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Full Length Research

Evaluation of the nutritional status and total daily energy expenditure of farmers, fishermen and fish farmers in the northern areas of the Republic of Congo

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ABSTRACT: A descriptive cross-sectional study was carried out among farmers, fishermen and fish farmers aged from 18 to 90 living in the northern areas of the Congo. The objective of this study was to establish a link between total daily energy expenditure and nutritional status during the practice of agriculture, fishing or fish farming. Anthropometric parameters were collected. The people's nutritional status was assessed from calculated Body Mass Index. Total daily energy expenditure was estimated by determining a basal expenditure which is multiplied by the physical activity level for famers/ fishermen. The basal metabolic rate of each subject was estimated from Henry's predictive equations. Statistical tests (chi-square test, Pearson's correlation coefficient and ANOVA test) were used for the statistical analysis of the results. The results showed that the average age of the population was 47.14±13.65 years, the average weight was about 59.96±11.67 kg and the average height was about 1.63±0.08 m. The average Body Mass Index was 23±4 kg/m². The mean total daily energy expenditure was 2697±480 kcal/d (men: 3041±321, women: 2271±245). The prevalence of underweight was 10%. It was higher for farmers (16.7%) than fishermen (3.7%) and fish farmers (2%). The prevalence of overweight was 22%. It was higher for fish farmers (29%), fishermen (26.9%) than farmers (15.2%). In conclusion, the population studied appears to be the victim of a double nutritional and energy burden statistically influenced by the type of activity performed. The correlation was weakly positive (r=0.234) between the Body Mass Index and the total daily energy expenditure which significantly varied (p<0.001) according to the performed activity.

Keywords: Farmers, fishermen, fish farmers, nutritional status, total daily energy expenditure.

INTRODUCTION

The Body Mass Index (BMI) is the most widely used measure to determining an individual's nutritional status. The BMI is an international standard adopted to determine a person's build based on his height and weight. It enables individuals to be classified according to their body size into lean, normal-weight, overweight or obese people (Dubot-Guais, 2005). It should be noted that BMI can represent very different proportions of body fat, depending on age, sex, ethnicity and sports training (NNR, 2012). A normal BMI for adults between 18 and 65 years is between 18.5 and 24.9 kg/m². In the elderly (> 65 years), taking into account a loss of height of 1 to 2 cm per decade, the BMI will increase and will no longer present the same associations of morbidity and mortality. A BMI <23 kg/m² accompanied by an involuntary weight loss is associated with an increased risk of mortality, this is also the case with a BMI >33 kg/m². While overweight does not seem to be associated with an increased risk after 65 years. For pregnant or breastfeeding women, the BMI is calculated on the weight before pregnancy. Preconception BMI is an independent predictor of several complications during pregnancy (EFSA, 2013).

Determining an individual's energy expenditure, taking into account his level of physical activity and nutritional status, is very important in order to adjust his nutritional intake (Pinheiro Volp et al., 2011). Physical activity covers a wider field than that of sport alone, it includes professional activities, almost every day travel and leisure activities. Caspersen et al. (1985) proposed the definition of physical activity as the set of bodily movements produced by the activation of skeletal muscles and resulting in a substantial increase in energy expenditure above resting metabolism. This definition was later adopted by the World Health Organization (WHO). Nutrition is the basis of physical performance; it provides the energy for biological work and the chemicals needed to extract and use the potential energy from food. This energy is used to allow the body to function properly and to perform all of its basic functions. It is divided into three positions of unequaled importance: the energy necessary to maintain basic physiological functions (breathing, heartbeat, etc.) at rest, on an empty stomach, awake and in a neutral environment (EFSA, 2013) which represents 45 to 75% of energy expenditure over 24 hours; the amount of energy required for the digestion or thermal effect of food which is proportional to the amount of food intake and corresponds to about 10% of an individual's total energy expenditure and the rate of energy expenditure in the event of physical activity (variable depending on factors such as age, weight or intensity of the effort) which represents between 15 and 50% or more of the energy expenditure total.

The last two expenses are qualified as extra-basal expenses. The 24-hour energy expenditure therefore makes it possible to determine an individual's daily energy need. Several methods are used to determine this energy expenditure. Among them are indirect calorimetry, bioelectrical impedance, the double-labeled water method and predictive equations. Regarding the predictive equations, energy expenditure is estimated by determining a basal expenditure which is multiplied by the physical activity level (PAL). To evaluate the basal metabolic rate (BMR), predictive equations are proposed on the basis of easily observable parameters (weight, height, sex, age, etc.). The equations proposed by Henry (2005), Schofield et al. (1985), Harris and Benedict (1919), Mifflin et al. (1990), and Muller et al. (2004) have almost identical validity, but no equation can predict BMR very precisely (EFSA, 2013). Some researchers have aimed to create or validate equation models for measuring energy expenditure. Given the prevalence of overweight in the population, European Food Safety Authority (EFSA) and United Kingdom (UK) use Henry's formula, the benefit of which would be to avoid overestimation of BMR (CSS, 2016). In case of overweight or obesity (BMI 25 to 40 kg/m²), there is no consensus on which predictive equation used. EFSA proposes the Mifflin equation, while the UK states that Henry's equation shows 79% accuracy in this population (CSS, 2016).

The nutritional status which represents the state of the organism resulting from the ingestion, absorption and use of food, as well as factors of a pathological nature is therefore a reliable indicator making it possible to assess the energy balance. Indeed, a BMI ≥30 shows that the person consumes more than 2580 kcal, he eats more and spends little and has less physical activities. It can be due to overeating (obesity: results from a positive imbalance in the energy balance over a too long period) and genetic factors. A BMI <18.5 reflects undernourishment (Schindler et al., 2010). Weight loss is a situation where the energy intake from food does not compensate for the expenditure in calories for the maintenance of the body and for the metabolic reactions initiated after rest, during movement. An insufficient calorie intake is contemporaneous with a relative deficiency in proteins and micronutrients (vitamins, zinc, iron, and selenium), all cofactors of important functions (healing, immunity, and fight against oxidative stress). The body then draws on reserves.

Consequently, agriculture, fishing and fish farming are included among physical activities. This research consists of evaluating the TDEE in people practising these activities in the northern areas of the Republic of Congo as well as their nutritional status. Also, the correlation between the TDEE, the practice of the professional activity and the BMI defining the nutritional status in the same people, could be established. It should be noted that in the literature, many researchers have already looked into the topic of energy expenditure such as Vial (2013) and Miller et al. (2018). However, no study on the link between energy expenditure and the practice of agriculture, fishing or fish farming has yet been carried out in Congo. This study seeks to fill the gap.

MATERIALS AND METHODS

To conduct this study, survey cards, adult measuring boards and scales were used. The measuring rods used were those of the United Nations International Children Fund (UNICEF) model for measuring the standing position, a length of 200 cm with graduations of 0.1 cm. The scales used were Seca brand electronic scales with a weighing capacity of 1 to 150 kg in 100 g divisions with an accuracy of ±100 g.

This was a cross-sectional study which consisted in evaluating the nutritional status and estimating the energy expenditure of farmers, fishermen and fish farmers in the departments of Sangha, Cuvette, Cuvette-Ouest and

Plateaux which are considered as the study area. In this work, the anthropometric variables used were: age, sex, height and weight of each respondent practising mainly agriculture, fishing or fish farming. The population concerned by this study was that of 36 localities of farmers, fishermen and fish farmers drawn at random in 19 districts in the departments of Sangha (Mokéko, Ouesso and Pikounda), Cuvette (Boundji, Makoua, Ntokou, Owando, Oyo and Tchikapika), Cuvette-Ouest (Etoumbi, Ewo, Mbama and Okoyo) and Plateaux (Djambala, Gamboma Lékana, Mpouya, Ngo and Ollombo).

Sampling was done using the simple random selection method. The survey was carried out among 548 study participants aged from 18 to 90, including 303 men and 245 women. All respondents over 90 and all of them under 18 were excluded from the numbers of study participants surveyed. Ethical approval was obtained from the Faculty of Science and Techonology at Marien NGOUABI University from the research certificate of March 29th 2019/UMNG/FST/FD-SB. Consent from the participants was obtained prior to them answering the questionnaire.

The main work consisted in determining the households of farmers, fishermen and fish farmers in the different localities of the urban or rural communities drawn by lot. In each household, women and / or men whose main activity is either agriculture, fishing or fish farming were interviewed in order to collect their ages. Weight and height measurements were taken using the same measuring devices for each participant. The weight is measured in light clothing and without shoes in order to obtain the most accurate result possible, and it is measured to the nearest 0.05 kg. The height is measured without shoes and to the nearest 0.1 cm.

Anthropometric measurements were analyzed according to WHO (2006) standards and the different malnutrition were defined for BMI. For 18-year-old adolescents, the BMI was interpreted on the basis of age-specific curves and for which categories of underweight, normal weight and overweight/obesity are determined as a function of percentiles fixed on these curves (CSS, 2016; Mabossy-Mobouna and Mokémiabeka, 2018).

The Total daily energy expenditure (TDEE) was estimated by determining a basal expenditure which is multiplied by the physical activity level (PAL). The basal metabolic rate of each subject was estimated from Henry's predictive equations:

- 18-30 years: 14.4W+313H+113 for men and 10.4W+615H-282 for women;
- 30-60 years: 11.4W+541H-137 for men and 8.18W+502H-11.6 for women;
- >60 years: 11.4W+541H-256 for men and 8.52W+421H+10.7 for women

Where: W = body weight and H = height.

The WHO/FAO/UNU PAL values for famers/fishermen were used: 2.10 for men and 1.82 for women. The data processing was carried out with Statistical Package for the Social Sciences (SPSS) version 20 and Excel 2013 software. The input and production of the raw tables was done with SPSS and Excel software. Quantitative variables are expressed as the mean (M) ± standard deviation (SD) while indicating the extreme values (minimum and maximum). Qualitative variables are expressed in numbers and percentages. The chi-square (c2) test is used for the comparison of variables by Student's law with (k-1) degree of freedom, with a significance level of 5%.

Pearson's correlation coefficient measures the strength of the bond between two characters. It is therefore an important parameter in the analysis of linear regressions (single or multiple). The Analysis of Variance (ANOVA) test makes it possible to demonstrate the influence of a factor on the nutritional status of different study participants. It was used to compare each age, BMI and BMR between females and males, farmers, fishermen and fish farmers.

RESULTS

Sociodemographic characteristics and occupational activity of the study participants surveyed

Table 1 represents the socio-demographic characteristics and occupational activity of the respondents surveyed. A total of 548 study participants were surveyed in four departments of the northern part of the Republic of Congo, 56% rural inhabitants against 44% citizens. The gender of respondents was evenly distributed: 55.29% males and 44.71% females. The mean age of the study population was 47.14±13.65 years, the mode was equal to 43 years and the median 46 years. The mean ages were significantly different between women (44.98±12 years) and men (48.88±12.75 years); between farmers (48.05±14.74 years), fishermen (45.41±12.71 years) and fish farmers (47.27±11.56 years) ($p<0.001$). On the occupational activity level, 52.6% of respondents practiced agriculture as their main activity, 29.2% fishing and 18.2% fish farming.

Basic physical characteristics and BMI

The Table 2 shows the distribution of the body size of the study participants. The average weight of the studied population was about 59.96±11.67 kg. It was 61.38±10.44 kg for men and 58.20±12.84 kg concerning women. The average height of that population was about 1.63±0.08 m. The women average height was 1.575±0.07 m and 1.67±0.07 m for men. The mean weights were significantly different between farmers (56.37±10.51kg), fishermen (64.25±11.08 kg) and fish farmers (63.43±12.50 kg)

Table 1. Sociodemographic characteristics and occupational activity of the study participants surveyed.

Variables		Departments				p-value
		Cuvette	Cuvette-Ouest	Plateaux	Sangha	
Gender	Male (%)	57.4	50.6	56.3	59.7	P=0.502
	Female (%)	42.6	49.4	43.7	40.3	
Mean age (years)		44.52±12	49.37±15	44.52±12	53.13±12	P<0.001
Main activity	Farming (%)	26.5	61.4	65.5	50.0	P<0.001
	Fishing (%)	61.8	6.0	19.5	44.4	
	Fish farming (%)	11.7	32.6	15.0	5.6	
Community	Rural (%)	64.0	56.0	35.6	20.8	P<0.001
	Urban (%)	36.0	44.0	64.4	79.2	
Age group	18-29 years (%)	14.0	18.8	8.6	5.6	p=0.001
	30-60 years (%)	75.7	65.7	80.5	68.0	
	61-90 years (%)	10.3	23.5	10.9	26.4	

Table 2. Basic physical characteristics and BMI.

Variables		Basic physical characteristics and BMI		
		Weight (kg)	Height (m)	BMI ($kg.m^{-2}$)
Overall		59.96±11.67	1.63±0.08	22.68±4.13
Gender	Male	61.38±10.44	1.67±0.07	21.98±3.20
	Female	58.20±12.84	1.57±0.07	23.55±4.92
Main activity	Farming	56.37±10.51	1.60±0.08	21.8±3.90
	Fishing	64.25±11.08	1.65±0.08	23.59±4.08
	Fish farming	63.43±12.50	1.64±0.08	23.55±4.40
	p-value	p<0.001	p<0.001	p<0.001
Department	Cuvette	63.60±11.59	1.65±0.08	23.45±4.42
	Cuvette-Ouest	55.04±10.32	1.60±0.08	21.31±3.15
	Plateaux	60.69±11.52	1.63±0.09	22.95±4.27
	Sangha	62.65±11.53	1.63±0.09	23.80±4.43
	p-value	p<0.001	p<0.001	p<0.001
Community	Urban	60.73±12.60	1.62±0.09	23.17±4.62
	Rural	59.36±10.87	1.63±0.08	22.31±3.66
	p-value	P=0.173	P=0.272	P=0.015

(p<0.001). The mean heights were significantly different between farmers (1.60±0.08 m), fishermen (1.65±0.08 m) and fish farmers (1.64±0.08 m) (p<0.001). The difference is not significant between the weight (p=0.173) and the height (p=0.272) of the populations of the two types of communities, rural and urban. These results indicated that the average BMI of the surveyed population was 22.68±4.13 kg/m^2. The mean BMI were significantly different between women (23.35±4.92) and men (21.98±3.20); between farmers (21.88±3.9), fishermen (23.59±4.08) and fish farmers (23.55±4.4) and also from the rural community (22.31±3.66) to the urban community (23.17±4.62) (p<0.05).

Nutritional situation

The distribution of study participants according to their

Table 3. Nutritional situation.

Variables		Nutritional status				p-value
		Underweight	Normal	Overweight	Obesity	
Gender	Male (%)	9.3	76.1	11.6	3.0	*p*<0.001
	Female (%)	11.4	59.2	20.0	9.4	
Department	Cuvette (%)	6.6	66.2	18.4	8.8	p<0.001
	Cuvette-Ouest (%)	17.6	71.2	8.4	1.8	
	Plateaux (%)	7.5	68.5	18.4	5.6	
	Sangha (%)	4.2	68.0	18.1	9.7	
Community	Urban (%)	8.7	66.4	15.8	9.1	P=0.090
	Rural (%)	11.4	70.4	15.0	3.2	
Main activity	Farming (%)	16.7	68.1	11.5	3.7	p<0.001
	Fishing (%)	3.7	69.4	19.4	7.5	
	Fish Farming (%)	2.0	69.0	20.0	9.0	

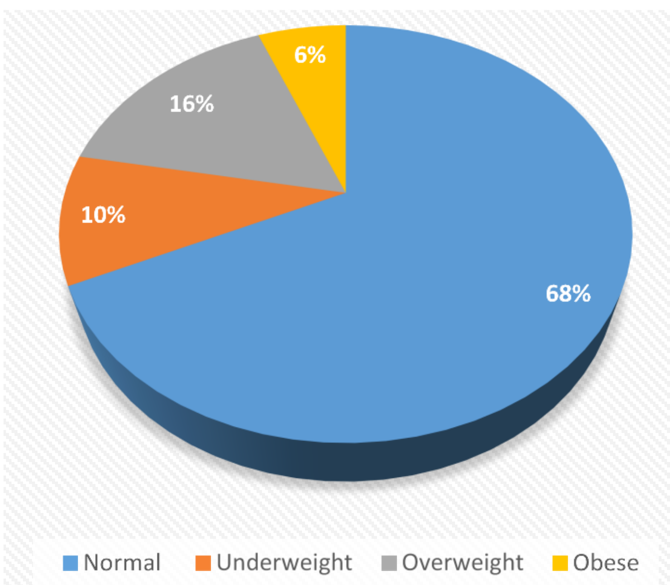

Figure 1. Distribution of study participants according to the Body Mass Index

body size is shown in Figure 1. These results showed overall more normal-weight respondents (68%) than overweight (16%) or obese (6%) among study participants. There was a weak negative *(*r=-0.016) and statistically insignificant (p=0.715) correlation between BMI and the age of the respondents surveyed with an index. This shows that as the age increases, the more chronic energy deficiency sets in the surveyed population, but very slowly. These results (Table 3) show that the rate of overweight/ obesity was higher for women (29.4%) than to men (14.6%). The prevalence of underweight was also higher for women than to men (11.4% vs. 9.3%). The nutritional status of men and women in the study population indicated significant difference (p<0.001). Therefore, there is a significant difference between the nutritional situation of the inhabitants of the different departments (p<0.05). The prevalence of underweight was also unevenly distributed according to the community of residence of the study participants surveyed. There was a high prevalence overweight (24.9% with 9.1% of the obesity rate) in the population living in urban communities compared to that of rural communities (18.2% with 3.2% of the obesity rate). The difference is not significant between the nutritional situation of the populations of the two types of communities (p=0.09).

Those results reveal that the prevalence of underweight was unevenly distributed according to the main professional activity sector practiced by the study participants surveyed. A high prevalence of chronic energy deficiency was noted among farmers (16.7%) compared to fishermen (3.7%) and fish farmers (2%). On the other hand, the prevalence of overweight was low for farmers (15.2%) and very high to fishermen (26.9%) and fish farmers (29%). The type of activity practiced therefore has a significant influence on the subject's nutritional state (p<0.001).

Basal metabolic rate and total daily energy expenditure

The results of Table 4 show the basal metabolic rate and the Total daily energy expenditure. The average TDEE of the surveyed population was 2697±480 kcal/d. There is a statistically significant difference between men and women with respectively 3041±321 kcal/d for men and 2271±245 kcal/d for women (p<0.001). The mean TDEE was higher

Table 4. Basal metabolic rate and Total daily energy expenditure.

Variables		Basal metabolic rate and Total daily energy expenditure			
		BMR (kcal/d)	BMR/body weight (kcal/kg/d)	TDEE (kcal/d)	TDEE/body weight (kcal/kg/d)
Gender	Male (*n*=303)	1448±153	23±2.4	3041± 321	50 ± 4.1
	Female (n=245)	1248 ±135	22 ±2,5	2271±245	40 ± 4.6
	Overall (n=548)	1358 ±176	23 ±2.4	2697±480	46±6.7
	p-value	p<0.001	P=0.169	p<0.001	p<0.001
Age groups	Male (18-29 years)	1480 ±139	23±2.2	3109±291	53±3.3
	Female (18-29 years)	1308±120	23±2.5	2830±218	41±4.0
	Male (30-60 years)	1469±143	23±2.3	3084±305	51±3.7
	Female (30-60 years)	1265±121	23±2.5	2302±220	40± 4.6
	Male (61-90 years)	1343±162	23±2.8	2820±340	46±3.33
	Female (61-90 years)	1107±119	24±2.3	2014±217	39 ± 4.9
	p-value	p<0.001	P=0.311	p<0.001	p<0.001
Main activity	Farming (n=288)	1299 ±163	23 ±2	2556 ±447.148	46 ± 6.87
	Fishing (160)	1429 ±166	23 ±2	2854 ±471.908	45 ± 6.46
	Fish farming (n=100)	1416 ±168	23 ±2	2852 ±463.65	46 ± 6.33
	p-value	p<0.001	P=0.002	p<0.001	P=0.313
Department	Cuvette (n=136)	1416 ±171	23 ±2.5	2818 ± 454	45 ± 6.92
	Cuvette-Ouest (n=166)	1290 ±176	24 ±2.1	2546 ± 482	47 ± 6.20
	Plateaux (n=174)	1371 ±164	23 ±2.5	2723 ± 454	46 ±6.89
	Sangha (n=72)	1377 ±168	22 ±2.5	2749± 463	44 ±6.397
	p-value	p<0.001	p<0.001	p<0.001	P=0.060
Community	Urban (n=241)	1356 ±182	23 ±2.4	2690 ±491	45 ± 6.67
	Rural (n=307)	1360 ±172	23 ±2.4	2701± 472	46 ± 6.62
	p-value	P=0.768	P=0.274	P=0.792	P=0.056

to men than women of the same age group. Furthermore, the expression of TDEE as a function of body mass was TDEE/body weight = 50±4.1 kcal/kg/d for men and 40±4.6 kcal/kg/d for women. The difference observed was statistically significant (p<0.001). The TDEE was negatively correlated according to the age group (r=-0.455).

The TDEE was lower between farmers than fishermen and fish farmers. This difference was statistically very significant (p<0.001). However, expression of TDEE as a function of body mass no longer gave a significant difference (p=0.313). The results indicate that the TDEE and the TDEE/body weight varied by department. The TDEE was lower in Cuvette-Ouest and higher in Cuvette. The TDEE varied very significantly from one department to another (p<0.001). However, the TDEE/body weight was not significantly different from one department to another (p=0.060).

The TDEE and the TDEE/body weight were almost the same between the study participants surveyed in urban communities practicing these three types of activities and those in rural communities carrying out these same activities. The differences observed were not statistically significant (p=0.768).

Correlation between BMI and TDEE

A mean positive correlation (r=0.234) and statistically very significant (p<0.001) was noted between the total daily energy expenditure and the body mass index of the study participants surveyed. In addition, the lower the BMI the more TDEE/body weight increased (r=-0.709).

DISCUSSION

In this study, there were more males than females; furthermore, rural communities were greater than those of urban communities. These results are different from those of Becila (2014) where the female respondents were more than males. In addition, he observed that respondents who lived in urban areas were in great majority.

The average BMI of the surveyed population is 22.68±4.13 kg/m^2. This average BMI is much higher than that obtained by Mabossy-Mobouna and Mokemiabeka (2018) in the city of Brazzaville (18.65±0.9) but, it appears lower than that obtained by Becila (2014) in the Constantine region in Algeria (25.44±0.67) and Ocobock et al. (2020) in Finland.

The proportion of underweight study participants was quite considerable. These results were different from those obtained by Becila (2014) where underweight study participants were in the minority in the Constantine region in Algeria and from those of Elmotia (2010) who made contrary observations to El Haouz in Morocco but similar to those of Baali (2012) in the city of Marrakech, Fifalianaharintsoa (2017) in the region of Vakinankaratra in Madagascar and Mabossy-Mobouna and Mokemiabeka (2018) in the city of Brazzaville. The prevalence of overweight/obesity observed in the surveyed sample was much higher than that reported in several studies in Tunisia (Gaha et al., 2002; Regaeig et al., 2010; Boukthir et al., 2011) and in Morocco (Elmotia, 2010; Achouri et al., 2016). It was close to that recorded in the United States by Caballero et al. (2003) but lower than that obtained in the Middle East by Al-Isa et al. (2010).

These results demonstrate within the sample the coexistence of the double nutritional burden: obesity and undernourishment, a consequence of the nutritional transition experienced by developing countries (Baali, 2012; Achouri et al., 2016; Mabossy-Mobouna and Mokemiabeka, 2018).

The women rate of overweight/obesity was higher than that of men. This could be justified by the difference in the distribution of body fat by sex or by the fact that men were more active than women. Similar observations have been made by Achouri et al. (2016), and Mabossy-Mobouna and Mokemiabeka (2018). The overweight of women in the surveyed sample had a higher rate than that of women nationally obtained during the Congo Demographic and Health Survey (EDSCII, 2012). The prevalence of underweight was also higher for women than to men. This differs from the results obtained by Baali (2012), Dekkaki (2014) in Morocco and Mishra and Dunkwal (2020) in Bikaner District in India. However, this rate of chronic energy deficiency for women in the sample was lower than for women nationally (EDSCII, 2012). The nutritional situation of the inhabitants varied from one department to another. This difference could be due to differences in body fat depending on ethnicity (NNR, 2012), culinary habits, lifestyle, socio-economic distribution or the physical activity level practiced in the department.

There was a high prevalence overweight in the population living in urban communities compared to that of rural communities. This could be explained by the fact that in the two types of communities, the culinary habits, lifestyles, socio-economic distributions and the physical activity level practiced are very different. Indeed, urbanization increases the risk of obesity (overeating, snacking, lower physical activity level, etc.). Likewise, the prevalence of underweight was low in urban communities than in rural communities (8.7% vs. 11.4%). These results are different from those of Nurrizka et al. (2020).

The average basal metabolic rate of the surveyed population was 1358±176 kcal/d. It was much lower than those obtained by Ocobock et al. (2020) in Finland to the average of a healthy population. The study population had on average a low calorie diet. These results were similar to those of Miller et al. (2018) among rural farmers in the village of Ngilo-Ilo. In addition, several studies had already demonstrated this difference according to the sexes (Gaillard et al., 2007; Vignoles, 2014; Miller et al., 2018; Ocobock et al., 2020). Furthermore, the expression of BMR as a function of body mass was BMR/body weight = 23 kcal/kg/d for men and 22 kcal/kg/d for women. These data are almost similar to those found in the Vignoles (2014) work but higher than those of Gaillard et al. (2007). However, they are contrary to those of Ocobock et al. (2020), whose ratio was greater in women than in men. The TDEE was lower for farmers than fishermen and fish farmers. This difference could be due to an insufficiency of food intake in most farmers thus allowing the reduction of their basic metabolic rate in order to be able to preserve energy reserves. In this study, it was necessary to show the boundaries through the lack of data on the dietary intakes of the study participants surveyed.

The correlation was weakly positive (r=0.234) between the BMI and the TDEE which significantly varied (p<0.001) according to the performed activity. In fact, the high prevalence of chronic energy deficiency was noted among farmers compared to fishermen and fish farmers. This could be explained either by the fact that agriculture is an endurance-type physical activity leading to the oxidation of lipids, or by a mismatch between the intake and the protein and/or energy requirements of the body leading to a negative energy balance for most farmers. On the other hand, the prevalence of overweight was low for farmers and very high to fishermen and fish farmers. This difference could be either in the diet of fishermen and fish farmers who have a high energy density (excessive consumption of fish) than those of farmers (excessive consumption of vegetables) or to overfeeding in most fishermen and fish farmers, or to a low energy expenditure during the practice of fish farming and certain types of fishing (Mabossy-Mobouna and Loubelo, 2020).

When the BMI was low, the TDEE/body weight increased. This could be due to the fact that during undernutrition, the loss of lean mass occurs mainly in the skeletal muscles and only slightly affects highly metabolic organs (liver, brain, kidneys, digestive system) (Gaillard et al., 2007; Vignoles, 2014).

Conclusion

Knowing the basal metabolic rate allows us to estimate the total daily energy that the body needs to function according to the physical activity of the individual. This will allow the individual to best adjust his food intake to the real energy needs of his body. This will maintain a zero energy balance, essential for good nutritional status. The objective of this study was to establish a link between total daily energy expenditure and nutritional status during the practice of agriculture, fishing or fish farming by the Congolese. It emerges from this study that the subject's nutritional status and energy expenditure were significantly influenced by the type of activity practiced and the department of residence. In fact, the correlation was weakly positive (r=0.234) between the BMI and the BMR which significantly varied ($p<0.001$) according to the performed activity. However, underweight and overweight on the one hand, low-calorie metabolism and high-calorie metabolism on the other hand existed in the studied population. This was observed regardless of the department of residence or the type of activity performed. Further studies taking into account food intakes and the determination of biological markers to define the nutritional status of study participants would be necessary in order to better interpret the observed differences.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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