NUTRITIONAL PROFILE OF CHADIAN ELITE COMBAT ATHLETES: A QUANTITATIVE APPROACH IN THE PRE-COMPETITIVE PHASE

ABSTRACT

Nutritional balance represents a fundamental determinant of both athletic performance and health, particularly within elite combat disciplines, which are frequently exposed to dietary imbalances. The present investigation sought to quantitatively assess energy intake alongside macro- and micronutrient profiles in Chadian elite combat athletes during the pre-competitive phase. This prospective cross-sectional study included 63 athletes (32 men and 31 women), aged between 16 and 29 years. Dietary intake was evaluated using a 24-hour recall method, applying a multifactorial approach. Findings revealed significantly higher energy intake among men (3414.44 ± 210.21 kcal/day) compared with women (2665.54 ± 257.01 kcal/day; $p < 0.0001$), consistent with international recommendations for athletes. Protein intake was adequate (1.73 ± 0.37 g/kg/day in men; 1.59 ± 0.57 g/kg/day in women), with no statistical difference ($p > 0.05$). Lipid intake accounted for 30% of total energy in men and 28% in women ($p > 0.05$), considered satisfactory. Carbohydrate intake met recommended standards but was significantly higher in men (7.34 ± 1.14 g/kg/day) compared with women (6.34 ± 1.05 g/kg/day; $p < 0.001$). At the micronutrient level, excessive intakes of iron and phosphorus were observed, while a marked calcium deficiency affected both sexes ($p < 0.0003$). Intakes of vitamins B1, B2, B6 and C were generally adequate, albeit slightly above recommended thresholds. These results highlight the need for targeted educational strategies to address identified imbalances and optimise competitive preparation in Chadian athletes.

KEYWORDS : Sports nutrition; energy intake; macronutrient; micronutrient; combat sports; pre-competition.

INTRODUCTION

Energy deficits are frequently observed among athletes, adversely affecting both their health status and sporting performance (1) (2). This issue largely stems from athletes' insufficient knowledge of their precise energy requirements and of the macro and micronutrient intakes necessary to meet them adequately. Recent studies have highlighted a notable underestimation by athletes of their daily nutritional needs, particularly in terms of energy and carbohydrate intake, with statistically significant discrepancies compared with established recommendations (3). This observation is of particular relevance in the context of high-level combat sports, where athletes' dietary habits are often characterised by pronounced imbalances. Each martial art or wrestling discipline adheres to a specific set of rules defining its unique status, shaped by the techniques employed and the demographic profile of its practitioners (4). Despite these differences, combat sports are inherently technical and strategic disciplines, marked by high energy expenditure that varies according to weight category.Scientific literature indicates that face-to-face confrontations in combat sports place considerable demands on anaerobic energy systems, notably the Adenosine Triphosphate-Phosphocreatine (ATP-PCr) system and the lactic glycolytic system during intense maximal efforts, while aerobic processes remain active throughout the bout (5) (6) (7) (8). One of the principal nutritional challenges specific to combat sports lies in the system of weight categorisation, which frequently compels athletes to adopt rapid weight-loss (RWL) strategies prior to competition (9) (10). Such behaviours have given rise to a range of inappropriate dietary practices, including meal omission, exclusion of essential foods or entire food groups required to meet daily nutritional needs, and disordered eating behaviours such as binge-purge cycles involving the use of diuretics and laxatives. These practices pose major health risks and compromise athletic performance.For instance, rapid reductions in body mass (2–10%) through dietary restriction (fasting and dehydration) have been associated with: 1) increased oxidative stress leading to electrolyte and hormonal imbalances; 2) depletion of glycogen stores; 3) alterations in blood flow dynamics; 4) reduced plasma volume; and 5) significant acute renal impairment (11) (12). RWL strategies are also correlated with various deleterious physiological and psychological effects, such as reduced urinary output impairing toxin elimination, heightened fatigue, and concentration difficulties, particularly among wrestlers and taekwondo practitioners (13) (14). Several studies have further identified recurrent deficiencies in essential micronutrients among combat sport athletes, notably vitamin D, magnesium, and calcium (15) (8).Although the determinants of health risks associated with RWL strategies are increasingly well documented, their detrimental effects on performance remain insufficiently clarified. Under certain specific conditions, some studies suggest that RWL can be undertaken without inducing significant physiological or athletic impairments in combat sport practitioners (9) (16) (17) (18). Conversely, other authors adopt a more cautious stance, emphasising that more substantial reductions in body mass over a 24-hour period may impair the ability to sustain repeated physical efforts (19). Similarly, other investigations have reported that a perceived decline in energy levels constitutes the most frequently cited adverse effect of RWL, with additional negative consequences including cognitive disturbances such as reduced concentration and episodes of confusion, as well as diminished motivation impairing performance (14).It is therefore evident that, prior to implementing RWL strategies, a thorough assessment of the nutritional status of combat sport athletes is imperative to ensure optimal management that safeguards health and enhances performance. Athlete nutrition has long been a subject of concern for researchers worldwide, with numerous studies conducted in the field of sports nutrition (3) (20) (21) (22). However, research focusing specifically on combat sports remains relatively scarce, and very few studies have been undertaken in sub-Saharan Africa (11) (15).In Chad, historical data and empirical observations reveal that national athletes' performances in combat disciplines remain relatively modest on both African and international stages. This reality underscores the importance of rigorously examining athletes' dietary practices, particularly during the pre-competitive phase, a period in which nutritional behaviours more accurately reflect underlying habits. In this context, the present study aimed to quantitatively evaluate energy intake as well as macro- and micronutrient contributions among combat sport practitioners, with the objective of proposing appropriate dietary adjustments capable of preserving health and optimising performance.

METHODOLOGIE/APPROCH

Study Design and Setting

This investigation was conducted as a cross-sectional and prospective study aimed at analysing energy, macronutrient, selected mineral, and vitamin intakes among high-level combat sport athletes during a collective pre-competitive training period. The study took place in February and March 2023 in N'Djamena, the capital of Chad, within the framework of preparations for the African Games. Data collection was organised in two phases: 1) sociodemographic and anthropometric assessment, and 2) dietary intake analysis. Prior to questionnaire administration, the principal investigator introduced the study to the athletes, explained its objectives, and provided clear instructions to ensure accurate and honest reporting. Dietary surveys were conducted in training centres, while physico-chemical analyses of local foods were performed at the laboratory of the Centre for Food Quality Control of N’Djamena.

Statistical Analysis and Participants

A priori power analysis was performed using G*Power version 3.1.9.7 (Heinrich Heine University, Düsseldorf, Germany), which indicated that a minimum of 63 participants was required (independent t-test, statistical power = 0.82, alpha = 0.05). Seventy-two athletes were screened for eligibility, of whom 63 met the inclusion criteria. Participants were actively engaged in one of the following combat sports: Taekwondo (n = 26; 15 women, 11 men), Wrestling (n = 14; 7 women, 7 men), Karate (n = 14; 7 women, 7 men), and Judo (n = 9; 3 women, 6 men). The final sample comprised 31 women (49.2%) and 32 men (50.8%). Eligible athletes were members of the national team, holders of national and international licences issued by their federations, aged over 15 years, voluntary participants, and in good health. Individuals reporting medical conditions were excluded.

Ethical Considerations

The study was approved by the Ethics Committee of the Chadian Association of Health Researchers (Approval No. 002/ASCS/BE). Official authorisation was also obtained from the Ministry of Sports (Authorisation No. 0010/MJS/SG/DGS/DSHN). Written informed consent was obtained from all participants prior to data collection. Athletes and their coaches were briefed in detail about the study objectives before interviews commenced. Participants were explicitly informed of their right to withdraw at any time without consequence, and strict anonymity was guaranteed.

Data Collection Procedures

Data were collected by the principal investigator, assisted by students in Physical Education and Sport from the National Institute of Youth and Sports (INJS) in N’Djamena, using semi-structured questionnaires. These were administered within training facilities at least 45 minutes before practice sessions. The instruments were initially developed in French, with translations provided in national languages (Chadian Arabic or Sara) for athletes with limited proficiency in French. To ensure validity and reliability, a pre-test was conducted with 10 athletes from the selected sample. The questionnaire was subsequently reviewed by a research committee, academic staff, and nutritionists, and adjusted according to their recommendations.

Section 1: Sociodemographic Information and Anthropometric Measurements

The data collected included age, sex, educational level, socio-economic status, as well as alcohol and tobacco consumption. Height, weight, and body mass index (BMI) were assessed in accordance with the criteria established by the World Health Organization (WHO). Body weight was measured using a bioelectrical impedance scale (Tanita model BC-545; capacity: 150 kg; precision: 0.1%). Height was measured with a portable stadiometer on three occasions, with a one-minute interval between each measurement, and the mean value was recorded. BMI was calculated by dividing weight (kg) by height squared (m^2) and classified according to WHO thresholds.

Section 2: Dietary Intake

Nutritional intake among Chadian combat sport athletes was assessed using the 24-hour dietary recall method, adapted to local eating habits. This approach was reinforced by the use of food portion photographs accompanied by their respective weights, in order to address difficulties related to quantification. Participants were asked to report all foods and beverages consumed the previous day, specifying the time and type of meal (breakfast, lunch, dinner, snacks), including dietary supplements. Quantities ingested were estimated using household utensils (glasses, spoons, cups, calabash fragments, other kitchen tools, half-litre measures) when portion images were not available. An ingredient specification questionnaire was employed to collect complementary information from the athletes' caterers and to perform calculations in accordance with the method of Dop et al. (23). Dietary data were subsequently converted into mean daily nutritional intakes, including energy, macronutrients, minerals, and vitamins. In the absence of a food composition table specific to Chad, a systematic compilation of data from existing tables was undertaken following FAO/INFOODS guidelines, in order to establish an adapted database. Conversion of foods into macronutrients (proteins, lipids, carbohydrates), minerals (calcium, iron, phosphorus), vitamins (B1, B2, B6, C), and calculation of energy based on macronutrient content relied on the following sources: Improved Food Composition Table for West Africa (24); Food Composition and Nutrition Tables of Souci et al. (25) ; U.S. Department of Agriculture (USAD), & U.S. Department of Health and Human Services (HHS) database (26); and Food Composition Table for Congo Basin Countries (27).

RESULTS

Participants were aged between 16 and 29 years, with a mean age of 20.8 ± 3.2 years (18.6 ± 2.4 years in women and 23.1 ± 4.1 years in men; $p < 0.0001$). Mean height was 1.74 ± 0.05 m (1.69 ± 0.03 m for women and 1.78 ± 0.07 m for men; $p < 0.0001$), while mean body weight was 67.59 ± 9.23 kg (62.47 ± 7.72 kg in women and 72.71 ± 10.74 kg in men; $p < 0.0001$). The BMI was 22.24 ± 2.37 kg/m² (21.78 ± 2.26 kg/m² in women and 22.71 ± 2.48 kg/m² in men), with no statistically significant difference between groups ($p > 0.05$).

Table 1 shows that the mean daily energy intake of all participants was 3039.99 ± 233.60 kcal, with women consuming 2665.54 ± 257.01 kcal and men 3414.44 ± 210.21 kcal, a statistically significant difference between sexes ($p < 0.002$). Mean protein intake across the group was 1.66 ± 0.48 g/kg/day, with values of 1.59 ± 0.57 g/kg/day in women and 1.73 ± 0.37 g/kg/day in men, with no significant difference between sexes ($p > 0.05$). Lipid intake accounted for 29% of total energy intake (TEI), corresponding to 28% (~1.37 ± 0.57 g/kg/day) in women and 30% (~1.57 ± 0.46 g/kg/day) in men, with no significant difference at the 5% threshold ($p > 0.05$). Conversely, mean carbohydrate intake was significantly higher in men (7.34 ± 1.14 g/kg/day) compared with women (6.34 ± 1.05 g/kg/day; $p < 0.001$). The overall group mean carbohydrate intake was estimated at 6.86 ± 1.23 g/kg/day.

Table 1 : Energy and macronutrient intake (n = 63)

Parameters	**entire group (n=63)**	**Women (n=31)**	**Men (n=32).**	**p**
	X ± S.D.	**X ± S.D**	**X ± S.D**	
Energy (kcal)	3039,99 ± 233,60.	2665,54 ± 257,01	3414,44 ± 210,21	< 0,002
Protein (g/kg/day)	1,66 ±. 0.48	1,59 ± 0,57	1.73 ± 0.27	< 0,25
Fat (g/kg/day/%)	1,47±0,51/29% TEI	1,37 ±0,54 /28% TEI	1,57 ± 0,51/30%TEI	< 0,12
Carbohydrate (g/kg/day)	6,86 ± 1,23	6,86 ± 1,05.	6, 86± 1,14	< 0,001

TEI :Total Energy Intake ; X : mean ; S.D : Standard Deviation

Table 2 presents mineral intakes of Chadian combat sport athletes during the pre-competitive training period. Mean daily intakes of calcium, iron, and phosphorus for the entire group were 379.65 ± 127.44 mg/day, 24.13 ± 6.08 mg/day, and 1608.75 ± 412.35 mg/day, respectively. Calcium intake was higher in men (412.58 ± 116.92 mg/day) than in women (341.57 ± 132.89 mg/day), with a statistically significant difference ($p < 0.01$). Mean daily iron intake was 20.89 ± 4.87 mg/day in women and 27.37 ± 5.71 mg/day in men, with significantly higher values in men ($p < 0.0002$). Phosphorus intake averaged 1376.91 ± 339.94 mg/day in women and 1816.59 ± 402.57 mg/day in men, revealing a highly significant difference ($p < 0.003$).

Table 2 : Daily mineral salt intake (n = 63)

Parameters	entire group (n=63) X ± S.D.	Women (n=31) X ± S.D	Men (n=32). X ± S.D	p
Calcium (mg)	379,65 ± 127,44	341,57 ± 132,39	412,58 ± 116,92	< 0,01
Iron (mg)	24,13 ± 6,08	20,89 ± 4,87	27,37 ± 5,71	< 0,002
Phosphorus (mg)	1608,751 ± 412,35	1376,91 ± 339,94	1816,59 ±412, 35	< 0,003

TEI :Total Energy Intake ; X : mean ; S.D : Standard Deviation

Table 3 presents daily vitamin intakes. Mean thiamin (vitamin B1) intake was 1.15 ± 0.24 mg/day in women and 1.57 ± 0.30 mg/day in men. Riboflavin (vitamin B2) intake was approximately 1.95 ± 0.44 mg/day in women and 2.43 ± 0.87 mg/day in men. Pyridoxine (vitamin B6) levels were 2.14 ± 0.45 mg/day in women and 2.84 ± 0.79 mg/day in men. Finally, mean ascorbic acid (vitamin C) intake was 113.36 ± 44.44 mg/day in women and 146.55 ± 54.16 mg/day in men. Application of the independent samples t-test revealed highly significant sex differences for thiamine ($p < 0.0001$), riboflavin ($p < 0.007$), pyridoxine ($p < 0.0001$), and ascorbic acid ($p < 0.01$).

Table 3 : Daily vitamin intake of respondents (n = 63)

Parameters	Entire group (n=63) X ± S.D.	Women (n=31) X ± S.D	Men (n=32). X ± S.D	p
Thiamin (mg)	1,36 ± 0,34	1,15 **±0,24**	**1,57±0,30**	< 0,001
Riboflavin (mg)	2,19 ± 0,73	1,95± 0,44	2,43 ± 0,87	< 0,002
Pyridoxine (mg)	2,40± 0,73	2,14 ± 0,45	2,84 ± 0,79	< 0,001
Ascorbic acid (mg)	130,65 ± 51,93	113, 36 ±42, 83	146,55 ±54,16	< 0,0,13

TEI :Total Energy Intake ; X : mean ; S.D : Standard Deviation

DISCUSSION

The present study aimed to analyse the energy and nutrient intakes of elite Chadian athletes engaged in combat sports, with particular attention to sex-related differences. As a preliminary investigation, it highlights certain dietary specificities observed during the pre-competitive preparation phase. In the absence of prior research addressing nutrition recommendations specific to Chadian athletes, or more broadly African athletes, this study relied, as did other investigations conducted on the continent, on international guidelines. The references consulted include expert reports from FAO/WHO/UNU, the International Olympic Committee (IOC), the French Agency for Food, Environmental and Occupational Health & Safety (ANSES), the European Food Safety Authority (EFSA), as well as position statements from the International Society of Sports Nutrition and the Academies of Nutrition and Dietetics in Canada and the United States. These international recommendations were adapted to the local context through the integration of typical, locally available foods.

The main findings can be summarised as follows: 1) Estimated energy intakes of Chadian combat sport athletes, both male and female, fall within the ranges recommended by international organisations, with a highly significant superiority among men ($p<0.0001$). 2) Protein and lipid intakes appear broadly consistent with recommendations, with no significant sex differences at the 5% threshold. 3) Conversely, a statistically highly significant difference ($p<0.001$) was observed for carbohydrate intake, with higher values among men. 4) Iron and phosphorus intakes exceeded recommended levels, while a notable calcium deficiency was identified in both groups. 5) Daily intakes of vitamins B1, B2, B6 and C were generally satisfactory, albeit slightly above recommended values.

Optimal athletic performance is contingent upon a balanced diet, rich in energy and essential nutrients, which supports adaptation to training and facilitates post-competition recovery (28). In this context, the mean daily energy intake observed among Chadian male athletes, estimated at approximately 3414.44 kcal, falls within the recommendations of 3200-3450 kcal/day for individuals with moderate to high physical activity levels (PAL: 1.75-1.9) (29). This energy value is not markedly different from the recommended dietary allowances (RDA) for elite French athletes, estimated at 3400 kcal/day for the same age group (30), although it remains lower than values reported among Lithuanian endurance athletes engaged in high-intensity disciplines such as swimming (3707.1 kcal/day) or road cycling (3641.8 kcal/day) (31). The recurrent challenge of weight control in combat sports, often driven by competitive strategies, necessitates strict dietary management among Chadian athletes, which may explain their relatively lower energy intake compared with Lithuanian athletes. However, lower energy intakes, ranging from 2566 to 2985 kcal/day in men, have also been reported in a study by Wardenaar et al. (32), involving a cohort of 553 Dutch elite and sub-elite athletes from endurance, team, and strength disciplines. Similarly, lower values than those observed among Chadian athletes were reported by Onywera et al. in elite Kenyan long-distance runners, with an average intake of 2987 kcal/day. A comparable gap was noted in the study by Bouhika et al. (34), conducted among Congolese athletes preparing for an international half-marathon, with a mean energy intake of 2980.93 kcal. The relative superiority of energy intake among Chadian athletes, while remaining within normative limits, compared with Kenyan and Congolese athletes, may be attributed to the availability and diversity of energy sources in local dietary practices. According to FAO, food resources in Chad are primarily based on cereals (millet, sorghum, pearl millet, “bérébéré”) and tubers (cassava, sweet potato, taro, yam), which constitute excellent sources of carbohydrates, complemented by abundant lipid sources that also provide energy.

Among Chadian female athletes, the mean daily energy intake, estimated at 2665.54 ± 257.01 kcal, falls within the range of recommended intakes for women engaged in intense physical activity, set by FAO/WHO/UNUat 2250–2750 kcal/day (29). These values are also comparable to those reported among Lithuanian female swimmers and cyclists, with respective intakes of 2563.3 kcal and 2772 kcal (31) , and close to values observed in highly active French female athletes, estimated at 2700 kcal (30). In contrast, markedly lower values were reported in the study involving 52 elite American female athletes (gymnasts, long-distance and middle-distance runners), with a mean intake of 1600 kcal (35), representing a difference of more than 1000 kcal compared with Chadian data. This substantial discrepancy is primarily explained by the aesthetic constraints associated with certain sports disciplines, where emphasis on body image frequently leads to restrictive, hypocaloric diets, under the mistaken belief that weight reduction may enhance performance (35), a phenomenon not observed among female combat sport athletes.

Beyond their structural role, proteins serve as an energy substrate mobilised during the depletion of carbohydrate reserves, particularly through the oxidation of branched-chain amino acids (36)(Tarnopolsky et al., 2004). They contribute to muscle protein synthesis and provide protection against damage induced by prolonged exertion (37)(38). Adequate management of protein intake is therefore essential for the maintenance of muscle mass, the optimisation of performance, and recovery (39).The mean protein intake of Chadian combat sport athletes was estimated at 1.73 ± 0.37 g/kg/day in men and 1.59 ± 0.57 g/kg/day in women, with no statistically significant difference between the two groups ($p>0.05$). These values fall within international recommendations (1.2-2 g/kg/day) (40) (41) and reflect the high local consumption of meat, made accessible by its relatively low cost.

The principal sources include beef, goat, camel meat (19.5 g protein/100 g), fish from Lake Chad, poultry, locusts, and various legumes (beans, ground peas). Collectively, these foods, widely represented in the Chadian household diet, provide high-quality protein intake.Nevertheless, these values remain lower than those reported by Lukas et al. (42) among elite Ethiopian long-distance runners, whose intakes reached 1.8 g/kg/day. This difference underscores the importance of nutritional timing in disciplines with high energy expenditure, such as long-distance running (~700 kcal/h) (43), where protein oxidation contributes more substantially to meeting energy requirements. By contrast, combat sports, characterised by short, intense, and intermittent efforts, rely primarily on aerobic glycolysis and lipid oxidation, thereby explaining relatively lower protein demands.

With regard to daily lipid intake, the findings of the present study indicate a mean consumption representing 30% of total energy intake (TEI), equivalent to 113.48 ± 34.02 g/day in men, and 28% of TEI, corresponding to 84.12 ± 28.4 g/day in women. These values fall within the margins of the consensual nutritional recommendations established by Thomas et al.(20-30%) (41), applicable to athletes irrespective of sex. A broader range of recommendations, with a higher upper limit, is reported in other scientific sources, namely 20-35% (26). Among Chadian athletes, the observed lipid intakes (30% in men and 28% in women) did not differ significantly ($p>0.05$), although a slight superiority was noted in men. These results are consistent with the ranges reported in elite French athletes(30). In comparison, data from other African contexts reveal lower lipid intakes: 23.3% among Ethiopian long-distance runners (44); 11.38% among Congolese footballers from Brazzaville; and 10.88% among basketball players (45). Chadian athletes therefore exhibit markedly higher lipid intakes. This specificity reflects a dietary pattern characterised by substantial fat consumption, particularly vegetable oils and animal fats, which are widely used in the preparation of traditional dishes and readily available in local markets. Conversely, the more moderate lipid intake observed among female athletes appears to be influenced by social representations linking fat consumption to the risk of overweight.

The diet of Chadian athletes provides on average 7.34 ± 1.14 g/kg/day of carbohydrate in men, compared with 6.34 ± 1.05 g/kg/day in women. This difference, statistically highly significant at the 5% threshold, highlights a greater consumption among male athletes. Nevertheless, both values fall within the consensual recommendations for athletes engaged in high-intensity physical activity, namely 5-12 g/kg/day (41) (46). It should be noted that higher intakes, ranging from 8 to 12 g/kg/day, are recommended for athletes undertaking particularly high training volumes (≥ 8 h/week), in order to promote rapid and continuous replenishment of endogenous glycogen stores (40).

Comparison of carbohydrate intakes among Chadian athletes with those reported in other international cohorts reveals notable differences. For instance, Wardenaar et al. (2017) observed a maximum mean carbohydrate intake of approximately 5 g/kg/day(32), lower than the values recorded in both sexes of Chadian athletes. Conversely, Lukas et al.reported higher intakes among elite Ethiopian long-distance runners, reaching 9 g/kg/day (42), exceeding Chadian values. These discrepancies can be explained by contextual factors and the specific demands of the disciplines practised. Among Chadian athletes, the predominance of combat sportscharacterised by explosive and intermittent efforts sustained over prolonged durations results in high energy requirements. This demand is further reinforced by the abundant availability of carbohydrate-rich foods within local dietary habits, thereby facilitating an optimal coverage of needs. In contrast, the higher intakes observed among Ethiopian athletes are explained by the practice of intense endurance exercise at altitude (approximately 2400 m), a physiological context that increases energy demand and justifies nutritional strategies tailored to their status as world-renowned long-distance runners

The assessment of mineral intake among Chadian combat sport athletes revealed a marked calcium deficiency, with mean values of 412.58 ± 116.92 mg/day in men and 341.57 ± 132.89 mg/day in women. These levels are well below international recommendations, which set daily intake at 1000 mg/day for adults aged 19-50 years and 1300 mg/day for adolescents aged 9-18 years (47) (26) (30). Martin proposed slightly different thresholds, namely 900 mg/day for men and 1200 mg/day for women (30). The observed intakes are therefore more than 50% lower than recommended. Similar deficiencies have been reported among South African martial arts practitioners (15), whereas elite South African wrestlers demonstrated considerably higher intakes, reaching 1281.4 ± 1209.6 mg/day (1) and 1241 mg/day (48). This disparity suggests that the deficiencies observed in Chad are strongly influenced by geographical and socio-economic factors. In the south of the country, an agricultural region from which the majority of these combat athletes originate, the consumption of plant-based beverages (notably tea) predominates over milk and dairy products, which are the principal sources of calcium but often financially inaccessible. By contrast, the north, characterised by cattle and camel farming, favours more regular consumption of dairy products. These findings align with concerns raised by the IOC Expert Group, which emphasises the frequent occurrence of mineral deficiencies, particularly calcium, among elite athletes(47). Calcium is essential for maintaining homeostasis, deficiency therefore exposes athletes to bone fragility, stress fractures, osteoporosis, muscle cramps, and neuromuscular disorders(41) (49).

In parallel, iron and phosphorus intakes appear excessive: 20.89 ± 4.87 mg/day in women and 27.37 ± 5.71 mg/day in men for iron; 1376.91 ± 339.94 mg/day in women and 1816.59 ± 402.57 mg/day in men for phosphorus. These values substantially exceed the recommendations of EFSA (50) and Martin (30), which suggest 9–11 mg/day of iron for men, 16 mg/day for women, and 700- 750 mg/day of phosphorus for both sexes. Although both minerals support haemoglobin synthesis, ATP production, and muscle repair, their excess can be harmful. The scientific literature notes that iron overload may lead to iron storage disease, oxidative stress, cardiovascular risk, and hepatic dysfunction (51). Similarly, excessive phosphorus intake can cause calcium–phosphorus imbalance, bone fragility, hyperphosphataemia, and metabolic disorders (52) (53). The causes of these excesses can be attributed to the availability of dietary sources such as red meat (beef, camel, sheep, goat), dried fish, and cereals, which are regularly consumed in traditional Chadian dishes.

The daily vitamin intakes observed among Chadian combat sport athletes were found to be slightly above the reference thresholds established by ANSES (54), which are based on the international recommendations of WHO/FAO(55). These benchmarks set nutritional requirements for vitamin B1 at 1.1-1.2 mg/day for women and 1.3-1.4 mg/day for men; for vitamin B2 at 1.4-1.5 mg/day for women and 1.6-1.7 mg/day for men; for vitamin B6 at 1.5-1.6 mg/day for women and 1.6-1.7 mg/day for men; and for vitamin C at 110 mg/day for both sexes. It is important to recall that B-complex vitamins are closely linked to energy metabolism, which justifies their modulation according to physical activity level (PAL: 1.8-2). By contrast, vitamin C plays an essential role in collagen synthesis, antioxidant protection, and the optimisation of iron absorption, and is therefore not correlated with PAL or sex.The observed exceedances may be explained, on the one hand, by the increased micronutrient requirements induced by the intensive practice of combat sports, which strongly mobilise energy and nutrient reserves, and on the other hand, by the availability and integration of specific food sources within local dietary habits.

This study makes a significant contribution to the enrichment of the literature on sports nutrition in sub-Saharan Africa, by providing novel data on the nutritional intakes of Chadian combat sport athletes during the pre-competitive preparation phase. Through the application of the 24-hour dietary recall method, the analysis enabled rigorous methodological triangulation between athletes' self-reported consumption, local measurement units (bowls, spoons, fragments of calabash) or photographs of food portions, and the biochemical properties of traditional Chadian foods.

Study Limitations

The study remains coherent despite two methodological limitations. First, the 24-hour dietary recall method requires constant vigilance from the research team and sustained cooperation from participants. It relies on respondents' ability to remember their consumption from the previous day, which may affect data accuracy. Second, the limited number of participants per sporting discipline restricts the generalisation of findings to all combat sport athletes in Chad. Nevertheless, these limitations do not compromise the robustness of the observations. The combination of dietary recall with food portion estimation ensured reliable data collection during the pre-competitive period. The credibility of the results was further strengthened by a rigorous protocol, voluntary recruitment, and the freedom granted to participants to withdraw at any time, thereby ensuring the precision and reliability of responses.

CONCLUSION

The findings of this study highlight a general adequacy of energy and macronutrient intakes with international recommendations, while revealing notable imbalances in micronutrient status. In particular, excessive iron and phosphorus intakes contrast with a significant calcium deficiency, whereas vitamin intakes appear broadly satisfactory, despite occasional exceedances of recommended thresholds. These observations underscore the importance of structured nutritional guidance for athletes, based on educational programmes that integrate sporting, health, and nutritional dimensions. Such an approach would contribute simultaneously to optimising performance and safeguarding health, while enriching the scientific literature on sports nutrition in the African context.Furthermore, future research should involve larger and more representative samples, covering diverse combat disciplines, in order to provide a more comprehensive assessment of nutritional status, the impact of nutritional strategies, and the effects of educational interventions on athletes' performance and health. The resulting data could serve as discipline-specific dietary reference frameworks for combat sports.

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Declaration of Interest

The authors declare no conflict of interest in relation to this article.

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