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Prevalence and Associated Factors of Abnormal Gestational Weight Gain among Pregnant Women in Selected Private Hospitals in Kigali City

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Abstract: **Abnormal gestational weight gain (GWG) is a significant concern for maternal and child health in low- and middle-income countries like Rwanda. Insufficient GWG is linked to adverse outcomes such as low birth weight, preterm birth, perinatal mortality, and small-for-gestational-age infants, while excessive GWG is associated with metabolic complications, cesarean delivery, and childhood obesity. This study aimed to determine the prevalence and associated factors of abnormal GWG among pregnant women attending private hospitals in Kigali City, Rwanda. A cross-sectional study was conducted among 384 pregnant women, selected through systematic random sampling from selected private hospitals. Data were collected using structured questionnaires and medical records. Descriptive analysis and logistic regression were performed using STATA version 17. The results indicated that the prevalence of excess GWG was 54.9%, while inadequate GWG was 18.8%. Factors significantly associated with excess GWG included higher education levels (AOR = 4.94, 95% CI: 2.48–9.84, p < 0.001), taking IFA supplements (AOR = 4.3, 95% CI: 2.01–9.20, p < 0.001), taking deworming supplements (AOR = 8.61, 95% CI: 3.29–22.56, p < 0.001), and reduced physical activity (e.g., weekly activity: AOR = 13.84, 95% CI: 4.79–39.98, p < 0.001). Conversely, older maternal age (>35 years) (AOR = 0.45, 95% CI: 0.21–0.92, p = 0.028), public employment (AOR = 0.14, 95% CI: 0.06–0.28, p < 0.001), and receiving nutrition advice (AOR = 0.07, 95% CI: 0.03–0.14, p < 0.001) were associated with lower odds of excess GWG. For inadequate GWG, significant factors included older maternal age (>35 years) (AOR = 12.15, 95% CI: 5.59–26.44, p < 0.001), public employment (AOR = 2.89, 95% CI: 1.37–6.11, p = 0.005), and alcohol use (AOR = 209.7, 95% CI: 11.72–3750.71, p < 0.001). Protective factors against inadequate GWG included longer birth intervals (≥2 years) (AOR = 0.47, 95% CI: 0.24–0.91, p = 0.025), taking IFA supplements (AOR = 0.2, 95% CI: 0.10–0.44, p < 0.001), and taking rest (AOR = 0.0045, 95% CI: 0.00–0.08, p < 0.001). These findings underscore the need for targeted interventions to address abnormal GWG. Programs should focus on improving antenatal care services through nutritional counseling, promoting physical activity, addressing short birth intervals, and ensuring access to IFA and deworming supplements. Additionally, interventions should prioritize older women, public employees, and those with risky behaviors such as alcohol use to improve maternal and child health outcomes.**

Keywords: **Factors, Abnormal Gestational, Weight Gain, Pregnant Women, Private Hospitals, Kigali City.**

I. INTRODUCTION

Abnormal gestational weight gain (AGWG) can have a major impact on the mother's and child's long-term health, in addition to the short-term pregnancy outcomes. Premature birth, low birth weight babies, intrauterine hypotrophy, and subsequently a higher risk of mortality and morbidity are the main health hazards associated with inadequate weight gain during pregnancy (Victor et al., 2024). Gaining excessive weight during pregnancy can increase the likelihood of various

health conditions, such as having a baby that is overweight for its gestational age, gestational diabetes, cesarean birth, pregnancy-induced hypertension, and extended hospital admissions for the newborn. Moreover, retaining weight after delivery can raise the mother's risk of developing obesity later in life (Langley-Evans et al., 2022). Abnormal gestational weight gain (AGWG) can have significant long-term health impacts on both the mother and child, in addition to short-term pregnancy outcomes. Inadequate weight gain during pregnancy can lead to premature birth, low birth weight babies, intrauterine hypotrophy, and subsequently a higher risk of mortality and morbidity (Lackovic et al., 2024). Gaining excessive weight during pregnancy can pose several risks to both the mother and the baby. These risks include the possibility of delivering an overweight baby, gestational diabetes, pregnancy-induced hypertension, macrosomia, caesarean delivery, and extended hospital stays for the newborn.

Moreover, a higher postpartum weight following childbirth may increase the mother's chance of developing obesity later in life. It was found that obese women had a 33% lower chance of gaining excess weight compared to overweight women (odds ratio 0.67, 95% confidence range 0.48–0.94). Risk factors for excessive gestational weight gain were lower educational attainment, white or Indigenous identity, smoking, mood disorders, anxiety disorders, and Canadian citizenship, according to a systematic review (Farpour-Lambert et al., 2018). Nearly two-thirds (60%) of the women were overweight or obese during the early stages of pregnancy, and 41% gained too much weight. High early pregnancy body mass index was identified as a significant predictor of excessive gestational weight gain in multivariable logistic regression analysis (Senbanjo et al., 2021).

Rwanda is significantly influenced by both BMI and gestational weight gain. Out of 1000 individuals, 64.1% had a normal BMI, 26.1% were overweight, 6.7% were obese, and 3.1% were underweight. Sixty-eight percent of women gained less weight than was advised. Obese or overweight women had a higher risk of developing hypertension ($p<0.0001$). Women who were obese were more likely to need a cesarean section ($p<0.0001$). Excessive weight gain was linked to an increased incidence of hypertensive issues and cesarean sections (Nkubito et al., 2019).The main objective of this study was to determine prevalence and factors associated with abnormal Gestational Weight Gain Among Pregnant Women in Private Hospitals in Kigali City, Rwanda.I was guided by the following specific objectives:

i. To determine the prevalence of abnormal gestational weight gain among pregnant women attending Private Hospital in Kigali City, Rwanda

ii. To assess factors associated with abnormal gestational weight gain among pregnant women attending Private Hospital in Kigali City, Rwanda

II. THEORETICAL FRAMEWORK

Health Lifestyle Theory

The health lifestyle hypothesis, developed by Cockerham (2021), proposes a model that explains the behavioral patterns people adopt, which have either a positive or negative impact on their weight and other aspects of their health. These behaviors, such as eating, drinking, smoking, and exercising, form unique lifestyle patterns among different socioeconomic groups. According to Cockerham (2005), healthy lifestyles refer to societal patterns of behavior related to health, which are chosen among various options based on an individual's circumstances or life chances.

Although individuals make choices about their lifestyle, these decisions are influenced by various factors like their beliefs, societal norms, and available resources that are suitable for their living conditions or opportunities in life, which put them in line with others who have similar socio-economic status (Cockerham, 2021). The "healthy lifestyle hypothesis" posits that a person's life chances are determined by four structural elements that provide the social environment for socialization and experiences. These factors influence an individual's choices and agency. The four structural elements are: (1) class circumstances; (2) age, gender, and race/ethnicity; (3) collectivists, such as workplace, kinship networks, religion, politics, and ideology, among others; and (4) living conditions, including the quality of housing, public safety, neighborhood amenities, and accessibility of basic utilities. Habits are formed through the interaction of choices and opportunities, which result in specific behaviors related to health, such as social distancing, alcohol intake, smoking, calorie consumption, and more. These behaviors, known as health practices, are the components of a healthy lifestyle that, when repeated, become habits. According to Cockerham (2021), health practices are generally categorized as either positive or negative, but some lifestyles may consist of a mixture of both. Despite this, there is still a socioeconomic gradient from low to high among different lifestyles. Jamie (2019) suggests that individuals who belong to higher social classes generally lead healthier lifestyles and have lower rates of obesity compared to those who belong to lower social classes. On the other hand, those belonging to lower social classes usually have unhealthy lifestyles and higher rates of obesity.

III. CONCEPTUAL FRAMEWORK

The aim of the conceptual framework is to show the relationship between variables under the study. It shows the independents variables and dependent variables of the study. Below figure shows how those variables were related.

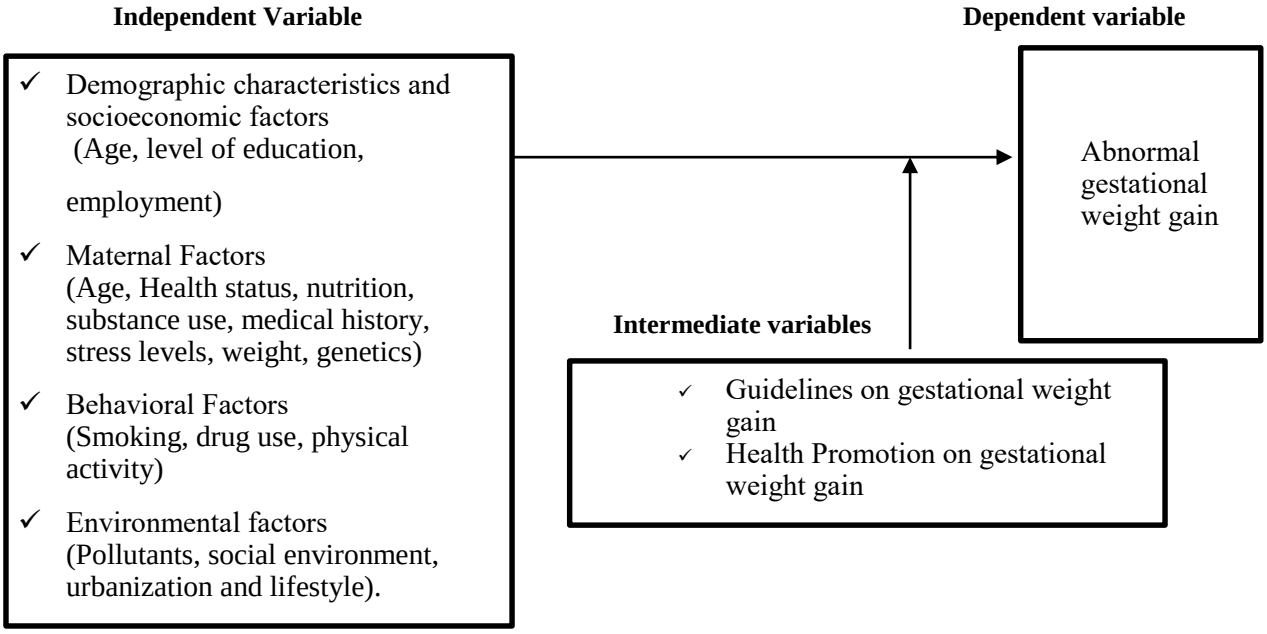

Figure 1: The conceptual framework

The conceptual framework illustrates that abnormal gestational weight gain (GWG) is influenced by a complex interplay of socio-demographic, maternal, and behavioral factors, both directly and through intermediate variables. Socio-demographic factors such as age, education, and income shape a pregnant woman's environment and access to healthcare, impacting her health literacy and utilization of antenatal services. Maternal characteristics, including parity and pregnancy intention, contribute to stress and psychosocial dynamics that can influence health behaviors. Behavioral factors, like diet and physical activity, are immediate determinants of GWG but are themselves shaped by health literacy, access to healthcare, and psychosocial well-being. This interconnected system underscores the need for multifaceted interventions addressing both direct and indirect pathways to promote healthy weight management during pregnancy.

IV. RESEARCH METHODOLOGY

Research Design

This study employed a cross-sectional research design to assess the prevalence and factors associated with abnormal gestational weight gain (GWG) among pregnant women attending private hospitals in Kigali City, Rwanda. The cross-sectional approach allowed for the collection of data at a single point in time, facilitating the analysis of socio-demographic, maternal, and behavioral factors in relation to GWG. This design is appropriate for understanding the relationships between variables and identifying key determinants within the study population.

Target Population

The target population for this study comprised pregnant women attending antenatal care services at private hospitals in Kigali City, Rwanda. This group was selected to provide insights into the prevalence and determinants of abnormal gestational weight gain within an urban healthcare setting, capturing a diverse range of socio-demographic and maternal characteristics.

Inclusion Criteria

The study included pregnant women who were attending antenatal care at selected private hospitals in Kigali City, and provided informed consent to participate. Participants needed to have complete medical records available to assess gestational weight gain and relevant health information.

Exclusion Criteria

Pregnant women who had pre-existing medical conditions that could influence weight gain, such as chronic hypertension or diabetes, were excluded from the study. Additionally, women with incomplete medical records or those who did not provide informed consent were not eligible to participate.

Sampling Design

A defined strategy for selecting a sample from a specific population is known as a sample design. It speaks of the method or approach the researcher would use to choose the items for the Pelorosso (2020) sample. This party of sampling design presents the sample size determination and sampling techniques as follow.

Sample Size Determination

The study used a Fisher's formula to determine simple size to be taken into consideration in this study.

$$n = \frac{z^2 p\,(1-p)}{d^2}$$

Therefore, Z= Normal standard variety= 5%, error p-<0.005, it will be 1.96.

P: Probability of success = 1/2 = 0.5, d2: precision error which is 5%, N: Calculated Sample Size

$$n = \frac{1.96^{2*0.0} * 0.05(1-0.5)}{0.05^2} = 384$$

In this study, a sample size of 384 was calculated to represent study population.

Sampling Technique

A systematic simple random sampling method was employed, where each individual in the target population had an equal chance of being selected. Using the total estimated population (709), every second pregnant women was selected while they were coming to the selected health facilities. The first pregnant women were selected randomly using a lottery method. This approach ensures that the sample is unbiased and representative of the population, enhancing the validity of the findings (Pelorosso, 2020). Questionnaires were distributed to randomly selected respondents until the required sample size was achieved.

Sampling Proportion Among Private Hospitals

The sampling proportion across private hospitals in Kigali City was allocated based on their estimated populations: 99 participants from La Croix du Sud, 63 from Polyclinique Polyfam, and 222 from King Faisal Hospital. This proportional allocation ensured representation relative to the hospital-specific population sizes, maintaining the study's methodological rigor.

Table 1: Sample Size Determination and Proportional Sampling Distribution Among Private Hospitals

Hospital	Estimated population	Sample taken
La Croix du Sud	183	(183/709)*384 = 99
Polyclinique Polyfam	117	(117/709)*384 = 63
King Faisal Hospital	409	(409/709)* 384 = 222
Total	**709**	

Data Collection Method

Research techniques are the useful ways to achieve a particular objective. Techniques are described by Pelorosso (2020) as methods that enable the researcher to gather data and information on the research under investigation. This study collected quantitative data where they were collected using a self- administered questionnaire.

Data Collection Instrument

This study utilized a questionnaire as the primary data collection instrument, incorporating both open-ended and close-ended questions. The questionnaire was divided into three sections: Section A gathered demographic and socioeconomic

information about the respondents, while Sections B, C, and D focused on assessing maternal, behavioral, and environmental factors associated with abnormal gestational weight gain among pregnant women, respectively. The questionnaire was designed in English, aligning with the academic language of Mount Kenya University and the administrative language of the selected private hospitals. It was structured based on the study objectives and included an introduction outlining the study's purpose, researcher identification, and clear instructions for respondents to follow.

Administration of Data Collection Instruments

After obtaining an approval letter from Mount Kenya University Rwanda and receiving authorization from the private hospitals, the researchers distributed questionnaires to participants to express their opinions and feelings. During the data collection period in April 2024, the researchers provided a full explanation of the study and its objectives to obtain informed consent. Participation in the study was entirely voluntary, with no coercion or incentives offered. Respondents were assured of confidentiality, as no names were recorded on the questionnaires. Each participant received a questionnaire to complete, which was then collected by the researchers. The collected data, comprising the completed questionnaires, were analyzed to draw meaningful conclusions.

V. RESEARCH FINDINGS AND DISCUSSION

1. Demographic Characteristics of Respondents

This section provides an overview of the demographic characteristics of the pregnant women who participated in the study. Understanding these characteristics is essential for interpreting the factors associated with abnormal gestational weight gain and for contextualizing the study findings within the broader population.

Table 2: Demographic Characteristics of Respondents

Characteristics	Frequency (n=384)	Percent (%)
Age of respondent		
Less than 35	340	88.5
Above 35 Years	44	11.5
Education Level		
Lower education	72	18.8
Higher education	312	81.3
Occupation		
Self-employed	100	26.0
Public employed	129	33.6
Private employed	155	40.4
Place of residence		
Rural	87	22.7
Urban	297	77.3

Source: primary data, 2024

The table shows that the majority of respondents were aged less than 35 years (88.5%), while only 11.5% were aged above 35 years. In terms of education level, a significant proportion had higher education (81.3%), whereas 18.8% had lower education. Regarding occupation, private employment was the most common (40.4%), followed by public employment (33.6%) and self-employment (26.0%). Lastly, the majority of respondents resided in urban areas (77.3%), with only 22.7% living in rural areas.

Maternal Characteristics

This section outlines the maternal characteristics of the respondents, including factors such as age at first marriage, parity, birth interval, gestational age, pregnancy intention, antenatal care visits, contraceptive use, and supplement intake. These characteristics are crucial for understanding their potential influence on gestational weight gain outcomes.

Table 3: Maternal Characteristics of Respondents

Characteristics	Frequency (n=384)	Percent (%)
Age at first marriage		
Less than 25	114	29.7
Above 25	270	70.3
Parity		
None	100	26.0
1 or More	284	74.0
Birth Interval		
<2 years	71	18.5
>= 2 years	313	81.5
Gestation Age		
<6 Months	42	10.9
6 - 7 Months	214	55.7
8 - 9 Months	128	33.3
Pregnancy intended		
No	87	22.7
Yes	297	77.3
ANC Visit		
<2 visits	124	32.3
3rd visit	164	42.7
4 and More	96	25.0
Contraceptive use		
No	215	56.0
Yes	169	44.0
Received nutrition advice		
No	187	48.7
Yes	197	51.3
Take IFA supplement		
No	101	26.3
Yes	283	73.7
Take deworming supplement		
No	328	85.4
Yes	56	14.6
Previous pregnancy complications		
Yes	85	22.1
No	299	77.9

Source: Primary data, 2024

The table indicates that the majority of respondents had their first marriage above 25 years (70.3%), while 29.7% were married before 25 years. Regarding parity, most participants had one or more children (74.0%), and 26.0% had none. The majority of respondents had a birth interval of two or more years (81.5%), with only 18.5% having intervals of less than two years. More than half of the pregnancies (70.8%) were between 7 to 9 months of gestation.

For pregnancy intention, 77.3% of pregnancies were intended, while 22.7% were unintended. Most respondents reported three antenatal care visits (42.7%), while 32.3% had fewer than two visits and 25.0% had four or more visits. Contraceptive use was reported by 44.0%, with the majority (56.0%) not using contraceptives. Nutrition advice was received by 51.3% of respondents, and 73.7% reported taking IFA supplements, whereas 26.3% did not. Deworming supplements were taken by 14.6% of respondents, with the majority (85.4%) not taking them. Lastly, most respondents (77.9%) had no previous pregnancy complications, while 22.1% reported complications.

Behavioral Characteristics

This section describes the behavioral characteristics of the respondents, including dietary habits, physical activity, smoking, alcohol use, and rest patterns. These behaviors are examined to understand their impact on gestational weight gain and maternal health during pregnancy.

Table 4: Behavioral Characteristics of Respondents

Characteristics	Frequency (n=384)	Percent (%)
Age at first marriage		
Less than 25	114	29.7
Above 25	270	70.3
Parity		
None	100	26.0
1 or More	284	74.0
Birth Interval		
<2 years	71	18.5
>= 2 years	313	81.5
Gestation Age		
<7 Months	112	29.2
7 – 9 Months	272	70.8
Pregnancy intended		
No	87	22.7
Yes	297	77.3
ANC Visit		
<2 visits	124	32.3
3rd visit	164	42.7
4 and more	96	25.0
Contraceptive use		
No	215	56.0
Yes	169	44.0
Received nutrition advice		
No	187	48.7
Yes	197	51.3
Take IFA supplement		
No	101	26.3
Yes	283	73.7
Take deworming supplement		
No	328	85.4
Yes	56	14.6
Previous pregnancy complications		
Yes	85	22.1
No	299	77.9

Source: Primary data, 2024

The behavioral characteristics of the participants show that the majority of respondents consumed fruits and vegetables weekly or rarely (59.6%) while 40.6% consume fruits daily. Regarding fast food, 59.1% consumed it rarely, whereas 22.1% consumed it daily. In terms of physical activity, 33.9% of respondents engaged in it rarely, with equal proportions (25.8%) reporting daily or no physical activity. Smoking and domestic violence were absent in all respondents (100.0%). Alcohol use was reported by 10.9% of respondents.

2. Presentation of Findings

This section presents the findings of the study in relation to the specific objectives outlined. The analysis begins with the prevalence of abnormal gestational weight gain among the respondents, followed by an examination of the socio-demographic, maternal, and behavioral factors associated with abnormal GWG.

2.1 The Prevalence of Abnormal Gestational Weight Gain Among Pregnant Women Attending Private Hospital in Kigali City, Rwanda

The table highlights the distribution of gestational weight gain across different BMI categories among the study participants.

Table 5: The Prevalence of Abnormal Gestational Weight Gain Among Participants

BMI Category	Total	Weight gain		Normal
		Excess	Inadequate	
Underweight	70	56 (80)	14 (20)	0 (0)
Normal weight	170	99 (58.2)	29 (17.1)	42 (24.7)
Overweight	100	42 (42)	14 (14)	44 (44)
Obese	44	14 (31.8)	15 (34.1)	15 (34.1)
Overall	384	211 (54.9)	72 (18.8)	101 (26.3)

Source: Primary data, 2024

The analysis of BMI categories reveals notable trends in weight gain patterns among the study population. Among underweight individuals, the majority (80.0%) experienced excess weight gain, while 20.0% had inadequate weight gain, and none achieved normal weight gain. For participants with a normal weight, excess weight gain was most prevalent (58.2%), followed by 17.1% with inadequate weight gain and 24.7% achieving normal weight gain.

In the overweight category, 42.0% experienced excess weight gain, while 44.0% maintained normal weight gain, and 14.0% had inadequate weight gain. Among obese participants, the proportions of inadequate and normal weight gain were equal (34.1%), whereas excess weight gain was observed in 31.8%. Overall, across all participants, 54.9% of participants experienced excess weight gain, 18.8% had inadequate weight gain, and 26.3% achieved normal weight gain.

2.2 The Factors Associated with Abnormal Gestational Weight Gain Among Pregnant Women Attending Private Hospital in Kigali City, Rwanda

The analysis of factors associated with abnormal gestational weight gain (GWG) involved both bivariate and multivariate logistic regression methods. In the bivariate analysis, each socio-demographic, maternal, and behavioral variable was tested for its association with abnormal GWG using chi-square tests. Variables that showed a significant association at a p-value of less than 0.05 were then included in the logistic regression model. The logistic regression analysis provided Adjusted Odds Ratios (AOR) along with 95% Confidence Intervals (CI) to determine the independent effects of these factors on abnormal GWG (excess or inadequate) while controlling for potential confounders. A significance level of 0.05 was used to assess the strength of these associations. The AORs indicate the likelihood of experiencing abnormal GWG associated with each factor, providing insight into which variables have the most substantial impact on gestational weight outcomes.

The bivariate analysis of factors associated with abnormal gestational weight gain among pregnant women

The bivariate analysis examines the association between maternal sociodemographic, behavioral, and pregnancy-related characteristics and weight gain during pregnancy (inadequate or excess).

Table 6: Bivariate Analysis of Factors Associated with Abnormal Gestational Weight Gain

Variable	Excess weight Gained		Chi-square (χ^2)	P-Value	Inadequate weight gain		Chi-square (χ^2)	P-Value
	No (n=173)	Yes (n=211)			No (n=312)	Yes (n=72)		
Age of Respondent							79.71	**<0.001**
Less than 35	143 (42.1)	197 (57.9)	10.74	**0.001**	298 (87.6)	42 (12.4)		
Above 35 Years	30 (68.2)	14 (31.8)			14 (31.8)	30 (68.2)		
Education Level			7.71	**0.006**			0.25	0.615
Lower education	43 (59.7)	29 (40.3)			57 (79.2)	15 (20.8)		
Higher	130 (41.7)	182 (58.3)			255 (81.7)	57 (18.3)		

education								
Occupation			17.38	**<0.001**			28.54	**<0.001**
Self-employed	29 (29)	71 (71)			85 (85)	15 (15)		
Public Employed	73 (56.6)	56 (43.4)			86 (66.7)	43 (33.3)		
Private Employed	71 (45.8)	84 (54.2)			141 (91)	14 (9)		
Place of Residence			2.02	0.155			0.17	0.68
Rural	45 (51.7)	42 (48.3)			72 (82.8)	15 (17.2)		
Urban	128 (43.1)	169 (56.9)			240 (80.8)	57 (19.2)		
Age at First Marriage			25.19	**<0.001**			3.32	0.068
Less than 25	25 (46.3)	29 (53.7)			25 (166.7)	99 (660)		
Above 25	25 (14.8)	144 (85.2)			25 (43.9)	213 (373.7)		
Parity			49.32	**<0.001**			27.91	**<0.001**
None	15 (15)	85 (85)			100 (100)	0 (0)		
1 or More	158 (55.6)	126 (44.4)			212 (74.6)	72 (25.4)		
Birth Interval			8.46	**0.004**			27.91	**<0.001**
<2 years	43 (60.6)	28 (39.4)			42 (59.2)	29 (40.8)		
>= 2 years	130 (41.5)	183 (58.5)			270 (86.3)	43 (13.7)		
Gestation Age			3.64	0.056			4.05	**0.044**
<7 Months	42 (35.5)	70 (62.5)			98 (87.5)	14 (12.5)		
7 - 9 Months	131 (48.2)	141 (51.8)			214 (78.7)	58 (21.3)		
Pregnancy Intended			1.38	0.239			18.27	**<0.001**
No	44 (50.6)	43 (49.4)			57 (65.5)	30 (34.5)		
Yes	129 (43.4)	168 (56.6)			255 (85.9)	42 (14.1)		
ANC Visit			13.13	**0.001**			2.25	0.325
<2 visits	54 (43.5)	70 (56.5)			106 (85.5)	18 (14.5)		
3rd visit	89 (54.3)	75 (45.7)			129 (78.7)	35 (21.3)		
4 and More	30 (31.3)	66 (68.8)			77 (80.2)	19 (19.8)		
Contraceptive Use			1.13	0.288			0.50	0.479
No	102 (47.4)	113 (52.6)			172 (80)	43 (20)		
Yes	71 (42)	98 (58)			140 (82.8)	29 (17.2)		
Received Nutrition Advice			4.42	**0.035**			2.51	0.11
No	74 (39.6)	113 (60.4)			158 (84.5)	29 (15.5)		
Yes	99 (50.3)	98 (49.7)			154 (78.2)	43 (21.8)		
Take IFA Supplement			41.03	**<0.001**			55.39	**<0.001**
No	73 (72.3)	28 (27.7)			57 (56.4)	44 (43.6)		
Yes	100 (35.3)	183 (64.7)			255 (90.1)	28 (9.9)		
Take Deworming Supplement			10.65	**0.001**			15.13	**<0.001**
No	159 (48.5)	169 (51.5)			256 (78)	72 (22)		
Yes	14 (25)	42 (75)			56 (100)	0 (0)		
Previous Pregnancy Complications			1.35	0.245			16.92	**<0.001**
Yes	43 (50.6)	42 (49.4)			56 (65.9)	29 (34.1)		
No	130 (43.5)	169 (56.5)			256 (85.6)	43 (14.4)		
Fruit and Vegetable Intake			0.059	0.807			0.08	0.77
Daily	71 (45.8)	84 (54.2)			127 (81.9)	28 (18.1)		
Weekly/Rarely	102 (44.5)	127 (55.5)			185 (80.8)	44 (19.2)		
Fast Food Consumption			38.43	**<0.001**			0.37	0.83
Daily	14 (16.5)	71 (83.5)			71 (83.5)	14 (16.5)		

Weekly	44 (61.1)	28 (38.9)			58 (80.6)	14 (19.4)		
Rarely	115 (50.7)	112 (49.3)			183 (80.6)	44 (19.4)		
Physical Activity			15.48	**0.001**			14.93	**0.002**
Daily	57 (57.6)	42 (42.4)			70 (70.7)	29 (29.3)		
Weekly	14 (25)	42 (75)			42 (75)	14 (25)		
Rarely	59 (45.4)	71 (54.6)			116 (89.2)	14 (10.8)		
Never	43 (43.4)	56 (56.6)			84 (84.8)	15 (15.2)		
Alcohol Use			2.61	0.106			6.58	**0.01**
No	159 (46.5)	183 (53.5)			284 (83)	58 (17)		
Yes	14 (33.3)	28 (66.7)			28 (66.7)	14 (33.3)		
Take a Rest			2.73	0.099			41.91	**<0.001**
No	44 (38.6)	70 (61.4)			70 (61.4)	44 (38.6)		
Yes	129 (47.8)	141 (52.2)			242 (89.6)	28 (10.4)		

Source: Primary data, 2024

The table presents the proportions of excess and inadequate weight gain across all variables, focusing on significant associations (p-value < 0.05). The analysis revealed that women under the age of 35 years were significantly more likely to experience excess weight gain (57.9%) compared to those aged above 35 years (31.8%, χ^2=10.74, p=0.001). Similarly, women with higher education levels showed a greater prevalence of excess weight gain (58.3%) compared to those with lower education (40.3%, χ^2=7.71, p=0.006). Occupation played a significant role, with self-employed women displaying the highest proportion of excess weight gain (71%), followed by private employees (54.2%) and public employees (43.4%, χ^2=17.38, p<0.001).

Regarding reproductive factors, women with no children had an 85% prevalence of excess weight gain compared to 44.4% among those with one or more children (χ^2=49.32, p<0.001). Women with a birth interval of 2 years or more were more likely to have excess weight gain (58.5%) compared to those with shorter intervals (39.4%, χ^2=8.46, p=0.004). Behavioral factors also played a role; daily fast-food consumption was associated with the highest prevalence of excess weight gain (83.5%, χ^2=38.43, p<0.001). Physical activity was inversely related to excess weight gain, with weekly activity associated with the highest prevalence (75%) and daily activity with the lowest (42.4%, χ^2=15.48, p=0.001).

Women aged above 35 years were significantly more likely to experience inadequate weight gain (68.2%) compared to those under 35 years (12.4%, χ^2=79.71, p<0.001). Occupation was another critical factor; public employees had the highest prevalence of inadequate weight gain (33.3%), compared to private employees (9%) and self-employed women (15%, χ^2=28.54, p<0.001). Parity showed a strong association, with women who had one or more children experiencing a higher prevalence of inadequate weight gain (25.4%) compared to those with no children (0%, χ^2=27.91, p<0.001).

Gestational age also influenced inadequate weight gain, with women in their last trimester (7-9 months) showing a prevalence of 21.3%, higher than those under 7 months (12.5%, χ^2=4.05, p=0.044). Behavioral factors such as deworming supplement intake and alcohol use were significant. Women who did not take deworming supplements had a significantly higher prevalence of inadequate weight gain (22%, χ^2=15.13, p<0.001), while alcohol use was associated with 33.3% prevalence compared to 17% among non-users (χ^2=6.58, p=0.01). Additionally, rest was a protective factor; women who rested showed a lower prevalence of inadequate weight gain (10.4%) compared to those who did not (38.6%, χ^2=41.91, p<0.001).

Multivariate Analysis

All variables that exhibited a significant association with excess or inadequate gestational weight gain in the bivariate analysis (p < 0.05) were included in the multivariate analysis. The analysis was conducted in three categories: socio-demographic, maternal, and behavioral factors. Both logistic regression and Firth's penalized likelihood logistic regression were used. Standard logistic regression was applied where model convergence was achieved, while Firthlogit was used to address issues of separation and small sample bias in cases with complete or quasi-complete separation. Adjusted odds ratios (AOR) with 95% confidence intervals were calculated to quantify the strength of associations while controlling for potential confounders.

Table 7: Logistic Regression Analysis of Factors Associated with Abnormal Gestational Weight Gain

Variables	AOR	95% CI	p value	AOR	95% CI	p value
	Excess weight Gained			Inadequate weight gain		
Socio-demographic factors						
Age of Respondent						
Less than 35	*Ref*			*Ref*		
Above 35 Years	0.45	[0.21-0.92]	**0.028**	12.15	[5.59-26.44]	**<0.001**
Education Level						
Lower education	*Ref*			a*		
Higher education	4.94	[2.48-9.84]	**<0.001**	a*		
Occupation						
Self-employed	*Ref*			*Ref*		
Public Employed	0.14	[0.06-0.28]	**<0.001**	2.89	[1.37-6.11]	0.005
Private Employed	0.23	[0.12-0.46]	**<0.001**	1.09	[0.46-2.60]	0.85
Maternal factors						
Age at First Marriage						
Less than 25	*Ref*			a*		
Above 25	0.32	[0.19-0.55]	**<0.001**	a*		
Parity						
None	*Ref*					
1 or More	0.16	[0.09-0.31]	**<0.001**	*1(omitted)*		
Birth Interval						
<2 years	*Ref*			*Ref*		
>= 2 years	1.01	[0.56-1.80]	**0.985**	0.47	[0.24-0.91]	0.025
Gestation Age						
<7 Months	a*			*Ref*		
7 - 9 Months	a*			4.16	[1.81-9.55]	0.001
Pregnancy Intended						
No	a*			*Ref*		
Yes	a*			0.61	[0.30-1.22]	0.159
ANC Visit						
<2 visits	*Ref*					
3rd visit	0.61	[0.36-1.03]	0.063	a*		
4 and more	1.46	[0.79-2.70]	0.222	a*		
Previous Pregnancy Complications						
Yes	a*			*Ref*		
No	a*			0.23	[0.11-0.48]	**<0.001**
Behavioral factors						
Received Nutrition Advice						
No	*Ref*			a*		
Yes	0.07	[0.03-0.14]	**<0.001**	a*		
Take IFA Supplement						
No				*Ref*		
Yes	4.3	[2.01-9.20]	**<0.001**	0.2	[0.10-0.44]	**<0.001**
Take Deworming Supplement						
No	*Ref*			b*		
Yes	8.61	[3.29-22.56]	**<0.001**	b*		
Fast Food Consumption						
Daily	*Ref*			*Ref*		

Weekly	0.01	[0.004-0.05]	**<0.001**	a*		
Rarely	0.08	[0.03-0.21]	**<0.001**	a*		
Physical Activity						
Daily	*Ref*			*Ref*		
Weekly	13.84	[4.79-39.98]	**<0.001**	0.01	[0.00-0.24]	0.003
Rarely	1.68	[0.74-3.84]	0.218	0.02	[0.00-0.40]	0.009
Never	6.31	[2.40-16.60]	**<0.001**	0.01	[0.00-0.12]	0.001
Alcohol Use						
No	a*					
Yes	a*			209.7	[11.72-3750.71]	**<0.001**
Take a Rest						
No	a*			*Ref*		
Yes	a*			0.0045	[0.00-0.08]	**<0.001**

Ref: Reference category, **a***: Not significant at bivariate level, **b***: removed due to convergence (one category achieved 100%)

Source: Primary data, 2024; *Ref:* Reference category

Factors associated with Excess Weight Gain

Age and education level were significant predictors of excess weight gain. Women above 35 years had 55% lower odds of excess weight gain compared to those under 35 (AOR = 0.45, 95% CI = [0.21–0.92], p = 0.028). This suggests that older women may have better weight management practices or physiological differences that reduce their risk of excessive weight gain during pregnancy. Conversely, women with higher education had nearly five times higher odds of excess weight gain compared to those with lower education (AOR = 4.94, 95% CI = [2.48–9.84], p < 0.001). This could reflect lifestyle differences, such as sedentary behavior or dietary patterns, associated with higher socioeconomic status. Occupation also played a significant role. Public employed and private employed women had 86% and 77% lower odds of excess weight gain, respectively, compared to self-employed women (AOR = 0.14, 95% CI = [0.06–0.28], p < 0.001; AOR = 0.23, 95% CI = [0.12–0.46], p < 0.001).

Delayed marriage and parity were protective against excess weight gain. Women who married above 25 years had 68% lower odds of excess weight gain compared to those who married earlier (AOR = 0.32, 95% CI = [0.19–0.55], p < 0.001). Similarly, women with 1 or more children had 84% lower odds of excess weight gain compared to nulliparous women (AOR = 0.16, 95% CI = [0.09–0.31], p < 0.001). These findings suggest that older maternal age at marriage and prior childbirth may confer protective effects, possibly due to greater experience with pregnancy-related weight management.

Nutritional and supplementation behaviors were strongly associated with excess weight gain. Women who received nutrition advice had 93% lower odds of excess weight gain (AOR = 0.07, 95% CI = [0.03–0.14], p < 0.001), highlighting the importance of dietary counseling during pregnancy. However, women who took IFA supplements (AOR = 4.3, 95% CI = [2.01–9.20], p < 0.001) and deworming supplements (AOR = 8.61, 95% CI = [3.29–22.56], p < 0.001) had significantly higher odds of excess weight gain. This may reflect underlying nutritional deficiencies or health conditions that necessitate supplementation and are also linked to weight gain.

Dietary habits and physical activity were also significant predictors. Women who consumed fast food weekly (AOR = 0.01, 95% CI = [0.004–0.05], p < 0.001) or rarely (AOR = 0.08, 95% CI = [0.03–0.21], p < 0.001) had substantially lower odds of excess weight gain compared to those who consumed it daily. Conversely, women who engaged in physical activity weekly (AOR = 13.84, 95% CI = [4.79–39.98], p < 0.001) or never (AOR = 6.31, 95% CI = [2.40–16.60], p < 0.001) had higher odds of excess weight gain compared to those who were active daily. These findings underscore the importance of a balanced diet and regular physical activity in preventing excessive weight gain during pregnancy.

Factors associated with Inadequate Weight Gain

Older age and occupation were significant predictors of inadequate weight gain. Women above 35 years had 12.15 times higher odds of inadequate weight gain compared to younger women (AOR = 12.15, 95% CI = [5.59–26.44], p < 0.001). This may reflect age-related physiological changes or comorbidities that impair weight gain during pregnancy. Additionally, public employed women had 2.89 times higher odds of inadequate weight gain compared to self-employed

women (AOR = 2.89, 95% CI = [1.37–6.11], p = 0.005), possibly due to work-related stress or time constraints affecting dietary intake.

Longer birth intervals and absence of previous pregnancy complications were protective against inadequate weight gain. Women with a birth interval of ≥2 years had 53% lower odds of inadequate weight gain (AOR = 0.47, 95% CI = [0.24–0.91], p = 0.025), suggesting that adequate spacing between pregnancies allows for better maternal recovery and nutritional replenishment. Similarly, women with no previous pregnancy complications had 77% lower odds of inadequate weight gain (AOR = 0.23, 95% CI = [0.11–0.48], p < 0.001), highlighting the importance of maternal health in supporting optimal weight gain.

Supplementation and lifestyle behaviors were strongly associated with inadequate weight gain. Women who took IFA supplements had 80% lower odds of inadequate weight gain (AOR = 0.2, 95% CI = [0.10–0.44], p < 0.001), emphasizing the role of micronutrient supplementation in supporting maternal nutrition. Conversely, women who engaged in physical activity weekly (AOR = 0.01, 95% CI = [0.00–0.24], p = 0.003), rarely (AOR = 0.02, 95% CI = [0.00–0.40], p = 0.009), or never (AOR = 0.01, 95% CI = [0.00–0.12], p = 0.001) had significantly lower odds of inadequate weight gain compared to those who were active daily. This suggests that moderate physical activity may support healthy weight gain, while excessive activity may hinder it.

Alcohol use was a particularly strong risk factor for inadequate weight gain. Women who used alcohol had 209.7 times higher odds of inadequate weight gain (AOR = 209.7, 95% CI = [11.72–3750.71], p < 0.001), underscoring the detrimental effects of alcohol on maternal and fetal health, the wide confidence interval is due to higher proportion of participants who do not drink alcohol. Additionally, women who took rest had 99.55% lower odds of inadequate weight gain (AOR = 0.0045, 95% CI = [0.00–0.08], p < 0.001), highlighting the importance of adequate rest and reduced stress during pregnancy.

VI. DISCUSSION

The prevalence of abnormal gestational weight gain observed in this study was 54.9% for excess weight gain and 18.8% for inadequate weight gain. These findings align with the results of (Kirchengast et al., 2024), who reported a high prevalence of pregnancy complications among women gaining weight above the IOM guidelines, including gestational hypertension (38.5%) and macrosomia (22.8%). The study found a similar prevalence of excess gestational weight gain (37.2%), although variations in populations, settings, or criteria used to define abnormal weight gain may account for differences. While that study focused on the direct association between weight gain and clinical complications, this study highlighted sociodemographic and behavioral factors influencing weight gain, such as employment status and physical activity.

The prevalence of excess weight gain in this study is lower than the 59.5% reported in a large cohort study by (Black et al., 2016). Black et al. attributed this higher prevalence to maternal overweight, obesity, and gestational diabetes mellitus (GDM), which contributed to adverse outcomes like large-for-gestational-age infants. Differences in prevalence may stem from variations in study populations and the criteria used to classify weight gain. While Black et al. emphasized BMI and GDM's role in fetal outcomes, this study focused on the broader impact of sociodemographic and behavioral factors, offering a complementary perspective.

In this study, abnormal weight gain (excess: 54.9%; inadequate: 18.8%) was significantly influenced by various factors. This finding is comparable to a study conducted in Thailand, where 62.34% of overweight and obese women experienced excessive gestational weight gain, and 12.99% had inadequate weight gain (Chairat et al., 2023). Both studies underscore the importance of antenatal care (ANC) interventions and weight management counseling to mitigate adverse outcomes. While the Thai study specifically emphasized ANC service quality for overweight and obese women, this study examined a broader range of sociodemographic and behavioral factors, highlighting the need for tailored interventions during pregnancy.

Employment status, pregnancy intention, and physical activity emerged as significant determinants of weight gain in this study.

Similar findings were reported in a study from Poland, which highlighted the influence of pre-pregnancy weight and lifestyle factors on gestational weight gain. Suliga et al. (2018) found that pre-pregnancy overweight or obesity significantly increased the risk of excessive weight gain (OR = 7.00, p = 0.031), while adherence to a prudent dietary

pattern reduced this risk. Both studies emphasize the importance of dietary guidance and behavioral interventions to manage weight gain, though the Polish study specifically focused on dietary patterns and smoking cessation, whereas this study explored a broader array of influences. This study's findings also align with research from China, which identified key sociodemographic and behavioral factors associated with gestational weight gain (Chen et al., 2024). In the Chinese study, pre-pregnancy underweight was a risk factor for low gestational weight gain, while obesity and a history of fetal macrosomia increased the risk of high weight gain. Seasonal variation, with pregnancies occurring in spring and summer, influenced weight gain, and regular exercise was found to be protective against high weight gain. Similarly, this study emphasized the impact of pre-pregnancy BMI and lifestyle behaviors, such as physical activity, on gestational weight outcomes.

VII. CONCLUSION

The study concluded that abnormal gestational weight gain is prevalent among pregnant women in Kigali City, and it is influenced by a range of sociodemographic, maternal and behavioral factors. The findings underscore the importance of targeted interventions aimed at promoting healthy weight gain during pregnancy, particularly among high-risk groups such as employed women and those with specific lifestyle patterns. Addressing these factors can contribute to better maternal and perinatal health outcomes.

VIII. ETHICAL CONSIDERATIONS

A cover letter recommending the researchers for permission to conduct the study was obtained from Mount Kenya University (MKU) and presented to the administration of the selected private hospitals for approval. The researchers provided participants with a full explanation of the study, its purpose, and objectives. To ensure confidentiality, participants were instructed not to include their names or any identifying information on the questionnaires. Designated submission points were provided where participants could return their completed questionnaires. Participation in the study was entirely voluntary, with no coercion or incentives offered.

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