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Association between weight gain, dietary practices and sociodemographic attributes among post-partum women in Arusha Urban, Tanzania

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Abstract

Overweight and obesity among women of reproductive age are a concern of public health significance. In Tanzania, various cultures perceive post-partum period as a delicate period where women participate in various habitual and traditional rituals as a way to protect themselves and their newborns. Currently, there is minimal information on the magnitude of post-partum overweight and obesity. A prospective health facility-based study using a multistage sampling is implemented to determine the magnitude of overweight and obesity among post-partum women six to twelve weeks after childbirth and their associating factors among Arusha Urban. The findings demonstrate an association between participants' sociodemographic characteristics such as age, marital status, education level, number of children, physical activities, contraceptive use, occupation and post-partum dietary practices and weight gain. Less than 50% of respondents achieved minimum dietary diversity (40.9%). The consumption of dark green leafy vegetables was significant ($p < 0.01$) to minimum dietary diversity, likewise to other fruits and vegetables; legumes, nuts and seeds; and eggs ($p < 0.01$). Overweight and obese participants were 54.3% at six weeks and 59.1% at 12 weeks. During pregnancy, 25.2% had recommended weight gain while 60.9% and 13.8% had inadequate and excessive weight gain respectively. The results show that gestational weight gain, maternal age, exposure to overweight messages, and minimum dietary diversity were significant with post-partum increase in BMI. The research suggests improving nutrition education, individual counseling, screening and routine monitoring of women's nutrition status at service delivery points and in the community.

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Introduction

The post-partum period begins with childbirth to six weeks (42 days) after delivery, a short post-partum duration, and a prolonged period which last one year. It is a period where a woman restores the reproductive organs and other biological systems to their pre-pregnancy state, where they undergo enormous physiological, social, and emotional changes. These bodily experiences are primarily caused by metabolic changes such as hemodynamics, involutions, and genitourinary recovery (Romano *et al.*, 2010). Therefore, a variety of traditional rituals are subjected to women as a way to protect themselves and their newborns, which makes the post-partum period to be considered a delicate period in many cultures (Altuntuğ *et al.*, 2018).

The sub-optimal behaviours influenced by culture and traditions on dietary practices among post-partum women play a significant role in overweight, obesity and post-partum weight retention. These are among the predisposing factors to non-communicable diseases and poor outcomes for maternal and child health (Diamond-Smith *et al.*, 2016).

Most women, especially in Africa, are confined to home environments after delivery for at least three months. A post-partum woman practices a sedentary lifestyle during this period, usually eating, feeding the baby and sleeping. There is a change in diets to starchy gruels, fatty meat and soups, which makes it easier to gain more weight than usual (Iliyasu *et al.*, 2006). At one year following birth, 14% to 26% of women are at least five kilograms (5kg) overweight, putting them at higher risk for obesity and its effects post-partum (Fadzil *et al.*, 2018). During the post-partum period, women's dietary patterns and practices change as they are fed high-calorie and reduced micronutrient-rich food (Makama *et al.*, 2021). These practices do not entail the minimum recommendations for vegetables, whole grains/fiber, fruits, and dairy; meanwhile exceed recommendations for total fat, refined grains, and empty calories, making most women more susceptible to being overweight and obese.

Post-partum weight retention increases the risks of hypertension, ischemic stroke, diabetes mellitus type 2, and ovarian and cervical cancer (O'Connor *et al.*, 2019). There are increased maternal and fetal risks during childbirth and adverse reproductive health outcomes of pregnancy complications for both mother and fetus. These include abortions, prematurity, reduced fertility, overweight offspring (approximately 4500 grams), and hypertensive disorders, the leading causes of global maternal and neonatal morbidity and mortality (Keskinkılıç *et al.*, 2017).

Post-partum weight retention is usually of a central obesity nature associated with excessive fat deposition in the internal organs, such as the intestines and liver (Gunderson, 2014). Factors contributing to these conditions include energy intake, age, minimal breastfeeding practices, lack of physical exercise, maternal income, and marital status (Endres *et al.*, 2015).

There is minimal information on the magnitude of post-partum overweight and obesity in Tanzania, a common phenomenon through observation and experience. Therefore, this study seeks to establish the magnitude of post-partum overweight and obesity and its association with dietary patterns and sociodemographic attributes in an urban setting.

Materials and methods

Study area

Arusha Urban is an area of Arusha city authority, located in northern Tanzania at 3.3869° S and 36.6830° E. It consists of 25 wards with a population of 416,442 (2012 Census) of different ethnicities engaged in various economic activities. It has three hospitals, nine health centres, and eight dispensaries. The study area was chosen due to the varied characteristics of its population, such as multicultural origins of different social and cultural values, ethnicity, and socio-economic characteristics. The area has social services such as health, education, water, markets, and communication channels.

Study design

The study used qualitative and quantitative methodologies to examine the relationship between post-partum dietary behaviours and their etiologies. This prospective study was conducted on health facilities using a multistage sampling strategy between March 2022 and June 2022. The first stage used a purposive sampling of three health facilities which were known to serve the highest number of post-partum women within the Reproductive and Child Health Clinics (RCHCs). In the second stage, post-partum women were randomly selected from the mentioned health facilities as they attended.

Sample size

Sample size was calculated from the standard formula for epidemiological studies described by (Cochran, 1977) in this case, where n is the total number of the sample, d is the absolute precision (5%), confidence interval (CI= 95%), Z is standard normal distribution (Z=1.96), and P is the proportion of overweight among women of reproductive age in Arusha region (P= 20.8%) (2015 TDHS).

= 253.14 ≈ 254 participants.

The available records show that in 2020, in all the selected facilities, a total of 4,958 deliveries were made, and therefore for this known population, a correction factor (Cochran, 1977) was applied to obtain a total of 242 participants.

Study participants and recruitment

The study involved post-partum women recruited from reproductive and child health clinics while attending their routine postnatal services. The study participants were enrolled six weeks post-partum and followed up to twelve weeks. The inclusion criteria for the study were post-partum women at six weeks attending routine infant immunization services at RCHCs. The study enrolled only those who consented to a follow-up of 12 weeks. However, the study excluded those in transit, not residents of Arusha Urban, and those with known chronic diseases like diabetes and cardiovascular diseases.

Ethical consideration

The KIDH, NM-AIST and CEDHA Health Research Committee (KNCHREC) approved the study. Relevant local government authorities granted permission to visit the health facilities. Before enrollment, the researcher provided a well-explained description of the purpose and objectives of the study to all participants. Participation was voluntary; all respondents signed informed consent, and confidentiality was maintained throughout the study. All procedure was conducted according to the guidelines laid down in the Declaration of Helsinki of 1975.

Study variable

The outcome variable for this study is the participant's body mass index (kg/m2) at six and 12 weeks post-partum. Participants recalled their pre-pregnancy body weight and provided their four antenatal body weights from the antenatal clinic card. Height and post-partum body weight measurements were measured at baseline (six weeks post-partum) and followed at six weeks. The participant's weight and height were measured using the SECA 878 digital scale and height board. Body mass index (BMI) is obtained by dividing weight (in kg) and its respective height (in square meters) and classified as underweight (BMI < 18.5), normal (18.5 ≤ BMI ≤ 24.9), overweight (24.9 5 ≤ BMI ≤ 29.9), and obese (BMI ≥ 30).

Predictor variables included individual characteristics such as maternal age, education level (no formal education, primary, secondary or college), employment status (employed, farmer, business or other including household), marital status (married, single, cohabiting, or divorced), contraceptive use (binary), and the number of children. All variables were collected from the respondents, while participants' maternal age was from the reproductive and child health clinic card.

Dietary diversity, gestational weight gain and participation in physical activities are the potential confounding variables. A proxy measure of nutrient adequacy and a qualitative measure of food consumption of a post-partum woman was measured using a 24-hour recall dietary diversity questionnaire (Swindale and Bilinsky, 2006).

Using this tool, participants recalled all foods eaten and beverages taken in the previous 24 hours inside and outside the home, including any snacks eaten between main meals. The variable used nine distinct food groups to measure the dietary diversity of the participants, where those who reported consuming food from at least five groups met dietary diversity criteria. A binary variable measured participant engagement in physical activity, where women were asked about their engagement in physical activities and the kind of activities they were involved in. We computed gestational weight gain (GWG) using the height and gestational weight at different gestational ages and classified the weight gain as recommended, inadequate and excessive. The classification of GWG depends on pre-pregnancy body weight as specified in the guideline for weight gain during pregnancy (Council, 2010).

Data analysis

We used IBM SPSS Version 25 for statistical analyses. We computed measures of central tendency to describe some social demographic data and frequencies for categorical variables. We also used the Pearson chi-square test to compare weight gain (BMI) with independent and confounding variables. We also compute ordinal logistic regression at 6 and 12 weeks post-partum using BMI in three levels: normal (BMI <25), overweight only (25 ≤ BMI < 30) and obese (BMI ≥ 30) as a dependent variable. We used multiple imputation methods (Rubin, 1996) to handle missing values for the recall of the pre-pregnancy body weight.

Results

Sociodeographic characteristics of study participants

The results obtained during this study in Table 1A&B show that at 6 and 12 weeks post-partum, women were more overweight and obese than normal (slightly above 50% of the 247 recruited). The age of study participants ranged from 18 to 45 years; the mean ± sd was 28.2 ± 5.9 years. A significant positive relationship between age and BMI was observed at six and twelve weeks (p <0.01 for both). Most of our study participants (207) were married, and the relationship between marital status and BMI was significant at six weeks (p=0.02). Nearly 50% of our participants were engaged in business activities, followed by those doing household chores; overall occupation status and BMI have a significant relationship at 6 and 12 weeks (p < 0.01). Fifty-nine percent of the participants had two children, and those with more than five children were 9%; as such, the number of children born and BMI were statistically significant at both periods (p< 0.01).

Regarding education level, the study demonstrated that most of our participants had primary education (46%), and only 15% had college and higher education, with no significant relationship with BMI during both periods. Participation in physical activities has nearly been equal, with 51% of the participants reporting engaging (p=*0.01* at six weeks and p=*0.04* at 12 weeks). Most of the participants (59%) did not attain dietary diversity, and the relationship with BMI was significant at 6 and 12 weeks (p < 0.05).

Contraceptive use seems to be a significant factor in both periods, where 22% have reported using. Most of those using contraceptives fall into the overweight or obese category, where at six weeks accounts for 61.6% and 69.5% at 12 weeks. The most reported methods are implants, injectables, pills and IUCD. The results show that gestational weight gain is a significant factor, where those with inadequate weight gain were 60.9%, those with recommended were 25.2% and 13.8% had excessive weight gain.

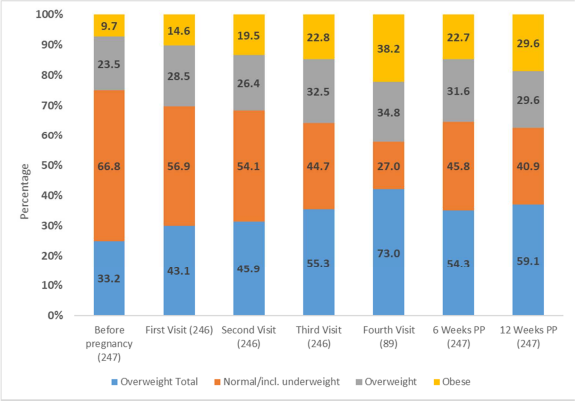

Fig. 1. Trend in weight changes before pregnancy, during pregnancy and six and 12 weeks post-partum

Table 1A. The association between sociodemographic characteristics and BMI at 6 and 12 weeks post-partum

Variables	BMI status at 6 weeks post-partum‡				BMI status at 12 weeks post-partum‡				Total women
	Normal	Under weight	Over weight	Obese	Normal	Under weight	Over weight	Obese	
Age†									
18-19	6(75)	1(12.5)	1(12.5)	-	5(62.5)	1(12.5)	2(25.0)	-	8
20-29	75(52.1)	3(2.1)	46(31.9)	20(13.9)	71(49.3)	1(0.7)	41(28.5)	31(21.5)	144
30-39	24(28.2)	2(2.4)	28(32.9)	31(36.5)	22(25.9)	-	26(30.6)	37(43.5)	85
40-45	2(20)	-	3(30)	5(50)	1(10.0)	-	4(40)	5(50.0)	10
Chi², *p*-value	37.5, <0.001				37.94, <0.001				
Marital status									
Married	86(41.6)	3(1.5)	65(31.4)	53(25.6)	79(38.2)	1(0.5)	58(28)	69(33.3)	207
Single	3(8.8)	18(52.9)	11(32.4)	2(5.9)	18(52.9)	1(2.9)	12(35.3)	3(8.8)	34
Cohabiting	0(0)	0(0)	2(100)	0(0)	0(0)	0(0)	2(100)	0(0)	2
Divorced	0(0)	3(75)	0(0)	1(25)	2(50)	0(0)	1(25)	1(25)	4
Chi², *p*-value	19.07, 0.0246				15.22, 0.085				
Level of education									
Primary school	53(46.9)	2(1.8)	28(24.8)	30(26.6)	47(41.6)	0(0)	33(29.2)	33(29.2)	113
Secondary school	42(42.9)	3(3.1)	34(34.7)	19(19.4)	40(40.8)	1(1.0)	28(28.6)	29(29.6)	98
College and above	12(33.3)	1(2.8)	16(44.4)	7(19.4)	12(33.3)	1(2.8)	12(33.3)	11(30.6)	36
Chi², *p*-value	6.77, 0.342				3.41, 0.757				
Occupation									
Employed	9(24.3)	1(2.7)	20(54.1)	7(18.9)	11(29.7)	0(0)	15(40.5)	11(29.7)	37
Farmer	7(22.6)	0(0)	11(35.5)	13(41.9)	5(16.13)	0(0)	13(41.9)	13(41.9)	31
Business	51(42.2)	4(3.3)	37(30.4)	29(24)	44(36.4)	2(1.7)	34(28.1)	41(33.9)	121
Other	40(69)	1(1.7)	10(17.2)	7(12.1)	39(67.2)	0(0)	11(19)	8(13.8)	58
Chi², *p*-value	34.42, <0.01				31.26, <0.01				
No. of children									
1-2	77(53.1)	4(2.8)	48(33.1)	16(11)	70(48.3)	2(1.4)	47(32.4)	26(17.9)	145
3-4	23(29.1)	2(2.5)	23(29.1)	31(39.2)	23(29.1)	0(0)	20(25.3)	36(45.6)	79
5 and more	7(30.4)	0(0)	7(30.4)	9(39.1)	6(26.1)	0(0)	6(26.1)	11(47.8)	23
Chi², *p*-value	29.64, <0.01				24.39, <0.01				
Total	6(2.4)	107(43.3)	78(31.6)	56(22.7)	2(0.8)	99(40.1)	73(29.6)	73(29.6)	247

† Years in terms of mean (sd) = 28.2 (5.9), ‡ The table presents the value as frequency (percentage)

Table 1B. The association between maternal health behaviors and BMI at 6 and 12 weeks post-partum

Variables	BMI status at 6 weeks post-partum‡				BMI status at 12 weeks post-partum‡				Total women
	Normal	Under weight	Over weight	Obese	Normal	Under weight	Over weight	Obese	
Participation in physical activities									
Yes	4 (3.4)	62 (52.1)	35 (29.4)	18(15.1)	2 (1.7)	56 (47.1)	33 (27.7)	28(23.5)	119
No	2 (1.6)	44 (35.2)	41 (32.8)	38(30.4)	0	42 (33.6)	38 (30.4)	45(36.0)	125
Chi², *p*-value	11.35, 0.01				8.31, 0.04				
Contraceptive use									
Yes	1 (1.92)	19(36.5)	11(21.2)	21(40.4)	0	16(30.8)	10(19.2)	26(50)	52
No	5(2.8)	85(46.7)	61(33.5)	31(17.1)	2(1.1)	81(44.5)	56(30.8)	43(23.6)	182
Chi², *p*-value	12.98, <0.01				13.86, <0.01				
Gestational weight gain									
Inadequate	5(3.3)	93(62)	44(29.3)	8(5.3)	2(1.3)	83(55.3)	46(30.7)	19(12.7)	150
Recommended	1(1.6)	12(19.4)	27(43.6)	22(35.5)	0(0)	14(22.6)	21(33.9)	27(43.6)	62
Excessive	0(0)	2(5.9)	7(20.6)	25(73.5)	0(0)	2(5.9)	6(17.6)	26(76.5)	34
Chi², *p*-value	101.05, <0.01				70.95, <0.01				
Dietary diversity									
Yes	4 (3.9)	51 (50.5)	29 (28.7)	17(16.8)	1 (0.9)	49 (48.5)	30 (29.7)	21(20.8)	101
No	2 (1.4)	56 (38.4)	49 (33.6)	56(22.7)	1 (0.7)	50 (34.3)	43 (29.4)	73(29.6)	146
Chi², *p*-value	6.69, 0.08				7.54, 0.06				
Total	6(2.4)	107(43.3)	78(31.6)	56(22.7)	2(0.8)	99(40.1)	73(29.6)	73(29.6)	247

† Years in terms of mean (sd) = 28.2 (5.9), ‡ The table presents the value as frequency (percentage)

Trend in weight change with gestational age

Fig. 1 presents the trend in weight changes using BMI, estimated prior pregnancy, during pregnancy (at most 4 ANC visits) and post-partum (at two-time points). Participants' body weight trends increased with the increase in their gestational age. At the fourth antenatal visit, the increase in BMI was at its peak. There was a slight drop in BMI six weeks after delivery, which is linked to the effects of childbirth whereby new birth baby, placenta, liquor and membranes were delivered. The increase in the trend of obesity and total overweight from pre-pregnancy to the fourth visit was found to be statistically significant (*p for trend* <0.05).

The classification of recommended gestational weight gain depends on pre-pregnancy nutrition status (BMI), where for those who are underweight, normal, overweight and obese, their total weight gain is 12.5-18 kgs, 11.5-16 kgs, 7-11.5 kgs, and 5.0-9 kgs respectively (Rasmussen *et al.*, 2010). The results have shown that 60.9% had inadequate weight gain, 28.2% had recommended weight gain, and 25.2% had excessive weight gain.

Table 2. Distribution of consumed foods from various food groups when above or below the threshold of five food groups

Food groups	Frequency	Minimum dietary diversity		*p*-value
		Yes [n (%)]	No [n (%)]	
Starchy staples	247	101 (40.9)	146 (59.1)	*
Dark green leafy vegetables	43	37 (86)	6 (14)	<0.001
Other vitamin A-rich fruits and vegetables	83	74 (89.2)	9 (10.8)	<0.001
Other fruits and vegetables	23	23 (100)	0 (0)	<0.001
Organ meat	216	90 (41.7)	126 (58.3)	0.513
Meat and fish	246	101 (41.1)	145 (58.9)	0.405
Eggs	8	8 (100)	0 (0)	0.001
legumes, nuts and seeds	16	15 (93.8)	1 (6.3)	<0.001
Milk and milk products	246	101 (41.1)	145 (58.9)	0.405
Total	247	101 (40.89)	146 (59.11)	

Minimum dietary diversity and distribution of foods consumed during the post-partum period

Table 2 summarizes all food consumed in terms of food groups during the post-partum period, where 59.1% of the women did not reach minimum dietary diversity (did not consume food from at least five groups). The results show that all participants consumed starchy staples, and nearly all participants (246) consumed meat and fish (predominantly meat), milk and milk products. Organ meat consumption was also high, where 87% of participants reported consuming it. The least consumed foods were eggs, legumes, nuts and seeds, fruits and vegetables. Most women who attained minimum dietary diversity have reported consuming food items from these least consumed food groups.

In addition, Table 2 shows the relationship between the minimum dietary diversity score and each food group based on ten food groups (FAO and FHI360, 2016). The relationship between minimum dietary diversity and the consumption of dark green leafy vegetables was statistically significant ($p < 0.001$), likewise to other vitamin A-rich fruits and vegetables; other fruits and vegetables; legumes, nuts and seeds; and eggs ($p = 0.001$). Also, most participants (over 86%) who consumed foods from the least consumed ones have attained minimum dietary diversity.

Factors associated with post-partum weight gain in terms of BMI

This study uses ordinal logistic regression to model the relationship between a post-partum BMI in an ordinal order of three distinct groups (normal, overweight only and obese) and sociodemographic characteristics of the participants. There were no missing data in both dependent and independent variables, and variables were independent. The analysis checked for all assumptions of ordinal logistic regression. Table 3 presents the full models,

showing the odds of an explanatory variable being in a higher category are proportional to the odds of it being in a lower category of BMI. Findings present *p*-values <0.01, <0.05 and <0.1, and those of <0.05 and <0.01 were considered statistically significant.

Table 3 presents the association of weight gain (measured in BMI) at six and 12 weeks post-partum in ordinal order with the explanatory variables. The table presents bivariate analysis results showing the relationship between the outcome variable with each explanatory variable. At both 6 and 12 weeks post-partum, age ($p < 0.05$), marital status ($p < 0.1$), occupation ($p < 0.1$), engagement in physical activities ($p < 0.05$) and minimum dietary diversity ($p < 0.1$ at six weeks and $p < 0.05$ at 12 weeks) were statistically significant to BMI. The results show that with a unit increase in age, the odds of being obese or overweight compared to normal are 1.072 and 1.073 times greater than in the normal category at six and 12 weeks, respectively.

Table 3. Coefficient estimates of factors associated with overweight and obesity based on an ordinal logistic regression model

Variables	BMI status at six (6) weeks post-partum				BMI status at 12 weeks post-partum			
	OR	p-value	[95% CI]	Sig	OR	p-value	[95% CI]	Sig
Age	1.07	0.03	[1.01 1.14]	**	1.073	0.023	[1.01 1.14]	**
No of children	1.13	0.34	[0.88 1.45]		1.01	0.45	[0.86 1.40]	
Marital status								
Married	1				1			
Single	0.51	0.09	[0.23 1.11]	*	.507	0.08	[0.24 1.08]	*
Cohabiting	1.72	0.64	[0.17 17.31]		1.333	0.80	[0.14 12.7]	
Divorced	0.22	0.26	[0.02 3.05]		.697	0.75	[0.08 6.15]	
Level of education								
Primary	1				1			
Secondary	0.97	0.91	[0.53 1.75]		1.01	0.99	[0.56 1.80]	
College+	0.81	0.68	[0.29 2.26]		0.98	0.96	[0.36 2.65]	
Occupation								
Employed	1				1			
Farmer	1.04	0.95	[0.32 3.43]		0.93	0.90	[0.29 2.99]	
Business	0.58	0.22	[0.23 1.45]		0.77	0.57	[0.31 1.91]	
Other (Household)	0.36	0.06	[0.12 1.04]	*	0.37	0.06	[0.13 1.05]	*
Heard about overweight								
No	1				1			
Yes	1.48	0.19	[0.82 2.67]		1.34	0.33	[0.75 2.39]	
Engagement in physical activities								
No	1				1			
Yes	0.53	0.02	[0.31 0.89]	**	0.59	0.04	[0.35 0.98]	**
Contraceptive use								
No	1				1			
Yes	2.19	0.01	[1.21 3.96]	***	2.56	< 0.01	[1.41 4.64]	***
Gestational weight gain								
Recommended	1				1			
Inadequate	0.13	<0.01	[0.07 0.24]	***	0.21	<0.01	[0.11 0.37]	***
Excessive	5.19	<0.01	[2.11 12.80]	***	4.37	<0.01	[1.74 10.96]	***
Minimum dietary diversity among participants								
MDD met	1				1			
MDD not met	1.59	0.09	[0.94 2.7]	*	1.59	0.04	[1.11 3.14]	**

*** p<.01, ** p<.05, * p<.1

For those who were single, their odds of being in higher BMI were 50% less than in normal BMI at both periods. For those doing household work, their odds of being in higher BMI were nearly 70% less than in normal BMI at both periods. Post-partum women who engaged in physical activities had 47% and 41% lower odds of having higher BMI than the normal at 6 and 12 weeks.

Contraception use and GWG are statistically significant with BMI at both follow-up times (both at (p < 0.01). For participants who reported using contraceptives, their odds of likely to be overweight or obese versus normal are 2.18 at six weeks and 2.56 at 12 weeks higher than those who did not use contraceptives. For those who had inadequate weight gain during pregnancy, their odds of having high BMI were 87% at six weeks and 79% at 12 weeks, less likely compared to those with recommended GWG, while the odds of those with excessive weight gain were 5.19 at six weeks and 4.37 at 12 weeks higher versus those with recommended GWG. In addition, the odds for those who had not met minimum dietary diversity was 1.59 times higher for being overweight or obese versus normal.

Table 4 presents a reduced multivariate model with a step-wise method. The study fitted the multivariate ordinal model using the significant variables in Table 3. The analysis removed the terms with p ≥ pr (0.2) from the final model.

Table 4. Coefficient estimates of factors associated with overweight and obesity at 6 and 12 weeks post-partum based on an ordinal logistic regression model (reduced model)

Variables	BMI status at 6 weeks post-partum				BMI status at 12 weeks post-partum			
	OR	p-value	[95% CI]	Sig	OR	p-value	[95% CI]	Sig
Age	1.06	0.03	[1.01 1.12]	**	1.07	< 0.01	[1.02 1.12]	***
Ever heard about overweight								
No	1				1			
Yes	1.65	0.09	[0.93 2.92]	*	1.484	0.16	[0.85 2.59]	
Engagement in physical activities								
No	1				1			
Yes	0.71	0.23	[0.39 1.25]		0.757	0.32	[0.44 1.31]	
Women dietary diversity								
High	1				1			
Low	2.39	< 0.01	[1.33 4.30]	***	2.345	< 0.01	[1.34 4.09]	***
Pregnancy weight gain								
Recommended	1				1			
Inadequate	0.15	< 0.01	[0.08 0.29]	***	0.25	< 0.01	[0.14 0.47]	***
Excessive	6.08	< 0.01	[2.33 15.93]	***	4.79	< 0.01	[1.81 12.70]	***
Contraceptive use								
No	1				1			
Yes	1.18	0.64	[0.59 2.36]		1.558	0.202	[0.79 3.08]	

*** p<.01, ** p<.05, * p<.1

The results show that for those with low dietary diversity, their odds of being obese or overweight versus in normal BMI are 1.6 and 1.7 times greater at six and 12 weeks, respectively, than those who met their minimum dietary diversity (p < 0.1 and p < 0.05, respectively) when the effect of other variables is constant. Among post-partum women who engaged in physical activities, their odds of being obese or overweight versus in normal BMI were 56% and 47% lower at six and 12 weeks, respectively, than those who did not engage in physical activities (p < 0.01 and p <0.05, respectively). A unit increase in age of the post-partum women at both periods, the odds of being obese or overweight versus in normal BMI are 1.12 times greater than being in normal BMI (p < .01). Additionally, those who had heard about being overweight had 1.8 and 1.7 higher odds of being in higher BMI categories versus normal at six and 12 weeks, respectively (p < 0.05).

While controlling for age, hearing about being overweight, engagement in physical activities, dietary diversity and contraceptive use, the odds of participants who have inadequate GWG are 85% at six weeks and 75% at 12 weeks less likely to be overweight or obese compared to those in recommended GWG (p < 0.01 at both periods), the odds of participants who have excessive GWG are 6.08 at six weeks and 4.37 at 12 weeks higher to be in overweight or obese versus those in recommended GWG (p < 0.01 at both periods).

Discussion

The study aimed to establish the magnitude of post-partum overweight and obesity and its association with dietary patterns and sociodemographic attributes. The study has shown that maternal age, exposure to knowledge about overweight (or obesity), participation in physical activities and dietary diversity are critical attributes of post-partum weight gain. Results show that overweight and obesity at both six and 12 weeks post-partum is high, and it has shown some indication of a decrease during the six weeks port-partum due to bodily weight adjustment to pre-pregnancy weight and a steady increase with the post-partum period.

Gestational weight gain has consistently been a critical variable in determining post-partum BMI, where most participants had inadequate GWG (60.9%). In addition, most participants have not met the minimum dietary diversity (59.1%); their meals constitute high animal fats, staple foods, dairy products, and added sugar beverages, which subjects them to weight gain.

This study reveals that an increase in age among post-partum women increases the odds of being obese or overweight compared to normal (Girdhar *et al.*, 2016; Nurul-Farehah and Rohana, 2020; Østbye *et al.*, 2012), which suggests that maternal age essential in determining weight gain during the post-partum period. An increase in age has been found to be associated with abdominal obesity, a risk factor related to hormonal and lifestyle changes. As age increases, body fat distribution and metabolism changes contribute to insulin resistance and metabolic syndrome (Jura and Kozak, 2016). However, this result slightly differs from the one by Boudet-Berquier *et al.*, which found that younger women (aged between 25 and 29) were more likely to be obese than those between 30 and 34 (Boudet-Berquier *et al.*, 2017).

The results of this study show that women who heard about being overweight or obesity had an increased risk of becoming overweight or obese than being normal compared to post-partum women who had not heard about overweight or obesity. This is also a case in the study conducted among American women aimed to recognize misperceptions in the diagnosis and treatment of obesity and people's consideration of weight loss. It is seen that most obese women were aware of the effects of excessive weight gain, which is an indication that individual awareness is not all about knowledge acquisition (Rosenthal *et al.*, 2017). Garad *et al.* found that knowledge and skills acquisition on overweight and obesity compared is a crucial positive attribute to only being exposed to information (Garad *et al.*, 2020). The study conducted in Asia to assess levels of nutrition knowledge among post-partum women shows that there is also limited information about nutrition from health practitioners (Nikolopoulos *et al.*, 2017) which hinders the delivery of appropriate messages at health facilities.

Another important finding is that women with limited physical activities have more odds of being overweight or obese than those involved in any physical activities. Restricted physical activities during the post-partum period increase the risks of overweight and obesity, predisposing factors to cardiovascular diseases and diabetes (O'Connor *et al.*, 2019). These results have also been the case in an intervention study among overweight or obese pregnant and post-partum women to examine weight change, where the intervention group lost more body weight than those in the control groups (Choi *et al.*, 2013). However, to reduce the risk of post-partum weight retention and excessive weight gain during pregnancy and the post-partum period, combined intervention approaches such as the consumption of a low glycemic load diet and light to moderate physical activities are known to be successful in reducing excessive weight gain during pregnancy and the post-partum period (Farpour-Lambert *et al.*, 2018).

The most apparent result found in this study is that women who had not reached minimum dietary

diversity had elevated chances of having higher BMI categorization than normal. These results may partly be due to an abrupt change in dietary patterns and practices after childbirth influenced by social-cultural beliefs, which are unhealthful to both women and infants (Makama *et al.*, 2021; Smith *et al.*, 2022). Usually, post-partum women are cared for by both traditional and modern providers during delivery and the post-partum period, allowing them to adopt both traditional and modern practices (Diamond-Smith *et al.*, 2016). After giving birth, women usually stay indoors, cared for and fed by relatives or mothers-in-law. Chinese women stay indoors for 30 days; they call it "Zuo Yuezhi", meaning "Doing a month", where mothers-in-law provide care and support (Smith *et al.*, 2022). During this period, they are fed reasonably large amounts of food, often high caloric rich food, five to eight times a day and restrictions of any physical activity. In addition, women are restricted or do not tend to consume some food items, such as vegetables and fruits.

Contraceptives were positively associated with overweight or obesity at six and 12 weeks post-partum. Women who use contraceptives had a positively increased odds of 2.18 at six weeks and 2.56 at 12 weeks post-partum (p <0.01) of being overweight or obese. This finding is consistent with the one in an intervention study among post-partum women to examine weight retention risk factors and their relationship to obesity at one year, where the results revealed increased odds of overweight/obesity among women on contraceptives utilization compared to none contraceptive users (Endres *et al.*, 2015).

Other findings have shown that advanced age correlates with contraceptive use and contributes to synergetic effects on body weight (Nikolopoulos *et al.*, 2017). Contraception use is an essential factor among overweight or obese women due to thromboembolic events (Hammad *et al.*, 2023). A key thing to note here is the use of a safe and effective contraceptive method, where Progestrin only Pills (POPs), Levonorgestrel (LNG) and Etonogestrel (ETG) Implants as well as the Copper Intrauterine device (CU-IUD) and Levonorgestrel intrauterine device (LNG-IUD) are WHO recommended methods for contraception among post-partum women (Cipriani *et al.*, 2020).

Maternal overweight and obesity are among the determinants of low birth weight. At twelve weeks post-partum, the trends of overweight and obese were on the rise, after a low decrease at six weeks due to bodily adjustment to pre-pregnancy body weight. Total overweight and obese at six weeks were 54.3% and 59.1% at twelve weeks. GWG is a critical factor of post-partum weight retention; results show that those with excessive GWG have elevated odds of being overweight or obese at six and 12 weeks post-partum, consistent with results of other studies (Mamun *et al.*, 2010; Sha *et al.*, 2019). Mamum *et al.* further describe that GWG contributes to overweight or obesity, which may have implications for the future of post-partum women.

Conclusion

The research findings demonstrate an association between participants' sociodemographic characteristics, post-partum dietary practices, and weight gain. The nutritional knowledge gap and lifestyles, including cultural values, influence suboptimal dietary practices and post-partum weight gain. Nutrition education and individual counselling are more beneficial than just hearing nutrition information.

Recommendation(s)

Our results suggest improvement in providing nutrition education, individual counselling, screening and routine monitoring of women's nutrition status at service delivery points and in the community. Knowledge acquisition will support behaviour change and health promotion to post-partum women and their infants. It is essential to identify pregnant women showing risks of maternal and post-partum obesity to deliver appropriate and timely interventions. In addition, the study suggests a comprehensive system to assess pre-pregnancy BMI and GWG as key components during ANC.

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