*. 2014. <https://doi.org/10.1155/2014/148391>.
16. Johnson J, Clifton RG, Roberts JM, Myatt L, Hauth JC, Spong CY, Varner MW, Wapner RJ, Thorp JM, Mercer BM, et al. Pregnancy outcomes with weight gain above or below the 2009 institute of medicine guidelines. *Obstet Gynecol*. 2013;121(5):969–75.
17. Begum F, Colman I, McCargar LJ, Bell RC. Gestational weight gain & early postpartum weight retention in a prospective cohort of alberta women. *J Obstet Gynaecol Can*. 2012;34(7):637–47.
18. Asefa F, Cummins A, Dessie Y, Hayen A, Foureur M. Gestational weight gain & its effect on birth outcomes in sub-Saharan Africa: systematic review & meta-analysis. *PLoS ONE*. 2020;15(4):1–23.
19. Wang D, Wang M, Darling AM, Perumal N, Liu E, Danaei G, Fawzi WW. Gestational weight gain in low-income & middle-income countries: a modelling analysis using nationally representative data. *BMJ Glob Health*. 2020; 5(11):1–9.
20. Abrams B, Altman SL, Pickett KE. Pregnancy weight gain: still controversial. *Am J Clin Nutr*. 2000; 71(5): 1233S-1241S.
21. Hasan ST, Khan MA, Ahmed T. Inadequate maternal weight gain in the third trimester increases the risk of intrauterine growth restriction in rural Bangladesh. *Plos One*. 2019; 14(2).
22. Garay SM, Sumption LA, Pearson RM, John RM. Risk factors for excessive gestational weight gain in a UK population: a biopsychosocial model approach. *BMC Pregnancy Childbirth*. 2021;21(1): 43.

23. Bengtson M-B, Martin CF, Aamodt G, Vatn MH, Mahadevan U. Inadequate gestational weight gain predicts adverse pregnancy outcomes in mothers with inflammatory bowel disease: results from a prospective US pregnancy cohort. *Dig Dis Sci*. 2017;62(8): 2063-9.
24. Catalano PM, Shankar K. Obesity & pregnancy: mechanisms of short term & long term adverse consequences for mother & child. *BMJ*. 2017 Feb 8;356
25. Champion ML, Harper LM. Gestational Weight Gain: Update on Outcomes & Interventions. *Curr Diab Rep*. 2020;20(3): 11.
26. Institute of Medicine (US) & National Research Council (US) Committee to Reexamine IOM Pregnancy Weight Guidelines. *Weight Gain During Pregnancy: Reexamining the Guidelines*. Rasmussen KM, Yaktine AL, editors. Washington (DC): National Academies Press (US); 2009.
27. Rasmussen KM, Yaktine AL (eds). *Weight gain during pregnancy: Re-examining the Guidelines*. Institute of Medicine (US) & National Research Council (US) Committee to Re-examine IOM Pregnancy Weight Guidelines. Washington (DC): National Academies Press; 2009.
28. Siega-Riz AM, Viswanathan M, Moos M-K, Deierlein A, Mumford S, Knaack J, et al. A systematic review of outcomes of maternal weight gain according to the Institute of Medicine recommendations: birthweight, fetal growth, & postpartum weight retention. *American journal of obstetrics & gynecology*. 2009;201(4):339. e1-. e14.
29. Nutrition S-Co, Coordination ACo. 4th report on the world nutrition situation. *Nutrition throughout the life cycle*. Geneva: ACC/SCN/WHO. 2000.
30. Rodrigues PL, de Oliveira LC, Brito Ados S, Kac G. Determinant factors of insufficient & excessive gestational weight gain & maternal-child adverse outcomes. *Nutrition*. 2010 Jun;26(6):617-23. doi: 10.1016/j.nut.2009.06.025. Epub 2009 Nov 26. PMID: 19944566.
31. Walker LO. Managing excessive weight gain during pregnancy & the postpartum period. *J Obstet Gynecol Neonatal Nurs*. 2007 Sep-Oct;36(5):490-500. doi: 10.1111/j.1552-6909.2007.00179.x. PMID: 17880322.
32. Kouba, I., Del Pozzo, J., Lesser, M.L. et al. Socioeconomic & clinical factors associated with excessive gestational weight gain. *Arch Gynecol Obstet* (2023). <https://doi.org/10.1007/s00404-023-07000-0>

33. Ahmed, K.Y., Abrha, S., Page, A. et al. Trends & determinants of underweight & overweight/obesity among urban Ethiopian women from 2000 to 2016. *BMC Public Health* 20, 1276 (2020). <https://doi.org/10.1186/s12889-020-09345-6>
34. Changamire FT, Mwiru RS, Peterson KE, Msamanga GI, Spiegelman D, Petraro P, Urassa W, Fawzi WW. Effect of multivitamin supplements on weight gain during pregnancy among HIV-negative women in Tanzania. *Matern Child Nutr.* 2015 Jul;11(3):297-304. doi: 10.1111/mcn.12018. Epub 2012 Dec 17. PMID: 23253638; PMCID: PMC3874066.
35. Rasmussen KM, Catalano PM, Yaktine AL. New guidelines for weight gain during pregnancy: what obstetrician/gynecologists should know. *Current opinion in obstetrics & gynecology.* 2009;21(6):521.
36. Siega-Riz AM, Viswanathan M, Moos M-K, Deierlein A, Mumford S, Knaack J, et al. A systematic review of outcomes of maternal weight gain according to the Institute of Medicine recommendations: birthweight, fetal growth, & postpartum weight retention. *American journal of obstetrics & gynecology.* 2009;201(4):339. e1-. e14.
37. Institute of Medicine. *Weight gain during pregnancy: reexamining the guideline.* Washington DC: National Academy Press; 2009.
38. Desyibelew HD, Dadi AF (2019) Burden & determinants of malnutrition among pregnant women in Africa: A systematic review & meta-analysis. *PLOS ONE* 14(9): e0221712. <https://doi.org/10.1371/journal.pone.0221712>
39. Gebre, B., Biadgilign, S., Taddese, Z. et al. Determinants of malnutrition among pregnant & lactating women under humanitarian setting in Ethiopia. *BMC Nutr* 4, 11 (2018). <https://doi.org/10.1186/s40795-018-0222-2>
40. Hasan SMT, Rahman S, Locks LM, Rahman M, Hore SK, Saeed KN, et al. (2018). Magnitude & determinants of inadequate third trimester weight gain in rural Bangladesh. *PLoS ONE* 13(4): e0196190. <https://doi.org/10.1371/journal.pone.0196190>.
41. Changamire, F.T., Mwiru, R.S., Peterson, K.E., Msamanga, G.I., Spiegelman, D., Petraro, P., Urassa, W. & Fawzi, W.W. (2015), Multivitamins & weight gain during pregnancy. *Matern Child Nutr*, 11: 297-304. <https://doi.org/10.1111/mcn.12018>
42. Mahrokh Dolatian, Nasibeh Sharifi, Zohreh Mahmoodi, Azita Fathnezhad-kazemi, Elahe Bahrami-vazir, Tayebeh Rashidian. Weight gain during pregnancy & its associated factors: A Path analysis. *Nursing Open.* 2020; 7:1568–1577. DOI: 10.1002/nop2.539.

43. Abdulai Abubakari et al. Effect of maternal dietary habits & gestational weight gain on birth weight: an analytical cross-sectional study among pregnant women in the Tamale Metropolis. *Pan African Medical Journal*. 2023;44(19). 10.11604/pamj.2023.44.19.38036.
44. Olapeju Adefunke Esimai & Ebenezer Ojofeitimi. Pattern & Determinants of Gestational Weight Gain an Important Predictor of Infant Birth Weight in a Developing Country. *Global Journal of Health Science*; Vol. 6, No. 4; 2014 ISSN 1916-9736 E-ISSN 1916-9744.
45. Wei Zhenga Wenyu Huangb Zhi Zhangc Li Zhanga Zhihong Tiana Guanghui Lia Weiyuan Zhanga. Patterns of Gestational Weight Gain in Women with Overweight or Obesity & Risk of Large for Gestational Age. *Obes Facts* 2019;12:407–415. DOI: 10.1159/000500748.
46. Moein Yoosefi, Azin Khosrovirad, Seyed Hossein Seyed Agha, Lalaeh Zand Parsa, Negar Rezaei, Mahmood Bakhtiyari, Farid Zayeri. Gestational weight gain during pregnancy & its determinants: A longitudinal study. *Caspian J Reprod Med*, 2018, 4 (1): 8 -13.
47. Ana Claudia Santos Amaral Fraga, Mariza Miranda Theme Filha. Factors associated with gestational weight gain in pregnant women in Rio de Janeiro, Brazil, 2008. *Cad. Saúde Pública*, Rio de Janeiro, 30(3):633-644, mar, 2014.
48. Gebremedhin S, Bekele T (2021) Gestational weight gain in sub-Saharan Africa: Estimation based on pseudo-cohort design. *PLoS ONE* 16(5): e0252247. <https://doi.org/10.1371/journal.pone.0252247>.
49. Fekede Asefa & Dereje Nemomsa. Gestational weight gain & its associated factors in Harari Regional State: Institution based cross-sectional study, Eastern Ethiopia. *Reproductive Health* (2016) 13:101. DOI 10.1186/s12978-016-0225-x.
50. Asefa et al. Patterns & predictors of gestational weight gain in Addis Ababa, Central Ethiopia: a prospective cohort study. *Reprod Health* (2021) 18:159. <https://doi.org/10.1186/s12978-021-01202-y>.
51. Suliga et al. Factors associated with gestational weight gain: a cross-sectional survey. *BMC Pregnancy & Childbirth* (2018) 18:465 <https://doi.org/10.1186/s12884-018-2112-7>.
52. FAO, FHI 360. Minimum dietary diversity for women: a guide for measurement. Rome: FAO; 2016. <http://www.fao.org/3/a-i5486e.pdf>. Accessed 10 Nov 2017.
53. Gebreyesus SH, Lunde T, Mariam DH, Woldehanna T, Lindtjørn B. Is the adapted Household Food Insecurity Access Scale (HFIAS) developed internationally to measure food insecurity valid in urban & rural households of Ethiopia? *BMC Nutrition*. 2015;1(1):1-10

Annex I: English Version Questionnaire

I. Information sheet

Greeting - Hello! My name is _____

This study is conducted by Dr Eyerusalem Mengistu who is from AAU, College of health sciences department of Obstetrics & Gynecology. She has permission from the University & any responsible body. The reason why she came here is to conduct research on Patterns & determinants of gestational weight gain among women attending antenatal care.

The Purpose of this study is to determine patterns & determinants of gestational weight gain among women attending ANC. If so, would you like to participate on this interviewer-administered questionnaire? This may take 40-50 minutes. All the information that you are going to provide me will remain confidential & you don't need to mention your name.

For this reason, I kindly request you to give me your sincere & truthful answer. All this is completely on voluntary bases & you have the right to refuse from participation. Participation or non-participation & refusal to answer questions will have no effect on your service. If you have further questions or would like to know the results of this study, please feel free to contact the principal investigator with the following address.

Dr Eyerusalem Mengistu Cell phone: +251 911137983

II. Consent form

I have read all the process & the objective of the study & I have understood the same as written that includes informed about the purpose, advantage, & disadvantage of this study titled Patterns & determinants of gestational weight gain among women attending antenatal care

I also understood that the research imposes no risk & no compensation would be provided to me. I have been told that if I feel discomfort to respond to any of the question, I am free to drop it any time wish to do so.

I have understood the information given & the participation is completely voluntary based. I have been told that my answers to the questions will not be given to anyone & not expect to write my name. Now I am giving my consent to participate in the study voluntarily.

Could I have your permission to continue?

1. Yes
2. No, Stop & thank the respondent.

Witness' signature certifying that the informed consent has been given

Witness: Signature_____

Dated _____ Data collector:

Name_____ Signature _____ Dated_____

Result:

1. Questionnaire completed _____
2. Questionnaire partially completed _____
3. Participant refused _____
4. Others (please Specify) _____

Checked by Supervisor:

Name _____

Supervisor's Signature _____

Date _____

Questionnaire

Part I. Sociodemographic characteristics of the study participants

1. Age in years_____
2. Marital status
 - I. single
 - II. Married
 - III. Divorced
 - IV. Widowed
3. Residence
 - I. Addis Ababa
 - II. Out of Addis Ababa
4. Educational status
 - I. No formal education
 - II. Primary education
 - III. Secondary education
 - IV. College & above
5. Partner's educational status
 - I. No formal education
 - II. Primary education
 - III. Secondary education
 - IV. College & above
6. Occupational status
 - I. No paid employment
 - II. House wife
 - III. Government/private employee
 - IV. Merchant
 - V. Student
 - VI. Daily laborer
7. Partners occupation
 - I. No paid employment
 - II. Government employee
 - III. Private employee
 - IV. Merchant
 - V. Student
 - VI. Daily laborer
8. Estimated average monthly income _____
9. Number of family size in the household_____
10. Number of under five children in the household_____

- 11. Physical activity during pregnancy
 - I. Sedentary
 - II. Light
 - III. Moderate
 - IV. Vigorously

Part II. Reproductive characteristics of the study participants

- 1. Pregnancy condition
 - I. Wanted
 - II. Unwanted
- 2. Was the pregnancy supported
 - I. Yes
 - II. No
- 3. Type of pregnancy
 - I. Planned
 - II. Unplanned
- 4. Gravidity / Number of children _____ (If primigravid mention)
- 5. Gestational age at ANC initiation in weeks_____
- 6. Had any obstetric related complication in this pregnancy like
 - I. Pregnancy induced hypertension
 - II. Gestational diabetes mellitus
 - III. Antepartum hemorrhage
 - IV. Others, specify_____
- 7. Gestational age during the data collection in weeks_____

Part III. Dietary diversity, anemia status of the study participant

1. Food group consumed in the 24 hrs.

- I. Foods from grains
- II. White roots, tubers & plantains
- III. Pulses (bean, peas & lentils)
- IV. Milk & milk products
- V. Meat & meat product
- VI. Any fresh or dried or shellfish
- VII. Eggs
- VIII. Vegetable
- IX. Fruits
- X. Any foods made with oil or fat

1. Minimum dietary diversity

Low dietary diversity

High dietary diversity

2. MUAC in cm_____

3. Hemoglobin level_____

Part IV. Items on the Household Food Insecurity Access Scale (HFIAS)

1. Worry about food
 - I. Yes
 - II. no
2. Unable to eat preferred foods
 - I. Yes
 - II. no
3. Eat a limited variety of foods
 - I. Yes
 - II. no
4. Eat foods that you really did not want to eat
 - I. Yes
 - II. no
5. Eat a smaller meal
 - I. Yes
 - II. no
6. Eat fewer meals in a day
 - I. Yes
 - II. no
7. No food to eat of any kind in the household
 - I. Yes
 - II. no
8. Go to sleep at night hungry
 - I. Yes
 - II. no
9. Go a whole day & night without eating anything
 - I. Yes
 - II. No

Part V. Characteristics of weight gain by specific body mass index

1. Pre-pregnancy / first trimester weight in kg_____
2. Weight in kg during data collection_____
3. Height in centimeter_____
4. Pre-pregnancy body mass index_____
5. Body mass index during data collection_____

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