

Associated Risk Factors of Non-Communicable Disease in Three Sites across Ivory Coast: An Urban (Cocody), Peri-Urban (Abobo) and Rural (Yocoboué) Area

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Abstract

Introduction: The prevalence of Non-communicable diseases (NCDs) has increased so it's becoming a global public health problem. This problem is also threatening in Sub-Saharan Africa (SSA) country including Ivory Coast. Ivory Coast is a country of 22.6 million people experiencing rapid economic development and social change. All development is typically associated with an increase in non-communicable disease (NCD) risk factors. Our study aimed to determine the prevalence and associated factors of the major risk factors of NCDs among the population of Cocody, Abobo and Yocoboué in the Ivory Coast. **Methods:** A descriptive and analytical cross-sectional study was conducted and involved 1146 adults of 19 to 60 years from general population in Cocody (urban), Abobo (peri-urban) and Yocoboué (rural). The WHO STEPS risk factor survey has been changed a bit and was administered. It contains anthropometric and biochemical measures. **Results:** The prevalence of NCD risk factors was markedly different across the three sites particularly between urban (Cocody) and rural (Yocoboué) areas. The overall prevalence estimates of the risk factors were 15.2% for current smoking, 57.71% for harmful use of alcohol, 58.84% for low physical activity, 24.71% for sedentariness (sitting at least 7 h), 69.45% for skipping breakfast, 61% for having late dinner and 36% for snacking. Concerning biological risk factor we noticed 40.95% for Overweight/obesity, 52.96% for abdominal obesity, 14.61% for raised blood pressure, 23.37% for raised blood sugar and 18.51 low HDL-C. Being female has

an important associated with an increased risk for having abdominal obesity (OR: 25.7) and being overweight or obese (OR: 11.3), suffering from hypertension increased with age, 30 - 39 years (OR 8.45), 40 - 49 years (OR 13.4) and 50 years and above (OR 24.6). **Conclusion:** Adult residents in the two (Urban and peri-urban) of three different areas are developing high-risk NCDs, particularly Cocody's population. At the end, we observed among participants that the female gender, living in urban areas and clustering are the most concerned by non-communicable disease risk factors. To reach the goal, preventive and therapeutic interventions are needed among the targeted population.

Keywords

Health, Chronic Non-Communicable Diseases, Risk Factors, Adult, Ivory Coast

1. Introduction

Human food has evolved over time and these changes are adapted to the lifestyle and environment evolution. However, this development retains the main goal of ensuring people physiological needs and good health [1].

Food and nutritional transitions have been characterized by the most marked changes such as the passage from hunting and gathering to the era of agriculture and breeding or that of a period of recurrent famine to a greater food prosperity one [2] [3].

The industrialized societies are generally confronted today with a growing challenge of imbalance between the abundance of food supplies on the one hand and the considerable drop in the energy needs of individuals [4].

The nutrition transition refers to the changes that populations experience in the quality and quantity of dietary behaviors and patterns. These changes go hand in hand with other lifestyle-related factors such as physical activity, work and family environments, and general health and socioeconomic well-being, all of which ultimately influence energy expenditure [5].

This might concern developed countries facing an incredible diversity and quantity of foodstuffs, but surveys in developing and low incomes countries showed that the rate of obesity and non-communicable diseases (NCDs) are increased [6].

In 2012, the World Health Organization have revealed that approximately 46% of all NCD-related deaths in 2012 were due to cardiovascular diseases (CVDs), followed by cancers (22%), respiratory disease (11%) and diabetes (4%) [7].

About low and middle-income countries (LMICs), it's noted nearly 80% of NCD-related deaths and 82% of all NCDs premature deaths occur [7].

Ivory Coast is considered as a lower-middle-income country, which is in rapid economic growth [8]. Surveys have shown that this kind of country is going through an epidemiological transition which results in the increasing prevalence

of NCDs and their risk factors [9].

The available evidence suggests this pattern is changing among those adult populations with longer exposure to modernisation. The latter is leading to rapid lifestyle changes associated with increases in CVD and diabetes [10].

The present study was designed to provide information on the magnitude of the NCD risk factors among the Ivorian adult population and a baseline for monitoring the trends, guiding decision making, and implementing appropriate interventions. To reach this goal, the study has concerned three different sociodemographic populations of Ivory Coast: an urban (Cocody), peri-urban (Abobo) and rural (Yocoboué) area.

2. Material and Methods

2.1. Study Type and Population

A descriptive and analytical cross-sectional study of a representative sample was conducted between August and November 2018. The study population concerned 1146 adults aged of 19 to 60 years old. These were men and women, living in urban area (Cocody), a peri-urban area (Abobo) and a rural locality in the south of Côte d'Ivoire (Yocoboué). To be Included on the study, participant should have living in the study area for at least 6 months, being aged 19 to 60 years, and having given informed consent. Participants who were excluded were those with disabilities (mentally deficient subjects) to answer questions, pregnant and breast-feeding's women and people diagnosed chronic diseases.

2.2. Conduct of Study

To collect data, we have used the World Health Organization (WHO) recommended surveillance of common risk factors with the "STEPwise" approach. Thus, STEPS approach focuses on the collection of data on key risk factors of major NCDs. It includes three sequential phases.

(Step 1) consists of collection on socio-demographic variables and behavioral risk factors by using of semi structured, interviewer-administered questionnaires [11].

(Step 2) It's question of obtaining clinical measurements such as Height (measured with a calibrated meter rule), Weight (using a standard weighing scale (TEFAL bodymaster). Body mass index (BMI) was derived by dividing weight (kg) by height squared (m^2) [12]. The waist circumference was obtained by using a non-extendable measuring tape [13].

(Step 3) this step concerns acquiring of biochemical measurements like blood pressure (*Omron M5-I*) [14], blood glucose, and high density lipoprotein (HDL-C [14]. We informed participants to have an overnight fasting 12 h before the day of data collection.

2.3. Dependent and Independent Variables

The dependent variables of this study concerned overweight and obesity, abdo-

minal obesity, raised blood pressure and raised blood sugar and low HDL-C. Whereas, socio-demographic characteristics and behavioural risk factors were the independent variables.

2.4. Statistical Analysis

Data were inputted and cleaned using the IBM SPSS version 20 (SPSS Inc, Chicago, IL). The results were expressed as percentage. The t tests and χ^2 tests were performed to analyse statistical differences.

Differences among rural, peri-urban and urban subjects were assessed using χ^2 tests or 1-way analysis of variance (ANOVA) with Tukey post hoc test [15].

The multivariate logistic regression analyses were performed to identify the associated factors of overweight and obesity, abdominal obesity, raised blood pressure, raised blood sugar and low HDL-C, and the socio-demographic variables and behavioural risk factors.

2.5. Ethical Considerations

The Ethical approval for the study was given by the Ivory Coast State Ministry of Health Ethical Committee. Written and informed consent was obtained from each participant before them involving in the research. The principles laid down in the Declaration of Helsinki have been followed during the study protocol and conduct. Data were collected anonymously.

3. Results

3.1. Characteristics of Participants

A total of 1146 people were surveyed. Women accounted for 60.03% of this population. The mean age was 38.72 ± 8.5 years. Across the sites, the most important of participants (49%) has between 30 - 39 years old. The education level was significantly higher in the urban area (84.4% in Cocody) than peri-urban area (72.4% in Abobo) and rural area (45% in Yocoboué). About one half of the respondents (47.62%) were self-employed. This status concerned most of the participants of the peri-urban area (Abobo, 50%) and rural area (Yocoboué, 57%) (See **Table 1**).

3.2. Prevalence of NCDs Behavioural Risk Factors

The finding results about the behavioural risk factor are on **Table 2**.

Tobacco consumption

The overall prevalence of current smoking was 15.2%. The prevalence of smoking among peri-urban (Abobo) population is higher (19.20%) than urban (Cocody; 16.90%) and rural (Yocoboué; 9.30%) area.

The prevalence of tobacco users increased between 19 - 39 years old (16.53% - 18.86%) and decreased among older persons aged 40 and above (12.39% - 9.19%). The prevalence of smoking was also significantly higher among males 34.93% than females 2.22%.

Table 1. Characteristics of study subjects.

Sociodemographics factors	Urban area		Rural area
	Cocody (n = 384)	Abobo (n = 384)	Yocoboué (n = 378)
Gender (%)			
Male	144	163	151
Female	240	221	227
Total	384	384	378
Age group (%)			
19 - 29	30.2	38.00	36.3
30 - 39	48.2	49.00	49.7
40 - 49	13.3	10.40	8.00
50 - 60	8.3	2.60	6.00
Education level (%)			
No education	15.60	27.6	55.00
Formal education	84.40	72.4	45.00
Primary	13.00	24.8	28.00
Secondary	38.00	26.5	16.00
High	33.40	21.1	01.00
Professional status (%)			
Unemployed	7.00	16.00	10.00
Houseswives	2.00	12.00	14.00
Employed	50.00	22.00	19.00
White collar	45.00	14.00	19.00
Blue collar	5.00	8.00	-
Self-employed	41.00	50.00	57.00

Table 2. Prevalence of behavioural risk factor for NCDs.

Characteristics	Current tobacco	Harmful use of alcohol	Physical inactivity	Sedentarity of ≥ 7 h	Skipping breakfast	Late dinner	Snacking
Overall (%)	15.2	57.71	58.84	24.71	69.45	61.00	36.00
Area							
Urban (Cocody)	16.90	57.81	65.4	36.78	76.56	81.77	64.64
Peri-urban (Abobo)	19.20	50.26	38.9	20.58	92.18	71.87	33.41
Rural (Yocoboué)	9.30	1.58	10.6	6.29	39.15	28.84	2.42
Gender							
Male	34.93	66.10	32.81	20.30	78.16	69.00	18.12
Female	2.22	11.83	38.56	22.24	55.02	55.23	47.96

Continued

Age group								
19 - 29	16.53	17.74	18.74	23.36	52.63	29.76	54.23	
30 - 39	18.86	30.58	20.62	20.81	75.22	37.05	36.07	
40 - 49	12.39	48.97	30.99	18.72	90.08	29.47	09.68	
50 - 60	9.19	14.30	47.75	21.91	84.61	3.71	0.00	

*Statistically significantly at $p < 0.05$.

Alcohol consumption

The prevalence of alcohol consumption of all the participants was 87.87%. Concerning binge drinking, it was 57.71%. Men consumption of alcohol was significantly higher (66.6%) compared to the level among women (11.83%). It's among the age group 40 - 49 years that the most significant prevalence was observed with 48.97%.

Physical inactivity

Physical inactivity was prevalent 58.84% among the study participants. The highest prevalence (65.4%) of low physical activity was from urban area (Cocody). Low practice of physical activity increased significantly with age: 18.74% for 19 - 29 years, 20.62% for 30 - 39 years, 31% for 40 - 49 years, 47.75% for 50 and above. Also, women were more inactive than (38.56%) than men (32.81%).

Sedentary behaviour

Participants reported 24.71% of waking time, in sedentary behavior (sitting for more than 7 hours). Urban area was associated to time spent in sedentary behaviours (Cocody; 36.78%, Abobo; 20.58% and Yocoboué; 6.29%). Age was inversely associated with time spent in sedentary behaviors, it was decreased between 19 - 49 years old (23.36% - 18.72%) and increased after 50 and above (21.91%). Among men and women, women were most positively associated with absolute time spent sitting than men (22.24% vs 20.3%).

Late dinner

Taking a late dinner was high among the respondents 61%. The late dinner intake concerned more than 3/4 of the urban area of Cocody population. The prevalence was more than 25% across all age groups but it was lowest among the group of 50 and above 3.71%. The male respondents were more to take late dinner than female (69% vs 55.23%).

Skipping breakfast

The general prevalence of skipping breakfast was 69.45% among respondents. Skipping breakfast was most significant among peri-urban persons (92%) than urban (76.56%) and rural area (39.15%). Compared to women (55.02%), significantly higher prevalence was observed with men 78.16%. Regarding age, the most significant prevalence was observed between 40 - 49 years old with 90.08%.

Snacking

The prevalence was 36% among the study participants. The highest prevalence

of snacking was from urban area (Cocody) (64.64%).

Snacking decreased with age, 54.23% for 19 - 29 years, 36.07% for 30 - 39 years, significantly increase 9.68% for 40 - 49 years, and decrease with age of 50 and above (84.61%).

Concerning gender, the prevalence of women with snacking habit was significantly higher (47.96%) than men (18.12%).

3.3. Prevalence of Biological Risk Factors

Overweight and obesity

The rate of overweight and obesity of respondents were respectively 31.33% and 22.41%. There was a positive associated between being overweight or obese and urban residence, age, female gender. About half of females were overweight or obese. We observed a high prevalence of among participants who aged above 40 years 49.33% and the respondents who living in urban area (Cocody) 59.6%.

Abdominal obesity

The general prevalence of abdominal obesity about all participants was 52.96%. Abdominal obesity was significantly important among female 70.93% than male 25.98%. It was significantly increased with age 39.6% for 19 - 29; 54.72% for 30 - 39; 69.42% for 40 - 49; 89.23% for respondents aged 50 and above. The respondents living in urban and peri-urban area were with a higher prevalence respectively 69% and 52.61%.

Raised blood pressure

The raised blood pressure among participants prevail 14.61%. This prevalence significantly increased with age 2.62% for 19 - 29; 4.8% for 30 - 39; 9.7% for 40 - 49; 16.9% for 50 and above. It's also noticed that male prevalent was significantly higher (34.93%) than female (16%).

Raised blood sugar

The prevalence of raised blood sugar among participants was 23.37%. The prevalence among males was highest 13.97% than females 29.63%. Also we observed a highest prevalence among group age of 50 - 60 years 67.69%.

Low HDL-Cholesterol

The prevalence of low HDL-C of all participants was 18.51%. We noticed that low HDL-C was most common among female 22.26% than among male at 12.88%. It's also significantly increased with age no one for 19 - 29; 26.20% for 30 - 39; 33.06% for 40 - 49; 38.49% for respondents aged 50 and above. The respondents living in urban and peri-urban area were with a higher prevalence respectively 28.12% and 21.35% than rural 5.85%. (**Table 3**)

3.4. Non-Communicable Diseases Associated Risk Factors

Sociodemographics and behavioural risk factors associated to non communicable diseases were presented on **Table 4**. Suffering from overweight and obesity among participants were being female (OR: 11.3), sedentarily (OR: 18.3), live in urban area (OR: 3.94) and skipping breakfast (OR: 3.65). Abdominal obesity

Table 3. Prevalence of biological risk factors for NCDs.

Characteristics	Overweight or obesity	Abdominal obesity	Raised blood pressure	Raised blood sugar	Low HDL-C
Overall (%)	40.95	52.96	14.61	23.37	18.51
Area					
Urban (Cocody)	59.60	69.00	29.17	34.34	28.12
Peri-urban (Abobo)	42.09	52.71	23.93	22.39	21.35
Rural (Yocoboué)	25.07	27.04	15.05	13.23	05.85
Gender					
Male	28.16	25.98	34.93	13.97	12.88
Female	49.42	70.93	16.00	29.63	22.26
Age group					
19 - 29	11.38	39.60	02.62	02.75	0.00
30 - 39	28.08	54.72	04.80	22.46	26.20
40 - 49	49.33	69.42	09.20	38.02	33.06
50 - 60	9.68	89.23	16.90	67.69	38.46

*Statistically significantly at $p < 0.05$.**Table 4.** Multiple logistic regression analysis relating bio-chemical results with sociodemographic characteristics and behavioural risk factor.

Variables	Overweight/obesity	Abdominal Obesity	Raised blood Pressure	Raised blood sugar	Low HDL-C
	OR [IC 95%]	OR [IC 95%]	OR [IC 95%]	OR [IC 95%]	OR [IC 95%]
<i>Sociodemographics characteristic</i>					
Age (Years)					
19 - 29	2.33 1.91; 4.32]*	2.55 [1.33; 4.60]*	1	1	1
30 - 39	4.45 [1.24; 5.48]*	6.67 [4.32; 12.6]*	8.45 [1.52; 20.2]*	1.46 [0.69; 2.86]	1.30 [0.79; 1.36]
40 - 49	5.62 [1.48; 21.4]*	7.86 [5.40; 19.6]*	13.4 [3.41; 40.9]*	2.83 [1.39; 4.90]	1.93 [1.09; 2.06]
50 - 60	3.41 [1.01; 5.67]*	7.68 [4.65; 21.2]*	24.6 [12.3; 68.7]*	3.48 [1.65; 8.69]	2.09 [0.69; 3.26]
Area					
Rural	1	1	1	1	1
Urban	3.94 [0.52; 7.27]*	5.19 [1.09; 10.7]*	1.91 [1.11; 3.27]	4.14 [1.27; 5.74]*	1.15 [0.50; 1.86]
Gender					
Male	1	1	1.97 [1.41; 2.75]	1	1
Female	11.3 [8.70; 24.4]*	25.7 [12.9; 54.7]*	0.90 [1.41; 2.75]	2.17 [0.80; 4.62]	1.55 [0.52; 2.45]

Continued

<i>Lifestyle</i>					
Tobacco					
No	1	1	1	1	0.9 [0.65; 1.54]
Yes	0.65 [0.54; 0.78]	0.51 [0.42; 0.60]*	1.74 [1.31; 2.64]	0.52 [0.59; 0.84]*	1
Harmful alcohol					
No	1	1	1	1	1
Yes	2.38 [1.01; 4.74]*	4.12 [0.80; 5.66]	2.98 [1.00; 8.91]	2.73 [1.03; 4.58]	1.33 [0.73 - 2.25]
Level of physical activity					
Vigorous	0.58 [0.41; 1.80]*	0.47 [0.25; 0.84]	0.64	1	0.83 [0.53; 1.25]
Moderate	1.53 [0.81; 3.80]*	1.09 [0.49; 2.88]	0.78 [0.90; 3.91]	2.67 [1.51; 4.55]	1.47 [1.23; 1.74]*
Light	2.93 [1.51; 5.71]*	1.88 [0.90; 3.92]	1	3.01 [2.00; 4.51]	1.51 [0.73; 2.25]*
Sedentarity time (sitting)					
<3 h	1	1	1	1	1
3 - 7 h	8.36 [3.53; 11.4]*	4.80 [1.09; 5.38]	2.86 [0.90; 3.91]	2.64 [1.21; 3.40]	1.64 [0.73; 2.25]*
≥7 h	18.3 [10.6; 30.1]*	5.41 [3.53; 12.5]	3.82 [1.08; 5.74]	4.57 [2.21 - 11.44]	2.04 [1.13; 4.65]*
<i>Eating behaviour</i>					
Day eating frequency					
1 - 2 times	2.40 [1.04; 8.21]*	1.30 [0.75; 1.82]	0.82 [0.50; 1.66]	1.94 [1.10; 3.22]	1.69 [1.23; 2.15]
3 times	0.73 [0.54; 1.80]*	0.60 [0.37; 1.19]	0.47 [0.26; 0.86]	0.88 [0.64; 1.36]	1
>3 times	2.77 [1.91; 5.20]*	2.04 [0.9; 4.25]	0.97 [0.33; 2.16]	1.80 [0.69; 4.92]	1
Snacking	1.53 [1.08; 4.80]	1.17 [0.95; 2.18]	1	2.18 [0.55; 4.78]	1
Skipping breakfast	3.65 [1.61; 8.44]	1	1	2.94 [1.38; 7.27]	1.87 [0.90; 3.01]
Late dinner	3.36 [1.51; 5.75]	2.12 [1.04; 8.2]	0.79 [0.59; 1.08]	2.05 [1.82; 5.08]	2.02 [1.19; 2.21]

*Statistically significantly at $p < 0.05$.

were associated to increasing age, being woman, live in urban area, sedentarity and harmful alcohol. About abdominal obesity, women were almost 26 times more to suffer from it than men (OR: 25.7). Having raised blood pressure was associated with age, binge drinking and overweight/obesity. Raised blood pres-

sure increased with age: 30 - 39 years (OR: 8.45), 40 - 49 years (OR: 13.4), 50 years and above (AOR: 24.6). The most important factors of raised blood sugar were sedentary (OR: 4.57) and skipping breakfast (OR: 2.94). The associated factors of low HDL-C were age of 50 years and above (OR: 2.09), sedentariness (OR: 2.04) and late dinner (OR: 2.02).

3.5. Prevalence (%) of Multiple NCDs Risk Factors among Study Population

In **Figure 1**, it's showed the prevalence of multiple NCD risk factors among all participants.

We observed that just a small proportion of participants (2.3%) were free of NCD risk factors. Also 80% of them had at least two NCD risk factors. The participants had on average of four (4) NCD risk factors.

4. Discussion

Our results showed a high prevalence of NCDS risk factor among study population. Concerning behavioral risk factors, 15.2% of participant consumed tobacco. This prevalence represented the half of those which was in France (32%) [16].

About alcohol, 57.71% of participants have used alcohol. This consumption reached those observed in previous surveys leaded in 2015 in Ivory Cost [17].

Alcohol and tobacco were most prevalent among male than women. Similar results were observed in others study [18] [19].

Physical inactivity and sedentariness prevailed respectively 58.84% and 24.71%. And women's prevalence was the most important in the two cases. Current study in Australia has showed the same remarks [20].

Certain dietary habits like skipping breakfast, having late dinner and snacking have been found among study population. Two behaviors such as skipping breakfast and late dinner were more prevalent among men than women [21].

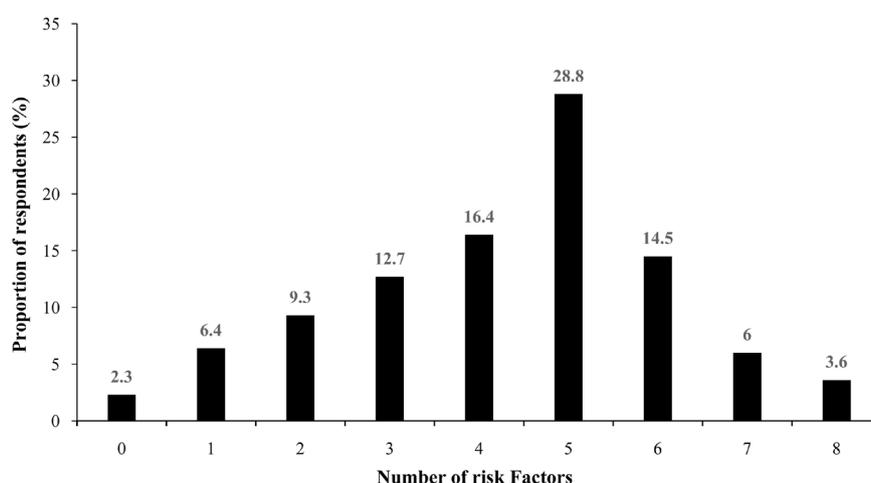


Figure 1. Prevalence of multiple risk factors among study population.

Many countries of Asia have accessed the prevalence of some NCDs risk factor [22].

Concerning anthropometric risk factors, our study have showed in this case that the prevalence of overweight and obesity were respectively 31.33% and 22.41% (55.47% the two together). This rate is close to those observed with Olamedji and coworker's study [23]. But lower than those reported in United States (60%) [24].

Data showed a higher prevalence of overweight and obesity in urban (Cocody, 59.6%) and peri-urban (Abobo; 42.09%) in contrast to rural area of Yocoboué (25.07%). Rarau and co-worker in 2017 reported that overweight and obesity prevalence were the highest in urban living place relative to rural place [25]. And again our results were in accordance to data from survey reported in Burkina Faso [26] [27].

In term of abdominal obesity (AO), it's was found high rate in urban living place (Cocody) than peri-urban (Abobo) and rural (Yocoboué) area. The prevalence of AO was also high among women than men. Previous study in India has showed the same results [28].

We found certain biological risk factors among the participants of the study. High blood pressure was observed among the population. It's less than quarter (14.61%) of participants who were concerned by this case. This prevalence was relatively high and reached those revealed by Sackou and *et al.* in Abidjan [29].

Raised blood pressure in our study was prevalent with men than women. Similar results was observed by Everett and Zajacova who have determined than male was most hypertensive [30] [31].

The prevalence of high blood sugar was 23.37 for the global population of this study. This rate is reached to those found in South African [32] [33].

Gender distribution of high blood sugar in our study is unsteady. A study in South Africa and other in Senegalese revealed higher rate among women [33] [34]. But in others surveys in Nigeria and Tunisia showed the contrary [35] [36].

Concerning HDL-C, we have observed in general a prevalence of 18.51%. This prevalence increased among women 22.26% than men (12.88%). Data from analysis among African American adults has described a high rate of HDL-C with women [37].

The results concerning association between certain sociodemographic characteristics (age, gender, residence place), lifestyle (alcohol and tobacco consumption, physical activity and sedentariness), eating behavior (eating frequency, skipping breakfast, late dinner and snacking) and anthropometric and biological risk factors (overweight/obesity, abdominal obesity, high blood pressure, high blood sugar and low HDL-C) have been demonstrated in the study.

Being overweight or obese was associated with much of the risk factors but the most strongly associated one was female gender. The same observation was found in a study in kaduna [38] and others authors have showed similar results [39]. This female predominance could be explained by pregnancies and sociocultural motivations [40]. These differences among female may due to the fact

that in subsaharan countries being overweight or obese is a sign of beauty, fertility, well-being [39]. Another explanation could be attributable to kind of daily activities practiced by women which was recognize as a light physical activity and they also prolonged sitting's time [41].

Our investigation about abdominal obesity was associated with greater odds of female gender. Women were about 26 times to be concerned by AO. Certain authors have found that these results are in line with ours [42]. Several ways can be explained this difference, first difference in sex steroid hormone cause divergence in body composition [43]. Secondly contrary to men, women have a genetic ability to accumulate fat [44]. Visceral fat and post partum abdominal caused by pregnancy were blamed [13]. With women, during post menopausal the body fat redistribution in abdominal area was important [45].

In our study; many factors were associated to hypertension such as age, urban area, male gender, tobacco and alcohol consumption, prolonged sitting time (≥ 7 hours). But the most strongly associated factor of high blood pressure mainly concerned age and particularly age group of 50 - 60 years old. That observation was found in other surveys [46]. Also it was confirmed in a study from cameroon [47] [48].

These results could be the fact that when age increases, the cells get old and arteries become rigid. Therefore this rigidity makes difficult the blood circulation which finally increases blood pressure [49].

Sedentary time (sitting time ≥ 7 hours) was main risk factor associated to raised blood sugar, it »s followed by urban residence place and light physical activity. The probable explanation of this association was due that certainly it's plausible that excess body fat could be the reason in part why sedentary lifestyle lead to a risk of raised blood sugar. Physical activity has resulted an acute contraction of active skeletal muscle which improves insulin action [50] [51].

Finding from participants of study revealed that the most important factor associated to low HDL-C was age (50 - 60 years old). Previous study observed the same results [52] [53].

This result could be due to the fact that when age increase, it causes biological change [54].

5. Conclusions

In conclusion, we observed that the population of study whether it's from the urban, peri-urban area or rural area, has some behavioral risk factors for NCDs. Those were very important were alcohol (respectively 57.81%; 50.26%; 1.58%), physical inactivity (respectively 65.4%; 38.9%; 10.6%), sedentariness (sitting at least 7 h) (36.78%, 20.58%, 6.29%) and late dinner (81.77%, 71.87%, 28.84%). Concerning biological risk factors for NCDs, we reported a rural-urban positive gradient for the prevalence of all of them.

Also, we have seen some interesting patterns of relation between socio-demographic, behavioral risk factors and biochemical risk factors. The most commons

behavioral risk factors associated to NCDs were age, urban area, female gender, harmful alcohol, sedentary, physical inactivity and late dinner. We noted that biological risk factors were most important with females than males. Overweight/obesity and abdominal obesity were most positively associated to the female gender, raised blood pressure to age particularly (50 - 60 years). Those of raised blood sugar were most associated with sedentary time (≥ 7 h) and low HDL-C to age (50 - 60 years). There was also observed a significant level of clustering of NCD risk factors and that concerned 80% of the participants. This study shows that the nutrition transition is ongoing in Ivory Coast and NCDs could be reduced substantially. So public health interventions against NCDs might be provided by promoting an active lifestyle, a more adequate diet and using the urban residence place as a platform of fighting.

Conflicts of Interest

The authors declare no conflict of interest.

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