Vol. 15(3), pp. 166-174, July-September 2023
DOI: 10.5897/JPHE2022.1429
Article Number: 6230C5E70991
ISSN 2141-2316

http://www.academicjournals.org/JPHE

ACADEMIC JOURNALS
expand your knowledge

Journal of Public Health and Epidemiology

Full Length Research Paper

Modifiable lifestyle factors and their relationships with metabolic disorders among adults in Burkina Faso: findings from the first national survey

Jeoffray Diendéré[1]*, Jean Kaboré[1], Augustin Nawidimbasba Zeba[1], William Kofi Bosu[2], Jérôme Winbetouréfâ Somé[1], Franck Garanet[1], Pingdéwendé Victor Ouédraogo[3], Abdoul Aziz Savadogo[3] and Athanase Millogo[3]

[1]Institut de Recherche en Sciences de la Santé (IRSS), Ouagadougou, Burkina Faso.
[2]Department of Public Health and Research, West African Health Organisation (WAHO), Bobo-Dioulasso, Burkina Faso.
[3]Centre Hospitalier Universitaire Sourô SANOU, Bobo-Dioulasso, Burkina Faso.

Received 30 December, 2022; Accepted 28 June, 2023

Modifiable lifestyle factors should primarily be targeted for the cardiovascular diseases' prevention. This study aimed to report the magnitude of modifiable lifestyle factors, their relationships with metabolic disorders in Burkinabè adults using nationally representative data. This cross-sectional study included 4100 adults selected through multistage cluster sampling performed during the first national survey conducted in Burkina Faso. The modifiable factors considered were tooth cleaning, fruit and/or vegetable (FV) intake, substances' use, physical activity and overweight/obesity, while metabolic syndrome abnormal components defined metabolic disorders. We performed logistic regressions. 31.1% cleaned the teeth at least twice a day, 4.9% consumed five or more FV, 39.7% used alcohol and/or tobacco, the prevalence of physical inactivity and overweight/obesity was, respectively 6.6 and 17.7%. About 41.0% had at least two metabolic disorders and 9.5% had at least three. Lifestyle factors associated with having at least two metabolic disorders were overweight/obesity, more FV intake (when five or more aOR=1.7, p<0.001), physical inactivity (aOR=1.3, p<0.05), and tooth cleaning (aOR=0.8, p<0.01). The same trend of relationships was observed with having at least three metabolic disorders. Excluding overweight/obesity and physical inactivity, unhealthy modifiable lifestyle factors were common and tooth cleaning was found as a protective practice for metabolic disorders.

Key words: Modifiable lifestyle factors, metabolic disorders, prevalence, relationships, Burkina Faso.

INTRODUCTION

Non-communicable diseases (NCDs) are emerging as significant contributors to disease burden in the low- and middle-income countries (LMICs) (Gheorghe et al., 2018; Gouda et al., 2019).

Modifiable risk factors such as unhealthy lifestyle behaviour contribute to the shifting disease burden and

*Corresponding author. E-mail: jeoffray.diendere@gmail.com. Tel: + 226 20 98 10 80 / +226 71 09 40 96. Fax: +226 20 97 48 68.

so should primarily be targeted (O'Donnell et al., 2016), particularly for cardiovascular diseases' prevention (Yusuf et al., 2015; Owolabi et al., 2018). Systematic reviews and meta-analyses have assessed the relationships between the modifiable lifestyle factors such as the alcohol consumption (Sun et al., 2014), tobacco use (Slagter et al., 2013; Oh et al., 2020), oral hygiene practices (Santoso et al., 2021), fruit and/or vegetable (FV) consumption (Lee et al., 2019; Picasso et al., 2019), physical inactivity (Amirfaiz and Shahril, 2019) excess weight and the metabolic disorders (Opio et al., 2020).

The World Health Organization (WHO) recommends the implementation of a national surveillance system for the risk factors for the NCDs (stepwise approach to surveillance [STEPS]) including those for cardiovascular diseases (Alwan et al., 2010) and while the US Centre for Disease Control and Prevention recommends the Behavioural Risk Factor Surveillance System (Mokdad et al., 2003). The WHO STEPS surveys use a standardized tool for data collection which include specific sections on behavioural risk factors (the alcohol and tobacco use, oral hygiene practices, fruit and vegetable intake, physical activity), anthropometry (measurement of the body mass index [BMI]) and the measurement of some biological parameters (World Health Organization, 2005) which may help identify metabolic disorders.

Observational studies (Panayiotou et al., 2013; La Carrubba et al., 2016) including cohort studies (McNeill et al., 2005) and meta-analyses (Gami et al., 2007) have supported that the presence of only two metabolic syndrome (MetS) abnormal components increased the risk for subclinical/clinical cardiovascular dysfunctions or events, alongside having the MetS (that is, having at least three abnormal components). Thus, highlighting the associated factors with the presence of at least two or at least three abnormal components may lead to the relevant awareness with regard to those who may receive particular benefit from healthy lifestyle practices. Moreover, among the modifiable lifestyle factors, the most easily achievable at lower intervention costs should be known and prioritised in policies in LMICs.

The survey using the STEPS method in Burkina Faso provided the first national lifestyle variables which have not yet been analysed and especially in relation to metabolic disorders. This study aimed to examine the modifiable lifestyle factors and their relationships with metabolic disorders among adults in Burkina Faso, by using the first nationally representative data.

METHODOLOGY

Description of the Burkina STEPS survey

The cross-sectional study covered all the 13 administrative regions of Burkina Faso and involved all three components (behavioural or lifestyle factors, anthropometric and biological measurements) (World Health Organization, 2005). The survey enrolled 4800 adults aged 25 to 64 years, based on a calculated sample size considered to achieve sufficient accuracy by weighting the numbers of age groups for each sex. It was also weighted to ensure representativeness with regard to the living environment (rural or urban areas).

Data were collected from 3 September to 24 October 2013 through face-to-face interviews in the language spoken by the participant. The data were collected using personal digital assistants with standardized WHO STEPS questionnaires loaded with eSTEPS software. Blood samples were collected for biological measurements.

The protocol of the STEPS survey was approved by the Ethics Committee for Health Research of the Ministry of Health of Burkina Faso (deliberation No: 2012-12092; December 05, 2012).

Written informed consent was systematically obtained from each participant in the STEPS survey.

Study variables

Sociodemographic data collected included living environment, sex, age, marital status, education level and occupation. Self-reported data on the modifiable lifestyle factors were also collected: alcohol and/or tobacco use, oral hygiene practices, FV consumption, and physical inactivity. The anthropometric measurements of weight, height, waist circumference (WC) were taken together with blood pressure (BP). These physical measurements and the biological measurements of fasting blood glucose (FBG) and high-density lipoprotein cholesterol (HDL-C) were used to determine the presence of metabolic disorders.

Alcohol consumption was defined as alcohol intake in the past one month while current tobacco use was defined as use of smoked or smokeless tobacco in the past 12 months.

The oral hygiene practices were categorized based on the frequency of cleaning teeth per day, with, at least, twice daily cleaning being recommended (Chapple et al., 2015). Typical daily FV intake was derived from the number of servings of FV consumed per day during a typical week. Five or more daily FV servings were recommended (World Health Organization & Food and Agriculture Organization, 2003). Data on self-reported physical activity were collected using the validated Global Physical Activity Questionnaire (Bull et al., 2009). Physical activity was determined from the amount of time being physically active in three domains; transport, at work and during leisure time. Participants were asked about the frequency, intensity and duration of their work-, travel- and leisure-related physical activity (vigorous or moderate), in a typical week. BMI, calculated as a subject's weight divided by height², in kg/m², was characterized as underweight (BMI<18.5 kg/m²), normal (BMI=18.5 – 24.9 kg/m²), overweight (BMI=25 – 29.9 kg/m²), and obesity (BMI ≥30 kg/m²) states (World Health Organization, 2000).

Each MetS abnormal component counts as one metabolic disorder and using the International Diabetes Federation criteria (Alberti et al., 2006), the metabolic disorders were: (i) elevated BP with systolic BP ≥ 130 or diastolic BP ≥ 85 mmHg, or currently taking anti-hypertensive medication; (ii) raised FBG ≥ 5.6 mmol/l or previously diagnosed type 2 diabetes; (iii) reduced HDL-C of < 1.03 mmol/l in men and <1.29 mmol/l in women; (iv) and central obesity defined a WC ≥ 94 in men and 80 cm ≥ in women (Alberti et al., 2006). Since consistent data supported that the increased number of MetS abnormal components showed a significant increased value in predicting cardiovascular impairment or events (Gami et al., 2007), the outcome variables we considered were having at least two on the one hand; and at least three metabolic disorders on the other hand.

WC was measured, to the nearest 0.1 cm, using a flexible

measuring tape placed at midpoint between the last rib and the iliac crest, with the subjects in light clothing, standing upright and breathing normally (Després et al., 2001). BP (in mmHg) was measured three times using an electronic BP device, and the mean value used in the analysis. The biochemical tests were done on fasting capillary blood samples.

Of the sample of 4800 individuals surveyed, 105 were not eligible; 10, 493 and 92 subjects had missing or invalid data on sociodemographic variables, lifestyle factors and MetS components, respectively. The number of missing or invalid lifestyle factors was as follows: 1 for tobacco, 6 for oral hygiene practice, 279 for FV intake, 2 for physical activity and 205 for BMI. Thus, we included 4100 participants who had complete data in our secondary data analyses.

Statistical analyses

StataCorp Stata Statistical Software for Windows (Version 14.0, College Station, Texas, US) was used to analyze the data. The continuous variables were expressed as the means ± standard deviations, and categorical variables expressed as percentages. In the stepwise logistic regression models, we dichotomized the outcome variable as the presence of at least two (yes/no), or at least three metabolic disorders (yes/no), while the lifestyle factors were the explanatory variables, with adjustment on sociodemographic factors (sex, age, urban-rural residence, marital status, education and occupation). For all analyses, a p-value below 0.05 was considered significant.

RESULTS

The sample was made up of 2087 (50.9%) females and the mean age was 38.6 ± 11.1 years. The participants were predominantly aged 25-29 years (44.2%), rural residents (79.7%), illiterates (77.3%), currently married or cohabiting (86.7%) or engaged in an occupation without formal and regular income (94.3%) (Table 1). Of the sample studied, 31.1% cleaned the teeth at least twice a day, only 4.9% consumed five or more FV servings, 39.7% were current alcohol and/or tobacco users, 6.6% were physically inactive and 17.7% were overweight/obese. About 40.7 and 9.5% of participants had at least (any) two or three metabolic disorders, respectively.

Table 2 summarizes results from stepwise logistic regressions and sociodemographic factors associated with having at least two metabolic disorders were living in urban area (aOR=1.4, p<0.001), being female (aOR=1.9, p<0.001) and older age (aOR = 1.2 to 2.3; p<0.01). Concerning modifiable lifestyle factors, consuming more FV (when the number was three to four servings, aOR=1.3, p<0.0001; for five or more servings aOR=1.7, p<0.001) and physical inactivity (aOR=1,3; p<0.05) and increased BMI (for overweight aOR=3.7, p<0.001 and for obesity aOR=9.6, p<0.001) were unfavourable factors for having at least two metabolic disorders, while cleaning the teeth at least twice a day was a protective factor (aOR=0.8, p<0.01). Furthermore, when the binary variable “having at least three metabolic disorders” was considered as the outcome in the logistic regression model, the significant factors remained identical, except only for the variable professions earning formal and regular income (aOR=1.4; p=0.02).

DISCUSSION

Only 4.9% consumed five or more FV. The low rainfall in the wide area of Burkina Faso (the Sahelian and Sudano-Sahelian areas) may explain the low availability of FV. Despite. These products are not sustainable over all seasons because of the issue of their storage and processing remains a major challenge for the country. Moreover, the value of the FV consumption is not be well known by the general population and thus, the nutrition education should be undertaken (Wagner et al., 2016). There was an insufficient prevention for the licit psychoactive substance use such as alcohol and tobacco in Burkina Faso (respective prevalence of the use was 28.1 and 20.4%). The WHO reported in 2014 as in 2018, the absence of a national monitoring system regarding alcohol consumption, alcohol-related health disorders, and alcohol policy response in Burkina Faso. There were no restrictions for on- or off-premise sales concerning the hours, days, density, specific events and intoxicated persons (WHO, 2014, 2018). At the time of this study, the WHO also noticed the low level of achievement with regards to the tobacco control policy, that is, the “MPOWER” guidelines: Monitoring (epidemiological data collecting on tobacco use), Protect (smoke-free policies), Offer (cessation programs), Warnings (health warnings, mass media), Enforce (advertising bans) and Raise (taxation). As was observed in a STEPS survey in Indian adults STEPS survey in Indian adults (prevalence of 29%) (Sreenivasan et al., 2016), less than a third of Burkinabè adults cleaned the teeth at least twice a day (31.1%).

The prevalence of overweight/obesity (17.7%) was among the low levels in sub-Saharan Africa (Bosu, 2015) but it should be read in conjunction with the higher rate of underweight (Yaya et al., 2018), especially in rural areas (Diendéré et al., 2020) with the lower food availability. The prevalence of the physical inactivity (6.6%) was also low and identical to the previous rate (6.7%) described in the study including sub-Saharan African countries (Guthold et al., 2008) or to the level found in a Kenyan STEPS survey (7.7%) (Gichu et al., 2018). Evidence from the literature suggests that triglycerides may be normal among West Africans with MetS (Sumner et al., 2010) and the absence of this parameter in our study would at least affect our results. The prevalence of MetS may be perceived as low (9.5% had at least three abnormal components). However, a significant part of Burkinabè adults (about 41% who had at least two abnormal components). The presence of multiple components are associated with significant risk of cardiovascular events (McNeill et al., 2005; Gami et al., 2007). Such authors recommended that these individuals should be considered as being in an early stage of the arteriosclerosis

Table 1. Description of the socio-demographic characteristic, lifestyle factors and metabolic disorders.

Socio-demographic characteristic	n (%)
Age ranges (years)	
25 - 29	1814 (44.2)
30 - 44	1036 (25.3)
45 - 54	757 (18.5)
55 - 64	493 (12.0)
Sex	
Men	2013 (49.1)
Women	2087 (50.9)
Residence area	
Rural	3267 (79.7)
Urban	833 (20.3)
Education level	
No formal/No education	3171 (77.3)
Primary achieved	634 (15.5)
Secondary or more	295 (7.2)
Occupation	
Professions providing formal and regular income	234 (5.7)
Professions without formal and regular income	3866 (94.3)
Marital status	
Never or previously married	547 (13.3)
Currently married/cohabiting	3553 (86.7)
Lifestyle factors	
Oral hygiene practices	
Tooth cleaning frequencies	
Never cleaned the teeth	233 (5.7)
Less than once a day	512 (11.5)
Cleaning the teeth once a day	2079 (50.7)
Cleaning the teeth at least twice a day	1276 (31.1)
Use of alcohol or tobacco	
Current alcohol consumption	
Not consumers	2948 (71.9)
Consumers	1152 (28.1)
Current tobacco use:	
Not users	3262 (79.6)
Users	838 (20.4)
Current alcohol and/or tobacco use:	
Non-user of alcohol or tobacco	2472 (60.3)
User of alcohol and/or tobacco	1628 (39.7)
Physical lifestyle (number of the practice of physical activities per week):	
Physically inactive	271 (6.6)
Physically active	3829 (93.4)

Table 1. Cont'd

Consumption of fruits and vegetables (number of servings consumed per day):	
0	2187 (53.3)
1 - 2	975 (23.8)
3 - 4	739 (18.0)
≥5	199 (4.9)
Body mass index status:	
Underweight	456 (11.1)
Normal weight	2919 (71.2)
Overweight	547 (13.4)
Obese	178 (4.3)
Metabolic disorders	
Presence of abnormal metabolic components	
Raised waist circumference: yes	889 (21.7)
Raised blood pressure: yes	1381 (33.7)
Raised fasting blood sugar: yes	359 (8.8)
Reduced high-density lipoprotein cholesterol (HDL-C): yes	3162 (77.1)
Metabolic disorders' accumulation	
No abnormal metabolic component	402 (9.8)
With one abnormal metabolic component	2030 (49.5)
With two abnormal metabolic components	1278 (31.2)
With three abnormal metabolic components	355 (8.7)
With four abnormal metabolic components	35 (0.8)

Source: Authors 2022

process (Chen et al., 2015; Zhu et al., 2018).

Associations with increased number of metabolic disorders: consuming more FV was an unfavourable factor for having at least two abnormal components. This findings contrary the results from the meta-analysis including international studies (Tian et al., 2018) highlighting that FV intake was inversely associated with risk of MetS. It is possible that individuals who consume FV may be those who already have cardiovascular disease or diabetes and may want want to prevent any complications. Similar pattern (concerning vegetable servings and overweight/obesity) was observed among adolescents whom the parents were highly aware of their weight status and also advised to change their children's health behaviours (Tovar et al., 2012), suggesting actually the therapeutic lifestyle change process (Wagner et al., 2016).

The increased metabolic risk in physically inactive individuals we reported was consistent with the literature (Houti et al., 2016; Díaz-Martínez et al., 2018; Gallardo-Alfaro et al., 2020). The number of abnormal components usually increases in tobacco or alcohol users (Vancampfort et al., 2016) but this analysis did not find a significant relationship. Tobacco and alcohol are the psychoactive substances and their contents (nicotine and ethanol from tobacco and alcoholic beverages, respectively) can decrease the appetite (Edge and Gold, 2011) via the ghrelin hormone pathway (these substances have an acute inhibitory effect on human ghrelin secretion (Deschaine et al., 2021), lower the hunger rate (Levin et al., 2006) with anorectic effects (Koopmann et al., 2015, 2018), that may result into insufficient food intake (Jo et al., 2002), particularly in the context of low food availability (Yeomans, 2010). Burkina Faso usually has a low food availability (particularly in rural area with 77.3% of the population), and subjects may adjust to hunger through tobacco consumption. Such behaviour was noted in a supplemental qualitative study (interview) in three Ethiopian pastoral communities with a long tradition of tobacco use (Etu et al., 2017). Thus, the decrease of anthropometric (including WC) values was plausible (Edge and Gold, 2011) and combined to the diastolic BP decreasing due to the potential effect of nicotine included in tobacco (Diendéré et al., 2020), the number of abnormal components could be lowered. The similar observations may be reported in alcohol users (Deschaine et al., 2021; Levin et al., 2006). Overweight or obesity increased the risk for having at least two abnormal components or having at least three abnormal components as the finding of Omuse et al. (2017) concerning relationships with MetS in Kenya aOR=5.01, $p<0.001$ and 5.23, $p<0.001$) for overweight

Table 2. Factors associated with the presence of "at least two metabolic disorders" and "at least two metabolic disorders" in the multivariable analyses.

Parameter	Relationships with having at least two abnormal components						Relationships with having at least three abnormal components					
	Univariable analysis			Multivariable analysis			Univariable analysis			Multivariable analysis		
	cOR	95% CI	p-value	aOR	95% CI	p-value	cOR	95% CI	p-value	aOR	95% CI	p-value
Residence: Urban vs rural (Ref)	2.1	1.8-2.4	0.0001	1.4	1.2-1.7	0.0001	3.1	2.5-3.8	0.0001	1.6	1.2-2.1	0.001
Sex: Female vs male (Ref)	1.8	1.6-2.0	0.0001	1.9	1.6-2.1	0.0001	3.2	2.5-4.1	0.0001	3.1	2.3-4.1	0.001
Age range (years)												
25 – 34 (Ref)	1			1						1		
35 – 44	1.3	1.1-1.5	0.001	1.2	1.1-1.5	0.015	1.6	1.2-2.1	0.001	1.5	1.1-2.1	0.007
45 – 54	1.6	1.4-1.9	0.0001	1.7	1.4-2.0	0.0001	2.2	1.6-2.9	0.0001	2.3	1.7-3.2	0.0001
55 – 64	2.0	1.7-2.5	0.0001	2.3	1.9-2.9	0.0001	2.6	1.9-3.5	0.0001	3.6	2.6-5.2	0.0001
Marital status: Married/cohabiting vs no (Ref)	0.9	0.7-1.1	0.084	>0.9	0.8-1.2	0.73	0.7	0.6->0.9	0.03	0.9	0.6-1.2	0.44
Education levels												
No formal/no education (Ref)	1			1			1			1		
Primary achieved	1.2	0.9-1.4	0.073	1.1	0.9-1.4	0.31	1.2	0.9-1.6	0.24	>0.9	0.7-1.4	0.81
Secondary or more	1.5	1.2-1.9	0.001	>1.0	0.7-1.3	0.89	2.3	1.6-3.1	0.0001	1.4	0.9-2.1	0.17
Professions providing formal and regular income Yes vs No (Ref)	1.6	1.4-1.8	0.0001	1.1	0.9-1.3	0.18	2.3	1.8-2.8	0.0001	1.4	1.1-1.8	0.02
Physical activity: Yes vs No (ref)	1.8	1.4-2.3	0.0001	1.3	1.1-1.8	0.04	2.3	1.6-3.1	0.0001	1.5	1.1-2.2	0.038
Current use of alcohol and/or tobacco: Yes vs no (Ref)	0.8	0.7-0.9	0.002	0.9	0.8-1.1	0.14	0.8	0.6-0.9	0.013	>0.9	0.7-1.2	0.75
Cleaning the teeth at least twice a day: Yes vs no (Ref)	0.9	0.8-1.1	0.15	0.8	0.7-0.9	0.005	0.9	0.7-1.2	0.61	0.7	0.5-0.9	0.017
Number of fruits/vegetables consumed												
0	1			1			1			1		
1 - 2	1.2	1.1-1.4	0.027	1.2	1.1-1.5	0.012	1.3	>0.9-1.6	0.07	1.2	0.9-1.6	0.20
3 - 4	1.4	1.2-1.7	0.0001	1.3	1.1-1.6	0.007	1.3	1.1-1.7	0.049	1.2	1.9-1.7	0.17
≥5	1.4	1.2-1.8	0.001	1.7	1.2-2.3	0.001	1.5	>0.9-2.4	0.054	1.9	1.1-3.1	0.015
BMI categories												
Normal BMI	1			1			1			1		
Underweight	0.9	0.8-1.2	0.54	0.8	0.6-0.9	0.03	0.6	0.4-1.01	0.07	0.4	0.3-0.8	0.003
Overweight	3.9	3.2-4.8	0.0001	3.7	3.0-4.5	0.0001	5.9	4.5-7.5	0.0001	5.4	4.1-7.1	0.0001
Obese	13.0	8.3-20.3	0.0001	9.6	6.1-15.1	0.0001	16.3	11.7-22.8	0.0001	11.2	7.7-16.2	0.0001

Source: Authors 2022

and obesity, respectively (Omuse et al., 2017) and this is (consistent with international data (Brazil (Ramires et al., 2018), China (Li et al., 2018), and Iran (Jahangiry et al., 2019)).

Cleaning the teeth at least twice a day was a protective factor (aOR=0.8, p<0.01). Indeed,

having demonstrated that more frequent toothbrushing was related to a lower prevalence and incidence of MetS and its components, Kobayashi et al. (2012) suggested that more frequent toothbrushing may contribute to the prevention of MetS due to the inflammation/triglyceride pathway (Kobayashi et al., 2012). Moreover, the finding of the link between the poor oral hygiene and the high levels of inflammatory cytokines with the risk of excess of weight resulted in authors concluding that the early proper dental prophylaxis and treatment could lead to the better prevention of metabolic disorders (Nijakowski et al., 2020). The 5-year follow-up retrospective study (of 3722 participants aged 35-64 years) reported that participants with more frequent daily toothbrushing tend to have significantly lower odds of developing the increased number of components or MetS (p for trend = 0.01) (Tanaka et al., 2018). It also specified that the risk of development of MetS was significantly lower in participants brushing teeth ≥3 times/day than in those brushing teeth ≤1 time/day (aOR=0.64, CI: 0.45-0.92). The efficiency of the healthy oral hygiene practice in the secondary prevention of cardiovascular events was also described. It was reported that patients with coronary heart disease who reported practicing interdental cleaning reduced tobacco exposure and had a significant decreased adjusted risk for new cardiovascular events (HR=0.2, CI:0.06-0.6) than those who did not report practicing interdental cleaning (Reichert et al., 2015). Other researchers noted the significant relationship between oral health behaviour and stroke (odds for stroke even was of 2.15, CI: 1.01-4.58 for those who daily did not clean the teeth) (Cho et al., 2021). Although, consistent data reported benefits (with regards to the MetS prevention) from the adequate/healthy oral practice, this fundamental public health issue is still neglected by the healthcare workers (Chen, 2018).

Findings suggested that (except for overweight/obesity and physical inactivity) unhealthy lifestyle practices were common among adults in Burkina Faso and the adequate oral hygiene practice should be included among the protective behaviours of metabolic disorders.

Limitations

We did not assess some important potentially-modifiable variables such as psychological stress (Kuo et al. 2019) and sleep quality (Lian et al. 2019). Triglycerides were not measured and so our estimate of the prevalence of MetS may be underestimated. However, we based our definition of MetS, on the most common components. Evidence from the literature suggests that triglycerides may be normal among West Africans with MetS (Sumner et al., 2010). While these first nationally-representative data from 2013 may no longer reflect the current situation, they provide a baseline that can be compared with future WHO STEPS survey data.

Conclusion

Except for overweight/obesity and physical inactivity, unhealthy modifiable lifestyle factors were common in Burkinabè adults. Similarly, the prevalence of multiple metabolic disorder components was significant. The unfavourable and unexpected effect of more FV intake with increased number of abnormal components may be understood as the therapeutic lifestyle change effect. Tooth cleaning at least twice a day was revealed as a protective practice and should be promoted in the general population and included in the therapeutic lifestyle change policy for the potentially at risk individuals.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

REFERENCES

Alberti KGMM, Zimmet P, Shaw J (2006). Metabolic syndrome—A new world-widedefinition. A Consensus Statement from the International Diabetes Federation. Diabetic Medicine: A. Journal of the British Diabetic Association 23(5):469-480. https://doi.org/10.1111/j.1464-5491.2006.01858.x

Alwan A, MacLean DR, Riley LM, Espaignet ET, Mathers CD, Stevens GA, Bettcher D (2010). Monitoring and surveillance of chronic non-communicable diseases: Progress and capacity in high-burden countries. The Lancet 376(9755):1861-1868. https://doi.org/10.1016/S0140-6736(10)61853-3

Amirfaiz S, Shahril MR (2019). Objectively Measured Physical Activity, Sedentary Behavior, and Metabolic Syndrome in Adults: Systematic Review of Observational Evidence. Metabolic Syndrome and Related Disorders 17(1):1-21. https://doi.org/10.1089/met.2018.0032

Bosu WK (2015). An overview of the nutrition transition in West Africa: Implications for non-communicable diseases. The Proceedings of the Nutrition Society 74(4):466-477. https://doi.org/10.1017/S0029665114001669

Bull FC, Maslin TS, Armstrong T (2009). Global physical activity questionnaire (GPAQ): Nine country reliability and validity study. Journal of Physical Activity and Health 6(6):790-804. https://doi.org/10.1123/jpah.6.6.790

Chapple ILC, Van der Weijden F, Doerfer C, Herrera D, Shapira L, Polak D, Madianos P, Louropoulou A, Machtei E, Donos N, Greenwell H, Van Winkelhoff AJ, Eren Kuru B, Arweiler N, Teughels W, Aimetti M, Molina A, Montero E, Graziani F (2015). Primary prevention of periodontitis: managing gingivitis. Journal of Clinical Periodontology 42:16, S71-76. https://doi.org/10.1111/jcpe.12366

Chen L, Zhu W, Mai L, Fang L, Ying K (2015). The association of metabolic syndrome and its components with brachial-ankle pulse wave velocity in south China. Atherosclerosis 240(2):345-350. https://doi.org/10.1016/j.atherosclerosis.2015.03.031

Chen MY (2018). Misperception of Oral Health among Adults in Rural Areas: A Fundamental but Neglected Issue in Primary Healthcare. International Journal of Environmental Research and Public Health 15(10):E2187. https://doi.org/10.3390/ijerph15102187

Cho MJ, Kim YS, Park EY, Kim EK (2021). Association between Periodontal Health and Stroke: Results from the 2013-2015 Korea National Health and Nutrition Examination Survey (KNHANES). Journal of Dental Sciences 16(1):268-274. https://doi.org/10.1016/j.jds.2020.05.006

Deschaine SL, Farokhnia M, Gregory-Flores A, Zallar LJ, You ZB, Sun H, Harvey DM, Marchette RCN, Tunstall BJ, Mani BK, Moose JE, Lee MR, Gardner E, Akhlaghi F, Roberto M, Hougland JL, Zigman JM, Koob GF, Vendruscolo LF, Leggio L (2022). A closer look at alcohol-

induced changes in the ghrelin system: novel insights from preclinical and clinical data. Addiction Biology 27 :e13033. https://doi.org/10.1111/adb.13033

Díaz-Martínez X, Petermann F, Leiva AM, Garrido-Méndez A, Salas-Bravo C, Martínez MA, Labraña AM, Duran E, Valdivia-Moral P, Zagalaz ML, Poblete-Valderrama F, Alvarez C, Celis-Morales C (2018). [Association of physical inactivity with obesity, diabetes, hypertension and metabolic syndrome in the Chilean population].Revista Medica De Chile 146(5):585-595. https://doi.org/10.4067/s0034-98872018000500585

Diendéré J, Zeba AN, Nikièma L, Kaboré A, Savadogo PW, Tougma SJB, Tinto H, Ouédraogo A (2020). Smokeless tobacco use: Its prevalence and relationships with dental symptoms, nutritional status and blood pressure among rural women in Burkina Faso. BMC Public Health 20(1):579. https://doi.org/10.1186/s12889-020-08700-x

Edge PJ, Gold MS (2011). Drug withdrawal and hyperphagia: Lessons from tobacco and other drugs. Current Pharmaceutical Design 17(12):1173-1179. https://doi.org/10.2174/138161211795656738

Etu ES, Gemeda DH, Hussen MA (2017). Prevalence and factors that influence smokeless tobacco use among adults in pastoralist communities of Borena Zone, Ethiopia: Mixed method study. TobaccoInduced Diseases 15:1. https://doi.org/10.1186/s12971-016-0106-7

Gallardo-Alfaro L, Bibiloni MDM, Mascaró CM, Montemayor S, Ruiz-Canela M, Salas-Salvadó J, Corella D, Fitó M, Romaguera D, Vioque, J, Alonso-Gómez ÁM, Wärnberg J, Martínez JA, Serra-Majem L, Estruch R, Fernández-García JC, Lapetra J, Pintó X, García Ríos A, Tur JA (2020). Leisure-Time Physical Activity, Sedentary Behaviour and Diet Quality are Associated with Metabolic Syndrome Severity: The PREDIMED-Plus Study. Nutrients 12(4):E1013. https://doi.org/10.3390/nu12041013

Gami AS, Witt BJ, Howard DE, Erwin PJ, Gami LA, Somers VK., Montori VM (2007). Metabolic syndrome and risk of incident cardiovascular events and death: A systematic review and meta-analysis of longitudinal studies. Journal of the American College of Cardiology 49(4):403-414. https://doi.org/10.1016/j.jacc.2006.09.032

Gheorghe A, Griffiths U, Murphy A, Legido-Quigley H, Lamptey P, Perel P (2018). The economic burden of cardiovascular disease and hypertension in low- and middle-income countries: A systematic review. BMC Public Health 18(1):975. https://doi.org/10.1186/s12889-018-5806-x

Gichu M, Asiki G, Juma P, Kibachio J, Kyobutungi C, Ogola E (2018). Prevalence and predictors of physical inactivity levels among Kenyan adults (18-69 years): An analysis of STEPS survey 2015. BMC Public Health 18(Suppl 3):1217. https://doi.org/10.1186/s12889-018-6059-4

Gouda HN, Charlson F, Sorsdahl K, Ahmadzada S, Ferrari AJ, Erskine H, Leung J, Santamauro D, Lund C, Aminde LN., Mayosi BM, Kengne AP, Harris M, Achoki T, Wiysonge CS, Stein DJ, Whiteford H (2019). Burden of non-communicable diseases in sub-Saharan Africa, 1990-2017: Results from the Global Burden of Disease Study 2017. The Lancet Global Health 7(10):e1375-e1387. https://doi.org/10.1016/S2214-109X(19)30374-2

Guthold R, Ono T, Strong KL, Chatterji S, Morabia A (2008). Worldwide Variability in Physical Inactivity: A 51-Country Survey. American Journal of Preventive Medicine 34(6):486-494. https://doi.org/10.1016/j.amepre.2008.02.013

Houti L, Hamani-Medjaoui I. Lardjam-Hetraf SA, Ouhaibi-Djellouli H, Chougrani S, Goumidi L, Mediene-Benchekor S (2016). Prevalence of Metabolic Syndrome and its Related Risk Factors in the City of Oran, Algeria: The ISOR Study. Ethnicity and Disease 26(1):99-106. https://doi.org/10.18865/ed.26.1.99

Jahangiry L, Khosravi-Far L, Sarbakhsh P, Kousha A, EntezarMahdi R, Ponnet K (2019). Prevalence of metabolic syndrome and its determinants among Iranian adults: Evidence of IraPEN survey on a bi-ethnic population. Scientific Reports 9(1):7937. https://doi.org/10.1038/s41598-019-44486-8

Jo,YH, Talmage,DA, Role LW (2002). Nicotinic receptor-mediated effects on appetite and food intake. Journal of Neurobiology 53(4):618-632. https://doi.org/10.1002/neu.10147

Kobayashi Y, Niu K, Guan L, Momma H, Guo H, Cui Y, Nagatomi R (2012). Oral health behavior and metabolic syndrome and its components in adults. Journal of Dental Research 91(5):479-484. https://doi.org/10.1177/0022034512440707

Koopmann A, Bez J, Lemenager T, Hermann D, Dinter C, Reinhard I, Hoffmann H, Wiedemann K, Winterer G, Kiefer, F. (2015). Effects of Cigarette Smoking on Plasma Concentration of the Appetite-Regulating Peptide Ghrelin. Annals of Nutrition and Metabolism 66(2–3):155–161. https://doi.org/10.1159/000381834

Koopmann A, Schuster R, Kiefer F (2018). The impact of the appetite-regulating, orexigenic peptide ghrelin on alcohol use disorders: A systematic review of preclinical and clinical data. Biological Psychology 131:14-30. https://doi.org/10.1016/j.biopsycho.2016.12.012

Kuo WC, Bratzke LC, Oakley LD, Kuo F, Wang H, Brown RL (2019). The association between psychological stress and metabolic syndrome: A systematic review and meta-analysis. Obesity Reviews. An Official Journal of the International Association for the Study of Obesity 20(11):1651-1664. https://doi.org/10.1111/obr.12915

La Carrubba, S., Antonini-Canterin F, Fabiani I., Colonna P, Pugliese NR, Caso P, Conte L, Benedetto F, Zito C, Citro R, Carerj S, Di Bello V (2016). Prevalence and Prognostic Impact of Metabolic Syndrome in Asymptomatic (Stage A and B Heart Failure) Patients. Metabolic Syndrome and Related Disorders 14(3):1870194. https://doi.org/10.1089/met.2015.0143

Lee M, Lim M, Kim J (2019). Fruit and vegetable consumption and the metabolic syndrome: A systematic review and dose-response meta-analysis. The British Journal of Nutrition 122(7):723-733. https://doi.org/10.1017/S000711451900165X

Levin F, Edholm T, Schmidt PT, Grybäck P, Jacobsson H, Degerblad M, Höybye C, Holst JJ, Rehfeld JF, Hellström PM, Näslund E (2006). Ghrelin Stimulates Gastric Emptying and Hunger in Normal-Weight Humans. The Journal of Clinical Endocrinology and Metabolism 91(9):3296-3302. https://doi.org/10.1210/jc.2005-2638

Li Y, Zhao L, Yu D, Wang Z, Ding G (2018). Metabolic syndrome prevalence and its risk factors among adults in China: A nationally representative cross-sectional study. PloS One 13(6):e0199293. https://doi.org/10.1371/journal.pone.0199293

Lian Y, Yuan Q, Wang G, Tang F (2019). Association between sleep quality and metabolic syndrome: A systematic review and meta-analysis. Psychiatry Research 274:66-74. https://doi.org/10.1016/j.psychres.2019.01.096

McNeill AM, Rosamond WD, Girman CJ, Golden SH, Schmidt MI, East HE, Ballantyne CM, Heiss G (2005). The metabolic syndrome and 11-year risk of incident cardiovascular disease in the atherosclerosis risk in communities study. Diabetes Care 28(2):385-390. https://doi.org/10.2337/diacare.28.2.385

Mokdad AH, Stroup DF, Giles WH (2003). Behavioral Risk Factor Surveillance Team. Public health surveillance for behavioral risk factors in a changing environment. Recommendations from the Behavioral Risk Factor Surveillance Team. MMWR. Recommendations and Reports: Morbidity and Mortality Weekly Report. Recommendations and Reports 52(RR-9):1-12.

Nijakowski K, Lehmann A, Rutkowski R, Korybalska K, Witowski J, Surdacka A (2020). Poor Oral Hygiene and High Levels of Inflammatory Cytokines in Saliva Predict the Risk of Overweight and Obesity. International Journal of Environmental Research and Public Health 17(17):E6310. https://doi.org/10.3390/ijerph17176310

O'Donnell MJ, Chin SL, Rangarajan S, Xavier D, Liu L, Zhang H, Rao-Melacini P, Zhang X, Pais P, Agapay S, Lopez-Jaramillo P, Damasceno A, Langhorne P, McQueen MJ, Rosengren A, Dehghan M, Hankey GJ, Dans AL., Elsayed A (2016). INTERSTROKE investigators. Global and regional effects of potentially modifiable risk factors associated with acute stroke in 32 countries (INTERSTROKE): A case-control study. Lancet (London, England) 388(10046):761-775. https://doi.org/10.1016/S0140-6736(16)30506-2

Oh SS, Jang JE, Lee DW, Park EC, Jang SI (2020). Cigarette type or smoking history: Which has a greater impact on the metabolic syndrome and its components? Scientific Reports 10(1):10467. https://doi.org/10.1038/s41598-020-67524-2

Omuse G, Maina D, Hoffman M, Mwangi J, Wambua C, Kagotho E, Amayo A, Ojwang P, Premji Z, Ichihara K, Erasmus R (2017). Metabolic syndrome and its predictors in an urban population in Kenya: A cross sectional study. BMC Endocrine Disorders 17(1):37.

https://doi.org/10.1186/s12902-017-0188-0
Opio J, Croker E, Odongo GS, Attia J, Wynne K, McEvoy M (2020). Metabolically healthy overweight/obesity are associated with increased risk of cardiovascular disease in adults, even in the absence of metabolic risk factors: A systematic review and meta-analysis of prospective cohort studies. Obesity Reviews 21(12):e13127. https://doi.org/10.1111/obr.13127
Owolabi MO, Sarfo F, Akinyemi R, Gebregziabher M, Akpa O, Akpalu A, Wahab K, Obiako R, Owolabi L, Ovbiagele B, SIREN Team, & as part of H3Africa Consortium (2018). Dominant modifiable risk factors for stroke in Ghana and Nigeria (SIREN): A case-control study. The Lancet. Global Health 6(4):e436–e446. https://doi.org/10.1016/S2214-109X(18)30002-0
Panayiotou AG, Griffin M, Kouis P, Tyllis T. Georgiou N, Bond D, Nicolaides AN (2013). Association between presence of the metabolic syndrome and its components with carotid intima-media thickness and carotid and femoral plaque area: a population study. Diabetology and Metabolic Syndrome 5:44. https://doi.org/10.1186/1758-5996-5-44
Picasso MC, Lo-Tayraco JA, Ramos-Villanueva JM, Pasupuleti V, Hernandez AV (2019). Effect of vegetarian diets on the presentation of metabolic syndrome or its components: A systematic review and meta-analysis. Clinical Nutrition 38(3):1117-1132. https://doi.org/10.1016/j.clnu.2018.05.021
Ramires EKNM, Menezes RCE de, Longo-Silva G, Santos TG D, Marinho P, de M, Silveira JAC da. (2018). Prevalence and Factors Associated with Metabolic Syndrome among Brazilian Adult Population: National Health Survey - 2013. Arquivos Brasileiros De Cardiologia 110(5):455-466. https://doi.org/10.5935/abc.20180072
Reichert S, Schlitt A, Beschow V, Lutze A, Lischewski S, Seifert T, Dudakliewa T, Gawe R, Werdan K, Hofmann B, Schaller HG, Schulz S (2015). Use of floss/interdental brushes is associated with lower risk for new cardiovascular events among patients with coronary heart disease. Journal of Periodontal Research 50(2):180-188. https://doi.org/10.1111/jre.12191
Santoso CMA, Ketti F, Bramantoro T, Zsuga J, Nagy A (2021). Association between Oral Hygiene and Metabolic Syndrome: A Systematic Review and Meta-Analysis. Journal of Clinical Medicine 10(13):2873. https://doi.org/10.3390/jcm10132873
Slagter SN, van Vliet-Ostaptchouk JV, Vonk JM, Boezen HM, Dullaart RP, Kobold ACM, Feskens EJ, van Beek AP, van derKlauw MM, Wolffenbuttel BH (2013). Associations between smoking, components of metabolic syndrome and lipoprotein particle size. BMC Medicine 11(1):195. https://doi.org/10.1186/1741-7015-11-195
Sreenivasan PK, Prasad KVV, Javali SB (2016). Oral health practices and prevalence of dental plaque and gingivitis among Indian adults. Clinical and Experimental Dental Research 2(1):6-17. https://doi.org/10.1002/cre2.15
Sumner AE, Zhou J, Doumatey A, Imoisili OE, Amoah A, Acheampong J, Oli J, Johnson T, Adebamowo C, Rotimi CN (2010). Low HDL-Cholesterol with Normal Triglyceride Levels is the Most Common Lipid Pattern in West Africans and African Americans with Metabolic Syndrome: Implications for Cardiovascular Disease Prevention. CVD Prevention and Control 5(3):75-80. https://doi.org/10.1016/j.cvdpc.2010.07.003
Sun K, Ren M, Liu D, Wang C, Yang C, Yan L (2014). Alcohol consumption and risk of metabolic syndrome: A meta-analysis of prospective studies. Clinical Nutrition 33(4):596-602. https://doi.org/10.1016/j.clnu.2013.10.003
Tanaka A, Takeuchi K, Furuta M, Takeshita T, Suma S, Shinagawa T, Shimazaki Y, Yamashita Y (2018). Relationship of toothbrushing to metabolic syndrome in middle-aged adults. Journal of Clinical Periodontology 45(5):538-547. https://doi.org/10.1111/jcpe.12876
Tian Y, Su L, Wang J, Duan X, Jiang X (2018). Fruit and vegetable consumption and risk of the metabolic syndrome: A meta-analysis. Public Health Nutrition 21(4):756-765. https://doi.org/10.1017/S136898001700310X
Tovar A, Chui K, Hyatt RR, Kuder J, Kraak VI, Choumenkovitch S., Hastings A, Bloom J, Economos CD (2012). Healthy-lifestyle behaviors associated with overweight and obesity in US rural children. BMC Pediatrics 12:102. https://doi.org/10.1186/1471-2431-12-102
Vancampfort D, Hallgren M, Mugisha J, De Hert M, Probst M, Monsieur D, Stubbs B (2016). The Prevalence of Metabolic Syndrome in Alcohol Use Disorders: A Systematic Review and Meta-analysis. Alcohol and Alcoholism 51(5):515-521. https://doi.org/10.1093/alcalc/agw040
Wagner MG, Rhee Y, Honrath K, Blodgett Salafia EH, Terbizan D (2016). Nutrition education effective in increasing fruit and vegetable consumption among overweight and obese adults. Appetite 100:94-101. https://doi.org/10.1016/j.appet.2016.02.002
World Health Organization (WHO) (2000). Obesity: Preventing and Managing the Global Epidemic (Technical Report 894). World Health Organization.
World Health Organization (WHO) (2005). WHO steps surveillance manual: The WHO stepwise approach to chronic disease risk factor surveillance. World Health Organization.
World Health Organization, & Food and Agriculture Organization. (2003). Diet, Nutrition, and he Prevention of Chronic Diseases: Report of a Joint WHO/FAO Expert Consultation. World Health Organization.
World Health Organization (WHO) (2014). Global Status Report on Alcohol and Health 2014. WHO. http://www.who.int/substance_abuse/publications/alcohol_2014/en/
World Health Organization (WHO) (2018). Global Status Report on Alcohol and Health 2018. WHO. http://www.who.int/substance_abuse/publications/global_alcohol_report/en/
Yaya S, Ekholuenetale M, Bishwajit G (2018). Differentials in prevalence and correlates of metabolic risk factors of non-communicable diseases among women in sub-Saharan Africa: Evidence from 33 countries. BMC Public Health 18(1):1168. https://doi.org/10.1186/s12889-018-6085-2
Yeomans MR (2010). Short term effects of alcohol on appetite in humans. Effects of context and restrained eating. Appetite 55(3):565-573. https://doi.org/10.1016/j.appet.2010.09.005
Yusuf S, Wood D, Ralston J, Reddy KS (2015). The World Heart Federation's vision for worldwide cardiovascular disease prevention. Lancet (London, England) 386(9991) :399-402. https://doi.org/10.1016/S0140-6736(15)60265-3
Zhu WH, Chen LY, Lu CR, Su L, Fang LZ (2018). [Association between the accumulation of metabolic syndrome abnormal components and arterial pulse wave velocity among adult individuals undergoing routine health examination]. Zhonghua Xin Xue Guan Bing Za Zhi, 46(10):810-817. https://doi.org/10.3760/cma.j.issn.0253-3758.2018.10.009