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Nutritional status and associated factors among community-dwelling elderly.

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List of abbreviations

BMI: Body Mass Index.

CFA: Communautés Françaises d'Afrique

CI: Confidence Interval

COVID: Corona Virus Disease

IEC: Institutional Ethics Committee.

WC: Waist Circumference.

MUAC: Mid-Upper Arm Circumference

OR: Odds Ratio

WHO: World Health Organization.

Abstract

Background and aims.

Although the ageing of the Cameroonian population is a public health issue in the coming years, the nutritional status of the elderly is unknown. The aim of the study was to assess the nutritional status, health status and associated socio-demographic factors among elderly in Cameroon.

Methods

A cross-sectional study of 599 elderly (aged ≥ 60) was conducted in urban and rural areas. Several socio-demographic, sanitary, and anthropometric (weight, height, body mass index (BMI), Waist Circumference (WC), Mid-Upper Arm Circumference (MUAC)) data were collected. Nutritional status was defined according to WHO. Multinomial analysis was performed to identify factors associated with nutritional status. The threshold of statistical significance was 5%.

Results

The population, representative of the elderly, was aged 68.9 ± 7.2 years, with sex ratio M/F=0.93, weight 68.5 ± 14.7 kg, BMI 24.7 ± 5.3 , WC 90.1 ± 12.8 cm and MUAC 28.2 ± 5.0 cm. According to BMI, undernutrition was 19.7%, normal status 37.9%, overweight 24.9%, obesity 17.5%. The concordance for undernutrition between BMI and MUAC was weak ($\kappa=0.3$). In multinomial analysis, only no medication was negatively associated with undernutrition (OR=0.3). Obesity was positively associated with the urban environment (OR=4.8) and inactivity (OR=2.9) and negatively associated with male gender (OR=0.4), widowed (OR=0.2), head of household (OR=0.4), no income (OR=0.3), one pathology (OR=0.4), no medication (OR=0.2), having normal diastolic pressure (OR=0.2).

Conclusions

Undernutrition and obesity (more frequent in women, and in urban area) affect 37.2% of the elderly. These nutritional disorders are a public health problem that cannot be ignored.

Key words: Elderly, socio-demographic, health, undernutrition, obesity

1. Introduction

Ageing is a natural process characterized by benign or severe changes that alter the functioning and balance of the human body (1). In 2015, the proportion of people aged 60 years or older was 12% in the World and 5% in Africa and Cameroon and might double by 2050 becoming a major public health problem (2–4). Ageing is associated with an increased prevalence of co-morbidities and altered nutritional status (undernutrition/obesity) (5,6). Undernutrition is associated with increased risk of frailty, falls, dependence on activities of daily living, hospitalization and prolonged hospital stay, increased health care costs, poor quality of life, and increased mortality (2,3,7,8), while obesity is associated with decline in functional abilities, metabolic syndrome, cardiovascular disease, arthritis, pulmonary abnormalities, urinary incontinence, visual impairment, and various cancers (9).

In previous studies among elderly in Africa, low education, advanced age, inactivity, low income, isolation, rurality, male gender and high mortality were associated with undernutrition (10–15), while urbanity, female gender, young age, hypertension, arthritis, diabetes and nutritional transition were associated with obesity (13,14,16–23). Less is known about the situation in Cameroon. A publication of Helpage International (10,22) on people aged ≥ 55 years, conducted in 2004 in only one Cameroonian rural subdivision out of 360 (24) and in one ethnic group out of 248 (25) has shown a prevalence of undernutrition of 5.5% and obesity of 19.0%. These old and partial data should not have been extrapolated to the entire country, hence the raison of our study. The main objective of this study was to assess the nutritional status and associated socio-demographic and health condition factors, among a representative population of

elderly in Cameroon and secondarily to assess the correlation between two undernutrition diagnostic methods (BMI and MUAC).

2. Materials and Methods

2.1. Period and ethical approval

The study was conducted from December 2018 to September 2020 in the whole country of Cameroon (population in 2010: 19,406,100 inhabitants) (4), divided into 10 regions: Adamawa, Center, East, Far North; Littoral, North, North-West; West; South, South-West. The protocol was approved by the Institutional Ethics Committee (IEC) of the University of Douala (Cameroon) (decisions N° 1668 CEI-Udo/12/2018/T and N° 1668 CEI-Udo/02/2020/T).

2.2. Design, sample size and sampling

This study, cross sectional and descriptive, involved elderly (age \geq 60 years) living in community, resident for more than 6 months in the locality, not hospitalized and without hearing impairment/disability.

Due to the lack of data in Cameroon, the prevalence of undernutrition and obesity was considered unknown for the calculation of the sample size. The estimated prevalence of altered nutritional status was 50%, and the margin of error was chosen at 4%. Using Schwartz's formula (26), the minimum sample size was 597. A two-stage sampling procedure (i.e., stratified for areas and simple random for neighborhoods and villages) was used. Urban and rural areas were defined according to the country's 2010 general population and housing census (4). The ten regional capitals were considered urban, and all other localities were considered rural. In urban areas, three (or more if needed) neighborhoods were randomly selected. In rural areas, from a randomly selected division and sub-division, three villages (or more) were selected, and a door-to-door approach was carried out.

2.3. Data collection

An electronic questionnaire was used by trained staff through a suit and free open-source software (KoBoToolbox, Cambridge, USA). The socio-demographic data were age, gender, living area, marital status and regime, religious belief, level of education, household size, position in the household, lifestyle, housing, activity, and income, chronic diseases were cancer, diabetes, hyperlipidemia, hypertension, tuberculosis, viral infections, chronic pain, incontinence, stroke, arthritis or osteoarthritis, eye disorders and malaria) and blood pressure. The "lifestyle" referred to whether the elderly lived alone or with one or more relatives, "housing" designated whether the person was renting or not and "Living place" was defined as whether the person lived in a personal or third party's home. Pathologies were defined according to the International Classification of Diseases, Tenth Revision (ICD-10), and elderly classified as healthy or not, based on the medical record (27). Blood pressure was performed using an automatic monitor (Omron[®], M3-HEM-7131-E, Kyoto, Japan). The mean of the six measures (three per arm) was used. Hypertension was defined by systolic pressure ≥ 140 mmHg and/or diastolic pressure ≥ 90 mmHg or taking antihypertensive medication (28).

Height (m) was measured with a carpenter's tape (Yong Heng[®], YH-89U, Henan, China) to the nearest 0.1 cm. The weight was obtained barefoot with a digital scale (Omron[®], Kyoto, Japan) to the nearest 0.1 kg. Body mass index ($BMI = \text{weight}/\text{height}^2$; kg/m^2) was calculated (29). Waist circumference (WC) was measured with a non-stretch tape midway between the last rib and the iliac wing. The Mid-Upper Arm Circumference (MUAC) was measured with a Comed[®] (Villefranche-de-Rouergue, France) tape on the dominant arm, midway between the olecranon and the acromion. Nutritional status was based on BMI ($BMI < 18.5 \text{ kg}/\text{m}^2 = \text{undernutrition}$; $18.5 \text{ kg}/\text{m}^2 < BMI < 25 \text{ kg}/\text{m}^2 = \text{Normal}$; $25 \text{ kg}/\text{m}^2 < BMI < 30 \text{ kg}/\text{m}^2 = \text{overweight}$; $BMI \geq 30$

kg/m²=obesity), MUAC (<24 cm=undernutrition) and WC (>= 102 cm in men and 88 cm in women=abdominal obesity) as recommended (29,30).

2.4. Statistical analyses

Data analysis was carried out using SPSS.26 (SPSS, Chicago, USA). Quantitative data were expressed as mean \pm standard deviation (SD) and qualitative in number and percentage. The dependent variable was reduced to three modalities (undernutrition, normal/overweight, obesity) because of the relevance in clinical practice of undernutrition and overweight as the two majors at risk situations among the elderly. The t-tests, Mann-Whitney, ANOVA, Kruskal-Wallis tests were used to compare quantitative variables. The Chi-2 test was used for qualitative comparisons and the Fisher exact test when the theoretical frequencies were <5. Cohen's kappa coefficient of agreement (very strong>0.8) was calculated between the two diagnostic methods for undernutrition (31). Univariate and multinomial logistic regression were carried out to identify associations between nutritional status by BMI and associated factors. Variables with $p \leq 0.25$ in univariate were included in the multinomial regression model (32), for which a backward stepwise procedure was used. In multinomial analysis, the variables "married", "widowed", "education", "lifestyle", "income stability" and "source of income" were excluded due to multicollinearity (VIF>5). Confounding variables and the interactions between the independent variables in the final model were sought. Significance level was set at $p < 0.05$.

3. Results

3.1. sociodemographic and health characteristics

A total of 599 (33.6% in urban areas) people were included, with a sex ratio M/F of 0.93. Age was 68.9 ± 7.2 , lower for Males vs. Females (67.7 ± 5.0 vs. 70.0 ± 8.6 y; $p < 0.001$). The socio-demographic characteristics, health conditions and nutritional status are described in Table 1. The average household size (6.2 ± 3.6 individuals) was larger in urban than in rural areas (7.0 ± 3.8 vs. 5.8 ± 3.5 , $p < 0.001$), different according to marital status ($p < 0.001$), married people having the largest family size (7.3 ± 3.5). Most of the income came from Trade / Agriculture / Livestock / Crafts (53.6%) and was different according to area ($p = 0.002$), age ($p = 0.045$), gender ($p < 0.001$) and marital status ($p < 0.001$). Most of the elderly (50.7%) had an income $\geq 60,000$ CFA francs/92 €, the monthly average determined by the World Bank in 2019 in Cameroon (33). Polypathology was recorded at 35.7%, higher in the group whose age was > 80 (50.9%; $p < 0.001$). The systolic and diastolic pressures (133.6 ± 15.3 and 84.6 ± 7.2 mmHg respectively) were higher in subjects ≥ 80 years of age (138.8 ± 14.6 mmHg, $p = 0.006$; 87.5 ± 6.5 mmHg, $p < 0.001$) and in polypathological subjects (137.8 ± 15.3 mmHg, $p < 0.001$; 85.2 ± 8.3 mmHg, $p = 0.012$). Forty-two subjects (7.0%) had both systolic and diastolic hypertension. Systolic hypertension was higher when age was ≥ 80 ($p < 0.001$) and in urban areas ($p = 0.002$) while diastolic hypertension was present only in the 80 years and over ($p = 0.003$).

3.2. Nutritional status

The mean BMI (24.7 ± 5.3 kg/m²) was higher in urban than rural areas (25.7 ± 5.3 vs. 24.1 ± 5.3 kg/m²; $p = 0.001$), weakly and positively correlated with systolic ($r = 0.12$, $p = 0.002$) and diastolic ($r = 0.15$, $p < 0.001$) blood pressure. Mean MUAC was 28.2 ± 5.0 cm, higher in women (28.6 ± 5.2

vs. 27.6 ± 4.8 ; $p=0.018$) and in urban areas (29.3 ± 5.1 vs. 27.6 ± 4.9 ; $p<0.001$). Abdominal obesity was found in 31.9% of cases, higher among women than men (54.0% vs. 8.0%, $p<0.001$). Using BMI and taking normal/overweight nutritional status as a reference, univariate and multinomial analyses are presented in tables 2 and 3.

According to the BMI, the prevalence of undernutrition was 19.7% and 21.4% with MUAC. In univariate analysis (Table 2), undernutrition by BMI was positively associated with MUAC <24 cm (OR=9.2; 95%CI: 5.8-14.7, $p<0.001$), but the concordance between undernutrition by BMI and by MUAC was weak ($\kappa=0.3$). Men were more undernourished than women (25.4% vs. 14.5%, $p=0.001$) and the prevalence of undernutrition was lower for educated vs. uneducated people (17.5% vs. 24.0%, $p=0.002$). In multinomial analysis, undernutrition by BMI was negatively associated with no medication (OR=0.3, 95% CI: 0.1-0.8, $p=0.016$).

Using BMI, the prevalence of obesity was 17.5%, higher in women than in men (25.1% vs. 9.4%, $p<0.001$), in urban than in rural areas (22.9% vs. 14.8%, $p=0.014$) and in educated than in uneducated people (21.5% vs. 10.3%, $p=0.002$). Polypathology was more frequently found in cases of obesity (26.2% vs. 12.3 and 13.9% for one and no pathology respectively; $p<0.001$). In multinomial analysis, obesity was positively associated with living in urban areas (OR=4.8, 95% CI: 2.1-11.0, $p<0.001$) and being inactive (OR=2.9, 95% CI: 1.1-8.1, $p=0.040$). It was negatively associated with being male (OR=0.4, 95% CI: 0.1-0.9, $p=0.026$), widowed (OR=0.2, 95% CI: 0.1-0.6, $p=0.001$), a head of household (OR=0.4, 95% CI: 0.2-0.9, $p=0.043$), having no income (OR=0.3, 95% CI: 0.1-0.8, $p=0.02$), suffering from one chronic pathology (OR=0.4, 95% CI: 0.2-0.9, $p=0.021$), having no medication (OR=0.2, 95%CI: 0.1-0.7, $p=0.014$), and with a normal diastolic pressure (OR=0.2, 95% CI: 0.1-0.6, $p=0.002$).

4. Discussion

This study was the first national one in Cameroon on nutritional status, socio-demographic, and health factors of community-dwelling elderly (4). It was representative of the elderly for age (average 68.9 vs. 68.6y in 2010 data), sex ratio (M/F: 0.9) and area distribution (33.5% in urban vs. 66.5% in rural) (4).

The prevalence of undernutrition was 19.7%, higher than in other Sub-Saharan Africa studies (around 17.2%) using BMI among people aged ≥ 60 years, in both urban and rural areas, with a sex ratio close to ours (10,14,34–36). The concordance between undernutrition by BMI and MUAC seemed too weak ($\kappa=0.3$) to consider MUAC as a possible tool to replace BMI. Our study confirmed that MUAC was not a reliable index and should not replace BMI in the assessment of the undernutrition among elderly.

In multinomial analysis, only no medication consumption was negatively associated with undernutrition. Indeed, medications can change taste or cause digestive troubles, anorexia, leading to undernutrition (37). Moreover, the population without medication had probably better health status, without inflammatory disease, allowing to maintain a better food intake. In the same way, Rahi et al in 2020 showed that polymedication was positively associated with a risk of undernutrition in the elderly (38).

In multinomial analysis, no association was found between socio-demographic factors such as low income and undernutrition as observed in Kenya (10) Botswana (14), and Nigeria (35), maybe because the majority (50.7%) had monthly income higher than the 2019 national average (33). This would need to be verified in Cameroon in another study.

The prevalence of obesity was 17.5%, higher than the average (about 10.3%) of Sub-Saharan Africa countries using a similar methodology (10,14,34–36), and might approach middle- or high-income countries such as Brazil (29.6%) (39) and France (13.2-29.3%) (6).

Obesity was positively associated with the urban environment and with inactivity, probably related to the nutritional transition developed in Africa for several years (20,21,23,40,41), marked by an increased consumption of alcohol, sugary products, fats, animal products, and by a sedentary lifestyle (23). It is more observed in urban areas (16,21,23), among women (21,40,42), overweight/obese (20,21,23,40), hypertensives (23) and diabetics (21). In our study, being a male was negatively associated with obesity confirming that more women were touched. According to Case et al., obesity of women might be explained by food deprivation in childhood and the desire to catch up in adulthood, weight gain being considered as a sign of "good life"(43). Moreover, the feminization of obesity might be in part explained by an observed but poorly documented trend towards appreciation of gynoid obesity in Cameroon.

Being a male, a widowed, the head of the household, having no income, one pathology, no medication, normal diastolic pressure were negatively associated with obesity. According to Burani et al., being widowed might be associated with a poorer quality of life and a low and/or poor diet (12). Low income would imply the difficulty to obtain a sufficient diet, inducing more undernutrition than obesity (14). The presence of monopathology would lead to less obesity than poly pathology probably due to a high proportion of men (51.4 vs. 30.6%, $p=0.039$) and active individuals (47.4 vs. 30.8%, $p<0.001$). No medication might be linked to the absence of pathology, and therefore to a possibly increased mobility, thus reducing the risk of obesity (10). Negative association between obesity and normal diastolic pressure is confirmed by recent observations of Boateng et al. in Ghana (19).

Finally, undernutrition and obesity touched more than one among three elderly people, at least 50,000 people with the figures from 2010 (12). Taking into consideration the progressive increase of elderly in Cameroon, these nutritional troubles, with their well-known comorbidities appeared as public health problems, in a very low resources context.

The limitations of this study were its cross-sectional nature and the difficulty in demonstrating the temporal relationship between exposure and outcome, the period of data collection characterized by the occurrence of COVID-19 and barrier measures to be observed, and the declarative nature of some information. However, to our knowledge, this study was the first to have been conducted in a general population, in both urban and rural areas, with a sex ratio M/F and a mean age consistent with country data (4).

5. Conclusion

This representative study in the elderly at home in Cameroon revealed 19.7% of undernutrition, positively associated with no conventional medication. Obesity was noted in 17.5% of cases, positively associated with urban living and inactivity, and negatively associated with being male, widow/widower, head of household, without income, having one pathology, no medication, and a normal diastolic pressure. For a country already affected by serious health problems among children (44), undernutrition and obesity of the elderly thus appeared to be an additional burden on public health.

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Author Contributions

Gustave Mabiama: Conceptualization, methodology, investigation, data curation, formal analysis, writing original draft, preparation, editing. **Dieudonné Adiogo:** Conceptualization, visualization, supervision, validation. **Pierre Marie Preux:** Writing-review, supervision, validation. **Jean-Claude Desport:** Conceptualization, methodology, funding acquisition, writing-review, supervision, validation. **Philippe Fayemendy:** writing original draft, supervision. **Pierre Jésus:** Conceptualization, methodology, writing-review, supervision, validation. **All authors have seen and approved the final version of the document.**

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-Monogamy	212	74.1	37	66.1	128	77.1	47	73.4
-Polygamy	74	25.9	19	33.9	38	22.9	17	26.6
Widowed (253)								0.036
-Monogamy	208	82.2	45	91.8	140	81.9	23	69.7
-Polygamy	45	17.8	4	8.2	31	18.1	10	30.3
Religion								0.083
-Christian	422	70.5	81	68.6	256	68.1	85	81.0
-Muslim	98	16.4	21	17.8	69	18.4	8	7.6
-Animist/Atheist	79	13.2	16	13.6	51	13.5	12	11.4
Formal education								0.002
-No	204	34.1	49	41.5	134	35.6	21	20.0
-Yes	395	65.9	69	58.5	242	64.4	84	80.0
Household position								<0.001
-Head of household	365	60.9	82	69.5	240	63.8	43	41.0
-Not Head of household	234	39.1	36	30.5	136	36.2	62	59.0
Household size	6.2±3.6		5.8±4.1		5.9±3.2		7.6±4.3	<0.001
Lifestyle								<0.001
-With partner and children	110	18.4	19	16.1	71	18.9	20	19.0
-Alone/ With partner only	74	12.4	23	19.5	45	12.0	6	5.7
-With partner and grandsons	41	6.8	17	14.4	17	4.5	7	6.7
-With partner, sons and grandsons	116	19.4	16	13.6	73	19.4	27	25.7
-Without partner and with children	142	23.7	26	22.0	97	25.8	19	18.1
-Without partner and with sons and grandsons	116	19.4	17	14.4	73	19.4	26	24.8
Housing								0.030
-Rental accommodation	54	9.0	16	13.6	25	6.6	13	12.4

-Personal/family accommodation	545	91.0	102	86.4	351	93.4	92	87.6	
Living place									0.866
-Lives in his/her home	490	81.8	95	80.5	310	82.5	85	81.0	
-Lives in family's/non-family's member's home	109	17.6	23	19.5	66	17.5	20	19.0	
Active									0.008
-No	171	28.5	31	26.3	97	25.8	43	41.0	
-Yes	428	71.5	87	73.7	279	74.2	62	59.0	
Income									0.056
-No	116	19.4	19	16.1	68	18.1	29	27.6	
-Yes	483	80.6	99	83.9	308	81.9	76	72.4	
Income stability (n=483)									0.107
-Yes	171	35.4	33	33.3	102	33.2	35	46.1	
-No	312	64.6	66	66.7	205	66.8	41	53.9	
Source of income (n=483)									0.048
-Trade / Agriculture / Livestock / Handicrafts	259	53.6	42	42.4	168	54.5	49	64.5	
-Retirement pension	120	24.8	26	26.3	77	25.0	17	22.4	
-Donations and bequests	67	13.9	22	22.2	38	12.3	7	9.2	
Mixed/combined	37	7.7	19	9.1	25	8.1	3	3.9	
Monthly income (n=483)									0.683
- < 60,000 frs CFA/92€	238	49.3	49	49.5	155	50.3	34	44.7	
->=60,000 frs CFA/92€	245	50.7	50	50.5	153	49.7	42	55.3	
Health conditions									<0.001
-No pathology	101	16.9	14	11.9	73	19.4	14	13.3	
-One pathology	284	47.4	57	48.3	192	51.1	35	33.3	
-Polypathology	214	35.7	47	39.8	111	29.5	56	53.4	
Cancer									0.694
-No	585	97.7	114	96.6	368	97.9	103	98.1	
-Yes	14	2.3	4	3.4	8	2.1	2	1.9	

Diabetes									
-No	521	87.0	102	86.4	332	88.3	87	82.9	0.336
-Yes	78	13.0	16	13.6	44	11.7	18	17.1	
Hyperlipidemia									
-No	595	99.3	117	99.2	374	99.5	104	99.0	0.865
-Yes	4	0.7	1	0.8	2	0.5	1	1.0	
Hypertension									
-No	479	80.0	105	89.0	309	82.2	65	61.9	<0.001
-Yes	120	20.0	13	11.0	67	17.8	40	38.1	
Tuberculosis									
-No	579	96.7	113	95.8	365	97.1	101	96.2	0.753
-Yes	20	3.3	5	4.2	11	2.9	4	3.8	
Viral infections									
-No	589	98.3	116	98.3	369	98.1	104	99.0	0.813
-Yes	10	1.7	2	1.7	7	1.9	1	1.0	
Chronic pain									
-No	356	59.4	59	50.0	237	63.0	60	57.1	0.037
-Yes	243	40.6	59	50.0	139	37.0	45	42.9	
Urinary and/or fecal incontinence									
-No	588	98.2	115	97.5	368	97.9	105	100.0	0.291
-Yes	11	1.8	3	2.5	8	2.1	0	0.0	
Stroke									
-No	585	97.7	114	96.6	369	98.1	102	97.1	0.586
-Yes	14	2.3	4	3.4	7	2.1	3	2.9	
Arthritis and/or Osteoarthritis									
-No	569	95.0	110	93.2	355	94.4	104	99.0	0.097
-Yes	30	5.0	8	6.8	21	5.6	1	1.0	
Eye disorders									
-No	535	89.3	105	89.0	339	90.2	91	86.7	0.587

-Yes	64	10.7	13	11.0	37	9.8	14	13.3	
Malaria									0.386
-No	428	71.5	80	67.8	276	73.4	72	68.6	
-Yes	171	28.5	38	32.2	100	26.6	33	31.4	
Classical medicine									0.001
-No	186	31.1	27	22.9	137	36.4	22	21.0	
-Yes	413	69.9	91	77.1	239	63.6	83	79.0	
Tablets /d (n=413)	5.4±4.1		5.6±3.6		4.9±4.0		6.4±4.6		0.012
-1-4 tablets	227	55.0	49	53.8	144	60.3	34	41.0	0.009
->= 5 tablets	186	45.0	42	46.2	95	39.7	49	59.0	
Antidiabetic injection									0.575
-No	582	97.2	113	95.8	367	97.6	102	97.1	
-Yes	17	2.8	5	4.2	9	2.4	3	2.9	
Injections/d (n=17)	2.9±1.3		2.4±1.5		3.5±1.1		2.0±1.1		0.612
Traditional medicine									0.052
-No	328	54.8	63	53.4	218	58.0	47	44.8	
-Yes	271	45.2	55	46.6	158	42.0	58	55.2	
Traditional medicine (n=271): l/d	1.9±1.5		1.9±1.4		1.7±1.2		2.4±1.9		0.049
-1-2 liters/d	220	81.2	45	81.8	133	84.2	42	72.4	0.145
->2 l/d	51	18.8	10	18.2	25	15.8	16	27.6	
Systolic pressure (mmHg)	133.6±15.3		131.2±15.6		133.1±14.8		138.2±15.7		0.003
-Normal systolic pressure	470	78.5	92	78.0	307	81.6	71	67.6	0.008
-Systolic hypertension (>=140mmHg)	129	21.5	26	22.0	69	18.4	34	32.4	
Diastolic pressure (mmHg)	84.6±7.2		82.7±9.4		84.5±5.7		86.9±8.3		0.002
-Normal diastolic pressure (<90mmHg)	509	85.0	103	87.3	329	87.5	77	73.3	0.001
-Diastolic hypertension	90	15.0	15	12.7	47	12.5	28	26.7	
Height (m)	1.70±0.07		1.68±0.06		1.67±0.07		1.65±0.08		<0.001

Weight (kg)	68.6 ±14.7	50.6± 3.9	68.2±9.4	89.9 ±9.1	<0.001				
BMI (kg/m ²)	24.7 ±5.3	17.8 ± 0.7	24.4±2.6	33.2±2.9	<0.001				
WC (cm)	90.1±12.8	84.6±12.3	88.5±10.0	102.0 ±14.7	<0.001				
-Normal	408	68.1	104	88.1	273	72.6	31	29.5	<0.001
-Abdominal obesity	191	31.9	14	11.9	103	27.4	74	70.5	
MUAC (cm)	28.2±5.0	23.9±4.7	28.4±4.2	32.2±4.5	<0.001				
-Undernutrition	128	21.4	71	60.2	53	14.1	4	3.8	<0.001
-Normal and above	471	78.6	47	39.8	323	85.9	101	96.2	

n: number; SD: standard deviation; MUAC: Mid-Upper Arm circumference; WC: Waist circumference;
frs CFA: “francs des Communautés Françaises d’Afrique”.

Table 2. Socio-demographic and health factors associated with undernutrition and obesity compared to normal status/overweight in univariate analysis (n=599).

	Undernutrition vs. normal/overweight			Obesity vs normal/overweight		
	OR	95%CI	p	OR	95%CI	p
Area						
Urban vs. rural	1.1	0.7-1.7	0.653	1.8	1.1-2.7	0.014
Gender						
Men vs. women	1.6	1.1-2.5	0.025	0.4	0.2-0.6	<0.001
Age (years)						
60-69	1			1		
70-79	0.9	0.6-1.5	0.774	1.1	0.7-1.8	0.666
>=80	0.7	0.3-1.6	0.392	2.2	1.2-4.3	0.017
Marital status						
-Married/free union	1					
-Widowed	0.9	0.6-1.3	0.466	0.5	0.3-0.8	0.004
-Divorced	1.2	0.5-3.1	0.675	0.8	0.3-2.2	0.609
-Single	0.8	0.3-2.1	0.662	0.4	0.1-1.2	0.101
Married						
Monogamy vs. polygamy	0.6	0.3-1.1	0.103	0.8	0.4-1.6	0.587
Widowed						
Monogamy vs. polygamy	2.5	0.8-7.4	0.102	0.5	0.2-1.2	0.115
Religion						
-Christian	1					

-Muslim	0.	0.6-1.7	0.890	0.3	0.2-0.8	0.008
-Animist/Atheist	0.9	0.5-1.8	0.978	0.7	0.4-1.4	0.317
Formal education						
No vs. yes	1.3	0.8-1.9	0.249	0.5	0.3-0.8	0.003
Household position						
Head vs. not Head of household	1.3	0.8-2.0	0.261	0.4	0.3-0.6	<0.001
Lifestyle						
With partner and children	1			1		
With partner and grandsons	3.7	1.6-8.7	0.002	1.5	0.5-4.0	0.461
With partner, sons and grandsons	0.8	0.4-1.7	0.597	1.3	0.7-2.6	0.422
Alone/With partner only	1.9	0.9-3.9	0.075	0.5	0.2-1.3	0.137
Without partner and with children	1.0	0.5-1.9	0.996	0.7	0.4-1.4	0.308
Without partner and with sons and grandsons	0.8	0.4-1.8	0.710	1.3	0.7-2.5	0.491
Housing						
Rental vs. Personal/family accommodation	2.2	1.1-4.2	0.022	2.0	0.9-4.0	0.058
Living place						
Lives in his/her home vs. Lives in family's/non-family member's home	1.1	0.7-1.9	0.633	1.1	0.6-1.9	0.724
Active						
No vs. Yes	1.0	0.6-1.6	0.918	1.9	1.0-2.8	0.003
Income						
No vs. Yes	0.9	0.5-1.5	0.622	1.7	1.1-2.9	0.033
Income stability (n=483)						
Yes vs. No	1.0	0.6-1.6	0.984	1.7	1.0-2.8	0.041
Source of income (n=483)						
Trade / Agriculture / Livestock / Handicrafts	1			1		
Retirement pension	1.4	0.8-2.3	0.292	0.8	0.4-1.4	0.374
Donations and bequests	2.3	1.2-4.3	0.008	0.6	0.3-1.5	0.299

Mixed/combined	1.4	0.6-3.3	0.391	0.4	0.1-1.4	0.160
Monthly income (n=483)						
< 60,000 frs CFA vs. >=60,000 frs	1.0	0.7-1.6	0.886	1.3	0.8-2.1	0.383
CFA/92€						
Pathology						
Polypathology	1			1		
One pathology	0.7	0.5-1.1	0.123	0.4	0.2-0.6	<0.001
No pathology	0.5	0.2-0.9	0.020	0.4	0.2-0.7	0.004
Cancer						
No vs. Yes	0.6	0.2-2.1	0.441	1.1	0.2-5.4	0.888
Diabetes						
No vs. Yes	0.8	0.5-1.6	0.590	0.6	0.4-1.2	0.144
Hyperlipidemia						
No vs. Yes	0.6	0.1-6.9	0.703	0.6	0.1-6.2	0.633
Hypertension						
No vs Yes	1.8	0.9-3.3	0.083	0.4	0.2-0.6	<0.001
Tuberculosis						
No vs Yes	0.7	0.2-2.0	0.485	0.8	0.2-2.4	0.646
Viral infections						
No vs Yes	1.1	0.2-5.4	0.906	2.0	0.2-16.2	0.527
Chronic pain						
No vs Yes	0.6	0.4-0.9	0.012	0.8	0.5-1.2	0.273
Urinary and/or fecal incontinence						
No vs Yes	0.8	0.2-3.2	0.790	*	*	*
Stroke						
No vs Yes	0.5	0.2-1.9	0.333	0.6	0.2-2.5	0.530
Arthritis and/or Osteoarthritis						
No vs Yes	0.8	0.4-1.9	0.631	6.2	0.8-46.3	0.078
Eye disorders						
No vs Yes	0.9	0.5-1.7	0.712	0.7	0.4-1.4	0.306
Malaria						

No vs Yes	0.8	0.5-1.2	0.237	0.8	0.5-1.3	0.328
Classical medicine						
No vs Yes	0.5	0.3-0.8	0.007	0.5	0.3-0.8	0.002
Tablets consumption/d (n=413)						
>= 5 tablets	1			1		
1-4 tablets	0.8	0.5-1.3	0.292	0.5	0.3-0.8	0.003
No medication	0.5	0.3-0.8	0.004	0.3	0.2-0.5	<0.001
Antidiabetic injection						
No vs Yes	0.5	0.2-1.7	0.299	0.8	0.2-3.1	0.788
Traditional medicine						
No vs Yes	0.8	0.5-1.3	0.380	0.6	0.4-0.9	0.017
Traditional medicine (n=271): l/d						
1-2 vs. > 2	0.8	0.4-1.9	0.685	0.5	0.2-1.0	0.053
Systolic pressure (mmHg)						
Normal vs. Systolic hypertension	0.8	0.5-1.3	0.377	0.5	0.3-0.8	0.002
Diastolic pressure (mmHg)						
Normal vs. Diastolic hypertension	1.0	0.5-1.8	0.952	0.4	0.2-0.7	0.001
WC (cm)						
Normal vs. Abdominal obesity	2.8	1.5-5.1	0.001	0.2	0.1-0.3	<0.001
MUAC (cm)						
<24 vs >=24	9.2	5.8-14.7	<0.001	0.2	0.1-0.7	0.007

OR: Odds ratio; CI: confidence interval; *The proportion of the variable was too low to perform meaningful OR.

Table 3. Factors associated with undernutrition and obesity compared to normal status/overweight in multinomial analysis.

	Undernutrition vs. normal/overweight			Obesity vs normal/overweight		
	OR	95%CI	p	OR	95%CI	p
Area						
Urban vs. rural	0.9	0.1-1.8	0.710	4.8	2.1-11.0	<0.001
Gender						
Men vs women	1.3	0.6-2.9	0.445	0.4	0.1-0.9	0.026
Marital status						
-Married/free union	1			1		
-Widowed	1.2	0.4-1.8	0.761	0.2	0.1-0.6	0.001
-Divorced	1.2	0.2-5.8	0.865	1.5	0.2-9.8	0.654
-Single	0.5	0.1-2.6	0.388	0.2	0.0-1.6	0.128
Household position						
Head vs. not Head of household	1.4	0.6-3.7	0.455	0.4	0.2-0.9	0.043
Active						
No vs. Yes	0.7	0.3-2.0	0.561	2.9	1.1-8.1	0.040
Income						
No vs. Yes	0.7	0.2-2.4	0.600	0.3	0.1-0.8	0.020
Pathology						
One vs. polypathology	0.8	0.4-1.6	0.472	0.4	0.2-0.9	0.021
Tablets /d (n=413)						
>= 5 tablets	1			1		

1-4 tablets	0.8	0.4-1.7	0.532	1.6	0.6-3.8	0.325
No medication	0.3	0.1-0.8	0.016	0.2	0.1-0.7	0.014
Diastolic pressure (mmHg)						
Normal vs. Diastolic hypertension	1.8	0.6-5.0	0.274	0.2	0.1-0.6	0.002

OR: Odds ratio; CI: confidence interval; WC: Waist circumference; MUAC: Mid-Upper Arm Circumference.