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Prevalence of abdominal obesity and its association with cardiovascular risk among the adult population in Burkina Faso: findings from a nationwide cross-sectional study

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ABSTRACT

Objective The objective of this study is to determine the prevalence of abdominal obesity, its predictors and its association with cardiovascular risk among adults in Burkina Faso.

Design We performed a secondary analysis of data from a national cross-sectional study, using WHO STEPwise approach.

Setting The study was conducted in Burkina Faso, in all the 13 regions of the country.

Participants Our study involved 4308 adults of both sexes, aged between 25 and 64 years.

Primary and secondary outcomes Our primary outcome was abdominal obesity, which was defined using a cut-off point of waist circumference (WC) of ≥94 cm for men and ≥80 cm for women. The secondary outcome was very high WC (≥102 cm for men and ≥88 cm for women) (for whom weight management is required).

Results The mean age of participants was 38.5±11.1 years. The age-standardised prevalence of abdominal obesity was 22.5% (95% CI 21.3% to 23.7%). This prevalence was 35.9% (95% CI 33.9% to 37.9%) among women and 5.2% (95% CI 4.3% to 6.2%) among men. In urban areas, the age-standardised prevalence of abdominal obesity was 42.8% (95% CI 39.9% to 45.7%) and 17.0% (95% CI 15.7% to 18.2%) in rural areas. The age-standardised prevalence of very high WC was 10.2% (95% CI 9.3% to 11.1%). The main predictors of abdominal obesity were being female, increased age, married status, high level of education and living in urban areas. Abdominal obesity was also significantly associated with high blood pressure (adjusted prevalence ratio (aPR): 1.30; 95% CI 1.14 to 1.47) and hypercholesterolaemia (aPR: 1.52; 95% CI 1.18 to 1.94). According to the combination matrix between body mass index and WC, 14.6% of the adult population in Burkina Faso had an increased cardiometabolic risk.

Conclusion Our study showed a high prevalence of abdominal obesity and a high proportion of adults who require weight management strategies to prevent cardiometabolic complications. Strategies to reduce the burden of abdominal obesity and very high WC should be considered by Burkina Faso's policy-makers.

Strengths and limitations of this study

- ► To the best of our knowledge, this study is the first national representative study on abdominal obesity within the adult population of Burkina Faso.
- ► The waist circumference and risk factors used in this study were measured using the WHO STEPwise standard approach.
- ► Behavioural risk factors such as physical inactivity, alcohol consumption and type of fat may be affected by social desirability bias and recall bias.
- ► The measurement of the waist circumference only once might cause measurement bias.
- ► This study was a cross-sectional study and cannot be used to derive causal inference.

INTRODUCTION

Obesity is an increasing public health issue worldwide, particularly in low/middle-income countries. Globally, 603.7 million adults were found to be obese in 2015, and this number has risen since 1980.[1] Obesity is most often assessed using the body mass index (BMI),[2 3] which has proven to increase in parallel with the risk of cardiovascular diseases (CVDs) such as coronary heart diseases or strokes.[4] However, the BMI provides limited information on body fat distribution, which is related to metabolic risk.[4 5] The majority of fat is stored in the subcutaneous adipose tissue even though, in some individuals, excessive amounts may be accumulated intra-abdominally (visceral fat).[2] The visceral accumulation of body fat is due to genetic factors,[6–12] neuroendocrine perturbations[13] and environmental and lifestyle factors.[14] The combination of over consumption of energy-dense food and a sedentary lifestyle are well known to play a role in the accumulation of visceral fat.[2 15 16] The BMI alone seems insufficient to assess the distribution of body fat and evaluate the cardiometabolic risk among adults with excess of adiposity, because the BMI fails to capture the cardiometabolic risk related to abdominal obesity.[17] Abdominal obesity is responsible for increased risk of insulin resistance, type 2 diabetes mellitus, metabolic syndrome, CVDs, cancers, chronic respiratory diseases and all-cause mortality.[2 18–22]

Three anthropometric proxies are commonly used to assess abdominal obesity: waist circumference (WC), waist-to-height ratio and waist-to-hip ratio. Most studies on abdominal obesity have used WC as the defining criterion.[2 23 24] The WC is known to be sensitive to visceral fat accumulation.[25] Individuals with a larger WC have more abdominal fat than those with a smaller WC.[25] The threshold of WC used to define abdominal obesity depends on ethnic groups and the world's regions. For sub-Saharan Africa (SSA), WHO defined abdominal obesity by fixing sex-specific WC cut-off points at ≥94 cm for men and ≥80 cm for women.[4] This cut-off point appears to increase the risk of metabolic complications. Furthermore, the risk of cardiometabolic disorders is 'substantially increased' when the WC is ≥102 cm among men and ≥88 cm among women.[4] Using the WHO definition, Wong *et al*[26] reported that nearly half (41.5%) of the global adult population was abdominally obese and that this prevalence is rising worldwide, including in low-income and middle-income countries in SSA. However, there is little data on abdominal obesity in SSA as previously highlighted by Wong *et al*.[26] Some studies have been conducted in South Africa,[27] Kenya,[28] Uganda,[29] Nigeria[30] and Cote d'Ivoire.[31] Apart from that of Kabwama *et al*[29] in Uganda, most of these studies were conducted in local areas and, therefore, do not provide country-level estimates for the prevalence of abdominal obesity. The new consensus of the International Atherosclerosis Society (IAS) and the International Chair on Cardiometabolic Risk (ICCR) Working Group on Visceral Obesity, published in March 2020, concluded that decreasing WC is a critical target to reduce the cardiometabolic complications for both sexes.[17]

A recent population-based nationwide study in Burkina Faso has shown a high proportion (one out of five) of adults with abnormal weight.[32] In Northern Ouagadougou, Zeba *et al*[33] noted that the prevalence of abdominal obesity was 12.5%. In their study of specific populations in Bobo-Dioulasso, Marceline *et al*[34] found out that 64.9% of diabetics were abdominally obese. These studies, however, do not provide information on the nationwide prevalence of abdominal obesity. As is the case in many other developing countries, the management of cardiometabolic risk factors is becoming a public health challenge in Burkina Faso.[35] The added value of our study comes from our focus on the prevalence of abdominal obesity, predictors and its association with CVD risk among the adult population of Burkina Faso using data from the first national non-communicable disease (NCD) risk factors survey.

METHODS

Study design, setting and population

We conducted a secondary analysis of data from a cross-sectional survey, the national WHO STEPS survey aimed at assessing the risk factors for NCDs. This survey was carried out between 26 September and 18 November 2013 in Burkina Faso. Burkina Faso is located in the SSA region in West Africa, covering a total surface area of 272 960 km^2 with 20 870 060 habitants in 2019, with life expectancy at birth of 61.8 years. The proportion of the population living in the urban area increased (according to the results of the last national population census), from 12.7% in 1985 to 22.7% in 2006. The epidemiological profile is dominated by infectious diseases. Moreover, there is an increasing burden of NCDs, including CVDs, resulting in the country facing a double burden of diseases and progressive change in the pattern of diseases. The data used in our study were collected from a representative sample of adults between 25 and 64 years old. The study was designed to provide estimates at the national and regional levels, as well as places of residence (urban/rural). Participants were selected using a three-stage cluster stratified sampling method. A total of 240 enumeration areas (EA) were selected. Then, in each EA, 20 households were randomly selected. One respondent was identified in each household.[36]

Data collection

Data were collected electronically on a Personal Digital Assistant and consisted in face-to-face interviews, conducted after obtaining the informed consent of the respondent. Risk factors linked to NCDs, such as physical activity and biochemical parameters of the subjects selected to participate in the survey were collected using a STEPS instrument. The survey procedures involved three steps: the first step focused on sociodemographic information, behavioural measures and factors regarding physical activity, food hygiene, oral health and knowledge of NCD risk factors. Behavioural measures bordering on the consumption of tobacco and alcohol were also collected. The second step measured the following physical parameters: height was measured using a portable measuring rod for participants wearing neither shoes nor hats. Weight was measured using an electronic weighing scale (SECA) with the person being weighed lightly clothed, without shoes. The WC (umbilical perimeter) was measured using a measuring tape applied directly to the skin along the axillary line, midway in between the lower base of the last rib and the iliac crest of each side; the measurement was taken only once and rounded of the nearest 0.1 cm. Participants were ineligible for waist measurement if they were pregnant. Blood pressure was measured using an electronic sphygmomanometer. The third step was to measure blood sugar level and blood cholesterol from a capillary blood sample using an electronic device, CardioChek. Data were collected by graduate medical, nurses and student nurses.

Variables of interest

Outcome variable

In our study, the dependent variable was abdominal obesity, which was measured using the WC for each of the study participants. For the primary outcome, that is, the cut-off, a WC of ≥94 cm for men and ≥80 cm for women were used. To estimate the proportion of adults who needed to reduce their weights, we used a cut-off of WC ≥102 cm for men and ≥88 cm for women as a secondary outcome, as recommended by Lean *et al*.[37] This corresponds to a very high WC.[38]

Explanatory variables

To take into consideration the influence of potential predictors on the WC, based on previous studies,[27 29 39] we selected the following sociodemographic, behavioural and metabolic factors:

- Sociodemographic factors: Regarding the demographic factors, we categorised all the variables. Among these variables are the following: age (25–34, 35–44, 45–54, 55–64 years), sex (male/female), highest education level (no level, primary, secondary or higher), marital status (single/married), professional status (wage earner, self-employed, unemployed) and place of residence (urban/rural).
- Behavioural factors: The behavioural variables that could influence our dependent variable selected for our study are the following: smoking status (yes/no), alcohol use (yes/no), number of fruits or vegetables eaten per day, type of fat intake and physical activity (high, moderate and low intensity).
- Metabolic factor: We used the height and weight of the individuals to obtain their BMI and then categorised it into four groups (BMI <18.5 = underweight; 18.5≤BMI < 25=normal; BMI≥25 = overweight; BMI ≥30 = obesity). We also checked the association between abdominal obesity and other cardiovascular intermediate risk factors such as high blood pressure (HBP) as defined by the WHO (systolic blood pressure ≥140 mm Hg or diastolic blood pressure ≥90 mm Hg) and diabetes (capillary fasting blood glucose above or equal 6.1 mmol/L) and hypercholesterolaemia (capillary total cholesterol above or equal 5.2 mmol/L).

Cardiovascular health risk assessment

In this study, to assess cardiovascular health risk, we used the National Institute for Health and Clinical Excellence (NICE) BMI-WC matrix approach, which combines the BMI and WC values to define different levels of health risk.[38]

Statistical method

We first described the characteristics of the study population through a weighted analysis to take into account the sampling design. Standardisation was achieved using the age structure of the adult population of Burkina Faso in 2013.[40] We implemented a modified Poisson regression model using a generalised estimating equation to evaluate the association between abdominal obesity (primary outcome) and sociodemographic, behavioural and biological characteristics of the study population. With this model, we derived the prevalence ratios (PRs) and 95% CI. The covariates were used in the multivariable analysis based on the epidemiological plausibility and their contributions to the model. For the secondary outcome (very high WC), only the overall results and disparities by sex and residence were presented in the text. Statistical significance was accepted at the 5% level ($p<0.05$). all analysis was done using Stata v15.1.

Patient and public involvement

Patients or the public were not involved in the design, conduct, reporting or dissemination the plans of our research.

RESULTS

Sociodemographic characteristics of the study population

A total of 4308 participants with valid WC and BMI data were included in this study (figure 1). The mean age was 38.5±11.2 years and 41% of participants were aged between 25 and 34 years, 52.4% were female and 74.1% were living in rural areas. People with no formal education represented 78.6% of the participants (see table 1 for more details).

Prevalence of abdominal obesity

Among the 4308 participants, 876 had abdominal obesity. As shown in table 2, the overall age-standardised prevalence of abdominal obesity (primary outcome) was 22.5% (95% CI 21.3% to 23.7%). This age-standardised prevalence was 35.9% (95% CI 33.9% to 37.9%) among women and 5.2% (95% CI 4.3% to 6.2%) among men. The prevalence increased with the age groups as follows: 19.6% (95% CI 17.1% to 22.4%) for 25–34 years, 24.0% (95% CI 20.8% to 27.6%) for 35–44 years, 25.7% (95% CI 21.5% to 30.3%) for 45–54 years; 25.3% (95% CI 20.8% to 30.6%) for 55–64 years. No difference was observed regarding marital status, and the age-standardised prevalence of abdominal obesity among married people was 22.5% (95% CI 21.2% to 23.8%) and 23.6% (95% CI 19.7% to 27.5%) among the unmarried. The age-standardised prevalence of abdominal obesity was 19.4% (95% CI 18.1% to 20.7%) among people who had not attended formal school and 33.4% (95% CI 29.5% to 37.2%) for people who had attended primary school and 45.8% (95% CI 39.8% to 51.8%) for people who had attended at least secondary school. In urban areas, the age-standardised prevalence of abdominal obesity was 42.8% (95% CI 39.9% to 45.7%) as against 17.0% (95% CI 15.7% to 18.2%) in rural areas. Among women, the age-standardised prevalence of abdominal obesity in urban areas was 64.4% (95% CI 60.1% to 68.7%) as against 27.8% (95% CI 25.6% to 29.9%) in rural areas. Among men, it was 14.8% (95% CI 11.3% to 18.4%) in

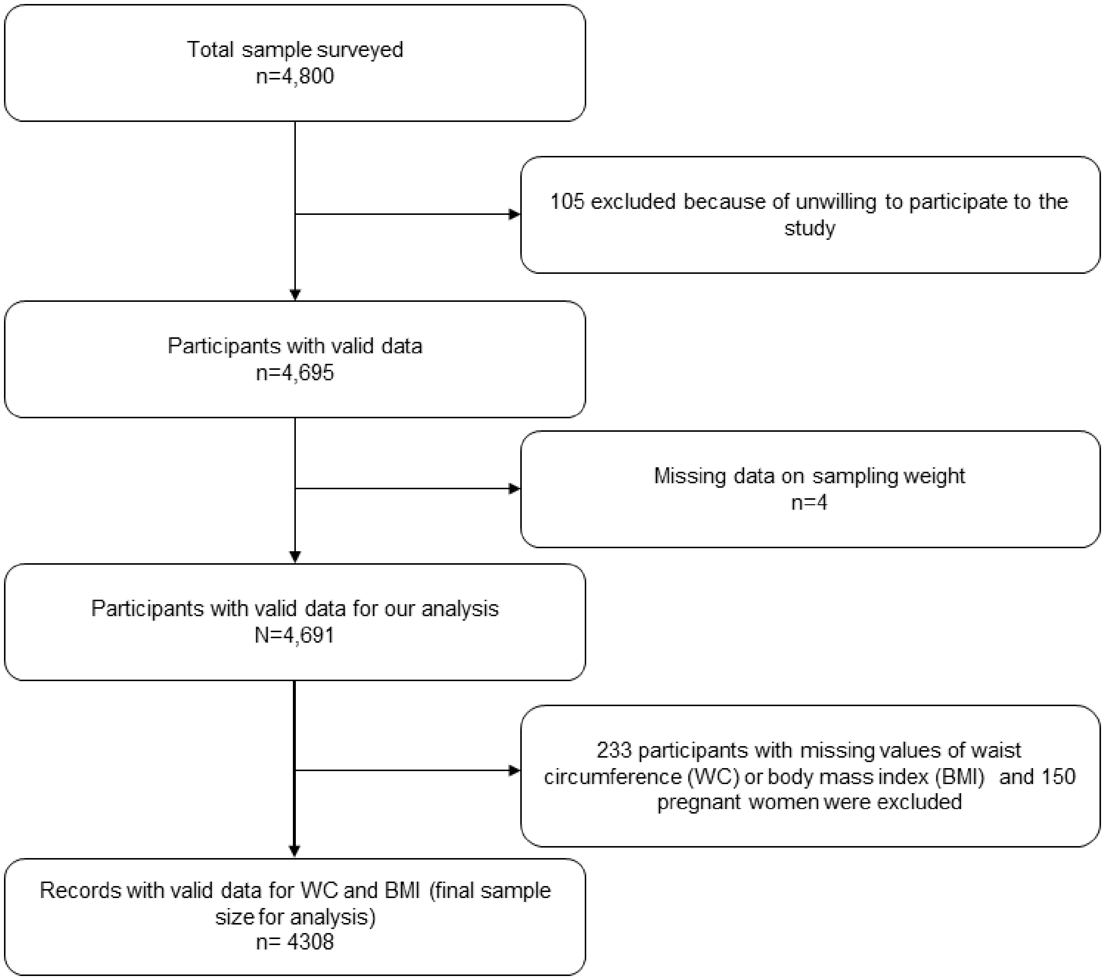

Figure 1 Flow chart of study participants.

urban areas and 3.1% (95% CI 2.3% to 3.9%) in rural areas.

Regarding very high WC (secondary outcome) the age-standardised prevalence was 10.2% (95% CI 9.3% to 11.1%). It was 16.9% (95% CI 15.3% to 18.5%) among women and 1.6% (95% CI 1.1% to 2.1%) among men. Regarding residence, we found that the age-standardised prevalence of very high WC was 25.3% (95% CI 22.7% to 28.0%) in urban areas and 6.0% (95% CI 5.2% to 6.8%) in rural areas .

Factors associated with abdominal obesity

Table 3 shows the results of the multivariable analysis. The main variables found to be associated with abdominal obesity are sex, age group, marital status, education, profession and residence. When the analysis was stratified by sex, we found out that among women, age group, marital status, education and residence were significantly associated with abdominal obesity, while among men, only age group and residence were significantly associated with abdominal obesity (see table 3 for more details).

Association between abdominal obesity and cardiovascular risk factors

After adjusting for the sociodemographic and behavioural characteristics of the study population, we found that abdominal obesity was significantly associated with HBP and hypercholesterolaemia. The prevalence of abdominal obesity was 1.3 times (adjusted Prevalence Ratio (aPR)): 1.30; 95% CI 1.14 to 1.47) higher among people with HBP, compared with those without (table 3). Besides, the prevalence of abdominal obesity was 1.5 times (aPR: 1.52; 95% CI 1.18 to 1.94) higher among participants with hypercholesterolaemia.

Cardiovascular health risk assessment

Using the NICE BMI-WC matrix to assess health risk, we found that the prevalence of 'increased risk', 'high risk' and 'very high risk' to health were 6.8%, 4.6% and 3.2%, respectively. The prevalence of at least increased risk to health was 14.6% (see table 4 for more details) and 83.6% of study population was classified as having 'low health risk'.

Table 1 Sociodemographic, behavioural and biological characteristics of the study population

Characteristics	Number	Percentage*
Sex	4308	
Women	2151	52.4
Men	2157	47.6
Age group, years	4308	
25–34	1917	41.0
35–44	1078	27.8
45–54	796	19.2
55–64	517	12.0
Marital status	4303	
Single	601	12.8
Married	3702	87.2
Highest completed level of education	4300	
No formal education	3380	78.6
Primary school	652	14.9
Secondary or higher	268	6.5
Profession	4303	
Wage earner	210	5.2
Self-employed	3088	68.9
Unemployed	1005	25.9
Residence	4308	
Urban	878	25.9
Rural	3430	74.1
Risk factors		
Current smoker	4307	
No	3760	88.4
Yes	547	11.6
Current drinker	4307	
No	3107	72.1
Yes	1200	27.9
Fruit and vegetable intake	4010	
<5	3819	95.7
≥5	191	4.3
Type of fat most commonly used	4197	
Vegetable oil	2620	63.3
Butter, lard or fat, margarine	1157	27.2
None or other	420	9.5
Physical activity	4307	
Intense	2639	60.6
Moderate	1110	25.5
Low	558	13.9
BMI class	4308	
Underweight	494	11.9
Normal	3095	70.2
Overweight	548	13.4
Obese	171	4.5
HBP	4305	
No	3441	76.9
Yes	864	20.1
Diabetes	4245	
No	4052	95.4
Yes	193	4.6
Hypercholesterolaemia	4283	
No	4190	97.8
Yes	93	2.2

*Weighted percentage. The missing data for some variables corresponds to non-responses for these questions during the STEP survey.
BMI, body mass index; HBP, high blood pressure.

DISCUSSION

This study reported for the first time the countrywide prevalence of abdominal obesity in Burkina Faso considering two cut-offs of WC. The estimate of the prevalence of abdominal obesity are lower than other estimates using the cut-off of ≥94 cm for men and ≥80 cm for women. In the literature, different cut-off points for WC have been used to evaluate abdominal obesity. Indeed, using a cut-off point for WC of ≥94 cm for men and ≥80 cm for women, a recent meta-analysis by Wong *et al*[26] reported that the global prevalence of abdominal obesity was 41.5% (95% CI 39.9% to 43.2%). This prevalence is higher than those reported in our study using the same WC cut-off point. It is known from Wong *et al*[26] that the prevalence of abdominal obesity is higher among populations of high-income countries and Caucasians.[26] In the context of SSA, different prevalence levels of abdominal obesity have been reported using a cut-off of ≥94 cm for men and ≥80 cm for women. Indeed, Owolabi *et al*[27] noted that the prevalence of abdominal obesity in South Africa was 67% when using the same cut-off as Wong *et al*.[26] The prevalence of abdominal obesity in Kenya was found to be 52.0%.[28] A study in Nigeria showed a prevalence of 30.1%.[30] Yayehd *et al*[41] noted that the prevalence of abdominal obesity was 48.8% in semiurban areas in Togo. Using the cut-off of ≥102 cm for men and ≥88 cm for women, Kabwama *et al*[29] showed that the prevalence of very high WC in Uganda was 11.8%, which is similar to those reported in our study using the same cut-off point. In SSA, abdominal obesity is seen as a sign of wealth, affluence, respect and dignity.[29] This harmful perception of abdominal obesity among the adult population of SSA presents a challenge for the implementation of weight management strategies. Considering the mediating role of abdominal obesity in the development of diabetes and cardiovascular and other chronic diseases, coupled with the high prevalence and harmful perception about

Table 2 Age-standardised prevalence of abdominal obesity based of the characteristics of the study population

	Men		Women		Total	
Characteristics	**n**	**Prev (95% CI)**	**n**	**Prev (95% CI)**	**n**	**Prev (95% CI)**
All participants	2157	5.2 (4.3 to 6.2)	2151	35.9 (33.92 to 37.9)	4308	22.5 (21.3 to 23.7)
Sex						
Women					2151	35.9 (33.9 to 37.9)
Men					2157	5.2 (4.3 to 6.2)
Age group, years						
25–34	915	3.5 (2.3 to 5.4)	1002	32.4 (28.2 to 37.0)	1917	19.6 (17.1 to 22.4)
35–44	539	8.8 (6.1 to 12.5)	539	38.3 (32.9 to 44.0)	1078	24.0 (20.8 to 27.6)
45–54	407	6.6 (4.4 to 9.8)	389	44.4 (37.2 to 51.9)	796	25.7 (21.5 to 30.3)
55–64	296	9.7 (6.2 to 14.8)	221	43.4 (35.9 to 51.2)	517	25.3 (20.8 to 30.6)
Marital status						
Single	326	4.6 (2.1 to 7.1)	275	38.2 (31.6 to 44.9)	601	23.6 (19.7 to 27.5)
Married	1828	5.1 (4.1 to 6.2)	1874	36.1 (33.8 to 38.3)	3702	22.5 (21.2 to 23.8)
Highest completed level of education						
No formal education	1595	3.8 (2.8 to 4.7)	1785	31.6 (29.5 to 33.7)	3380	19.4 (18.1 to 20.7)
Primary school	389	6.1 (3.6 to 8.7)	263	54.5 (47.9 to 61.1)	652	33.4 (29.5 to 37.2)
Secondary or more	165	21.9 (15.7 to 28.3)	103	63.9 (54.4 to 73.4)	268	45.8 (39.8 to 51.8)
Profession						
Wage earner	152	17.8 (11.4 to 24.2)	58	64.3 (54.1 to 74.5)	210	44.2 (37.8 to 50.7)
Self-employed	1914	4.1 (3.2 to 4.9)	1174	30.8 (28.2 to 33.5)	3088	19.1 (17.6 to 20.6)
Unemployed	90	9.1 (1.8 to 16.5)	915	39.8 (36.6 to 42.9)	1005	26.4 (22.7 to 30.1)
Residence						
Urban	407	14.8 (11.3 to 18.4)	471	64.4 (60.1 to 68.7)	878	42.8 (40.0 to 45.7)
Rural	1750	3.1 (2.3 to 3.9)	1680	27.8 (25.6 to 29.9)	3430	17.0 (15.7 to 18.2)
Risk factors						
Current smoker						
No	1612	5.5 (4.4 to 6.6)	2148	35.8 (33.8 to 37.9)	3760	22.6 (21.0 to 23.8)
Yes	545	4.2 (2.4 to 6.0)	2	nd	547	9.6 (0.0 to 20.5)
Current drinker						
No	1494	5.0 (3.9 to 6.1)	1613	36.9 (34.5 to 39.3)	3107	22.9 (21.5 to 24.3)
Yes	663	6.0 (4.1 to 7.8)	537	34.3 (30.3 to 38.4)	1200	21.9 (19.5 to 24.4)
Fruit and vegetable intake						
<5	1909	5.0 (4.0 to 6.0)	1910	35.7 (33.6 to 37.9)	3819	22.3 (21.0 to 23.6)
≥5	83	4.6 (0.2 to 9.0)	108	43.5 (34.6 to 52.5)	191	26.5 (21.1 to 31.9)
Type of fat most commonly used						
Vegetable oil	1313	7.2 (5.8 to 8.6)	1307	40.8 (38.1 to 43.5)	2620	26.1 (24.5 to 27.7)
Butter, lard or fat, margarine	534	1.7 (0.7 to 2.8)	623	27.9 (24.4 to 31.4)	1157	16.4 (14.4 to 18.5)
None or other	232	2.1 (0.3 to 4.0)	188	30.3 (23.7 to 36.8)	420	17.9 (14.1 to 21.6)
Physical activity						
Intense	1437	4.2 (3.2 to 5.2)	1202	36.2 (33.4 to 38.9)	2639	22.2 (20.6 to 23.8)
Moderate	468	4.3 (2.5 to 6.1)	642	32.6 (28.9 to 36.2)	1110	20.2 (18.0 to 22.4)
Low	252	12.4 (8.3 to 16.5)	306	41.3 (35.8 to 46.9)	558	28.7 (25.1 to 32.3)
BMI class						
Underweight	189	1.4 (0.0 to 3.4)	305	8.4 (5.4 to 11.4)	494	5.3 (3.4 to 7.2)
Normal	1652	1.5 (0.9 to 2.0)	1443	27.1 (24.8 to 29.4)	3095	15.8 (14.5 to 17.2)

Continued

Table 2 Continued

Characteristics	Men n	Men Prev (95% CI)	Women n	Women Prev (95% CI)	Total n	Total Prev (95% CI)
Overweight	265	19.8 (15.1 to 24.5)	283	85.9 (81.9 to 89.8)	548	57.1 (54.0 to 60.2)
Obese	51	63.6 (51.1 to 76.1)	120	95.9 (92.4 to 99.4)	171	82.0 (76.2 to 87.7)
HBP						
No	1686	4.0 (3.0 to 4.9)	1755	33.1 (30.8 to 35.3)	3441	20.4 (19.0 to 21.7)
Yes	470	9.3 (6.6 to 11.9)	394	47.7 (42.4 to 52.9)	864	30.9 (27.7 to 34.1)
Diabetes						
No	2023	5.1 (4.1 to 6.1)	2029	35.5 (33.4 to 37.6)	4052	22.2 (20.9 to 23.4)
Yes	101	6.4 (2.1 to 10.7)	92	44.4 (34.4 to 54.4)	193	27.9 (21.9 to 33.9)
Hypercholesterolaemia						
No	2112	5.0 (4.1 to 6.0)	2078	34.5 (32.5 to 36.6)	4190	21.6 (20.4 to 22.8)
Yes	33	17.6 (5.2 to 30.0)	60	78.7 (68.2 to 89.2)	93	52.2 (44.1 to 60.3)

BMI, Body mass index; HBP, High blood pressure; nd, there is only two smokers among women which is too small; Prev, age-standardised prevalence.

abdominal obesity in many SSA countries, there is an urgent need for strategies to raise awareness regarding the health implications of abdominal obesity.[27] Its high prevalence among some populations in SSA, including Burkina Faso, predicts a future epidemic of cardiometabolic complications if no effective action is taken. The current levels of abdominal obesity among the adult population of Burkina Faso is a wake-up call for policy makers to draft effective weight management strategies for the high-risk groups reported in this study.

The predictors of abdominal obesity reported in this study were similar to those reported by several other previous studies. Indeed, as shown by Wong *et al*,[26] the global prevalence of abdominal obesity is significantly higher among older individuals, female subjects, urban residents, Caucasians and populations of higher income level countries. Kabwama *et al*[29] also found out that the prevalence of abdominal obesity was significantly higher among women and being married, individuals with secondary education and urban dwellers in Uganda. The higher prevalence of abdominal obesity reported among women in many studies in both high-income and low-income countries appears to have numerous causes.[26 29 42] First, differences in the accumulation of abdominal fat among men and women is well known to be influenced by the differences in the level of steroid hormones between the sexes—these hormones drive body structure during the adolescent age. Second, as shown by some researchers, body fat deposit in adolescents appears to be influenced by genetic and environmental factors, which results in women having increased susceptibility to fat accumulation than men.[26 29 42] Third, the amount of abdominal fat tends to increase in women since it is influenced by each pregnancy they carried and the postmenopausal body fat distribution. The high prevalence of abdominal obesity in older individuals compared with the youth is, on the one hand, due to the fact that older individuals are typically physically inactive and therefore, expend less energy than young adults. On the other hand, this situation might also be explained by the well-known lower basal metabolism among older adults which, at that age, contributes to the accumulation of excess body fat due to the increased ratio of energy intake to expenditure. However, the onset of abdominal obesity at an early age appears to be associated with an increased risk of mortality.[43] This suggests that there is the urgent need for policies to prevent abdominal obesity among young people.[26] In our study, education level and professional status were significantly associated with abdominal obesity. Education level is a proxy indicator of higher socioeconomic status, which is generally associated with an increased risk of abdominal obesity.[44 45] This relation seems to disappear when adjusted for physical activity.[44] This suggests that there is the need to promote a healthy lifestyle among adults with high levels of education. We reported a high prevalence of abdominal obesity among urban dwellers. Socioeconomic status and urbanisation were associated with a dietary habit of excess fat and calorie intake. They are also known to be associated with lack of physical activity and stressful conditions, which tend to increase cortisol secretion and the risk of abdominal obesity.

This study also reported a high proportion of the adult population to be at a high risk of body fat-related cardiometabolic complications in Burkina Faso. Using the same approach (NICE BMI-WC), Owolabi *et al*[27] reported that nearly 67% of their study participants in South Africa had an increased risk of cardiometabolic complications. This can be explained by the fact that South Africa is at an advanced stage of epidemiological transition with a heavy burden of overweight and abdominal obesity.[27] Regarding our findings, it seems that Burkina Faso is at the early stages of the growing trend of over nutrition, which is one of the characteristics of the epidemiological transition. Such a situation

Table 3 Factors associated with abdominal obesity among the adult population of Burkina Faso

	Male		Female		Total	
Characteristics	**cPR (95% CI)**	**aPR (95% CI)**	**cPR (95% CI)**	**aPR (95% CI)**	**cPR (95% CI)**	**aPR (95% CI)**
Sex						
Women					1	1
Men					0.15 (0.12 to 0.18)	0.15 (0.11 to 0.19)
Age group, years						
25–34	1	1	1	1	1	1
35–44	1.73 (1.08 to 2.78)	2.14 (1.25 to 3.68)	1.29 (1.13 to 1.48)	1.25 (1.09 to 1.44)	1.33 (1.15 to 1.54)	1.30 (1.13 to 1.49)
45–54	1.69 (0.97 to 2.95)	1.54 (0.78 to 3.07)	1.53 (1.32 to 1.77)	1.54 (1.31 to 1.80)	1.49 (1.26 to 1.76)	1.51 (1.28 to 1.78)
55–64	2.09 (1.27 to 3.44)	1.82 (0.97 to 3.41)	1.57 (1.32 to 1.85)	1.62 (1.33 to 1.98)	1.39 (1.15 to 1.68)	1.64 (1.34 to 2.00)
Marital status						
Single	1	1	1	1	1	1
Married	1.50 (0.85 to 2.65)	1.46 (0.86 to 2.50)	1.04 (0.88 to 1.24)	1.17 (1.00 to 1.38)	1.27 (1.02 to 1.39)	1.21 (1.03 to 1.43)
Highest completed level of education						
No formal education	1	1	1	1	1	1
Primary school	1.36 (0.80 to 2.28)	1.19 (0.64 to 2.21)	1.29 (1.10 to 1.50)	1.26 (1.07 to 1.48)	1.00 (0.84 to 1.18)	1.21 (1.02 to 1.42)
Secondary or more	3.39 (2.06 to 5.64)	1.51 (0.73 to 3.13)	1.24 (0.95 to 1.62)	1.09 (0.83 to 1.44)	1.02 (0.77 to 1.35)	1.18 (0.92 to 1.52)
Profession						
Wage earner	1	1	1	1	1	1
Self-employed	0.30 (0.19 to 0.47)	0.80 (0.40 to 1.60)	0.65 (0.49 to 0.84)	0.77 (0.58 to 1.02)	0.70 (0.48 to 1.00)	0.71 (0.55 to 0.92)
Unemployed	0.65 (0.34 to 1.22)	1.16 (0.61 to 2.22)	0.73 (0.57 to 0.94)	0.82 (0.62 to 1.09)	1.69 (1.20 to 2.37)	0.80 (0.63 to 1.03)
Residence						
Urban	1	1	1	1	1	1
Rural	0.22 (0.15 to 0.33)	0.31 (0.20 to 0.49)	0.42 (0.36 to 0.50)	0.48 (0.40 to 0.58)	0.36 (0.31 to 0.43)	0.50 (0.42 to 0.60)
Risk factors						
Current smoker						
No	1	1	1	1	1	1
Yes	0.71 (0.46 to 1.11)	0.91 (0.55 to 1.54)	1.41 (0.87 to 2.29)	2.87 (2.37 to 3.47)	0.17 (0.11 to 0.27)	0.77 (0.46 to 1.29)
Current drinker						
No	1	1	1	1	1	1
Yes	1.21 (0.83 to 1.77)	0.89 (0.59 to 1.34)	1.01 (0.87 to 1.16)	0.94 (0.82 to 1.08)	0.86 (0.74 to 1.00)	0.97 (0.84 to 1.11)
Fruit and vegetable intake						
<5	1	1	1	1	1	1
≥5	1.05 (0.43 to 2.60)	1.26 (0.45 to 3.49)	1.18 (0.95 to 1.47)	1.24 (0.98 to 1.56)	1.23 (0.92 to 1.64)	1.27 (0.98 to 1.63)

Continued

Table 3 Continued

	Male		Female		Total	
Characteristics	**cPR (95% CI)**	**aPR (95% CI)**	**cPR (95% CI)**	**aPR (95% CI)**	**cPR (95% CI)**	**aPR (95% CI)**
Type of fat most commonly used						
Vegetable oil	1	1	1	1	1	1
Butter, lard or fat, margarine	0.29 (0.15 to 0.57)	0.37 (0.17 to 0.83)	0.93 (0.81 to 1.06)	0.96 (0.84 to 1.11)	0.91 (0.77 to 1.06)	0.88 (0.76 to 1.02)
None or other	0.34 (0.14 to 0.80)	0.54 (0.22 to 1.34)	0.93 (0.72 to 1.20)	0.92 (0.68 to 1.24)	0.78 (0.57 to 1.06)	0.82 (0.59 to 1.14)
Physical activity						
Intense	1	1	1	1	1	1
Moderate	1.01 (0.62 to 1.64)	0.88 (0.54 to 1.45)	0.92 (0.80 to 1.07)	0.90 (0.78 to 1.03)	1.19 (1.01 to 1.41)	0.89 (0.77 to 1.03)
Low	2.83 (1.87 to 4.28)	1.70 (1.06 to 2.71)	1.07 (0.91 to 1.26)	0.94 (0.80 to 1.10)	1.51 (1.27 to 1.80)	1.03 (0.88 to 1.20)
HBP						
No	1	1	1	1	1	1
Yes	2.45 (1.69 to 3.54)	1.84 (1.20 to 2.83)	1.37 (1.22 to 1.54)	1.20 (1.06 to 1.36)	1.41 (1.23 to 1.62)	1.30 (1.14 to 1.47)
Diabetes						
No	1	1	1	1	1	1
Yes	1.54 (0.85 to 2.78)	1.42 (0.83 to 2.41)	1.16 (0.92 to 1.46)	1.07 (0.84 to 1.38)	1.16 (0.90 to 1.50)	1.17 (0.92 to 1.49)
Hypercholesterolaemia						
No	1	1	1	1	1	1
Yes	3.45 (1.46 to 8.13)	1.66 (0.76 to 3.61)	1.77 (1.41 to 2.21)	1.50 (1.19 to 1.91)	2.39 (1.82 to 3.13)	1.52 (1.18 to 1.94)

.aPR, adjusted prevalence ratio; cPR, crude prevalence ratio; HBP, high blood pressure.

Table 4 Cardiovascular health risk assessment using the NICE BMI-WC matrix

		Waist circumference (WC)		
		Low	High	Very high
Body mass index (BMI) class	Underweight (<18.5 kg/m²)	11.1	0.5	0.2
	Normal (18.5 to <25 kg/m²)	59.9	8.0	2.4
	Overweight (25 to <30 kg/m²)	5.8	3.9	3.8
	Obese (30 to <40 kg/m²)	0.5	0.8	2.7
	Morbid obese (40 kg/m² or more)	0.1	0.0	0.4

Low risk, Increased risk, High risk, Very high risk.

The prevalence of at least increased risk was 14.6%. The prevalence of increased risk, high risk and very high risk of health were 6.8%, 4.6% and 3.2%, respectively.

BMI, body mass index; NICE, National Institute for Health and Clinical Excellence; WC, waist circumference.

offers a unique opportunity to control the prevalence of abdominal obesity and its related health risk before they reach those in the middle-income and high-income countries. This might be achieved through voluntary weight management strategies, which are needed for at least one in every ten adults in Burkina Faso (if we consider the WHO expert consensus). It might also be achieved through routine measurements of WC combined with BMI in clinical practice, as has been recommended by the IAS and ICCR Working Group on visceral obesity.[17] WC is known to be associated with cardiovascular and all-cause mortality, regardless of adjustments for BMI.[46 47] WC is a simple anthropometric measurement which can be easily conducted in settings with limited resources and might help in screening for cardiometabolic risk.[17] In our study, we found that abdominal obesity was significantly associated with hypertension and hypercholesterolaemia but not with diabetes. The same finding had been noted by Owolabi *et al*.[27] In addition, abdominal obesity is known to be an important mediator of insulin resistance and endothelial dysfunction.[48] Our results might be explained by the fact that many abdominally obese people may not yet have experienced the biological symptoms of insulin resistance. The association between hypercholesterolaemia and abdominal obesity appeared to be confirmed even in the model adjusted for BMI categories. This finding suggests that the WC is an indicator of total cholesterol level particularly among women. The systematic use of the WC measurements in primary healthcare might help in the early diagnosis of women with abdominal obesity and those at risk of CVDs in clinical practice.[17]

The limitations of our study have to be taken into account when discussing its results. First, this study used a cross-sectional design so we cannot make causal interpretations. Second, the behavioural risk factors might be affected by social desirability bias and recall bias. Finally, another limitation of this study is the fact that the measurement of the WC was done only once. However, in spite of these limitations, this study is the first population-based study with a large sample size in the country on abdominal obesity that was conducted using a standard approach implemented by WHO.

CONCLUSION

Our study showed a high prevalence of abdominal obesity among adults in Burkina Faso and a high proportion of adults with abdominal obesity who require weight management strategies to prevent the occurrence of cardiometabolic complications. The prevalence was significantly higher among women, the elderly, people with higher educational levels, urban-dwelling adults and those with HBP or hypercholesterolaemia. These findings could be a wake-up call on policy-makers to improve weight-loss strategies in the country. Promoting the adoption of a healthy lifestyle and dietary habits might curb the rising household-level and health-system-related costs of cardiometabolic complications associated with abdominal obesity. This is crucial in limited-resource settings, such as in Burkina Faso, to prevent premature health deterioration and encourage sustainable economic growth in a country currently at an early stage of epidemiological and demographic transition.

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