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Physical activities and cardiometabolic profiles of African overweight and obese pregnant women

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Abstract

Background Pregnancy triggers physiological adjustments through hormonal changes, supporting foetal growth and preparation for labour. Becoming more pronounced with excessive weight, these changes may trigger pathophysiological changes and unmask pre-existing disease conditions. In developing countries, many pregnant women experience either inadequate or excessive weight gain and may present with perturbed metabolism. Lifestyle interventions, including regular physical activity, are important but often overlooked in these settings. Context-specific data on physical activity and cardiometabolic profile of overweight and obese pregnant women are limited in sub–Saharan Africa, specifically Tanzania. The current analysis aimed to determine the relationship between pre-pregnancy overweight/obesity, pregnancy physical activity and cardiometabolic factors among pregnant women.

Methods This cross-sectional study involving 243 pregnant women aged 18–35 was conducted in selected antenatal clinics in Dodoma, of whom 37% ($n=91$) were overweight or obese. The current analysis assessed physical activity, anthropometric, and cardiometabolic parameters and compared between overweight/obese and normal-weight participants.

Results Overweight and obese pregnant women demonstrated significantly lower levels of physical activity across various domains, including overall physical activity ($p<0.001$) and median METs (metabolic equivalent of tasks) minutes per week ($p<0.001$) compared with their normal weight counterparts. In particular, they had lower median METs obtained from the occupational domain ($p=0.037$). Additionally, the same group engaged less in exercise or leisure time physical activities ($p=0.014$), with a lower percentage of contribution to total METs minutes per week obtained from these activities ($p=0.002$). Furthermore, overweight or obese participants exhibited higher systolic blood pressure ($p<0.001$), diastolic blood pressure ($p=0.008$), haemoglobin levels ($p<0.001$), fasting blood glucose levels ($p=0.005$), serum triglycerides levels ($p=0.012$), and total cholesterol levels ($t(234)=1.98$, $p=0.048$) than their normal–weight counterparts.

Conclusion and recommendations Overweight and obese pregnant women showed lower physical activity levels, with low levels of both occupational and leisure time (exercise) physical activities, possibly explaining the observed cardio metabolic perturbation in this group. An intervention aiming at promoting physical activity and enhancing cardiometabolic health among this group is necessary.

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Keywords Physical activity, Pregnancy, Overweight, Obesity, Blood glucose, Glucose tolerance, Lipid profile, Cardiometabolic

Background

Pregnancy causes physiological adjustments mediated by the accompanying hormonal changes [1]. These changes occur to support foetal growth and prepare for labour [1]. Elevated levels of oestrogen and progesterone mediate most cardiometabolic changes; however, other convoyed hormonal system changes are synergistic in causing those changes. Particularly hyper-cortisol states, stimulation of the Renin-Angiotensin-Aldosterone system (RAAS), growth hormone production by the placenta, insulin resistance, and resetting of osmoreceptors for anti-diuretic hormone (ADH) release [2, 3]. These alterations cause fluid retention and a shift in the metabolism towards utilising fat rather than glucose and proteins, which are preserved for foetal development [2, 3]. Some of these changes influence biochemical values and can even mimic certain medical diseases [4]. These changes tend to be excessive, impactful and difficult to reverse in overweight and obese women [4].

While in high-income countries, the issue has been gaining weight more than the Institute of Medicine (IOM) recommends [5], in low-income countries, more focus has been on underweight [6]. The tendency has recently shifted towards an increase in overweight and obesity [6]. The shift is likely due to improvements in living conditions, health interventions, and lifestyle changes [7]. As a state of transition, Tanzania is currently experiencing both underweight and excessive weight in pregnancy [8, 9]. Recent data indicate that the prevalence of overweight and obesity in pregnancy in Tanzania is around 26.5% and 12.3%, respectively [10]. This is an important concern since cardiometabolic changes tend to be excessive among women with excessive weight and can unmask pre-existing metabolic conditions or progress to pathological conditions and result in undesirable pregnancy outcomes [4, 11, 12]. Moreover, the changes do not adequately reverse in overweight and obese women who retain weight after pregnancy thus, they tend to accumulate in successful pregnancies, increasing the risk for cardiovascular diseases, central obesity, and type 2 diabetes mellitus (T2DM) [5, 9, 13]. Physical activity (PA) is among the proposed means to control pregnancy-related body weight and cardiometabolic changes [14, 15].

PA has been reported to have cardiometabolic benefits even when there is no significant effect on body weight [16]. The American College of Obstetricians and Gynaecologists (ACOG) recommends pregnant women who were active before pregnancy to maintain their activity level or initiate safe physical activities (PAs) if they were previously inactive [17]. Evidence shows that optimum diet and PA in pregnancy are associated with a decrease in operative delivery rates, the risk of gestational diabetes mellitus, hypertension and postpartum recovery time [17–19]. The American College of Sports Medicine (ACSM) recommends that pregnant women dedicate at least 150 min weekly or 30–50 min daily for 3–5 days for moderate-intensity PAs [20].

Historically, in African settings, pregnant women were discouraged from participating in physical activities (PAs) due to concerns about foetal safety. However, these reservations were rooted in socio-cultural misconceptions rather than evidence-based practice [21]. Increasing evidence regarding the safety and health advantages of staying physically active during and after pregnancy [22–26] has stimulated the integration of PA counselling as a standard component of care provided to expectant and breastfeeding mothers [27, 28]. However, there is a widespread sedentarism tradition during pregnancy in African settings. While many previously inactive women tend to remain inactive during pregnancy, a significant number of those who were active before often reduce their levels of activity after becoming pregnant [29–31].

In high-income settings, pregnancy-related physical activity (PA) and cardiometabolic changes have been extensively researched; however, evidence unique to sub-Saharan Africa, particularly Tanzania, is still lacking. Given the region's unique double burden of malnutrition and the ways that sociocultural norms and transitions affect maternal health practices, this is noteworthy. Our study closes this gap by comparing the cardiometabolic profiles and PA levels of overweight and obese pregnant women in Tanzania to those of normal weight.

Methods

Design and sampling

We employed a cross-section design to study PA and related cardiometabolic profiles of pregnant women with pre-pregnancy overweight or obesity. The study recruited consecutively 243 pregnant women who attended antenatal clinics at Makole Health Centre in Dodoma, Tanzania, from 16th February to 15th March 2024. The sample size was calculated based on the mean weight gain (6.3 kg) from the second to the third trimester and a variance (4.9) obtained from documented gestational weight gain in a prospective pregnancy cohort in urban Tanzania [9]. The assumptions included a mean weight gain in the study group of ± 1 kg, a 95% level of significance, a power of 80% and a 25% non-response.

Inclusion and exclusion criteria

Participants aged 18–35 with 6–40 weeks-old singleton pregnancy were included. We excluded women who were known to have been diagnosed with cardiovascular diseases or any other disease which by itself or its management can potentially affect body weight, physical abilities, cardiometabolic profile or contraindicated exercise. Since participants were to be categorised based on pre-pregnancy weight, women who didn't know their body weight at least three months before becoming pregnant were excluded. Underweight participants were not involved in the final analysis. Participants who did not complete measurements or failed to turn up for repeated measurements when scheduled were not included in the final analysis.

Variables measurement and data collection

A custom-designed tool adapted from WHO STEPS, the General Society Survey (GSS), and the Demographic Health Survey (DHS) questionnaires [32–34] was used to collect sociodemographic information. A custom-designed tool adapted from the DHS questionnaire [33] collected information regarding obstetrics and gynaecology history. PA was assessed using the International Physical Activity Questionnaire Long Form (IPAQ-L) [35]. We used IPAQ due to the feasibility challenges of using objective PA measures in given study settings. Several studies have used IPAQ in pregnancy previously [36–40]. Self–reported PAs were used to calculate average metabolic equivalents of a task (METs). Participants were regarded as physically active if they accumulated at least 600 METs minutes weekly. A custom-designed checklist was used to collect data on cardiometabolic parameters.

Experts panel, including exercise physiologists, obstetricians/gynaecologists, and experienced midwives, reviewed and validated the data collection tools through face-to-face meetings. The meeting reviewed and ranked each section and its items on a 1–5 scale, with a 4 or 5 score indicating agreement. Then, the panel provided comments suggesting modifications, additions or omissions to improve content validity at item level.

Weight was measured in Kg using a standard calibrated machine (Seca, China), but it was not used to categorise participants. Participants were categorised into normal–weight or overweight/obese groups depending on their pre-pregnancy weight. Heart rate (HR) in beats per minute and blood pressure (BP) in mmHg were measured using a digital upper arm sphygmomanometer (Omron 5 series®, BP7200, Japan) [41] while following 2020 International Society of Hypertension Global Hypertension Practice Guidelines [42]. Measurements were done on a single contact except when BP was 130–139 systolic or 85–89 diastolic, for which measurements were repeated on the next day, and the final BP measurement was considered in this case.

Haemoglobin concentration (Hb) in mg/dl was measured from venous blood using the HemoCue® Hb 801 system following the WHO guide for haemoglobin measurement in population-level anaemia surveys [43]. Blood glucose was measured in mg/dl from capillary blood using a digital glucometer (Accu-Check® Guide, Roche Diabetes Care, Switzerland) [44] and a tolerance test was done using 50 g of pure glucose dissolved in 200 ml of water. The first glucose measurement was done in the morning between 7 and 9 a.m. after at least 8 h of fasting. If fasting could not be ascertained, the measurement was rescheduled for the next day. The second plasma glucose measurements were done 1 h after taking the glucose solution, and they were restricted from eating anything in the meantime. Serum triglycerides, total, LDL and HDL cholesterol were measured in mg/dL from fasting venous blood using an automatic analyser (Cobas® 6000, Roche, Germany) [45].

Data analysis

Data were entered into Microsoft Excel and analysed using Stata v18. Categorical variables were coded, described by proportions and compared using the chi-square test. Total cholesterol and LDL were described using mean and compared by t-test. Other numerical variables were not normally distributed hence, described using median and independent samples, Mann-Whitney U Test was used for comparison. A p-value of 0.05 was considered an acceptable level of significance.

Ethical consideration

Ethical clearance was sought from Muhimbili University's institutional review board. Permission to conduct the study was obtained from the relevant authorities. All study protocols were carried out in line with Helsinki's declaration. Informed consent was offered in writing and signed by all participants. The safety and well-being of participants were given the highest priority throughout. Those found with abnormal parameters were referred for further medical attention.

Results

Sociodemographic characteristics of participants

The study involved a total of 243 pregnant women, of whom 37% ($n = 91$) were overweight or obese. The median age of participants was 26 (18–35), and 40% ($n = 97$) had primary education. About 45% ($n = 110$) were self-employed, 77% ($n = 188$) were married, and 82% ($n = 199$) lived with partners. Participants' partners' median age was 31 (21–55), and 47% ($n = 114$) had secondary education, with 59% ($n = 144$) being self-employed. About 49%

($n = 119$) had < 300,000/- TSh (115 USD) monthly income, and 64% ($n = 156$) could only afford basic needs.

Compared to normal-weight participants, overweight/obese were older ($p < 0.001$) and had older partners ($p = 0.045$), with secondary education ($p = 0.002$) and were able to meet all the needs ($p = 0.002$) with their increased average monthly family income ($p = 0.001$) (Table 1).

Obstetric and gynaecological history

On average, 51% ($n = 123$) of participants were in the third trimester with a median gestational age of 25 (6–36) weeks. Almost 40% ($n = 97$) had first pregnancy, 49% ($n = 119$) had given birth previously, and 4% ($n = 8$) had given birth four times or more. About 10% ($n = 23$) had a history of pregnancy which did not end up in giving birth to a live baby, whereas 7% ($n = 18$) had an abortion and 3% ($n = 7$) had stillbirth. Among those who had given birth previously, 14% ($n = 17$) had a history of caesarean

Table 1 Sociodemographic characteristics of participants

Characteristic	Normal weight	Overweight/ Obesity	*p*-value
	n (%)/ Median (Range)	*n* (%)/ Median (Range)	
Age	25 (18–35)	28 (18–35)	< 0.001
Education Level			
Never attended school	10 (6.6%)	3 (3.3%)	0.060
Primary education	65 (42.8%)	32 (35.2%)	
Secondary education	44 (28.9%)	33 (36.2%)	
College	33 (21.7%)	23 (25.3%)	
Occupation			
Housewife	62 (40.8%)	29 (31.9%)	0.100
Self employed	66 (43.4%)	44 (48.4%)	
Employed	17 (11.2%)	11 (12.1%)	
Unemployed	4 (2.6%)	2 (2.2%)	
Student	3 (2.0%)	5 (5.5%)	
Marital status			
Married	117 (78.0%)	71 (78.0%)	0.065
Relationship without marriage	29 (19.3%)	20 (22.0%)	
Single mother	4 (2.7%)	0 (0.0%)	
Living with partner			
Yes	124 (84.9%)	75 (82.4%)	0.702
No	22 (15.1%)	16 (17.6%)	
Partner's age	30 (21–55)	33 (23–50)	0.045
Partner's education			
Primary education	35 (24.6%)	12 (13.2%)	0.002
Secondary education	61 (43.0%)	52 (57.1%)	
College	46 (32.4%)	27 (29.7%)	
Partner's occupation			
Self employed	86 (60.6%)	58 (63.7%)	0.548
Employed	52 (36.6%)	33 (36.3%)	
Unemployed	2 (1.4%)	0 (0%)	
Student	2 (1.4%)	0 (0%)	
Financial situation			
Able to meet all the needs	28 (19.2%)	30 (33.0%)	0.002
Barely make basic needs	103 (70.5%)	53 (58.2%)	
Can't make basic needs	10 (6.8%)	8 (8.8%)	
Don't know	5 (3.4%)	0 (0%)	
Average monthly income (Tsh*)			
Bellow 300,000	86 (58.5%)	33 (36.3%)	0.001
300,000-500,000	41 (27.9%)	37 (40.7%)	
500,000–1,000,000	12 (8.2%)	13 (14.3%)	
1,000,000–2,000,000	2 (1.4%)	7 (7.7%)	
Above 2,000,000	6 (4.1%)	1 (1.1%)	

*Tsh: Tanzania Shilling Currency

section (c/section), 3% ($n=4$) assisted virginal delivery, 7% ($n=8$) preterm labour and 24% ($n=32$) gave birth to a big baby (birthweight ≥ 4.0 kg), 44.6% ($n=50$) had sustained perineum tear, and 30% ($n=32$) had episiotomy done (Table 2).

Compared to normal participants, overweight/obese had lower gestational age ($p=0.007$), high gravidity ($p=0.012$), higher parity ($p=0.029$), and higher number of living children ($p=0.002$) (Table 2).

Physical activities (PAs)

A majority, 84% ($n=204$) of participants attained adequate PA levels, whereby 96% ($n=221$) engaged in moderate-intensity occupational PAs. About 92% ($n=212$)

Table 2 Obstetric and gynaecological history of participants

Characteristic	Normal weight	Overweight/ Obesity	*p*-value
	n (%)/ Median (Range)	*n* (%)/ Median (Range)	
Gravida			
1	68 (44.7%)	29 (31.9%)	0.012
2–4	80 (52.6%)	54 (59.3%)	
5+	4 (2.6%)	8 (8.8%)	
Gestational age	28 (6–39)	22 (6–39)	0.007
1st trimester	14 (9.2%)	11 (12.1%)	0.038
2nd trimester	51 (33.6%)	44 (48.4%)	
3rd trimester	87 (57.2%)	36 (39.6%)	
Parity			
0	79 (53.9%)	42 (46.2%)	0.019
1	41 (27.0%)	20 (22.0%)	
2–3	27 (17.8%)	23 (25.3%)	
4+	2 (1.3%)	6 (6.6%)	
Abortions			
0	140 (92.1%)	85 (93.4%)	0.901
1	8 (5.3%)	4 (4.4%)	
2–4	4 (2.6%)	2 (2.2%)	
Stillbirths			
0	145 (95.4%)	91 (100%)	0.170
1	7 (4.6%)	0 (0%)	
No. of living children			
0	77 (50.7%)	29 (31.9%)	0.003
1	40 (26.3%)	25 (27.5%)	
2–4	35 (23.0%)	33 (36.3%)	
5+	0 (0.0%)	4 (4.4%)	
History of preterm delivery			
No	64 (91.4%)	47 (95.9%)	0.345
Yes	6 (8.6%)	2 (4.1%)	
History of C/S*delivery			
No	62 (88.6%)	40 (81.6%)	0.165
Yes	8 (11.4%)	9 (18.4%)	
History of AVD#			
No	67 (95.7%)	40 (97.6%)	0.651
Yes	3 (4.3%)	1 (2.4%)	
History of Episiotomy			
No	53 (75.7%)	30 (61.2%)	0.133
Yes	17 (24.3%)	19 (38.8%)	
History of perineal tear			
No	41 (58.6%)	21 (63.6%)	0.067
Yes	38 (61.3%)	12 (36.4%)	
History of big baby			
No	50 (74.6%)	34 (69.4%)	0.245
Yes	17 (25.4%)	15 (30.6%)	

*C/S: Caesarean Section #AVD: Assisted Virginal Delivery

engaged in travel PAs, and 53% ($n = 123$) engaged in moderate-intensity exercise/leisure PAs. None of the participants reported engaging in any vigorous-intensity activities. The median % of the contribution of exercise/leisure PAs to total METs minutes/week was 15% (0.6–82.4%), and the median daily sedentary time was 240 (30–720) minutes.

Compared to normal-weight, overweight/obese participants were significantly less active ($p < 0.001$) and had lower median total METs minutes/week ($p < 0.001$) with lower median METs from occupational ($p = 0.037$) PAs. They also engaged less in exercise or leisure PAs ($p = 0.014$), with a lower contribution of such activities to total METs minutes/week ($p = 0.002$) (Fig. 1). There was no statistically significant difference in sedentary time.

Cardiometabolic profile

The median systolic BP was 113.5 mmHg (82–177), diastolic BP was 67 mmHg (50–98), resting HR was 76 beats/minute (60–139), Hb was 11.5 mg/dl (8.0–15.5), FBG was 70 mg/dl (52–94), one-hour OGT was 92 mg/dl (65–155), serum triglycerides was 27 mg/dl (6–45). The mean serum total cholesterol was 83.8 ± 17.3 mg/dl, and LDL was 43 ± 13.9 mg/dl.

Compared to normal-weight, pregnant participants with overweight/obesity had higher systolic BP ($p < 0.001$), diastolic BP ($p = 0.008$), Hb ($p < 0.001$), FBG ($p = 0.005$), serum triglycerides ($p = 0.012$), and total cholesterol ($t(234) = 1.98$, $p = 0.048$). Although it was not statistically significant, overweight/obese participants had higher heart rates, one-hour OGTT, LDL cholesterol and lower HDL cholesterol (Fig. 2).

Discussion

The prevalence of overweight and obesity among pregnant women in low-middle-income countries parallels its increase among women in the general population [6, 8, 9]. Consequently, the cardiometabolic state is likely to be

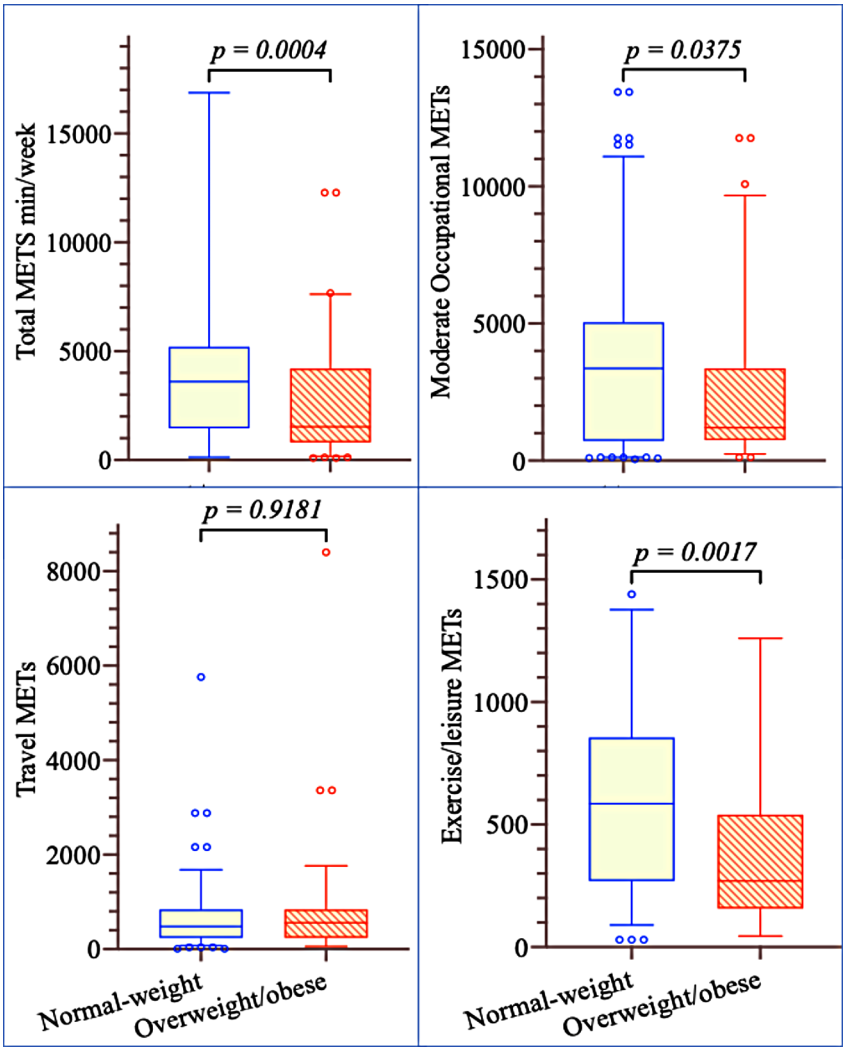

Fig. 1 Physical activity level of overweight/obese participants versus normal-weight

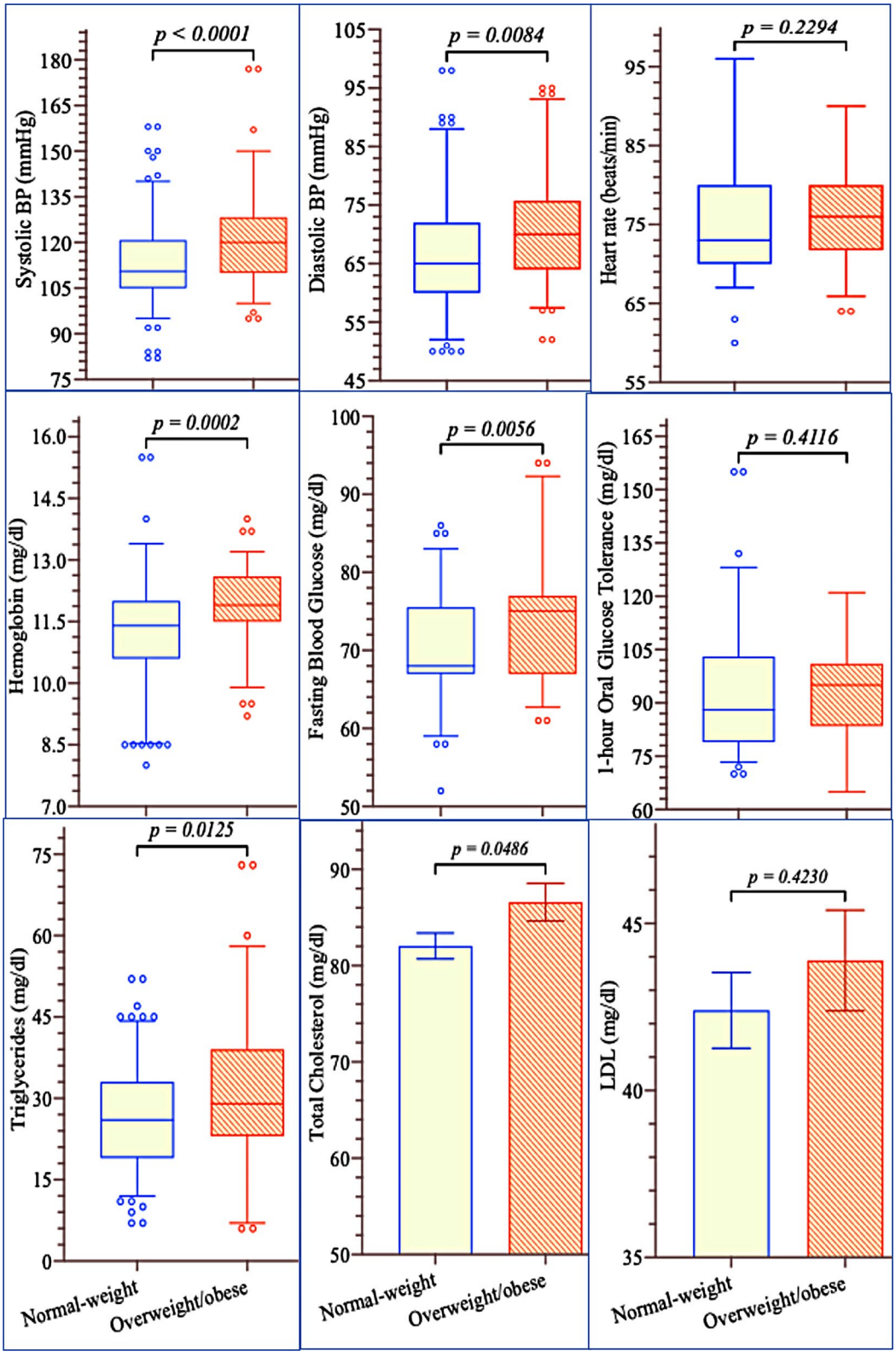

Fig. 2 Cardiometabolic profile of overweight/obese participants versus normal-weight

abnormal in pregnant women with abnormal weight [4]. Regular PA is among the key recommendations for optimising cardiometabolic changes during pregnancy [14, 15]. However, data on PA and its relation to cardiometabolic profile among pregnant women in Sub-Saharan Africa is still limited. This study provides context-specific evidence potentially informing contextualised interventions targeting physical activity, overweight and obesity among pregnant women. Our findings indicate that overweight/obese pregnant women had lower levels of PA compared to normal-weight women, with reduced contributions from both occupational and exercise/leisure activities. Additionally, overweight/obese women exhibited elevated blood pressure, fasting blood glucose, lipid profile, and haemoglobin levels.

We found lower levels of PA in overweight and obese pregnant women, including reduced occupational activities. Lower PA levels among overweight and obese pregnant women as compared to normal-weight women have been observed previously [46]. A growing body of evidence shows that overweight and obese pregnant women who were active before becoming pregnant tend to decrease their PA levels during pregnancy or remain inactive if they were inactive [29–31, 47]. A decrease in PA was previously linked to gestational age, with a higher prevalence among those with advanced pregnancies [47]. However, in the current study, most overweight/obese participants had younger pregnancies than their normal-weight counterparts. This implies that gestational age alone is insufficient to explain the PA disparity between overweight/obese and normal-weight women.

Our findings revealed that exercise or leisure PA contribute minimally to overall PA among pregnant women, particularly those with overweight or obesity. This aligns with the previous study conducted in Ethiopia [48]. However, these findings contrast with the 2012 Tanzania STEPS survey, which suggests that urban women often engage in exercise or leisure PA to compensate for otherwise sedentary working conditions [49]. This discrepancy may be attributed to unique factors affecting pregnant women. For instance, women who previously engaged in exercise might stop during pregnancy due to cultural misconceptions about safety [48, 50, 51].

Transport–related PA (active commuting) did not differ significantly between overweight/obesity and normal–weight pregnant women despite its marked contribution to overall PA. This could be attributed to the recent increase in the use of motorcycle taxis [52, 53] known as 'boda–boda', which are widely available and affordable across socioeconomic classes. In Tanzania, overweight and obesity are still considered problems related to higher socioeconomic status (SES), partly due to lower levels of transport and work-related PAs among those with higher SES [49].

Currently, widely available technology and motorised transportation reduce occupational and travel physical demands and are available even to lower SES. In contrast to data from high-income countries, where exercise and leisure PA may compensate for sedentary work and commuting patterns [54–56], our study shows that exercise PA contributes very little to overall activity levels in African settings. This highlights the need for context-specific interventions to promote physical activity among overweight and obese pregnant women.

Our findings that women who were overweight or obese had higher blood pressure are consistent with other studies that consistently correlated obesity and higher blood pressure attributed to vascular dysfunction, increased cardiac output, and RAAS activation [57, 58]. Nonetheless, other scientists contend that being overweight or obese does not necessarily result in elevated blood pressure, particularly during the early stages of pregnancy, since physiological adaptations such as systemic vasodilation counteract the hypertensive effects of obesity [59]. Different demographic variables, such as age, parity, or the degree of obesity, may have contributed to this disparity. Participants in the current study who were overweight or obese had greater parity and were comparatively older. Vascular functioning deteriorates with ageing [60], and physiological changes tend to be retained in successive pregnancies [13].

Also, overweight and obese women exhibited elevated lipid profiles consistent with previous authors who reported higher levels of triglycerides and cholesterol in overweight and obese pregnant women compared to normal-weight women [61]. Obesity augments the physiological hyperlipidaemia of pregnancy due to increased lipolysis and fat mobilisation to support foetal growth [62]. Similarly, overweight and obese women had heightened FBG indicative of impaired insulin functioning, which can also influence lipid metabolism and increase free fatty acids mobilisation [63]. The insulin resistance of pregnancy exacerbates that of pre-pregnancy obesity [2, 3, 64].

Interestingly, overweight and obese women had higher haemoglobin levels compared to the normal-weight group, aligning with recent studies of obesity and anaemia in the non-pregnant population [65, 66]. According to previous studies, having more body mass raises oxygen demand, which in turn stimulates the release of erythropoietin, which raises haemoglobin synthesis [67, 68]. Additionally, in this study, participants who were overweight or obese had higher nutritional and economic status, which could have enhanced their consumption of nutrients needed for haemoglobin production. However, our findings contradict previous studies that suggested low-grade inflammation of obesity causes iron deficiency-related low haemoglobin levels [69, 70].

Further research is needed to understand the relationship between iron metabolism, haemoglobin and body mass in pregnancy.

Limitations of the study

This study has several limitations worth noting. While several exclusion criteria were applied to control potential confounders that were difficult to account for, it could have limited the nature of the study participants who were included in this study. Participants were compared based on their pre-pregnancy weight, but we did not inquire whether they were taking any weight-affecting medication by the time weight was recorded. Although the use of objective PA measures is recommended [71], their feasibility was challenging in the study settings hence, we resorted to using IPAQ–L. Despite good reliability, IPAQ tends to overestimate PA in inactive pregnant women [72, 73]. Therefore, women in the study settings could have been less active than the level reported in this study. There may have been variation in the results since this study included women with different levels of heterogenicity. Even if important aspects were taken into account, unmeasured influences cannot be completely ruled out. Stratified sampling should be taken into consideration in future research to better account for these variations and improve the generalisability of the results.

Conclusion and recommendations

Overweight/obese pregnant women exhibit lower levels of physical activity compared to normal–weight women, with reduced contributions from both occupational and exercise/leisure activities. This likely explains the observed perturbation in cardiometabolic profiles in this group and underscores the necessity for interventions aimed at increasing PA levels to improve cardiometabolic health outcomes. Given higher mean Hb levels in obese/overweight pregnant mothers and contradicting evidence regarding haemoglobin, further research is warranted to explore the complex interplay between PA, gestational age, and cardiometabolic health among pregnant mothers.

Abbreviations

ACOG	American college of obstetrics and gynaecology
ACSM	American college of sport medicine
ADH	Antidiuretic hormone
AVD	Assisted vaginal delivery
BP	Blood pressure
DHS	Demographic health survey
FBG	Fasting blood glucose
Hb	Haemoglobin
HDL	High density lipoprotein
HR	Heart rate
IOM	Institute of medicine
IPAQ-L	International physical activity questionnaire longform
LDL	Low density lipoprotein
MET	Metabolic equivalent of the task
OGTT	Oral glucose tolerance test
PA	Physical activity
PAs	Physical activities
RAAS	Renin angiotensin aldosterone system
SES	Social economic status
STEPS	Stepwise approach to non–communicable diseases risk factor surveillance
T2DM	Type 2 diabetic mellitus
TSh	Tanzania shilling
WHO	World health organization

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Author contributions

JJR conceptualized the study, handled data collection, analysed data, and authored the first manuscript draft. ID contributed to the study's data collection and manuscript writing. FLM and AMT conceptualized and supervised the study, oversaw data collection, and critically reviewed the manuscript. All authors actively participated in the final version's approval.

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Data availability

The datasets used and/or analysed during the current study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

Ethical clearance was sought from Muhimbili University's institutional review board. Permission to conduct the study was obtained from the relevant authorities. All study protocols were carried out in line with Helsinki's declaration. Informed consent was offered in writing and signed by all participants. The safety and well-being of participants were given the highest priority throughout. Those found with abnormal parameters were referred for further medical attention.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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