*World Journal of Nutrition and Health, 2021, Vol. 9, No. 1, 7-15*
Available online at http://pubs.sciepub.com/jnh/9/1/2
Published by Science and Education Publishing
DOI:10.12691/jnh-9-1-2

# Association between Lifestyle Factors, Eating Habits and Metabolic Syndrome in Cameroonian Pregnant Women

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*Received July 10, 2021; Revised August 14, 2021; Accepted August 23, 2021*

**Abstract** Although poor eating habits and lifestyle factors have been reported to be associated with metabolic syndrome (MS), little is known about this association in Cameroonian pregnant women. The aim of this study was to describe lifestyle choices and eating habits in Cameroonian pregnant women, and determine their association with MS and its components. A hospital-based cross-sectional study was conducted on 859 participants aged 17-45 years (mean ± SD: 27.3±5.6) from the Littoral and Centre Regions of Cameroon. Height, weight, serum lipid profile, fasting blood glucose and arterial blood pressure were measured using standard procedures. Information concerning the lifestyle, eating habits and sociodemographic characteristics were recorded using structured questionnaire. Metabolic syndrome was diagnosed using a slightly modified of National Cholesterol Education Adult Treatment Panel III criteria. Statistical analysis was performed through descriptive statistics, including mean, standard deviation, frequency and logistic regression analysis in Statistical Package for Social Sciences (version 23) software. Statistical significance was set at p-value <0.05. The proportion of participants who reported eating fruits and vegetables occasionally, sugary foods and drinks ≥ 5 times a week and fatty foods ≥ 5 times a week were 77.4%, 23.7% and 22.8% respectively, 41.6% and 39.8% had unhealthy (long and short) sleeping duration and lack of physical exercise respectively. Also, 54.8% were alcohol consumers. Non-sedentary participants (OR: 0.49; 95% CI: 0.29 - 0.85) had lower odds to develop metabolic syndrome compared to sedentary participants. Participants with short sleep and long sleep duration were 5.1 and 2.4 times respectively more likely to have MS than those with normal sleep duration. Participants who had vigorous activities or physical exercise (OR: 0.39; 95% CI: 0.18 - 0.82; p: 0.014) where significantly less likely to experience MS than those with lack of physical exercise after controlling for potential covariates (age, parity, gravidity, BMI). Moreover, high consumption of sugary drinks, fatty foods, alcohol consumption (OR: 2.0; 95% CI: 1.12 - 3.58; p: 0.019) were associated with MS. Our findings suggest that, adoption of healthy lifestyle and dietary habits should be encouraged to reduce the prevalence of metabolic syndrome and its abnormal components. Further prospective studies are needed to consolidate our findings.

***Keywords:*** *metabolic syndrome, pregnancy, lifestyle, risk factors, eating habits, association*

**Cite This Article:** Jules Destin Djeufouata, Walter Ebot Ojong, Theophile Nana Njamen, Jules Clement Nguedia Assob, and Bruno Phelix Telefo, "Association between Lifestyle Factors, Eating Habits and Metabolic Syndrome in Cameroonian Pregnant Women." *World Journal of Nutrition and Health*, vol. 9, no. 1 (2021): 7-15. doi: 10.12691/jnh-9-1-2.

## 1. Introduction

Metabolic syndrome, a constellation of interrelated risk factors including hypertension, elevated fasting blood glucose, obesity, hypertriglycerideamia and low high density lipoprotein cholesterol that predispose individuals to risks of type 2 diabetes mellitus and cardiovascular diseases [1,2] has grown to an important public health concern globally [3] as a result of changes in lifestyles and dietary habits [4]. In fact, lifestyle and diet changes have occurred with industrialization, urbanization, economic development and market globalization [5,6].

Eating habits refer to why and how people eat, which foods they eat and with whom they eat, as well as the way people obtain, store, use and discard foods [7]. Poor eating habits include under or over-eating, not having enough of health foods we need each day, or consuming too much foods and drinks, which are low in fiber or high in fat, salt and or sugar, skipping breakfast, snack in between meals, low consumption of fruits and vegetables [8].

Several studies have reported the association between unhealthy diet, lifestyle and the presence of metabolic syndrome in adult population [10,11].

Lifestyle factors such as alcohol consumption, cigarette smoking, sleeping duration, sedentary behaviour and physical activity have been reported to be associated with metabolic syndrome and its components [12-15].

Indeed, inadequate sleeping duration (short or long) has been shown to be associated to various detrimental health effects. For example, habitual short sleep duration is associated with hypertension, diabetes, obesity and, metabolic syndrome [12,16] while long sleep duration is associated with obesity, diabetes, heart disease, stroke [12,17], dyslipidemia; insulin resistance and hormonal imbalance [18].

Alcohol can be helpful or harmful in the human body according to quantity and quality of alcohol consumed. The association of alcohol consumption with metabolic syndrome and its components differs by timing of such consumption and beverage type. Hence, light to moderate alcohol consumption is associated with a lower prevalence of metabolic syndrome, with a favorable influence on lipids, waist circumference and fasting insulin [19,20]. On the contrary, great consumption, and specifically outside meals was associated with high prevalence of metabolic syndrome [13].

The association between physical exercises or activities and metabolic syndrome is controversial. Indeed, several studies have reported a significant relationship [13,21], while others have reported no significant relationship [22,23].

Garralda et al [24] reported that high adherence to the healthy lifestyle was associated with a lower risk of developing metabolic syndrome.

Most of the studies to date concerning the association between eating, lifestyle habits and metabolic syndrome have been conducted in Europe, in America, and Asia whereas there are relatively few studies in Cameroonian populations and especially among pregnant women. Also, because, lifestyle and eating habits are modifiable behavioural risk factors of metabolic syndrome and its component, knowledge of lifestyle and eating habits of the population is important for the prevention and control of metabolic syndrome, cardiovascular diseases and related diseases. Therefore, the aim of the present study was to describe eating and lifestyle habits of the study participants and to determine their associations with metabolic syndrome and its components.

# 2. Material and Methods

## 2.1. Ethical Considerations

The protocol was approved by the Centre Regional Ethics Committee for Human Health Research (CRERSH/C) CE No 1545/CREESHC/18. Administrative authorizations were obtained from the Regional Delegates of Public Heath for Centre and Littoral Regions, from the Directors of Hospitals of different study sites as well as from the Faculty of Health Sciences authorities. All stages of the research were carried out in strict compliance with the rules set out in the Helsinki Declaration.

## 2.2. Framework, Type and Period of Study

This was a hospital-based cross-sectional, descriptive and analytical study carried out in 16 public health facilities, selected using a multi-stage, proportionate sampling in the Centre and Littoral Regions of Cameroon from June 1st, 2018 to August 2nd, 2019.

Socio-demographic and anthropometric data were collected using a structured, pretested and validated questionnaire. Biochemical analyses were carried out at the Laboratory Unit of Bangangté District Hospital.

## 2.3. Study Population

Apparently healthy pregnant women aged 17 to 45 years, permanently resident in the data collection areas for at least one year who signed the informed consent form were included in the study.

Participants who did not fulfil the criteria above and or who were physically handicapped, were mentally ill, had uncontrolled endocrine disease, renal failure, complicated pregnancy were excluded from the study.

## 2.4. Sampling Method and Sample Size

We applied the multi-stage, proportionate sampling strategy for the health facilities study sites and consecutive proportionate sampling for the selection of participants. The sample size was obtained using the LORENZ formula ($t^2$ p (1-p) / $e^2$). We assumed a prevalence (p) of 50 %. With a minimum confidence level of 95% and maximum likely error (e) of 5%. t = % point corresponding to significant level of 95% = 1.96. The sampling design and the value of imponderable were set at 2 and 10% respectively. The calculated sample size was therefore 847 participants.

## 2.5. Data Collection

### 2.5.1. Administration of Questionnaires

The questionnaire was designed according to modified model "WHO STEPS instrument for chronic diseases" [25], written in English and French and administered in a step by step and face to face approach. This was preceded by the signature of the informed consent.

### 2.5.2. Anthropometric, Physiological and Biochemical Measurements

Anthropometric (Height and weight), physiological (systolic and diastolic blood pressure) and biochemical (fasting blood glucose, a 12-hours fasting serum total cholesterol, High Density Lipoprotein Cholesterol, and triglycerides concentrations) measurements were measured by trained field registered nurses, laboratory technicians and principal investigator using standard techniques.

The detailed procedures, reagents and apparatus used were described elsewhere [26].

All specimens and reagents were handled according to the manufacturer instruction.

## 2.6. Definition of Variables

Metabolic syndrome and its individual components were defined according to the modified criteria of National Cholesterol Education Panel Adult Treatment

Panel III as the presence of three or more of any of the following components: Triglycerides >1.75 g/L at the first quarter of pregnancy, >2.54 g/L at second quarter, at third quarter >4.14 g/L or use of low triglycerides drugs; high density lipoprotein cholesterol <0.35 g/L at first quarter of pregnancy, second quarter <0.42 g/L, third quarter <0.40 g/L; arterial blood pressure ≥ 130/85 mmHg or use of anti-hypertensive drugs; fasting blood glucose ≥1.01 g/L or use of diabetes drugs, pre pregnancy body mass index or BMI before 13 weeks of pregnancy ≥30 Kg/m$^2$).

***Lifestyle behaviour*** in the present study includes: alcohol and tobacco consumption, sedentary, physical exercise and sleeping duration.

*Alcohol consumption* status was divided into *non-drinkers* and *drinkers* while c*igarette smoking* status was categorized into *non-smokers* and *smokers*

*Sleep duration* was divided into three categories: short sleep duration (< 6 hours / day), normal sleep duration (6-9 hours / day), long sleep duration (> 9 hours /day).

*Sedentary behaviour* includes activities such as lying down, sitting, watching television, using the computer and other forms of screen based entertainment. Participants were classified into two main groups according the sitting or reclining time duration on typical day: sedentary (≥8 hours), non-sedentary (<8 hours a day).

*Physical activity* was classified according to weekly frequency according to the following categories: *none to light* (no physical activity beyond baseline activities of daily living to less than 150 minutes of moderate physical activity a week), *moderate* (moderate activity of 150 to 300 minutes, or 75 to 150 minutes of vigorous physical activity) and *vigorous exercise or high activities* (any activity causing a large increase in breathing or heart rate, performed during at least 25 minutes and at least 3 days/week or, more than the equivalent of 300 hours of moderate intensity physical activity).

***Eating behaviour:***

Frequency of consumption of fatty foods or sugary drinks a week were divided into three categories: (1) more than five time, (2) between 2-4 times and (3) one or less.

The frequency of daily meals taken was classified into one (1), two (2) and three (3) while the type of oil cooking oil used was split into crude red palm oil, refine oil and both.

The purchase foods in the market was categorized as: bought already cooked, self-cooked and both.

Eating in front of television was classified into always and sometimes or never whereas snack in between meals was divided into two groups: once and greater than once.

The frequency of consumption of fruits and vegetables was divided into two groups: everyday and occasionally.

Quantity of water consumed daily was categorized into three levels: a) < 1L, b) between 1 to 1.5 L and c) > 1.5 L.

Frequency of breakfast during a week was classified into three groups: daily, 3-4 times, 1-2 time/skip/rarely.

When stopped eating was grouped into before fullness, at fullness and more than fullness.

## 2.7. Data Entry and Analysis

After the manual counting of survey forms and biological analysis, the data were coded, entered into a computer using Epi-data®, Microsoft Excel 2007 for windows XP and finally transferred into the Statistical Package for Social Sciences (SPSS, version 23) for data analysis.

Continuous variables were reported as means and categorical variables as percentages.

Multivariate logistic regression analysis was used to assess the relationships between different variables and metabolic syndrome and its components with adjustment of potential confounding variables. Dependent variables were metabolic syndrome (dichotomous), metabolic syndrome components (qualitative, dichotomous) while independent variables were: lifestyle factors (sleep duration, physical exercise, sedentary lifestyle, alcohol consumption and smoking tobacco: qualitative) and eating habits (qualitative). Other variables included: gestational age (in weeks, continuous), age (years, continuous), parity and gravidity (continuous).

The results were statistically significant at p value <0.05.

# 3. Results

## 3.1. Socio-demographic Characteristic of the Study Participants

Out of a total of 960 pregnant women recruited in the two regions, 101 were excluded for various reasons and 859 were definitely included in the study. The response rate was therefore 89.5%.

The age of participants ranged 17 - 45 years (mean ± SD: 27.3 ± 5.6). Also the median age was 27 years old, this means that 50% of participants were aged between 17 and 27 years.

The distribution of participants was 8.0%, 53.1% and 38.1% respectively for first, second and third quarter of pregnancy.

## 3.2. Description of Lifestyle and Eating Habits of Study Participants

Sleep duration varied from 4 to 17 hours and the mean sleep duration was 8.5 hours a day. Also, the daily sedentary time varied from 3 to 12 hours and the average sitting or reclining time was 6.7 hours.

Table 1 indicates that:

Thirty nine and eight tenths percent of participants had lack of physical exercise.

More than 1/3 of the participants had sedentary lifestyle.

Smoking and eating in from of television were uncommon among the participants. There was low consumption of fruits and vegetables and high frequency of consumption of fatty foods and sugary drinks by the participants.

A majority of participants had 3 meals patterns a day.

More than half of study population had snacks in between meals greater than once a day, stopped eating at fullness and more than fullness, had healthy sleep duration, were alcohol consumers and used both (red palm oil or and refined oil) for cooking.

**Table 1. Lifestyle and eating habits of the study population**

| | N | % | | N | % |
|---|---|---|---|---|---|
| **Physical activities** | | | **Sleeping duration a day** | | |
| No to low | 342 | **39.8** | 1-5 hours | 52 | **6.1** |
| Moderate | 250 | **29.1** | 6-9 hours | 502 | **58.4** |
| Intense | 267 | **31.1** | ≥10 hours | 285 | **35.5** |
| **Sitting or reclining time / day** | | | **Alcohol consumption** | | |
| <8 hours | 566 | **65.9** | Yes | 471 | **54.8** |
| ≥ 8 hours | 293 | **34.1** | No | 386 | **45.2** |
| **Smoking tobacco products** | | | **Fruits/vegetables consumption** | | |
| **Yes** | 1 | **0.1** | Everyday | 194 | **22.6** |
| **No** | 858 | **99.9** | Occasionally/never | 665 | **77.4** |
| **Number of meals /day** | | | **Eating in front of television** | | |
| Three (3) | 611 | **71.1** | Always | 107 | **12.5** |
| One (1) or Two (2) | 248 | **28.9** | Sometimes /Never | 752 | **87.5** |
| **Type of cooking oil use in cooking** | | | **Having breakfast** | | |
| Red palm oil | 68 | **7.9** | Daily | 295 | **34.3** |
| Refined oil | 222 | **25.8** | 3-4 time /week | 377 | **43.9** |
| Both / Others | 569 | **66.3** | Skip /rarely/1-2 time /week | 187 | **21.8** |
| **Purchase of foods in the market** | | | **Snack in between meals** | | |
| Self-cooked | 189 | **22.0** | Once or never | 264 | **30.7** |
| Already cooked/Both | 670 | **78.0** | Greater than once | 595 | **69.3** |
| **Stop eating** | | | **Water consumption /day** | | |
| Before fullness | 304 | **35.4** | Less than 1L | 301 | **35.1** |
| At fullness | 416 | **48.4** | Between 1-1.5 L | 422 | **49.1** |
| More than fullness | 139 | **16.2** | Between 1.5-2.5 L | 136 | **15.8** |
| **Sugary foods and drinks** | | | **Fatty foods** | | |
| Daily/≥5 times / week | 204 | **23.7** | Daily /≥5 times / week | 196 | **22.8** |
| ≤2-4 times / week | 450 | **52.4** | ≤2-4 times / week | 486 | **56.6** |
| ≤ one/week | 205 | **23.9** | ≤ one / week | 177 | **20.6** |

N: number of participants, %: Percentage.

## 3.3. Association between Lifestyle Factors and Metabolic Syndrome

Table 2 indicates that in logistic regression analysis with metabolic syndrome as dependent variable, independent variables were socio-demographic factors, eating habits, obesity, gestational age, parity and gravidity, alcohol consumption, sedentary lifestyle and unhealthy sleep duration (short and long sleep duration) which were significantly and positively associated with metabolic syndrome. Indeed, alcohol consumers had a 2 fold risk to develop metabolic syndrome than non-consumers. Sedentary lifestyle was associated with a 2 fold risk to develop metabolic syndrome.

In terms of physical activity, only intense activities or physical exercises were associated with a reduced risk of metabolic syndrome compared to those with lack of physical exercises.

Long and short sleep duration were associated with a 2.43 and 5.13 fold risk of metabolic syndrome respectively.

**Table 2. Logistic regression analysis between lifestyle factors and metabolic syndrome**

| Variables | OR $_{unadjusted}$ (95%CI) | p | OR $_{adjusted}$*(95% CI) | p |
|---|---|---|---|---|
| **Alcohol consumption** | | | | |
| Yes | 2.24 (1.12 - 4.50) | **0.023** | 2.00 (1.12 - 3.58) | **0.019** |
| No | 1 | - | | - |
| **Sitting / reclining time** | | | | |
| < 8 hours | 0.42 (0.21-0.81) | **0.010** | 0.49 (0.29 -0.85) | **0.011** |
| ≥ 8 hours | 1 | - | 1 | - |
| **Sleep duration** | | **0.000** | | **0.000** |
| 1-5 hours | 6.13 (2.07-18.18) | **0.001** | 5.13 (2.17-12.05) | **0.000** |
| 6-9 hours | 1 | - | 1 | - |
| ≥ 10 hours | 4.67 (2.16-10.10) | **0.000** | 2.43 (1.36-4.37) | **0.003** |
| **Physical activities** | | 0.235 | | **0.043** |
| No to Low | 1 | - | 1 | - |
| Moderate | 0.897 (0.487-1.652) | 0.948 | 0.883 (0.481-1.622) | 0.689 |
| Intense | 0.496 (0.212-1.161) | 0.106 | 0.388 (0.183-0.823) | **0.014** |

* Adjusted for eating habits, body mass index, gestational age, parity and gravidity. OR : Odds ratio. p-value significant if < 0.05.

### 3.4. Association between Eating Habits and Metabolic Syndrome

Table 3 shows multivariate logistic regression analysis with presence or absence of metabolic syndrome as a dependent variable. It indicates that, the risk of metabolic syndrome among participants was decreased with the reduction of frequency of sugary foods and drinks consumption after adjusting for socio-demographic factors, lifestyle factors, body mass index, gestational age, parity and gravidity. Also a reduction of the frequency of consumption of fatty foods was significantly associated with a lower risk of metabolic syndrome even after adjusting for covariates.

Stop eating at fullness and more than fullness significantly increased the risk of metabolic syndrome compared to stop eating before fullness after adjusting for covariates.

However, frequency of consumption of fruits and vegetables, of breakfast a week, eating in front of television, snack between meals, quantity of water consumed daily, number of meals a taken daily, purchase foods in the market, and type of oil use in cooking were not significantly associated with metabolic syndrome in multivariate logistic regression analysis.

**Table 3. Logistic regression analysis between eating habits and metabolic syndrome**

| | Model I | | Model II | |
|---|---|---|---|---|
| | **OR (95% CI)** | **p** | **OR (95% CI)** | **p** |
| **Number of meals /day** | | | | |
| Three (3) | 1 | - | 1 | - |
| One (1) +Two (2) | 0.74 (0.33-1.64) | 0.462 | 0.79 (0.42-1.46) | 0.442 |
| **Type of oil use in cooking** | | 0.066 | | 0.267 |
| Red palm oil | 1 | - | 1 | - |
| Refine oil | 0.20 (0.05-0.82) | **0.025** | 0.43 (0.14-1.27) | 0.127 |
| Both / Others | 0.47 (0.14-1.59) | 0.225 | 0.67 (0.26-1.75) | 0.413 |
| **Purchase of foods in the market** | | 0.718 | | 0.761 |
| Bought already cooked | 1 | - | 1 | - |
| Self-cooked | 1.00 (0.00-) | 0.998 | 1.00 (0.00-) | 0.998 |
| Both | 1.00 (0.00-) | 0.998 | 1.00 (0.00-) | 0.998 |
| **Having breakfast** | | 0.922 | | 0.948 |
| Daily | 1 | - | 1 | - |
| 3-4 time /week | 0.78 (0.35-1.75) | 0.551 | 1.19 (0.62-2.30) | 0.606 |
| 1-2 time /week | 1.00 (0.32-3.14) | 0.994 | 1.27 (0.50-3.97) | 0.618 |
| Skip / rarely | 0.79 (0.22-2.90) | 0.723 | 1.10 (0.39-3.08) | 0.848 |
| **Eating in front of television** | | 0.710 | | 0.180 |
| Always | 1 | - | 1 | - |
| Sometimes | 1.28 (0.43-3.78) | 0.656 | 0.59 (0.27-1.31) | 0.195 |
| Never | 0.69 (0.11-4.25) | 0.690 | 0.28 (0.07-1.14) | 0.077 |
| **Snack in between meals** | | | | |
| Once | 1 | - | 1 | - |
| Greater than once | 1.43 (0.65-3.12) | 0.373 | 0.85 (0.46-1.58) | 0.602 |
| **Fruits / vegetables consumption** | | | | |
| Everyday | 1 | - | 1 | - |
| Occasionally/never | 2.62 (0.96-7.11) | 0.059 | 2.28 (0.98-5.28) | 0.054 |
| **Stop eating** | | 0.133 | | **0.008** |
| Before fullness | 1 | - | 1 | - |
| At fullness | 2.41 (0.97-6.02) | 0.059 | 3.33 (1.43-6.28) | **0.004** |
| More than fullness | 2.67 (0.88-8.05) | 0.082 | 2.22 (1.42-8.35) | **0.006** |
| **Water consumption /day** | | 0.489 | | 0.460 |
| Less than 1L | 1 | - | 1 | - |
| Between 1-1.5 L | 1.39 (0.63-3.08) | 0.416 | 1.42 (0.75-2.70) | 0.290 |
| Between 1.5-2.5 L | 1.83 (0.66-5.10) | 0.244 | 1.57 (0.69-3.57) | 0.282 |
| **Sugary foods and drinks** | | 0.078 | | **0.012** |
| Daily/≥5 times / week | 1 | - | 1 | - |
| ≤2-4 times / week | 0.48 (0.22-1.05) | 0.065 | 0.48 (0.26-0.88) | **0.018** |
| ≤ one/week | 0.31 (0.09-0.97) | **0.045** | 0.33 (0.14-0.77) | **0.011** |
| **Fatty foods** | | **0.032** | | **0.014** |
| Daily /≥5 times / week | 1 | - | 1 | - |
| ≤2-4 times / week | 0.45 (0.22-0.94) | **0.033** | 0.45 (0.24-0.83) | **0.010** |
| ≤ one / week | 0.27 (0.09-0.85) | **0.025** | 0.35 (0.14-0.87) | **0.023** |

Model I: crude model, Model II: Adjusted for lifestyle factors, obesity, age, gestational age, parity and gravidity. OR: odds ratio, 95% CI: 95% confidence interval. **Statistically significant (p<0.05).**

## 3.5. Association between Eating Habits and Metabolic Syndrome Components

Table 4 indicates that increased consumption of sugary foods and drinks, stop eating at fullness and more than fullness, eating in front of television were associated with increased risk to develop obesity. However no significant association was found between eating habits and low HDL cholesterol. Participants who consumed fatty food between 2 to 4 times a week had a 0.65 fold risk of hypertension compared to those with daily fatty food consumption. Also, have snack in between meals was associated with low risk to develop hypertension. Type of oil used in cooking was significantly associated with hyperglycaemia.

**Table 4. Logistic regression analysis of hypertension, hyperglycaemia, hypertriglyceridaemia and eating habits**

| | Hypertension | | Hyperglycaemia | | Hypertriglyceridaemia | | Low HDL-C | | Obesity | |
|---|---|---|---|---|---|---|---|---|---|---|
| | OR (95% CI) | p | OR (95% CI) | p | OR (95% CI) | p | OR (95% CI) | p | OR (95% CI) | p |
| **Number of meals /day** | | | | | | | | | | |
| Three (3) | 1 | - | 1 | - | 1 | - | 1 | - | 1 | - |
| One (1) +Two (2) | 0.91 (0.62-1.35) | 0.654 | 0.88 (0.64-1.20) | 0.414 | 0.53 (0.24-1.18) | 0.120 | 0.91 (0.59-1.39) | 0.654 | 1.04 (0.72-1.53) | 0.822 |
| **Type of oil use in cooking** | | 0.733 | | **0.006** | | 0.442 | | 0.756 | | 0.657 |
| Red palm oil | 1 | - | 1.32 (0.75-2.32) | 0.339 | 1 | - | | 1 | 1 | - |
| Refine oil | 0.86 (0.44-1.66) | 0.652 | 1 | - | 0.75 (0.19-2.97) | 0.685 | 1.19 (0.53-2.65) | 0.677 | 1.33 (0.64-2.75) | 0.446 |
| Both / Others | 0.79 (0.42-1.47) | 0.456 | 1.72 (1.23-2.40) | **0.001** | 0.49 (0.13-1.85) | 0.299 | 1.31 (0.61-2.79) | 0.493 | 1.38 (0.69-2.76) | 0.359 |
| **Purchase of foods in the market** | | 0.733 | | 0.201 | | 0.495 | | 0.261 | | 0.269 |
| Bought already cooked | 1 | - | 1 | - | 1 | - | 1 | - | | - |
| Self-cooked | 2.45 (0.53-11.18) | 0.248 | 0.58 (0.24-1.41) | 0.230 | 0.53 (0.05-5.33) | 0.592 | 0.60 (0.20-1.80) | 0.366 | 3.36 (0.74-15.26) | 0.116 |
| Both | 3.04 (0.69-13.36) | 0.140 | 0.50 (0.21-1.16) | 0.107 | 1.03 (0.13-8.51) | 0.977 | 0.90 (0.33-2.50) | 0.841 | 3.41 (0.77-15.02) | 0.105 |
| **Having breakfast** | | 0.538 | | 0.966 | | 0.760 | | 0.347 | | 0.309 |
| Daily | 1 | - | 1 | - | 1 | - | 1 | | 1 | - |
| 3-4 time /week | 0.98 (0.65-1.47) | 0.921 | 1.03 (0.74-1.42) | 0.872 | 0.70(0.30-1.62) | 0.407 | 1.03 (0.67-1.58) | 0.886 | 1.37 (0.92-2.03) | 0.116 |
| 1-2 time /week | 1.29 (0.74-2.23) | 0.371 | 1.12 (0.69-1.80) | 0.637 | 0.00 (0.000 | 0.996 | 0.53 (0.25-1.12) | 0.096 | 1.56 (0.90-2.71) | 0.112 |
| Skip / rarely | 0.75 (0.22-2.90) | 0.387 | 1.09 (0.65-1.80) | 0.750 | 1.23 (0.38-3.93) | 0.731 | 0.89 (0.45-1.74) | 0.725 | 1.16 (0.62-2.17) | 0.636 |
| **Eating in front of television** | | 0.740 | | 0.301 | | 0.483 | | 0.916 | | **0.021** |
| Always | 1 | - | 1 | - | 1 | - | 1 | - | 1 | - |
| Sometimes | 0.82 (0.49-1.36) | 0.438 | 0.97 (0.63-1.49) | 0.889 | 1.01 (0.32-3.15) | 0.988 | 0.89 (0.50-1.58) | 0.682 | 0.64 (0.39-1.03) | 0.068 |
| Never | 0.86 (0.42-1.75) | 0.676 | 0.66 (0.35-1.21) | 0.180 | 0.29 (0.03-2.74) | 0.277 | 0.93 (0.42-2.09) | 0.668 | 0.34 (0.15-0.74) | **0.007** |
| **Snack in between meals** | | | | | | | | | | |
| Once | 1 | - | 1 | - | 1 | - | 1 | 1 | | |
| Greater than once | 0.54 (0.37-0.79) | **0.001** | 1.02 (0.74-1.40) | 0.910 | 1.69 (0.66-4.32) | 0.274 | 0.98 (0.64-1.45) | - | 0.85 (0.59-1.24) | 0.407 |
| **Fruits /vegetables consumption** | | | | | | | | 0.915 | | |
| Everyday | 1 | - | 1 | - | 1 | - | 1 | - | 1 | - |
| Occasionally/never | 1.06 (0.69-1.61) | 0.783 | 1.14 (0.82-1.59) | 0.445 | 1.33 (0.52-3.40) | 0.558 | 1.20 (0.76-1.92) | 0.434 | 0.87 (0.59-1.29) | 0.498 |
| **Stop eating** | | 0.684 | | 0.515 | | **0.010** | | 0.592 | | **0.000** |
| Before fullness | 1 | - | 1 | - | 1 | - | 1 | - | 1 | |
| At fullness | 1.18 (0.81-1.73) | 0.384 | 1.18 (0.87-1.60) | 0.298 | 1.99 (0.75-5.32) | 0.167 | 0.99 (0.67-1.49) | 0.984 | 1.78 (1.21-2.63) | **0.004** |
| More than fullness | 1.11 (0.66-1.87) | 0.705 | 1.21 (0.80-1.82) | 0.372 | 4.90 (1.69-14.16) | **0.003** | 0.75 (0.42-1.36) | 0.343 | 2.81 (1.72-4.58 | **0.000** |
| **Water consumption /day** | | 0.907 | | 0.599 | | 0.622 | | 0.874 | | 0.328 |
| Less than 1L | 1 | - | 1 | - | 1 | - | 1 | - | 1 | - |
| Between 1-1.5 L | 1.06 (0.72-1.55) | 0.907 | 1.17 (0.86-1.59) | 0.324 | 1.44 (0.61-3.38) | 0.404 | 1.10 (0.72-1.67) | 0.656 | 0.80 (0.55-1.15) | 0.232 |
| Between 1.5-2.5 L | 0.96 (0.57-1.62) | 0.866 | 1.15 (0.75-1.75) | 0.521 | 0.99 (0.31-3.19) | 0.983 | 0.99 (0.56-1.76) | 0.970 | 0.71 (0.41-1.18) | 0.191 |
| **Sugary foods and drinks** | | 0.459 | | 0.886 | | 0.585 | | 0.929 | | **0.000** |
| Daily/≥5 times / week | 1 | - | 1 | - | 1 | - | | | 1 | |
| ≤2-4 times / week | 0.77 (0.51-1.16) | 0.213 | 1.01 (0.72-1.43) | 0.946 | 0.71 (0.286-1.76) | 0.458 | 1.10 (0.69-1.74) | 0.702 | 0.62 (0.42-0.90) | **0.013** |
| ≤ one/week | 0.86 (0.52-1.40) | 0.542 | 0.93 (0.62-1.39) | 0.719 | 1.11 (0.416-2.94) | 0.842 | 1.05 (0.61-1.82) | 0.856 | 0.34 (0.20-0.56) | **0.000** |
| **Fatty foods** | | 0.120 | | 0.996 | | 0.961 | | 0.523 | | 0.398 |
| Daily /≥5 times / week | 1 | - | 1 | - | | | | | | |
| ≤2-4 times / week | 0.65 (0.43-0.98) | **0.041** | 0.98 (0.69-1.39) | 0.937 | 0.95 (0.39-2.31) | 0.917 | 0.83 (0.53-1.30) | 0.418 | 0.76 (0.51-1.13) | 0.175 |
| ≤ one / week | 0.79 (0.48-1.32) | 0.380 | 0.99 (0.65-1.52) | 0.990 | 0.85 (0.28-2.63 | 0.781 | 0.72 (0.41-1.29) | 0.267 | 0.83 (0.50-1.37) | 0.460 |

OR: Odds ratio, CI: Confidence Interval.

Table 4 also indicates that stop eating more than fullness was significantly associated with a 4.9 fold risk to develop hypertriglyceridemia compared to those stop eating before fullness.

**Table 5. Multivariable logistic regression analysis between hypertriglyceridaemia, HDL-C, hypertension, hyperglycemia, obesity and lifestyle factors**

| | Low HDL-C | | Hypertriglyceridaemia | | Hypertension | | Hyperglycaemia | | Obesity | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Variables** | **OR (95 % CI)** | **p** | **OR (95% CI)** | **p** | **OR (95% CI)** | **p** | **OR (95% CI)** | **p** | **OR (95% CI)** | **p** |
| **Alcohol consumption** | | | | | | | | | | |
| Yes | 1 | - | 1 | | 1 | - | 1 | | 1 | - |
| No | 1.05 (0.73 - 1.51) | 0.788 | 0.21 (0.08 - 0.57) | **0.002** | 1.01 (0.72 - 1.41) | 0.956 | 0.14 (0.87 - 1.50) | 0.332 | 0.84 (0.61-1.15) | 0.282 |
| **Sitting or reclining time** | | | | | | | | | | |
| < 8 hours | 1 | - | 1 | - | 1 | - | 1 | - | 1 | - |
| ≥ 8 hours | 1.13 (0.77 - 1.65) | 0.537 | 1.71 (0.83 - 3.53) | 0.147 | 0.95 (0.67 - 1.35) | 0.774 | 1.17 (0.88 - 1.56) | 0.269 | 0.86 (0.61-1.20) | 0.365 |
| **Sleep duration** | | 0.668 | | **0.008** | | 0.124 | | 0.363 | | 0.266 |
| 1-5 hours | 1 | - | 0.521 (0.07-0.54) | **0.028** | 1 | - | 1 | - | 1 | - |
| 6-9 hours | 0.96 (0.44-2.08) | 0.908 | 1 | - | 1.06 (0.54-2.12) | 0.857 | 1.20 (0.67-2.17) | 0.541 | 1.63 (0.85-3.13) | 0.142 |
| ≥ 10 hours | 0.84 (0.57-2.23) | 0.376 | 1.61 (0.73-3.53) | 0.241 | 0.71 (0.50-1.01) | 0.058 | 0.86 (0.65-1.14) | 0.297 | 1.22 (0.87-1.72) | 0.254 |
| **Physical activities** | | 0.659 | | 0.546 | | 0.582 | | 0.997 | | 0.354 |
| No to Low | 1 | - | 1 | - | 1 | - | 1 | - | 1 | - |
| Moderate | 1.02 (0.66-1.59) | 0.914 | 1.62 (0.66-3.97) | 0.295 | 1.21 (0.81-1.81) | 0.363 | 0.99 (0.72-1.37) | 0.972 | 1.32 (0.90-1.94) | 0.152 |
| Intense | 1.28 (0.76-1.93) | 0.411 | 1.19 (0.44-3.19) | 0.733 | 1.23 (0.79-1.89) | 0.357 | 0.99 (0.69-1.39) | 0.936 | 1.21 (0.80-1.83) | 0.359 |

OR: odd ratio, 95% CI: 95% confidence interval. HDL-C: high density lipoprotein cholesterol, statistically significant ($p<0.05$).

### 3.6. Association between Lifestyle Factors and Metabolic Syndrome Components

Table 5 shows that non-alcohol consumers had a 0.21 fold risk to develop hypertriglyceridemia than alcohol consumers. Also, sleep duration was also significantly associated to the risk of hypertriglyceridemia. Indeed, short sleep duration was associated with a reduced risk of hypertriglyceridaemia compared with those with normal sleep duration. However, there was no significant association between hypertension, hyperglycaemia, obesity, low HDL-C and lifestyle factors.

## 4. Discussion

In the present study, only 0.1 % of participants smoked cigarettes. These could be explained by the fact that in African countries and particularly in Cameroon, consumption of cigarettes by women is very uncommon. According to Global Adult Tobacco Survey (GATS) [27], 6.0 % of adult up to 15 years actually smoked tobacco and among them, only 0.6 % were women.

Fifty nine point nine percent (59.9 %) of participants were alcohol consumers. In Cameroon, among of age 15 years or older, the prevalence of alcohol consumption at least once during the last month in females is 10.4 % [28]. This difference could be due to the difference of study areas. In fact, most of the study participants came from urban areas (Yaoundé and Douala) where consumption of alcohol is very common.

Alcohol consumption was positively associated with metabolic syndrome and hypertriglyceridaemia. This is in line with previous studies with reported that heavy alcohol drinking is associated with increased risk of metabolic syndrome and its components [13,29].

There was no significant association between alcohol consumption and serum high density lipoprotein cholesterol, obesity and hyperglycaemia. This is in contrast previous study which reported positive association between alcohol consumption and those individual components of metabolic syndrome [13,29]. Indeed, Yeomans *et al*. [29] reported that increase energy intake with alcohol use may promote positive energy balance and contributing factors to weight gain. This inconsistency with the current study could be explained by the fact that in the present study we did not assess the quantity and the type of alcohol drunk by each participant.

Unhealthy sleep duration (short or long sleep duration) was positively associated with metabolic syndrome whereas short sleep duration was significantly associated with hypertriglyceridaemia. This is consistent with previous studies which reported significant association of habitual short sleep duration [12,16,17], long sleep duration [12,17] and metabolic syndrome.

Lack of physical exercises of activities and high level of sedentary behaviour were observed among study the participants. This could be explained by significant lifestyle modifications observed in our society nowadays due to westernization: people are more educated, scientific and technical advances reach all places of the world and human knowledge has risen in every meaning, so that work is more intellectual and requires less physical effort in general. Also, there is lack of sport infrastructures or installations and the spirit of sportsmanship in Cameroon do not enable people to exercise regularly.

An inverse association between metabolic syndrome and vigorous exercise was identified, which may reflect a protective effect of intense exercise, but not low and moderate exercise on metabolic syndrome. Our findings are consistent with that of a previous study showing that moderate to vigorous activity has a preventive effect on the development of metabolic syndrome [16].

Sedentary lifestyle was positively associated with metabolic syndrome. This is in line with a meta-analysis carried out by Edwardson *et al*. [30] who reported that people who had greater sedentary time increased the odds of metabolic syndrome by 73 %.

There was low frequency of consumption of fruits and or vegetables by the study participants. This result is in line with Ntentie and collaborators findings who reported a low consumption of fruits and vegetables by Cameroonian population [31]. This could be explained by traditional and individual differences or disclaims towards certain foods, high prices and variable availability of many fruits and vegetables, their taste, the inconvenience of preparing them and concerns about quality and safety.

There was no significant association between consumption of fruits and vegetables, and metabolic syndrome. This is not corroborate previous studies [11,32]. This could be due to the fact that, in Cameroun, vegetables are usually consumed in form of sauce and this green vegetable soups are generally cooked with larger amounts of oil added to important quantities of protein sources (meat or fish, groundnut) which are also sources of fats [33,34]. All this results at the end to a high fat green vegetable sauce in which the higher amount of fats may probably interfere with the known beneficial effect of fibers on the health prevention and management of nutritional related diseases [32].

More than one-five of participants had regular consumption of fatty foods and sugary food and drinks. This could be due to high exposure of women to foreign media and especially occidental ones which promote consumption of high caloric foods, drinks and especially fast-foods. Also, high consumption of sugary foods and drinks, fatty foods were previously reported in a Cameroonian population by Ntentie *et al*. [31].

Metabolic syndrome was significantly associated with high consumption of sugary food and drinks, and fatty foods. This is in line with study carried out by Shin [10].

Stopped eating at fullness or more than fullness was associated with an increased risk of metabolic syndrome. This could be justify by the fact that eating until fullness or more than fullness is associated with increased of excess of calories and fat storage which could lead to obesity. Since obesity is considered as the hallmark of metabolic syndrome, it could induce the other individual components of metabolic syndrome.

Increased consumption of sugary foods and drinks, eating in front of television were associated with increased risk to develop obesity. This corroborates previous studies [10,35]. Indeed, eating in front of television have been reported to contribute to increased energy intake and could thereby be associated with increased body mass index. Another reason why television watching during meals might affect obesity status might be that TV watching may be associated with more 'mindless' eating, and may thus increase the amount of foods and thus the amount of calories consumed [36].

**Strengths and Limitations of the Study**

Our study provides information about metabolic syndrome in pregnant women. Few studies have examined the association of lifestyle factors and eating habits in Cameroon pregnant women. Also, significant association found between lifestyle factors, eating behaviour and metabolic syndrome in this study highlight the importance of adopting a healthy lifestyle and good eating habits to reduce the risk of metabolic syndrome in the study population.

However, the present study had some limitations: the first limitation stemmed from the lack of evidence-based identified definition for metabolic syndrome in pregnancy; thus, a pregnancy self-modified version of NCEP ATP III definition was used in this study. Information on lifestyle and eating habits were self-reported and could have been subjected to recall bias, elements of causality cannot be established as a result of the cross sectional nature of the study. Additionally, quantity and quality of alcohol, which are important determinants of overweight or obesity, of dyslipidemia and therefore of metabolic syndrome were not assessed.

## 5. Conclusion

The present study shows that unhealthy lifestyle as well as eating habits such as high consumption of sugary drinks, fatty foods, stop eating at fullness and more than fullness, use of red palm oil in cooking, were positively associated with metabolic syndrome. There was high proportion of alcohol drinkers (54.8%) while smoking tobacco product was uncommon (0.1% of participants). Also, 77.4% of the participants had low consumption of fruits and vegetables, whereas the consumption of sugar food and drinks were common. Hypertriglyceridaemia was associated with alcohol consumption and sleeping duration. Therefore, adoption of healthy lifestyle and good eating behaviours would help to reduce the incidence and prevalence of metabolic syndrome and its components. In the absence of contraindications, more vigorous or intense physical exercises or activities should also be considered to obtain additional health benefits. Further prospective studies are needed to consolidate our findings.

## Authors' Contributions

Study concept and design: JDD and BPT

Acquisition, analysis and interpretation of data: JDD

Drafting the work or revising: JDD, WEO, BPT, JCNA, WEO and TNN

Final approval of the manuscript: JDD, WEO, BPT, JCNA and TNN.

## Conflicts of Interest

The authors declare that there is no conflict of interest.

## Acknowledgements

The authors thank all the staff of the sixteen health facilities where the study was carried out.

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