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Research Article

Prevalence of Central Obesity and its Association with Cardiovascular Risk Factors among Women of Reproductive Age in Rwanda

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ABSTRACT

Central obesity is quite prevalent in women of reproductive age in Sub-Saharan Africa and has been a major risk factor for metabolic syndrome and cardiovascular diseases. However, few studies have analyzed its association with cardiovascular risk factors among those women. This study seeks to assess the magnitude of central obesity and its association with cardiovascular risk factors among women of reproductive age in Rwanda. The study used a cross-sectional study design, which involved 138 women aged between 15 and 49 years attending selected family planning centers in Kigali. Central obesity was measured through the size of the waist circumference. The adjusted logistic regression analysis with 95% confidence intervals was used to determine the correlates of central obesity. A statistical significance was defined at a p-value <0.05. Participants' mean age was 29.14 ± 6.72 with ages ranging between 18 and 45 years old. The prevalence of central obesity was 48.5%, and there was significantly associated with age (OR=2, 95% CI: 1.24-3.35), alcohol use (OR=5.8, 95% CI: 2.08-16.08), meat consumption (OR=5.3, 95% CI: 1.94-14.63), hypertriglyceridemia (OR= 3.87, 1.02-14.76), and elevated diastolic blood pressure (OR=6.1, 95% CI: 2.80-17.92). The prevalence of central obesity is relatively high among women of reproductive age, and it is associated with older age, elevated diastolic blood pressure, high triglycerides levels, meat, and alcohol consumption. The study recommends an intensive awareness about health risks associated with central obesity and its associated factors as a strategy to address the rising risk of cardiovascular diseases in this population.

Keywords: *women in reproductive age group, central obesity, cardiovascular risk factors, lipid profile*

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INTRODUCTION

There is a generalized misconception in the literature that premenopausal women are safe from cardiovascular diseases, thus ignoring the presence of potential cardiovascular risk factors. This delusion is a result of the existing literature that argues the high level of estrogen during reproductive age to be protective from cardiovascular risk (Habib, 2011, Iorga *et al*., 2017). Consequently, almost all researches about cardiovascular risk assessment focused largely on men and postmenopausal women (KH Humphries *et al*., 2018, Rossouw, 2002). However, some research indicates that the protection provided by estrogen in young women is reduced by the presence of potential risk factors like smoking habits, high blood pressure, dyslipidemia, diabetes, and central obesity (Australian Institute of Health and Welfare, 2019, Rehan *et al*., 2016). More recent evidence has revealed an equal risk for men and women as long as they are exposed to the same risk factors (Iorga *et al*., 2017, Peters *et al*., 2019).

Risk factors for cardiovascular diseases can fall into two categories. The first is the lifestyle-related factors which include tobacco use, alcohol consumption, physical inactivity, and an unhealthy diet rich in fats and carbohydrates (Jagannathan *et al*., 2019). The second is the metabolic factors which include abdominal obesity, high blood pressure, abnormal blood lipids, systemic inflammation, microalbuminuria, and diabetes mellitus (Wexnermedical.osu.edu, 2018). Central obesity, defined as excessive abdominal fats deposition, is an important determinant of a metabolic syndrome characterized by a constellation of glucose intolerance, hyperinsulinemia, and dyslipidemia (McKinney *et al*., 2013). It is an associated factor of cardiovascular diseases, among other metabolic diseases like diabetes, hypertension, microalbuminuria, atherosclerosis, arthritis, and some sort of cancers (Apovian, 2016).

Reports by the World Health Organisation (WHO) have consistently indicated obesity as a global epidemic due to its increase at an accelerated rate in both developed and developing countries (Shanthi *et al*., 2011). It is highly associated with the nutrition transition, accelerated urbanization, and advances in technology that have encouraged sedentary lifestyles (Charles *et al*., 2015). It prevails in both young and adults, and both males and females are affected. Looking at various African countries, central obesity is highly prevalent in women compared to men of the same age. For instance, the study conducted in Kenya reported the prevalence of central obesity as 68,3% in women and 21.1% in men (Mohamed *et al*. 2019). In Tanzania, a study indicated a prevalence of 35.14% in women and 6.89% in men (Munyogwa 2018). Also, a study conducted in Togo reported a prevalence of 53.6% in women and 8.4 % in men (Yayehd *et al*., 2017). This high prevalence of central obesity in women is calling for special attention as it represents the increased risk of cardiovascular diseases (CVD) in this population. Similarly, reports from developed countries reveal that CVD ranks top in causing high mortality and morbidity in women compared to men of the same age (Cífková *et al*., 2015).

The findings show the need for more studies about cardiovascular risk factors in women to inform efforts to address this rising health threat in this population. We argue that central obesity needs attention among other factors because it remains central to the development of CVDs. The awareness about the extent to which central obesity exists is critical in the management and prevention of CVDs. However, there is a dearth of studies about the prevalence of central obesity and its association with cardiovascular risk factors among women of reproductive age in developing countries and more so in Rwanda. Therefore, this study contributes to bridging that gap, using a sample selected among women of reproductive age in Rwanda.

MATERIALS AND METHODS

Study setting and design: The study used a cross-sectional study design, and the data were collected from September to November 2020 among women of reproductive age recruited from two family planning centers in Kigali, Rwanda. The centers were selected because they were among the centers we expected to have enough women of reproductive age. The selected centers are among the few publicly managed centers mainly segregated to offer free-of-charge family planning services in Kigali city. Each of the selected centers receives approximately 30 to 40 women of reproductive age daily.

Ethical considerations: The study was approved by the College of Medicine and Health Sciences Institution Review Board, University of Rwanda (reference: 042/CMHS IRB/2020). Permission was granted by the Rwanda Biomedical Center (reference: 417/RBC/2020) and the Rwanda Ministry of Health (ref: NHR/2020/PROT/030). The consent form indicating the purpose, importance, and involvement of the study, was prepared in Kinyarwanda, the local language, and given to participants to read and sign to indicate that they willingly accepted to be part of the study. All the records were kept confidential.

Sample size and sampling procedure: The study involved 138 women of reproductive age estimated using the formula designed for cross-sectional studies (Charan *et al*., 2013). The sample was calculated referring to the prevalence of central obesity (35%) previously reported in women living in Dodoma Tanzania (Munyogwa 2018), assuming 95% as a level of significance with a precision of 8%. A convenient sampling procedure was used; participants were recruited as they arrived at the center (provided that they signed the consent form) until the required number was reached. Based on participants' self-report, the study included only non-pregnant physically healthy women, without a history of chronic diseases like diabetes, heart diseases, kidney diseases, pronounced hypertension, and HIV as these diseases are more likely to be associated with heart diseases. At the center, the research team had time to talk to potential participants explaining the purpose and importance of the study, and they were given time to ask questions where they might need clarification. Those who fulfilled the earlier indicated requirements and who were willing to participate were recruited.

Data collection process and measurements: Interviews were used to collect data on the biodemographic characteristics of the study participants including age, parity, breastfeeding status, education level, physical activity, dietary intake, and alcohol consumption. Data on their blood pressure and waist circumference were also recorded. Also, blood samples were collected to test lipid profile, glycated hemoglobin, and inflammatory markers.

The data on the variable "age" was recorded in years, with reference to the previous birthday, while the data on breastfeeding status, alcohol, and coffee consumption were recorded as binary (Yes/No). For the variable "parity", the study participants were asked the number of children they have ever had, and the data was organized in two categories "two children or below and 3 and above" because most of the study participants reported having had 1 to 4 children. For the variable "education level", study participants were asked the level of education they have completed in reference to the education system in Rwanda. The variable was later analyzed as "less than secondary, and secondary or tertiary".

The data on physical activity was collected by asking the study participants to describe their daily activities; whether they spend much time sitting like working in an office, shop, or workshop, whether they have time for sports or whether their daily occupation makes them move and spend energy. Then, we used the information to classify them as "sedentary and non-sedentary". Sedentary individuals were those that reported spending much of their time sitting such as those working in the office, boutique, sewing/handcraft workshops, and housewives, while non-sedentary were those practicing farming activities, doing mobile business carrying things by head or hands, working at construction sites and those in security agencies.

Finally, for the data on dietary intake, the study participants were requested to report about the frequency of taking milk, fruits, meat, and vegetables per week reference to an average of the previous four weeks. The frequencies of taking milk, fruits, and meat were relatively low, so, the variables were analyzed as "No at all and once per week or more". However, for vegetables, the frequency was relatively high and the variable was analyzed as "three times or bellow, versus four times or higher".

Blood pressure was measured according to the International Society of Hypertension guidelines (Thomas *et al*. 2020), using a digital blood pressure monitor. Measurement was taken after 10 minutes of rest upon arrival of the participant and repeated twice at 5-minutes intervals while the individual's pressure was defined as the average of two readings. Participants were classified as having normal blood pressure for SBP ≤ 130mmHg and DBP ≤ 85mmHg, and elevated blood pressure for SBP > 130 and DBP > 85 mmHg (Thomas *et al*., 2020).

Waist circumference was measured (with a tape measure) at the level of the narrowest point between the lowest rib and the iliac crest. The measurement was taken on the skin with arms relaxed at the sides and the end of a normal exhalation. Central obesity was defined according to the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol In Adults (Adult Treatment Panel III) classification which defines central obesity as the waist circumference ≥ 88 cm (National Cholesterol Education Program 2001).

Fasting blood samples were drawn for lipid profile (Triglycerides: TG, low-density lipoprotein cholesterol: LDL-c, high-density lipoprotein cholesterol: HDL-c, and total cholesterol: TC), inflammatory markers (high sensitivity-C reactive protein: hs-CRP), and blood sugar (glycated hemoglobin) determination. Blood samples were analyzed using the Abbott ARCHITECTci4100 analyzer (Abbott Diagnostics Inc., Lake Forest, IL, USA). After laboratory analysis, lipid ratios TC/HDL and LDL/HDL were calculated.

The reference values for lipid profile components were ≤5.2 mmol/L for total cholesterol, ≤ 3.4 mmol/L for LDL, HDL ≥1.03 mmol/L, and TG ≤ 1.7 mmol/L. The TC/HDL ratio > 3.5 indicates a high risk of cardiovascular disease, while a value below 3.5 indicates low risk. The same, LDL/HDL ratio > 2.5 indicates high risk while a value below 2.5 indicates low risk (Calling *et al*., 2019). Blood sugar was classified into two categories HbA1C > 5.7% to indicate normal sugar, while a value ≥ 5.7 % indicated elevated sugar (American Diabetes Association, 2019). For hs-CRP, a value ≤ 3 mg/L indicated low risk, and a value greater than 3 mg/L indicated a high risk of cardiovascular disease (DM Vasudevan *et al*., 2011).

Statistical analysis

Central obesity was considered as the dependent variable while lipid profile components, lipid ratios, blood pressure, blood sugar, age, dietary intake, parity, breastfeeding status, alcohol consumption, education, and physical activity as independent variables. Data were described as mean ± standard deviation, and percentages, and presented in tables. The chi-square test was used to assess whether there is an association between central obesity and the baseline characteristics. The variables that showed a significant association was used in the adjusted logistic regression model, with 95% confidence intervals, to determine the correlates of central obesity

RESULTS

Table 1 shows the baseline characteristics of the study participants. The mean age was 29.1 ± 6.7, with ages ranging between 18 and 45 years old, and 29.7% had attained secondary or tertiary education. The majority (63.8%) of participants had not more than two children, and 66.7% of them were breastfeeding. Concerning diet, few took alcohol (29.0%) and coffee (21.0%), and 71.0% reported they eat meat at least once a week, 39.13% said they eat vegetables less than 4 times a week, and 73.2 % reported they eat fruit at least once a week, while those taking milk at least once per week were 71.6%. The assessment of the physical activity indicated that 75.4 % of participants were living a sedentary lifestyle.

Table 1:
Basic characteristics of the study participants.

Variable		Frequency (N=138)	Percentage/ mean ± SD
Age		138 (Min. 18; Max. 45)	29.1 ± 6.7
Education attainment	Less than secondary	97	70.3
	Secondary or Tertiary	41	29.7
Parity	<3	87	63.8
	≥ 3	51	36.2
Breastfeeding	No	46	33.3
	Yes	92	66.7
Physical activity	Sedentary	104	75.4
	Non-sedentary	34	24.6
Taking Alcohol	No	98	71.0
	Yes	40	29.0
Taking coffee	No	109	79.0
	Yes	29	21.0
Eating vegetables	< 4 times per week	54	39.2
	≥4 times per week	84	60.8
Eating fruits	Not at all	37	26.8
	≥ 1 time per week	101	73.2
Taking milk	No at all	39	28.4
	≥ 1 time per week	99	71.6

Table 2 shows the prevalence of central obesity according to all variables. 67 out of 138 (48.5%) participants had central obesity. The prevalence was significantly high in participants aged 30 years (66.7%, p= 0.001), participants with elevated (>3 mg/dl) hs-CRP (71.8%, p=0.001), individuals with elevated SPB (74.1%, p=0.003), and those with elevated DBP (75%, p=0.000). The prevalence was also significantly high among alcohol consumers (77.5%, p=0.000), participants who eat meat at least once a week (59.18%, p =0.000), participants with elevated cholesterol (68%, p=0.032, those with elevated triglyceride levels (76.2%, p=0.006), and those with a high LDL/HDL ratio (60.4%, p=0.028).

Table 2:
Chi square test indicating the prevalence of central obesity according to other cardiovascular risk factors.

Variable	Categories	Total sample (N=138) n (%)	Non-obese (N=71) n (%)	Obese (N=67) N (%)	p-value
Age in years	≤24	41(29.7)	27(65.8)	14(34.1)	0.001*
	25-29	37(26.8)	24(64.9)	13(35.1)	
	≥30	60(43.5)	20(33.3)	40(66.7)	
hs-CRP in mg/L	≤3	99(71.7)	60(60.6)	39(39.4)	0.001*
	>3	39(28.3)	11(28.2)	28(71.8)	
SBP in mmHg	≤130	111(80.4)	64(57.7)	47(42.3)	0.003*
	>130	27(19.6)	7(25.9)	20(74.1)	
DBP in mmHg	≤ 85	102(73.9)	62(60.8)	40(39.2)	0.000*
	>85	36(26.1	9(25.0)	27(75.0)	
HbA1C in %	<5.7	117 (84.7)	61(52.1)	56(47.9)	0.703
	≥5.7	21 (15.2)	10(47.6)	11(52.4)	
TC in mmol/L	< 5.2	113 (81.9)	63(55.7)	50(44.2)	0.032*
	≥5.2	25 (18.1)	8(32.0)	17(68.0)	
LDL in mmol/L	< 3.4	112(81.2)	62(55.4)	50(44.6)	0.057
	≥ 3.4	26 (18.8)	9(34.6)	17(65.4)	
HDL in mmol/L	≥ 1.03	98 (71.0)	50(51.0)	48(49.0)	0.875
	< 1.03	40 (29.0)	21(52.5)	19(47.5)	
TG in mmol/L	< 1.7	117 (84.8)	66(56.4)	51(43.6)	0.006*
	≥1.7	21(15.2)	5(23.8)	16(76.2)	
TC/HDL	< 3.5	58 (42.0)	35(60.3)	23(39.7)	0.075
	≥ 3.5	80 (58.0)	36(45.0)	44(55.0)	
LDL/HDL	< 2.5	85(61.6)	50(58.8)	37(41.2)	0.028*
	≥2.5	53 (38.4)	21(39.6)	30(60.4)	
Eating meat	No	40(29.0)	31(77.5)	9(22.5)	0.000*
	Yes	98(71.0)	40(40.8)	58(59.2)	
Alcohol use	No	98(71.0)	62(63.3)	36(36.7)	0.000*
	Yes	40(29.0)	9(22.5)	31(77.5)	
Taking milk	No	39(28.3)	24(61.5)	15(38.5)	0.137
	Yes	99(71.7)	47(47.5)	52(52.5)	
Using coffee	No	109(79.0)	48(44.0)	61(56.0)	0.001*
	Yes	29(21.0)	23(79.3)	6(20.3)	
Eating fruit	Not at all	37(26.8)	18(48.6)	19(51.3)	0.690
	≥ 1 times per week	101(73.2)	53(52.5)	48(47.5)	
Eating vegetables	< 4 times per week	54(39.1)	25(46.3)	29(53.7)	0.331
	≥ 4 times per week	84(60.9)	46(54.8)	38(45.2)	
Parity	< 3 children	87(63.0)	52(59.8)	35(40.2)	0.011*
	≥ 3 children	51(37.0)	19(37.2)	32(62.7)	
Breastfeeding	No	46(33.3)	22(47.8)	24(52.2)	0.547
	Yes	92(66.7)	49(53.3)	43(46.7)	
Physical activity	Sedentary	104(75.4)	55(52.9)	49(47.1)	0.555
	Non-sedentary	34(24.6)	16(47.1)	18(52.9)	
Education level	Less secondary	97(70.3)	54(55.7)	43(44.3)	0.127
	Secondary or tertiary	41(29.7)	17(41.5)	24(58.5)	

*Note: *, means statistically significant.*
Abbreviations: DBP, diastolic blood pressure; HDL, high-density lipoprotein cholesterol; LDL, low-density lipoprotein cholesterol; SBP, systolic blood pressure; TC, total cholesterol; TG, triglyceride; HbA1C, glycated hemoglobin

Similarly, the prevalence was high among individuals with a high TC/HDL ratio. Moreover, the prevalence was high in participants who had more than two children (62.7%, p=0.011), and in participants that did not drink coffee (56.9%, p= 0.001). Also, Table 2 shows that eating fruits and vegetables, taking milk, and breastfeeding status were not associated with obesity. Similarly, physical activity and education level were not associated with obesity.

Table 3 indicates the results from logistic regression analysis stratified by obesity categories and adjusted for age, total cholesterol, lipids ratios, triglycerides, hs-CRP, SBP, DBP, parity, eating meat, taking coffee, and alcohol use. The results show that the odds of being obese in participants aged 30 years and above is 2 times (95% CI: 1.24-3.35 that of participants aged below 25 years. The odds of obesity were 6 times (95% CI: 1.21-8.77) higher in individuals with elevated DBP compared to individuals with normal DBP. Eating meat is associated with obesity 5 times (95% CI: 2.21-18.50) higher than that of those who do not eat meat at all. The risk of obesity for those who use alcohol is 5.8 times (95% CI: 1.26-8.54) higher than that of those who do not take alcohol. The odds of being obese for individuals with hypertriglyceridemia is 3 times higher than that of individuals with normal blood triglycerides levels.

DISCUSSION

This study assessed the magnitude of central obesity and its association with other cardiovascular risk factors in women of reproductive age in Rwanda. The results inform the health policymakers and practitioners on the need to address the increase of central obesity among women of reproductive age to contribute to addressing the high prevalence of maternal cardiovascular diseases and death.

The findings reveal that the prevalence of central obesity among women of reproductive age was 48.5%, and it was associated with older age, frequent consumption of meat and alcohol, high diastolic blood pressure, and higher blood triglycerides levels. This prevalence is relatively high compared to that of 35% reported in Munyogwa *et al*. study conducted in Tanzania (Munyogwa *et al*, 2018), however, below that reported in Mohamed et.al study (68.3%) done in Kenya (Mohamed *et al*., 2019) and by Yayehd *et al*. study (53.6%) in Togo (Yayehd *et al*, 2017). The difference could be explained on one hand by the different cut-off values in defining central obesity. In our study, and the Munyogwa *et al*. study, central obesity was defined according to NIH guidelines (National Institute of Health, 2015) as a waist circumference greater or equal to 88 cm while Mohamed *et al*. and Yayehd *et al*. studies defined it according to the WHO guidelines(World Health Organization, 2008) as a waist circumference greater or equal to 80 cm. On the other hand, it could be due to the differences in the settings of each study and the associated lifestyle of the sampled women. Our study shares the high prevalence of central obesity with the studies conducted in Kenya and Togo (Mohamed *et al*., 2019, Yayehd 2017). The studies were conducted in similar urban settings where the majority of the study participants were housewives or do passive works such as working in the office, boutique, and sewing/handicraft workshops where they spend much of their time sitting a condition that pushed them to have a sedentary lifestyle.

Central obesity is reported in many previous studies to be associated with low physical activity (Calling *et al*., 2019, World Health organization, 2011). In contrast, our data did not show any association between physical activity and central obesity. The difference could be due to different criteria used in defining the categories of physical activity as we based our criteria on the types of occupation which we used to classify the participants as sedentary versus non-sedentary instead of counting the times an individual is engaged in an organized physical exercise as some studies did. This approach could be possible in our context because none of the respondents had reported engaging in organized sports activities. Our approach of considering the types of occupation was equally adequate since it was clear whether a given activity was energy-demanding such as working in construction sites or doing hawking activities, classified as non-sedentary, and non-energy demanding such as working in a kiosk or in-house activities, classified as sedentary.

Central obesity was consistently associated with lifestyle factors including fats containing foods (Rezazadeh *et al*., 2010) and not eating vegetables regularly (Sufa *et al*., 2019). In part, this is consistent with our findings that central obesity is associated with regular consumption of meat and inconsistent with regularly eating vegetables. Our findings reveal a high prevalence of central obesity in alcohol consumers compared to non-consumers, and it is in agreement with findings from other studies (Lourenço *et al*., 2012, Helmut *et al*., 2007, Kim *et al*., 2012)

Previous studies had revealed that central obesity is associated with many metabolic diseases such as dyslipidemia, hypertension, diabetes, and albuminuria (Naqvi *et al*., 2015), and this association would become stronger as an individual gets older (Yayehd 2017). Even though our participants were relatively young (18-45), the results indicated a statistically significant association between central obesity and the age of an individual. This finding is consistent with various prior studies (Anto *et al*., 2020, Rezazadeh *et al*., 2010).

For women of childbearing age, we hypothesized that breastfeeding would be a factor associated with central obesity. We based our hypothesis on that during the breastfeeding period, women need to eat more to get enough milk for their babies. However, the results indicated no association between breastfeeding and central obesity, and this is similar to other previous studies (Sufa *et al*., 2019, Lourenço *et al*., 2012). This implies that the quality of food ingested may play more role in inducing central obesity rather than breastfeeding itself.

The literature has documented the association of central obesity with markers of cardiovascular risks such as hypertension (Nurdiantami *et al*. 2018) and this is consistent with our findings. The odds of obesity were 6 times higher in individuals with elevated diastolic blood pressure compared to those with normal diastolic blood pressure. The literature also indicated the association of central obesity with dyslipidemia, a potential risk factor of coronary heart disease (Fakhrzadeh *et al*., 2015), and it is in agreement with our finding as our data indicated a significant association between central obesity and hypertriglyceridemia as reported in different studies (Naqvi *et al*., 2015, Omar *et al*., 2020).

This study is among the pioneering researches in Rwanda and sub-Saharan Africa in general that assessed the prevalence of central obesity and examined its association with cardiovascular risk factors in women of reproductive age in Rwanda. We hypothesize that Africa, which is undergoing rapid epidemiologic and nutritional transition (Steyn *et al*., 2014) needs more studies of this area to inform the public health efforts that address the rise of NCDs and cardiovascular diseases in particular. The strength of this study lies in combining variables like dietary intake, metabolic, and lifestyle factors to discuss the prevalence of central obesity. However, the study has some limitations including not considering the socio-economic factors which may have some association with CVD risk factors as well. Also, we were unable to collect full records of the respondents' dietary intake.

Another limitation may lay in the design of the study itself as it was cross-sectional and did not allow the examination of causal relationships. Thus, further studies, with a prospective approach, will be useful for the investigation of a causal relationship.

The study concludes that central obesity exists and is relatively high in young women in Rwanda, and it is associated with older age, elevated blood triglycerides levels, elevated diastolic blood pressure, regular consumption of meat, and alcohol use. It is quite established from the literature that cardiovascular diseases are currently the major causes of morbidity and mortality in sub-Saharan Africa and Rwanda in particular. Therefore, the study recommends health policymakers and public health officials establish strategies targeting the management of modifiable risk factors like high blood pressure, alcohol use, physical exercise, and eating habits to reduce the risk of cardiovascular diseases in young women.

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