

# Nutritional Profile of Pregnant Women in the Lake Area of Cotonou (Benin Republic)

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**Abstract** Adequate nutritional intake during pregnancy and the preconception period is crucial for optimal fetal development and maternal health. The objective of this study was to describe the nutritional profile of pregnant women in the lake area of Cotonou. A cross-sectional analytical study was conducted among 230 pregnant women attending four health centers (two public and two private) in the lake area of Cotonou. Data were collected using a standardized questionnaire, food frequency questionnaire, 24-hour dietary recalls, and Household Hunger Index (HHS). The simplified index of socio-economic position (IPSE) was used to determine the socio-economic level of the participants. Data were analyzed using SPSS 21 software. The chi-square test was used to compare and identify relationships between variables of interest. Analysis of the nutritional status of the participants reveals that 9.1% suffer from malnutrition. The consumption of alcohol, coffee, and tobacco was 32.2%, 34.8%, and 1.7%, respectively. Worryingly, 75% of women do not wash their hands before handling food. The evaluation of the food intake of pregnant women highlights an average energy intake lower than the recommendations. Even more worrying, more than half (57.4%) of women have lower energy intake than average. Finally, the study reveals that 11% of pregnant women are food insecure. Faced with these findings, it is imperative to

implement specific interventions aimed at optimizing the diet of pregnant women and their future babies. These interventions must take into consideration the socio-economic and demographic realities of the populations concerned, as well as issues related to food security.

**Keywords** Pregnant Woman, Nutritional Profile, Cotonou, Food Safety, Nutritional Status

## 1. Introduction

Adequate diet and nutritional intake during pregnancy and the period preceding pregnancy are generally considered optimal for fetal development and maternal health [1]. To meet the needs of the rapidly growing fetus and the increasing physiological needs of the mother, increased caloric and nutrient intakes, including folic acid, iron, iodine, and copper, are recommended [2]. Micronutrient deficiencies can impair maternal and fetal metabolic processes because micronutrients are involved in the formation of new cells and tissues, enzymatic activity, signaling and transcription pathways, and combating oxidative stress [3]. However, extensive

research to date has shown that a significant number of pregnant women fail to meet several nutritional recommendations [4].

A recent study in the Netherlands found that approximately 23–35% of women consumed at least the recommended 200 g of vegetables, and only half (51–56%) ate vegetables daily [5], [6]. Similarly, a Dutch cohort study showed that pregnant women consumed 0.4–1.0 servings of fish per week, which is lower than the recommended 2 servings per week [7].

Several studies have shown that inadequate nutrition during pregnancy is a major cause of uterine growth restriction [8]. The latter affects 3–9% of all pregnancies, and children with reduced fetal growth can have medium- and long-term consequences such as increased risk of hypertension, coronary heart disease, diabetes, and metabolic syndrome. [9].

In the United States, 23,000 infants died in 2015, and low birth weight was the second leading cause of death among the five leading causes of death [10].

Excessive nutrient intake can also pose potential problems for healthcare providers. For example, high maternal intake of vitamin A can cause liver toxicity and birth defects, and excess energy can cause abnormal weight gain, which can lead to premature fetal development and serious associated complications [11].

Given these potential risks, it is important to understand whether women are meeting dietary recommendations and standards. This knowledge will serve as tools for the development of effective intervention strategies and policies to prevent potential risks to maternal and child health. The aim of this study was, on the one hand, to describe the nutritional profile of pregnant women in the Cotonou Lake area of Cotonou and, on the other hand, to determine the risk of giving birth to a low-weight child at birth.

## 2. Materials and Methods

### 2.1. Study Framework

The study occurred in Cotonou in the Littoral Department of the Republic of Benin. Cotonou is located on the coastal strip that stretches between Lake Nokoué and the Atlantic Ocean and covers an area of 79 km<sup>2</sup>. The population of Cotonou in 2013 according to the fourth global census of population and housing is estimated at 679,012 inhabitants, 52% of whom are women, with a projection of 783,901 inhabitants in 2018. The gross literacy rate and school enrollment rate for those aged 15 and over are 73.8% and 80.4% respectively. A woman living in Cotonou can give birth to approximately 3 children. The Fon ethnic group occupies 56.6% of the population and 8% of foreign ethnic groups. The unemployment rate was 3.6%, which affected 41% of women. The main income-generating activities are

transport, fishing, livestock farming, and agriculture. Market gardening is the agricultural sector best suited to the lands of Cotonou, but is constrained by the lack of space.

### 2.2. Type and Study Population

A cross-sectional analytical study was carried out among pregnant women consulting in two public health centers (A ñjedo, Ahouansori) and two private centers (John Holt Clinic, La Confidence Clinic) in the lake area of Cotonou.

The study included pregnant women whose gestational age was less than or equal to 12 weeks and who had expressed the wish to give birth in the selected health center. All participants had resided in the study area for at least six months. Pregnant women who refused to consent to the study or those who consulted occasionally were excluded.

### 2.3. Sampling

#### 2.3.1. Method and Technique

The gestational selection process for this study took place in three rigorous stages, ensuring a representative and statistically robust sample. The proportional stratified sampling method was chosen to ensure an unbiased and fair selection of participants. Firstly, a reasoned selection of the districts of the lake area of Cotonou was carried out. This approach aimed to identify the most relevant areas for the study, taking into account relevant demographic, socio-economic, and health criteria. Then, a judicious selection of health centers and private clinics operating in the selected neighborhoods was carried out. This selection was based on criteria such as attendance, quality of services, and representativeness of the target population.

After determining the sample size to recruit for each health center and private clinic, pregnant women were included in the study using the convenience technique.

#### 2.3.2. Sample Size

Based on the sample size calculation formula proposed by Rea and Parker [12], a minimum size of 230 pregnant women was estimated. This estimate takes into account the following elements:

The prevalence of low birth weight in the Cotonou 1-4 health zone, is estimated at 17.4%;

The number of live births expected in the area is estimated at 3913;

A 10% increase was introduced into the calculation to compensate for possible biases linked to a non-response rate.

$$n = \frac{t^2 * P(1-P) * N}{(t^2 * P(1-P) + (N-1) * y^2)}$$

**n:** Sample size

**p:** prevalence

**N:** Size of the target population (expected birth)

y: Margin of sampling error  
t: Sampling confidence interval

To obtain a representative sample of the pregnant population in the lake area of Cotonou, a rule of proportionality was applied to each health center and private clinic selected. This rule took into account the number of live births recorded in each establishment in 2021, thus ensuring the proportional inclusion of pregnant women attending these structures.

#### 2.4. Data Collection Techniques and Tools

Several tools made it possible to collect the information necessary to achieve the objectives of this work. Indeed, a standard questionnaire was sent to pregnant women to collect sociodemographic, economic, anthropometric, environmental, hygienic, and lifestyle data.

Dietary data were collected using a food frequency questionnaire and 24-hour dietary recalls. The 24-hour dietary recall questionnaire was administered to pregnant women in two rounds, one of which must be on a weekend, using the USDA five-step multiple-pass method [13]. The second visit was made by telephone call with the selected pregnant women.

Household food security and hunger data were assessed using the Household Questionnaire Hunger Index (HHS).

#### 2.5. Determination of Socio-economic Level

The simplified socio-economic position index proposed by Philippe Genoud [14] was adapted to determine the socio-economic level of pregnant women. The calculation taking into account age, training level, and professional category makes it possible to better predict the income of pregnant women. The scores assigned to professional categories and training levels vary from 1 to 7 and increase when the job is less qualified or if the level of training is low. Pregnant women were then divided into five classes, from lower to upper class.

- 1 - 35 Lower class
- 36 - 54 Lower-middle class
- 55 - 67 Middle class
- 68 - 80 Upper-middle class
- 80 Upper class

$$IPSE = \text{age} - 6 \times NF - 4 \times CP + 55$$

Where IPSE= socio-economic position index; NF = training level; CP = professional category.

#### 2.6. Collection Process

Data collection was carried out by a research team composed of four nutritionists, a database manager, and the principal researcher who coordinated the activities. First, the team members were briefed on the work methodology specifically on the data collection tools, previously tested and validated, and on the rules of ethics

and confidentiality. Each investigator has a data collection site that represents the identified health facilities where he was on duty throughout the data collection period. Then the collection began after receiving the agreement of the health authorities of the health centers concerned. With the collaboration of the consulting midwives, eligible women were systematically referred to the investigators. Once arrive, they are informed of the objective of the research by reading the information note validated by the ethics committee and only submit to the tools when they understand the stakes of the research and give their informed consent. Since the collection tools are digitalized, the database manager ensures the completeness and accuracy of the data sent daily [15].

#### 2.7. Data Analysis

The study data were analyzed using SPSS version 21. Quantitative variables were expressed according to their mean. The qualitative variables, for their part, were presented by proportions or figures. Some quantitative variables were categorized and presented as percentages. The chi-squared test was carried out for comparison and the search for relationships between certain variables of interest. All results were evaluated at the 5% significance level.

#### 2.8. Ethical Aspects

Written consent was obtained from the women at the start of the study and they were reassured that they would not be at risk if they refused to participate in the study. We have received positive opinions from the health authorities of the Cotonou 1-4 zone, in this case from the zone coordinating doctor and the head doctor of the A ìj èdo health center for the implementation of this work. This study was also approved by the Health Sciences Research Ethics Committee (CER-SS) and registered under decision number 003-2023/CER-SS.

### 3. Results

#### 3.1. Sociocultural and Demographic Characteristics

The mean age of the 230 pregnant women included in the study was  $25.6 \pm 5.2$  years. The majority of participants (58.7%) were aged 17 to 25. Regarding professional activity, 39.6% of pregnant women were traders, and 31.3% were craftswomen. Crafts represented the main source of income for husbands for 40.9% of participants. Concerning the level of education, 41.3% of pregnant women had reached the secondary level. Religiously, 67.3% of participants were of Christian faith.

Twenty percent of pregnant women reported observing at least one food ban during their pregnancy. This was the second pregnancy or more for 64.8% of participants. On

average, pregnant women already had two children under the age of five, with the youngest being on average 3.1 ± 2.2 years old.

**Table 1.** Sociocultural and demographic characteristics of pregnant women

Variables	n=230	
	%	Mean ± standard deviation
<b>Age of mother (year)</b>		25.60 ± 5.23
<b>Number of children in the household</b>		1.93 ± 1.4
<b>Age of last child</b>		3.17 ± 2.21
<b>Age group</b>		
17-25	58.7	
26-35	37.0	
36-42	4.3	
<b>Mother's occupation</b>		
Artisan	31.3	
Shopkeeper	39.6	
Official	10.9	
Household	18.3	
<b>Father's profession</b>		
Artisan	40.9	
Trader	29.1	
Driver	7.0	
Official	23.0	
<b>Mother's educational level</b>		
Without Schooling	24.8	
Literate Or Primary Level	25.2	
Secondary level	41.3	
Higher level	8.7	
<b>Mother's religion</b>		
Christianity	67.0	
Islam	26	
Tradition	7.0	
<b>Food bans</b>		
No	80.0	
Yes	20.0	
<b>Gesture</b>		
Primigestes	35.2	
Multigestures	64.8	
<b>IPSE</b>		
Lower class	89.6	
Lower middle class	10.0	
Middle class	0.4	

IPSE: socio-economic position index

The average socio-economic position index (IPSE) of the participants was 22.96 ± 9.97. The majority of pregnant women (89.6%) belonged to lower socio-economic strata. We note that no participant belonged to the upper middle or upper classes (Table 1).

### 3.2. Lifestyle and Hygiene

This part of the study, focusing on risky behaviors among pregnant women, revealed that 32.2% of them consumed alcohol, 34.8% coffee, and 1.7% tobacco. The average frequency of consumption was 1.3 ± 1.1 times per week for alcohol, 1.6 ± 1.5 times for coffee and 1 ± 0.8 times for tobacco. Regarding hygiene practices, 57.4% of pregnant women used drinking water from the public water distributor (Soneb) for drinking and cooking. In addition, 52.6% of them systematically washed their hands with soap and water at critical times (Table 2). However, it is concerning that only 12.6% of pregnant women washed their hands after cleaning their child and 24.3% before handling food in the kitchen (Figure 1).

**Table 2.** Characteristics linked to the lifestyle and hygiene of pregnant women

Variables	%	Mean ± standard deviation
<b>Alcohol consumption (n=230)</b>		
No	67.8	
Yes	32.2	
<b>Coffee consumption (n=230)</b>		
No	65.2	
Yes	34.8	
<b>Tobacco consumption (n=230)</b>		
No	98.3	
Yes	1.7	
<b>Sources of drinking water (n=230)</b>		
Drilling	38.3	
Well	4.3	
Soneb *	57.4	
<b>Hand washing with soap (n=230)</b>		
No	47.4	
Yes	52.6	
Frequency of alcohol consumption (n=74)		1.3 ± 1.1
Frequency of coffee consumption (n=80)		1.6 ± 1.5
Frequency of tobacco consumption (n=4)		1 ± 0.8

\* **Soneb:** national water company of Benin

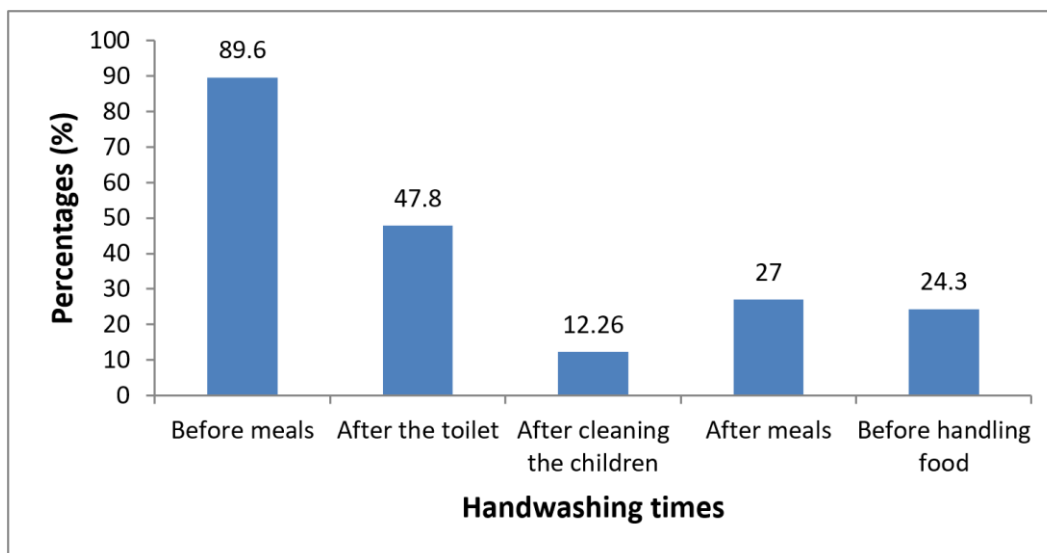


Figure 1. Distribution of pregnant women according to critical hand washing times

### 3.3. Nutritional Status of Pregnant Women

The pregnant women included in this study had an average height of 1.59m ( $\pm 0.06$ ) and an average weight of 62.09Kg ( $\pm 13.56$ ). The mean body mass index (BMI) was 24.30 Kg/m<sup>2</sup> ( $\pm 5.01$ ) and the mean upper arm circumference (MUAC) was 270.62mm ( $\pm 40.03$ ).

Based on BMI, the prevalence of malnutrition among pregnant women was 6.1%. Using arm circumference as an indicator, the prevalence of malnutrition was slightly lower at 5.7%. This difference in prevalence was not statistically significant ( $p = 0.32$ ) (Table 3).

Table 3. Anthropometric characteristics and nutritional status of pregnant women

Variables	%	Mean $\pm$ standard deviation
Midsized		1.59 $\pm$ 0.06
Average weight		62.09 $\pm$ 13.56
Average BMI		24.30 $\pm$ 5.01
Average BP		27.62 $\pm$ 4.03
<b>BMI</b>		
Thinness	6.1	
Normal	60.0	
Overweight	20.4	
Obesity	13.5	
<b>Upper arm circumference (mm)</b>		
<230	5.7	
$\geq$ 230	94.3	
<b>Undernutrition</b>		
No	90.9	
Yes	9.1	

The results of statistical analysis revealed a significant association between BMI and father's occupation ( $p = 0.01$ ), gestational age ( $p = 0.004$ ) and mother's age ( $p = 0.000$ ) (Table 4). The assessment of nutritional status by combining BMI and arm circumference identified that 9.1% of pregnant women suffered from malnutrition. This more comprehensive approach made it possible to detect a greater number of cases of malnutrition compared to the use of a single indicator.

It was observed that pregnant women who sought food assistance in times of difficulty were more likely to suffer from malnutrition ( $p = 0.040$ ). This association highlights the importance of managing dietary problems in pregnant women to prevent malnutrition.

Table 4. Association between BMI and father's occupation, mother's age and gestation

	BMI			p-value
	Thinness (%)	Normal (%)	Overweight Obesity (%)	
<b>Father's profession</b>				0.017
Artisan	50.0	49.3	21.3	29.0
Trader	35.7	23.9	34.0	41.9
Driver	7.1	8.0	6.4	3.2
Official	7.1	18.8	38.3	25.8
<b>Gesture</b>				0.004
Multigesture	28.6	63.0	68.1	83.9
Primigest	71.4	37.0	31.9	16.1
<b>Age group</b>				0.000
17-25	78.6	68.1	42.6	32.3
26-35	21.4	29.7	51.1	54.8
36-42	0.0	2.2	6.4	12.9

### 3.4. Food Consumption of Pregnant Women

The average energy consumption of the pregnant women studied was  $1,608.52 \pm 250.58$ Kcal (Table 5). This value is lower than the nutritional recommendations established for pregnancy. Indeed, energy needs gradually increase during pregnancy to meet the needs of fetal development and maternal physiological changes.

Despite this overall insufficiency, it is important to note that more than half (57.4%) of pregnant women had an energy intake even lower than the average (Table 6). This highlights a significant prevalence of insufficient energy intake in this population. Conversely, approximately 20% of pregnant women met energy intake recommendations.

In addition to overall energy insufficiency, the analysis revealed insufficient consumption of most of the nutrients studied, except carbohydrates and phosphorus (Table 5). This is concerning because nutrients are essential for the proper development of the fetus and the health of the mother.

### 3.5. Food and Nutritional Safety

The analysis reveals that the food security situation is critical for around 11% of pregnant women. Faced with these food difficulties, 36.5% of them resort to financial or food assistance from their loved ones as a resilience strategy.

The study highlights an average consumption of  $3.33 \pm 0.66$  food groups by pregnant women.

**Table 5.** Nutritional and energy values of food consumption of pregnant women

	Average	Standard deviation	Standard*
Energy (Kcal)	1608.52	250.58	2200
Protein (g)	40.66	5.75	55
Lipid (g)	23.86	5.40	ND
Glucide (g)	<b>204,27</b>	37.42	175
Fibre (g)	15,68	2.61	28
Calcium (mg)	189,21	13.91	800
Fer (mg)	9,245	2.83	27
Magnésium (mg)	284,25	48.99	350
Phosphore (mg)	<b>721,87</b>	92.39	700
Potassium (mg)	1683,45	98.06	4700
Sodium (mg)	170.86	17.97	1500
Zinc (mg)	5.34	2.32	9.5
VITB12 ( µg )	1.14	0.82	2.6
VITC (mg)	25.15	3.41	70
VITA ( µg )	104.31	13.51	770
VITB9 ( µg )	111.73	28.08	600

Standard\*: Institute of Medicine

**Table 6.** Food consumption of pregnant women

Variables	Frequency	Percentage
<b>Hunger Index (HHS)</b>		
Little or no hunger	204	88.7
Moderate hunger	18	7.8
Severe hunger	8	3.5
<b>SCA</b>		
Poor consumption	2	0.9
Consumption limit	24	10.4
Acceptable consumption	204	88.7
<b>SDA</b>		
< 4 food groups	140	60.9
≥ 4 food groups	90	39.1
<b>Food aid in case of difficulty</b>		
No	146	63.5
Yes	84	36.5
<b>Energy consumption</b>		
Below average	132	57.4
above average	98	42.6

## 4. Discussion

The present study aimed to describe the nutritional profile of pregnant women residing in the lake area of Cotonou. The analyses carried out highlighted that the majority of pregnant women (89.6%) came from disadvantaged socio-economic groups. In terms of risky eating behaviors, 32.2% of pregnant women consumed alcohol, 34.8% coffee, and 1.7% tobacco. Furthermore, it is worrying to note that approximately 75% of pregnant women did not wash their hands before handling food in the kitchen, thus potentially exposing their health and that of their fetus to health risks.

The assessment of the nutritional status of the participants revealed that 9.1% of them suffered from malnutrition. This alarming situation highlights the need for targeted intervention to improve the nutrition of pregnant women in this area.

Statistical analysis made it possible to identify a significant association between the nutritional status of pregnant women and several factors, such as the father's profession, gestation, the mother's age and the fact of having benefited from food aid, and finances during pregnancy. These results highlight the importance of taking these factors into account when implementing maternal and child nutrition programs.

The evaluation of the food consumption of pregnant women showed that the average energy intake of the population studied was lower than the recommended

standards. Even more worrying, more than half (57.4%) of pregnant women had lower energy intake than average. Finally, it emerged that the food security situation was critical for around 11% of pregnant women, further aggravating their nutritional vulnerability.

In view of the results obtained, it is undeniable that the objective of this study, aiming to depict the nutritional profile of pregnant women in the lake area of Cotonou, was fully achieved.

The validity of this study relates to the use of proportional stratified sampling with a reasoned selection of neighborhoods and health centers which made it possible to obtain a representative sample of the pregnant population in the lake area of Cotonou, with the use of standardized and validated questionnaires for data collection with the use of the USDA five-step multiple-pass method for dietary data collection and ethical approval from the Health Sciences Research Ethics Board health of Benin. However, the convenience technique for including participants can potentially introduce selection bias. Nevertheless, the solid methodology of this study makes it possible to provide reliable information on the nutritional situation of pregnant women in the lake area of Cotonou.

Comparison of our results with data from the literature highlighted notable convergences, but also divergences that can be largely attributed to methodological specificities, study contexts, and sociodemographic characteristics of the populations included. Thus, our conclusions concerning the absence of a significant link between socioeconomic status and the nutritional status of pregnant women differ from those reported by Janneth et al. [16] and Hanumant [17]. These differences could be explained by several factors. First, Janneth broadened her sample to a general population including people of both sexes and residing in both urban and rural areas, and assessed nutritional status indirectly, through the food insecurity indicator. Furthermore, Hanumant, although targeting pregnant women, used a body mass index (BMI) different from ours, which combined BMI and mid-upper arm circumference.

Concerning dietary diversity, our results indicate that nearly 61% of women have low dietary diversity. This proportion is slightly lower than that reported by Abebe et al. [18] (73%), but the prevalence of malnutrition is significantly lower in our study. These discrepancies could be explained by the significantly larger sample size of the Abebe et al.'s study, coupled with using a logistic regression model to adjust dietary diversity for other variables. In contrast, our study used a chi-square test to look for associations.

Regarding nutritional intake, our results show a lower average energy intake than that reported by Tayyem [19]. This discrepancy could be explained by the disadvantaged socioeconomic background of our study population, which translates into precarious living conditions.

Furthermore, Tayyem et al.'s methodology differs from ours with regard to the recruitment period of participants. Indeed, their subjects were recruited at different stages of pregnancy (9th, 20th, and 30th weeks), whereas our study focused on pregnant women less than 12 weeks. A systematic review [20] comparing the nutritional intakes of African pregnant women to those of Caribbean and American women highlights higher average intakes among the latter, with diets based on cereals. These observations support our results, which indicate low consumption of most nutrients except carbohydrates and phosphorus, reflecting the predominant cereal-based dietary habits in Africa.

In Congo, a study [21] reports that 25% of pregnant women have adequate dietary diversity but insufficient intakes of calcium, thiamine, riboflavin, and vitamin B6.

Regarding lifestyle, our results indicate a 1.7% prevalence of smoking during pregnancy, well below the 14.1% reported by Hoteit [22]. This difference can be explained by sociocultural values and the negative perception of society towards women smokers in Benin.

Concerning food insecurity, our results show 11.3% of pregnant women experiencing food insecurity, including 3.5% severely affected. These data are consistent with those of Azevedo's systematic review [23] (11.5 to 80%), and are explained by common factors such as low education level, low income, informal employment and unemployment. However, the results from a study conducted in Ethiopia [24] highlight a significant prevalence of food insecurity, estimated at 50% among individuals included. These data could be influenced by specific methodological choices, in particular the focus of recruitment on pregnant women during weeks 32 to 36 of their pregnancy. This particular period of the gestational cycle could accentuate the vulnerability of participants and, consequently, overestimate the overall prevalence of food insecurity.

## 5. Conclusions

This study highlights the precarious nutritional situation of pregnant women in the lake area of Cotonou, characterized by risky eating behaviors, a high prevalence of malnutrition, and insufficient energy intake. These results highlight the need for a multidimensional intervention aimed at improving access to a healthy and balanced diet, raising awareness of good food hygiene practices and strengthening maternal and child nutritional support programs.

## Conflict of Interest

The authors declare no conflict of interest for this study.

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