FOOD SECURITY AMONG YOUNG BENINESE FEMALE HANDBALL PLAYERS : CONTRIBUTION OF A NUTRITION EDUCATION PROGRAM

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ABSTRACT

Food security, defined as regular access to sufficient, varied, and nutritious food, is essential for health and athletic performance. Among young Beninese handball players, a lack of nutritional education can lead to limited dietary diversity and insufficient intake, signs of food insecurity that may contribute to the poor performance observed before 2019 at the continental level. Targeted nutritional education therefore appears necessary to improve their food consumption. Objective. This study aims to evaluate the effect of a nutritional education program on the food security of young Beninese handball players during their preparation for the 2019 Challenge Trophy. Methods. Direct observation of the three daily meals was conducted over the five days of preparation at each of the two training camps for the 2019 Challenge Trophy, with 36 young handball players. The Food Consumption Score (FCS), a food security indicator, was calculated before and after the nutritional education. The eight food groups defined by the French Agency for Food Safety (ANSES) served as a reference for assessing dietary diversity and safety. Results: The mean age of the participants was 17.0 ± 1.6 years. Before the nutrition education program (PEN), the Dietary Consumption Score (DCS) was 36, indicating a borderline level of food consumption and predisposing the players to a potential risk of food insecurity. After the intervention, the DCS reached 59, reflecting an acceptable level of food consumption and a state of food security. Conclusion: Nutritional education improved the food security of young female handball players by significantly increasing their dietary diversity during the preparation for the 2019 Challenge Trophy. These results highlight the importance of educational interventions in preventing food insecurity and optimizing athletic performance.

Keywords: Dietary diversity, Dietary Consumption Score, Nutritional education, Handball, Benin.

INTRODUCTION

Efforts to eradicate food insecurity worldwide are still far from achieving the 2030 Sustainable Development Goal (SDG). In Benin, 2017 estimates revealed that 42.9% of the population experienced marginal food insecurity, 9.6% moderate food insecurity, and 0.7% severe food insecurity. Furthermore, 21% of households were food insecure, compromising their ability to lead healthy and active lives (WFP, 2017).

In this context, the young female handball players targeted by this study constitute a particularly vulnerable group, given that nutrition is a key determinant of health and athletic performance (Sas-Nowosielski and Wycislik, 2019). Inappropriate nutrition can lead to fatigue, cramps, decreased performance, or even serious complications (Ebardo et al., 2025; Casa et al., 2019). Furthermore, food insecurity can reduce concentration during training and affect overall performance (Anziano and Zigmont, 2024). Among young Beninese female handball players, adequate nutritional monitoring remains insufficient, even during training camps in preparation for international competitions.

Their meals are often provided by caterers without training in sports nutrition (Kiki et al., 2021), which could contribute to the poor performances observed before 2019 at the continental level of the Challenge Trophy. In this context, nutritional education appears as an essential strategy to

improve athletes' food consumption (Douglas et al., 2024). Raising awareness among catering managers and advocating with the Beninese Handball Federation for adequate material and financial support are fundamental steps to strengthening the impact of the nutritional education program. The Food Consumption Score (FCS), a standardized tool developed by the World Food Program (WFP), is an accessible and relevant indicator for assessing nutritional adequacy, taking into account the diversity, frequency, and nutritional value of foods consumed (WFP, 2014). While several international studies have highlighted food insecurity among athletes, few have proposed an educational intervention involving all stakeholders. This study, the first of its kind in Benin, contributes to this effort.

It aims to identify potential nutritional imbalances among young Beninese handball players and to propose a strategy to improve their food consumption in order to optimize their health and performance.

METHODOLOGY

1. Research protocol

This uncontrolled intervention study was conducted with young female handball players from the Benin national team over a six-month period, as part of their preparation for the 2019 Challenge Trophy Tournament. Two five-day training camps, separated by an interval of five months and twenty days, were integrated into the protocol. During the first camp, initial data collection allowed for the calculation of the players' Dietary Consumption Score (DCS), constituting the diagnostic assessment prior to the implementation of the Nutrition Education Program (NEP). During the last 24 hours of this camp, an initial face-to-face NEP session was delivered to the handball players to reinforce their understanding of the importance of adequate nutrition in preventing food insecurity and promoting optimal athletic performance.

Between the two camps, four actions were undertaken. The first consisted of an advocacy campaign addressed to the Executive Committee of the Benin Handball Federation (FBHB) to ensure the availability of the financial resources necessary for implementing the recommended menus. The second involved the continuation of remote nutritional education: once a week, an SMS message was sent individually to the handball players reminding them of the importance of dietary diversity and adequate food consumption. The third action was to raise awareness among the catering staff regarding food choices, variety, adherence to meal frequency, and, above all, the strict application of the menus proposed by the researcher for implementation after the PEN at the second camp. The fourth action was the proposal of a varied menu, developed according to the recommendations of the AFSSA (2000), to cover the handball players' nutritional needs over a five-day period.

Three days before the start of the second camp, the five-day varied menu was made available to the cooks for preparation. During the last 24 hours of this camp, a second, identical data collection, conducted under the same conditions as the first, was carried out as a formative assessment. This second data collection allowed for the estimation of the SCA (Supplementary Dietary Capacity) after the intervention. Comparing the SCA before and after the PEN (Nutritional Education Program) was used to assess the effect of the nutritional education program.

Before the start of the study, authorization was obtained from the FBHB (Belgian Handball Federation) and the Sectoral Scientific Committee for Sciences and Techniques of Physical, Sports, and Socio-educational Activities of the University of Abomey-Calavi (CSS/STAPS/UAC). All players were informed of the objectives, benefits, and potential risks before providing their free, informed, and written consent. They were assured of data confidentiality and the destruction of the questionnaires within 12 months.

2. Study sample

The sample consisted of 36 female handball players from the 2019 Benin National Elite Team, aged 17 to 19. All were selected to prepare for and participate in the qualifying tournaments for the 2019 Challenge Trophy.

3. Data collection techniques and tools

Two data collection techniques were used: direct observation and a self-administered questionnaire. Direct observation allowed for an assessment of dietary diversity. A guide containing the eight food groups essential for a balanced diet, according to the French Agency for Food Safety (AFSSA, 2000), as well as information on water, was used. Observers checked the boxes corresponding to the food groups consumed at breakfast, lunch, and dinner each day. In accordance with AFSSA recommendations, the eight food groups should be represented at least at lunch and then at dinner.

The self-administered questionnaire collected sociodemographic data (age, height, weight, origin) and data related to sports participation, including length of time on the national team.

The content and structure of the observation guide and questionnaire were validated by a senior researcher at the University of Abomey-Calavi, an expert in food science.

4. Variable

Studied The only variable studied in this analysis is food insecurity. It was measured based on food consumption habits, a global indicator of individuals' diet that allows us to estimate whether individuals are consuming sufficient nutrients. The tool used is the Food Consumption Score (FCS), a standardized tool of the World Food Program (WFP, 2014). The FCS takes into account three elements: the diversity of foods consumed, the frequency with which different food groups are consumed, and their relative nutritional value. However, it does not measure the quantities of food consumed.

In this study, the handball team was treated as a household, as meals were served uniformly to all players and prepared by the same caterers under homogeneous socioeconomic and cultural conditions, thus ensuring a consistent assessment of the SCA (Small Cost of Consumption).

The consumption score was calculated using the following formula (Dassou et al., 2020; Sossa et al., 2014):

$$SCA = a_{ctl}x_{ctl} + a_{sugar}x_{sugar} + a_{milk}x_{milk} + a_{vegetablesCc}x_{vegetablesCc} + a_{fruitsCc}x_{fruitsCc} + a_{meat/egg/fish}x_{meat/egg/fish} + a_{Fatsvegetale}x_{Fatsvegetale} + a_{Fatsanimal}x_{Fats\ animal}$$

Legend. ctl: cereals, tubers, legumes; vegetables Cc: raw or cooked vegetables; fruits Cc: raw or cooked fruits; vegetable fats: cooking vegetable oils; animal fats: butter.

In this formula, ai represents the weight assigned to the food group, and xi, the number of days of consumption for each food group, which is generally less than or equal to seven days (PAM, 2014). The weight of each food is determined from the weighting table (Table I).

Furthermore, although water is not classified among the food groups, it plays an essential role in human nutrition, particularly for athletes (Evans et al., 2017). For this reason, this study considered the inclusion of water in the menu to raise awareness about hydration. Table I shows the weighting of the food groups used in calculating the Dietary Consumption Score.

Table I: Weighting of food groups for calculating the DCS

(Dassou et al., 2020, Sossa et al., 2014)

Food groups	Weighting (a)
Cereals/tubers/legumes	2 / 2 / 3
Milk and dairy products	4
Raw or cooked vegetables	1
Raw or cooked fruit	1
Meat/fish/eggs	4
Sugar and sugary product	0,5
Fats vegetable	0,5
Fats animals	0,5
Water	00

The SCA (Small Consumption Index) was assessed according to data defined by the literature, with a minimum value of 0 and a maximum value of 112 (Sossa et al., 2014). An SCA ≤ 35 indicates a level of food insecurity, and in this case, food consumption is considered poor. Values between 35 and 45 (35 < SCA ≤ 45) suggest a risk of food insecurity; therefore, consumption is considered borderline. Conversely, when the SCA > 45, consumption is considered acceptable and indicates a food security situation (WFP, 2014). Thus, the handball players' food consumption was classified into three categories: poor, borderlineand acceptable.

5. Statistical Analysis

The study data were analyzed using SPSS software (IBM, USA, version 22.0), for both the observation and the questionnaire. The sample sizes for each category (present or absent) for the observations were entered into a contingency table. Only food groups that underwent significant changes following the PEN were considered in this analysis, thus focusing on the dietary diversity of the handball players. Subsequently, McNemar's test was performed, using the outliers, i.e., those that showed changes following the PEN.

RESULTS: Sociodemographic, anthropometric, and sports participation characteristics of the handball players

(Table II: Table II: Sociodemographic, anthropometric, and sports participation characteristics of the handball players studied (n = 36)

Variables	Mean ± standard deviation
Age (years)	17,0 ± 1,6
Size (cm)	162,9 ± 7,2
Body mass (kg)	59,2 ± 6,4
Body mass index (kg/m2)	22,3 ± 1,6
Daily training hourly mass (H)	5,0 ± 0,0

Length of experience (years)	1,7 ± 0,6

2. Observational results

- **Dietary diversity**

Observations indicated that the three main meals for the handball players, particularly breakfast, lunch, and dinner, before the implementation of the Nutritional Impact Assessment (NIA), were deficient in dairy products, fruits, raw or cooked vegetables, and animal fats (butter), representing four of the eight necessary food groups (Table IV). Furthermore, water was not provided at the table for the players. Following the NIA, the number of food groups in the players' main meals increased from four to all eight. In addition, after the NIA (see Table V), water was served at the table with all main meals, increasing from 0% to 100%.

- **Food consumption score (FCS)**

Before the implementation of the Nutrition Education Program (NEP), the handball players' food consumption was considered borderline, with an FCS of 36 (between 35 and 45), suggesting a risk of food insecurity. Following the program, this score increased, indicating a significant improvement in food consumption, with an FCS of 59 (above 45), placing them in a food security category.

- **Food security**

The calculation of dietary diversity and the FCS allowed for an assessment of the handball players' food security during the two training camps for the 2019 Challenge Trophy Tournament. It improved from borderline to acceptable before and after the nutrition education program, respectively.

DISCUSSION

The objective of this study was to evaluate the effect of a nutritional education program on the food security of young Beninese female handball players during their preparation for the 2019 Challenge Trophy. The results obtained are reliable because the players were observed under real-world conditions of intensive training during a continental competition. All players were monitored through direct observation during their three daily meals at the two training camps in preparation for the 2019 Challenge Trophy Tournaments. This observation revealed the nutritional deficiencies the handball players faced. It is worth noting that the elite Beninese players had a BMI within the standards required for high-level physical activity: they were neither obese nor overweight. Furthermore, they had access to the three main meals each day during their stay at the two training camps.

The low SCA observed in the handball players before the PEN indicates a deficient diet, suggesting food insecurity during the first training camp. Indeed, the meals served to the players were deficient in raw or cooked vegetables, dairy products, butter, and raw or cooked fruit, the latter being very rare (see Table III). Moreover, the lack of water during meals is concerning, as hydration is essential for maintaining the physiological and psychological balance of athletes (Evans et al., 2017; Richard, 2014). Milk, rich in calcium, is essential for bone development (CAN, 2014) and particularly crucial for growing children whose nutritional needs increase during puberty (El-Shaheed et al., 2019). The lack of milk and butter, and the insufficient intake of fruits and vegetables in the diets of handball players, presents a risk of micronutrient deficiencies, such as calcium, vitamins, and minerals, potentially exposing them to malnutrition and negatively impacting their performance (Istace and Stévens, 2018). The absence of milk in the handball players' diets corroborates the results of a

previous study from ten years ago, which observed that the diet of residents of Porto-Novo, the city that hosted the training camps, was devoid of dairy products (Dansou et al., 2000).

Fruit and vegetable consumption is essential, but depends on various factors, including economic status, education level, family income, and availability (Tarigan et al., 2019). In Benin, other studies have shown that education level (Aguêh et al., 2016) and the perception of healthy eating (Nago et al., 2012) also influence fruit and vegetable consumption. Therefore, the lack of fruits and vegetables in the handball players' diets during the first training camp could be attributed to financial constraints and a lack of expertise among the catering staff in sports nutrition. This finding strongly challenges the tertiary sector stakeholders (the FBHB) involved in the handball players' training program regarding their financial investment in ensuring adequate nutrition for the players.

The diet of female handball players, based on cereals and starches as staple foods and deficient in fruits and animal products, is indeed common in low-income countries (Tarigan et al., 2019) such as the Republic of Benin. However, according to the WHO, a prolonged absence or excess of any of the essential nutrients can lead to nutritional diseases such as obesity, diabetes, and hypertension (WHO, 2024). The high physical demands of competition expose athletes to repeated injuries (Difiori et al., 2018), which can be exacerbated by nutritional deficiencies. It is therefore urgent to prevent all forms of malnutrition or poor dietary practices among female handball players in order to preserve their health and optimize their performance (Casa et al., 2019).

Among handball players prior to the PEN (Prior Nutrition Assessment), diets were not diversified, and the borderline SCA (Supplementary Dietary Allowance) suggests inadequate food consumption and a potential risk of food insecurity. These results are consistent with those obtained by the WFP (World Food Programme) with farming households in Benin, whose diets are not sufficiently diversified and are very low in fruits, meat, and milk. However, it must be acknowledged that the sample size of the handball players is small (36 players) compared to that of the Beninese population. These results contradict those of Gebre (2012) and Regassa et al. (2011), who respectively conclude in their studies that a large household size increases the risk of food insecurity and that household size determines food security status.

The results obtained among the handball players after the Nutrition Education Program (PEN) show that their food security improved from borderline to acceptable. These results are similar to those of the Carlton study, which showed that the food security of young athletes significantly increased after its nutrition education program (Carlton, 2021). Although this improvement is evident among the Beninese handball players, the scarcity of previous research on the effect of nutrition education on food insecurity limits the possibilities for contextualizing these results. Nevertheless, the observed improvement is a strong indicator of the intervention's effectiveness and suggests a positive impact on the population's dietary diversity, provided that monitoring is continuous. It is therefore imperative to ensure a consistently adequate food intake for the handball players. Furthermore, the Executive Committee should establish a formal system for monitoring the handball players' diets. This system should include the involvement of a sports nutrition and dietetics specialist and appropriate resources to maintain optimal nutritional levels sustainably.

CONCLUSION

The objective of this study was to evaluate the effect of nutritional education on the food consumption of young Beninese handball players during their preparation for the 2019 Challenge Trophy. The program led to an improvement in the players' food security status during the preparation period. The data indicate that the handball players were at risk of food insecurity, with a borderline consumption score of 36. At the end of the program, the consumption score increased considerably to 59, demonstrating acceptable consumption and improved food security. Essential foods such as raw or

cooked fruits, raw or cooked vegetables, dairy products, and butter, which were absent during the first phase of the program, were included in the second phase following the intervention of the program. This increased the diversity of the diet from 4 food groups to the 8 recommended by the French Agency for Food, Environmental and Occupational Health & Safety (ANSES). Furthermore, water consumption, which was nonexistent before the program, improved by 100% afterward. These results were made possible not only by the interaction of the actors involved in the preparation of the players but above all by the management used and the effectiveness of the nutritional education program offered on the importance of dietary diversity and appropriateness.

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