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SUBOPTIMAL ENERGY AND CARBOHYDRATE INTAKE IN MALE CROSSFIT® PRACTITIONERS: ADEQUATE PROTEIN BUT IMBALANCED DISTRIBUTION

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ABSTRACT

Objective: This study aims to evaluate the dietary intake of male CrossFit® practitioners, focusing on energy consumption, macronutrient distribution, and pre- and post-training nutrient intake. Materials and Methods: The study was conducted with 31 male CrossFit® practitioners. Participants provided four 24-hour dietary recalls over two weeks. Energy and nutrient intake were analyzed, and adequacy was evaluated against established nutritional recommendations. Protein and carbohydrate intake were compared pre- and post-workout, and the percentage of animal protein intake was assessed. Results: The average energy intake was 29.7 ±7.6 kcal/kg/day, below the recommended 30-50 kcal/kg/day. Carbohydrate intake averaged 3.4 ±1.0 g/kg/day, also below the recommended 5-12 g/kg/day, with only 9.67% meeting the recommendations. Protein intake was within the recommended range at 1.8 ±0.4 g/kg/day. Post-workout meals had significantly higher protein (41.4 ±15.9 g) and carbohydrate (66.2 26.7 g) intake compared to pre-workout meals (19.7 ±13.2 g and 50.6 ±25.2 g, respectively). The diet was predominantly animal-based, with animal protein comprising 77.7% of total protein intake. Conclusion: The study highlights suboptimal energy and carbohydrate intake among male CrossFit® practitioners, with adequate protein intake but an imbalance in protein distribution across meals.

Key words: Nutrient intake. Sports nutrition. Energy Availability. Macronutrient adequacy. Dietary patterns.

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RESUMO

Ingestão de energia e carboidratos abaixo do ideal em praticantes de CrossFit® do sexo masculino: proteína adequada, mas distribuição desequilibrada

Objetivo: Este estudo teve como objetivo avaliar a ingestão alimentar de praticantes de CrossFit®, com foco no consumo energético, distribuição de macronutrientes e ingestão de nutrientes pré e pós-treino. Materiais e Métodos: O estudo foi conduzido com 31 homens praticantes de CrossFit®. Os participantes forneceram quatro recordatórios alimentares de 24 horas ao longo de duas semanas. A ingestão de energia e nutrientes foi analisada e a adequação foi avaliada com base nas recomendações nutricionais estabelecidas. A ingestão de proteínas e carboidratos foi comparada entre pré e pós-treino, e o percentual de ingestão de proteína animal foi avaliado. Resultados: A ingestão média de energia foi de 29,7 ±7,6 kcal/kg/dia, abaixo da recomendação de 30-50 kcal/kg/dia. A ingestão média de carboidratos foi 3,4 ±1,0 g/kg/dia, também abaixo da recomendação de 5-12 g/kg/dia, com apenas 9,67% dos participantes atendendo às recomendações. A ingestão de proteínas estava dentro da faixa recomendada (1,8 ±0,4 g/kg/dia). As refeições pós-treino apresentaram ingestão significativamente maior de proteínas (41,4 ±15,9 g) e carboidratos (66,2 ±26,7 g) em comparação com as refeições pré-treino (19,7 ±13,2 g e 50,6 ±25,2 g, respectivamente). A dieta foi predominantemente baseada em proteína animal, que representou 77,7% da ingestão total de proteínas. Conclusão: O estudo destaca uma ingestão subótima de energia e carboidratos entre homens praticantes de CrossFit®, com ingestão adequada de proteínas, mas um desequilíbrio na distribuição de proteínas ao longo das refeições.

Palavras-chave: Ingestão de nutrientes. Nutrição esportiva. Disponibilidade energética. Adequação de macronutrientes. Padrões alimentares.

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INTRODUCTION

CrossFit® is a high-intensity functional training modality that integrates gymnastic movements, weightlifting, and cardiovascular exercises with minimal rest periods, leading to significant overload and fatigue (Souza and collaborators, 2021).

Conceived by Glassman, the training sessions, known as "workouts of the day" (WODs), demand high power and technical proficiency (Glassman, 2007).

CrossFit® training enhances various physical capacities, including aerobic capacity, strength, muscular endurance, power, speed, coordination, balance, flexibility, and precision, while also improving body composition (Barfield, Anderson, 2014; Gogojewicz and collaborators, 2020).

However, to ensure safety, practitioners should be supervised by trained professionals to mitigate risks of overtraining and injury (Drake and collaborators, 2017).

As of 2017, there were approximately 12,000 certified CrossFit® training centers worldwide (Moran and collaborators, 2017). In Brazil, 880 establishments were registered, serving around 40,000 practitioners (Sprey and collaborators, 2016).

The rapid growth in CrossFit® participation is attributed to its motivational and challenging nature (Tibana, Almeida, Prestes, 2015).

Effective CrossFit® training requires practitioners to use loads appropriate to their physical capacities, sufficient to stimulate physiological, metabolic, and morphological adaptations (Tibana, Almeida, Prestes, 2017).

Additionally, optimizing performance and adaptations, as well as ensuring adequate muscle recovery between sessions, necessitates appropriate energy and nutrient intake. Nutritional guidance is thus essential to ensure dietary intake supports performance, training adaptations, and health maintenance (Thomas, Erdman, Burke, 2016).

Despite the increasing number of CrossFit® practitioners, research on their dietary intake remains limited. Early studies, published in 2013, did not address nutritional aspects (Dominski and collaborators, 2018).

Later, studies began exploring hydration, nutrition, and supplementation (Escobar and collaborators, 2016; Kramer and collaborators, 2016). Brescansin and collaborators (2019) evaluated the dietary profile of CrossFit® practitioners, observing frequent intake of cereals, eggs, vegetable oil, dairy products, and vegetables, with higher consumption of processed meats compared to fruits and beef. Gogojewicz and collaborators (2020) found that the diets of CrossFit® athletes were hypocaloric, low in carbohydrates, and contained adequate amounts of proteins and fats.

Given the paucity of research on dietary intake, the significant number of CrossFit® practitioners, and the importance of adequate nutrition for performance and muscle recovery, this study aims to evaluate the dietary intake of CrossFit® practitioners, focusing on energy consumption, macronutrient distribution, and pre- and post-training nutrient intake.

MATERIALS AND METHODS

A descriptive, cross-sectional, and quantitative study was conducted to evaluate the dietary intake of male CrossFit® practitioners. The sample consisted of 31 male CrossFit® practitioners.

The inclusion criteria were: male gender, age 18 years or older, at least three months of CrossFit® training experience, and a training frequency of at least three times per week. All participants were informed about the study's objective and that their participation was voluntary, without any monetary incentives. Participation was conditioned upon signing the informed consent form.

The study was approved by the Human Research Ethics Committee of the Federal University of Lavras under the code number: 20221419.7.0000.5148.

For anthropometric assessment, weight was measured using a Welmy® scale with 0.1 kg precision, and height was measured using a Sanny® vertical stadiometer. Body mass index (BMI) was calculated by dividing weight by the square of height. A 24-hour dietary recall (R24h) was used to assess the dietary intake of CrossFit® practitioners. Four R24h recalls were collected from each participant over a two-week period on training days. Participants were instructed to report all foods consumed the day before the recall, including the times, preparation methods, and quantities of each food consumed. Foods were converted into energy and nutrients using the Brazilian Food Composition Table and the Table from the Brazilian Institute of Geography and Statistics provided by the "CalcNut" spreadsheet platform

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from the University of Brasília, available on its website (http://fs.unb.br/calcnut).

From the collected data, total and per kilogram body weight average daily energy and macronutrient intake, percentage distribution of macronutrients, adequacy percentage, and protein intake per meal (including pre- and post-workout) were calculated, as well as the distribution of animal and vegetable protein intake. Energy intake adequacy was calculated using the values recommended by the Brazilian Society of Sports Medicine (SBME, 2009), which advocates for energy intake between 30 and 50 kcal/kg/day. For protein intake, the range recommended by the International Society of Sports Nutrition - ISSN (Kerksick and collaborators, 2018) was adopted, suggesting a daily protein intake of 1.4-2 g/kg/day. Carbohydrate intake adequacy was calculated according to the values recommended by Souza and collaborators (2021), suggesting an intake between 5 and 12 g/kg body weight per day. For lipids, the recommendation from the American College of Sports Medicine - ACSM (Thomas, Erdman, Burke, 2016) was used, which advocates for lipid intake between 20 and 35% of total energy intake. Protein intake per meal was evaluated using the range of 20 to 40 grams per meal, as recommended by the ISSN (Kerksick and collaborators, 2018). Energy and nutrient intakes below or above these recommended ranges were considered inadequate.

Data were tabulated using Microsoft Excel, version 2007, and subsequently analyzed using Sigma Plot, version 14.0. Categorical variables were presented as absolute and relative numbers, and numerical variables were presented as means and standard deviations. To compare protein and carbohydrate intake between pre- and post-workout meals, the Shapiro-Wilk normality test and Student's t-test for independent samples were used. The significance level was set at 5%.

RESULTS

Thirty-one men participated in this study (weight = 79.86 ±7.64 kg; height = 1.77 ±0.02 m; BMI = 25.58 ±3.04). The average energy and macronutrient intake of the participants is summarized in Table 1.

The participants' mean energy intake was 29.7 ±7.6 kcal/kg/day, which is below the range recommended by the Brazilian Society of Sports Medicine (30-50 kcal/kg/day).

The average carbohydrate intake was 3.4 ±1.0 g/kg, also below the minimum recommended level (5-12 g/kg/day). Only 9.67% of participants had carbohydrate intake within the recommended range.

For protein (1.8 ±0.4 g/kg) and lipids (27.8 ±8.5%), the average values were within the recommended ranges by ISSN (1.4-2 g/kg/day) and ACSM (20-35%), respectively. The adequacy percentages for macronutrient intake among participants were 41.9% for energy, 58.1% for protein, 9.7% for carbohydrates, and 61.3% for lipids.

Table 1 - Average Energy and Macronutrient Intake of CrossFit® Practitioners.

Energy and Nutrients	Mean	SD	Min.	Max.	Recommendations
Energy (Kcal)	2348.5	595.9	1465.0	3661.3	-
Energy (Kcal/kg)	29.7	7.6	16.4	46.9	30-50 Kcal/kg/day*
CHO (g/kg)	3.4	1.0	1.8	5.3	5-12 g/kg/day**
CHO (%)	46.2	6.6	31.1	57.7	-
PTN (g/kg)	1.8	0.4	1.1	2.4	1.4-2.0 g/kg/day***
PTN (%)	25.2	5.2	13.7	38.0	-
LIP (g/kg)	0.9	0.4	0.3	2.2	-
LIP (%)	27.8	8.5	8.5	45.5	20-35% of total energy intake****
Dietary Fiber (g)	31.0	12.2	13.9	54.0	-

Legenda: CHO=carbohydrate, PTN=protein, LIP=fat. * Brazilian Society of Sports Medicine (SBME, 2009); ** Souza e collaborators, 2021; *** International Society of Sports Nutrition (Kerksick and collaborators, 2018); **** American College of Sports Medicine (Thomas, Erdman, Burke, 2016).

We evaluated the distribution of protein intake by meals (Figure 1).

Protein intake during breakfast, mid-morning snack, and supper was below the recommended 20-40 g per meal (Kerksick and collaborators, 2018). In contrast, protein intake during lunch and dinner exceeded the recommended levels.

Only the afternoon snack met the recommended criteria. The adequacy percentages for protein intake per meal were 26% for breakfast, 12.5% for mid-morning snack, 13.7% for lunch, 52% for afternoon snack, 25% for dinner, and 22.2% for supper. Notably, lunch and dinner often exceeded 40 g of protein, indicating excessive rather than inadequate intake. The percentages of individuals consuming more than 40 g of protein at lunch and dinner were 82.7% and 75%, respectively.

The percentage distribution of animal and plant-based protein intake in the meals consumed by CrossFit® practitioners is shown in Figure 2.

Animal protein was predominant in all meals, particularly at lunch and afternoon snack, where it exceeded 80%. Overall, animal protein accounted for 77.7% of total protein intake, while vegetable protein comprised 23.3%.

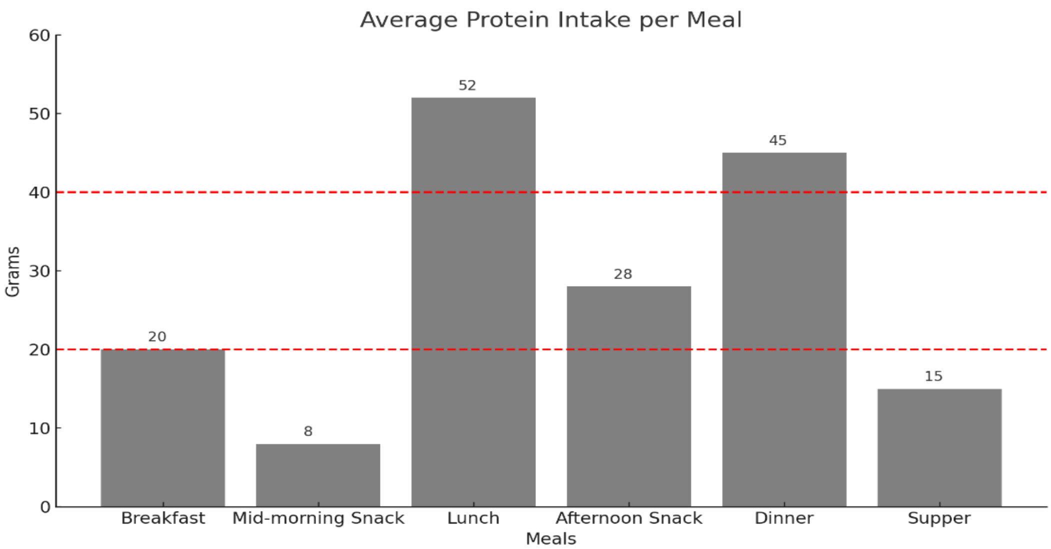

Figure 1 - Distribution of Protein Intake by Meal of CrossFit® Practitioners.

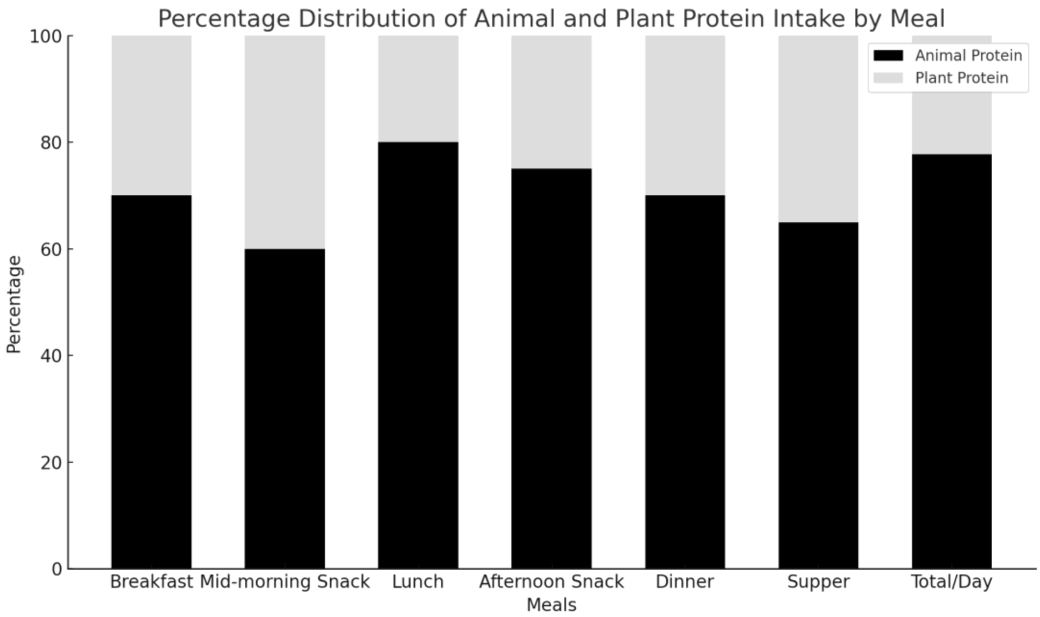

Figure 2 - Percentage Distribution of Animal and plant-based Protein Intake by Meal of CrossFit® Practitioners.

The average protein and carbohydrate intake in pre and post-workout meals, along with the percentage contribution of animal protein, is displayed in the Figure 3.

Both protein and carbohydrate intake were significantly higher in post-workout meals compared to pre-workout meals. The pre-workout values were 19.7 ±13.2 g for protein and 50.6 ±25.2 g for carbohydrates, while the post-workout values were 41.4 ± 15.9 g for protein and 66.2 ±26.7 g for carbohydrates (Figures 3A and C).

The percentage contribution of animal protein was significantly higher in post-workout meals (81.8 ± 10%) compared to pre-workout meals (59.2 ± 31.9%) (Figure 3B).

It is noteworthy that for 74.1% of participants, the post-workout meal was either lunch or dinner, which were identified as the meals with the highest protein intake.

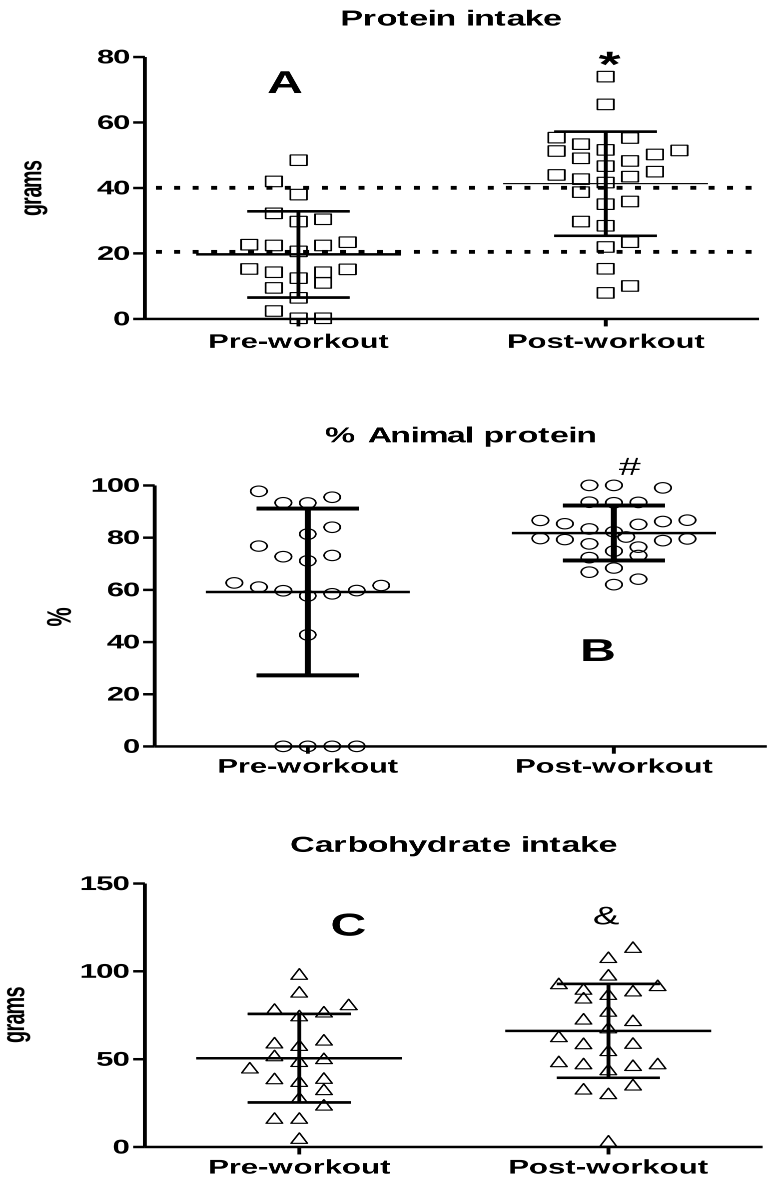

Figure 3 - Average protein and carbohydrate intake in Pre- and Post-Workout Meals of CrossFit® Practitioners. A – Proteína intake pre and pós-workout, B – Percentage of protein from animal foods pre and post-workout, and C – Carbohydrate intake pre and post-workout. *p<0,001, #p=0,001 and p=0,045.

DISCUSSION

The present study evaluated the dietary intake of male CrossFit® practitioners, focusing on energy consumption and macronutrient distribution, particularly protein intake, carbohydrate intake, and the percentage of animal protein. The results provide valuable insights into the nutritional practices of this athletic population and their alignment with established nutritional recommendations.

Similar results were found by Gogojewicz and collaborators (2020), who evaluated 62 CrossFit® athletes, including 31 men. The authors observed that the participants' diets were also hypocaloric (men = 27.8 kcal/kg/day; women = 29.5 kcal/kg/day), low in carbohydrates (men = 3.3 g/kg/day; women = 3.9 g/kg/day), adequate in protein (men = 1.6 g/kg/day; women = 1.6 g/kg/day), and fat (men = 30.5%; women = 29.7%).

The average energy intake of 29.7 ±7.6 kcal/kg/day observed in this study is slightly below the range recommended by the Brazilian Society of Sports Medicine (SBME, 2009), which suggests an intake of 30-50 kcal/kg/day for athletes. This discrepancy may indicate a potential risk of energy deficit among some participants, which could negatively impact performance and recovery. Studies have shown that inadequate energy intake can lead to decreased muscle mass, reduced endurance, and impaired immune function (Mountjoy and collaborators, 2014).

Carbohydrate intake, averaging 3.4 ± 1.0 g/kg, was also below the recommended range of 5-12 g/kg/day (Souza and collaborators, 2021). Only 9.67% of participants met the carbohydrate intake recommendations. Carbohydrates are critical for replenishing glycogen stores and sustaining high-intensity exercise performance (Thomas, Erdman, Burke, 2016).

The insufficient carbohydrate intake observed among the participants may compromise their ability to maintain optimal performance during training sessions and competitions. Previous research has highlighted the importance of adequate carbohydrate intake in enhancing endurance and reducing fatigue (Burke and collaborators, 2011).

In contrast, the protein intake of 1.8 ± 0.4 g/kg/day was within the recommended range of 1.4-2.0 g/kg/day suggested by the International Society of Sports Nutrition (Kerksick and collaborators, 2018). Adequate protein intake is essential for muscle repair, growth, and adaptation to training (Phillips, Van Loon, 2011).

The distribution of protein intake across meals, however, revealed imbalances, with breakfast, mid-morning snacks, and supper falling below the recommended 20-40 g per meal (Kerksick and collaborators, 2018).

Similar to our findings, Takai and collaborators (2021), who evaluated 90 university students of both sexes engaged in weight training, also observed an irregular pattern of protein intake throughout the day, with consumption primarily concentrated at lunch and dinner.

This suboptimal distribution may affect muscle protein synthesis rates, as evidence suggests that evenly distributing protein intake throughout the day can maximize muscle protein synthesis (Areta and collaborators, 2013).

The study also found that the majority of protein consumed was of animal origin, with animal protein comprising 77.7% of total protein intake. While animal proteins are high-quality proteins with complete amino acid profiles, diversifying protein sources to include more plant-based options can provide additional health benefits and improve dietary sustainability (Wolfe, 2015).

Increasing the intake of plant-based proteins could also contribute to better overall nutrient intake, as plant foods offer a range of vitamins, minerals, and fiber (Gorissen and collaborators, 2018).

Furthermore, the study observed an average fiber intake of 31 ±12.2 grams, which is below the recommended daily intake of 38 grams for adult males.

Interestingly, the post-workout meals contained significantly higher protein and carbohydrate content compared to pre-workout meals. The average post-workout protein intake was 41.4 ±15.9 g, while the pre-workout intake was 19.7 ±13.2 g. Similarly, carbohydrate intake was 66.2 ±26.7 g post-workout compared to 50.6 ±25.2 g pre-workout. This pattern aligns with recommendations to consume higher protein and carbohydrate quantities post-exercise to enhance recovery and glycogen replenishment (Ivy, 2004; Moore and collaborators, 2009).

The elevated percentage of animal protein in post-workout meals (81.8 ±10%) compared to pre-workout meals (59.2 ±31.9%) underscores the preference for animal-based protein sources in recovery nutrition.

Despite the valuable insights provided by this study, several limitations must be acknowledged. Firstly, the sample size was relatively small and limited to male CrossFit® practitioners from specific regions, which may limit the generalizability of the findings to broader populations, including female athletes and practitioners from different geographic locations.

Secondly, the study relied on self-reported dietary intake data using 24-hour dietary recalls. This method is subject to recall bias and underreporting or overreporting of food intake, which could affect the accuracy of the data collected.

Additionally, the use of four 24-hour recalls may not fully capture the variability in the participants' dietary intake over time. We collected four dietary recalls over two weeks to minimize biases. Thirdly, the cross-sectional design of the study does not allow for causal inferences. The relationships observed between dietary intake and performance or recovery cannot be definitively established as cause and effect.

Longitudinal studies would be necessary to better understand these relationships over time. Lastly, the study did not assess the participants' adherence to nutritional recommendations over a longer period, nor did it evaluate the impact of dietary intake on specific performance outcomes or health markers.

Future research should consider these factors to provide a more comprehensive understanding of the nutritional needs and practices of CrossFit® practitioners.

CONCLUSION

In conclusion, while the protein intake among CrossFit® practitioners appears adequate, the overall energy and carbohydrate intake are suboptimal.

Addressing these nutritional gaps is crucial for optimizing performance and recovery in this population.

Future research should explore targeted nutritional interventions and their effects on performance outcomes in CrossFit® athletes.

Furthermore, promoting a balanced intake of both animal and plant-based proteins could enhance overall dietary quality and sustainability.

REFERENCES

1-Areta, J.L.; Burke, L.M.; Ross, M.L.; Camera, D.M.; West, D.W.D.; Broad, E.M.; Jeacocke, N.A.; Moore, D.R.; Stellingwerff, T.; Phillips, S.M.; Coffey, V.G. Timing and distribution of protein ingestion during prolonged recovery from resistance exercise alters myofibrillar protein synthesis. Journal of Physiology. Vol. 591. Num. 9. 2013. p.2319-2331.

2-Barfield, J.; Anderson, A. Effect of CrossFit™ on health-related physical fitness: A pilot study. Journal of Sport and Human Performance. Vol. 2. Num. 1. 2014. p.23-28. 2014.

3-Brescansin, B.M.; Naziazeno, R.F.T.; Miranda, T.V. Análise do perfil alimentar de praticantes de CrossFit na região de Belém do Pará. Revista Brasileira de Nutrição Esportiva. São Paulo. Vol. 13. Num. 81. 2019. p. 830-838.

4-Burke, L.M.; Hawley, J.A.; Wong, S.H.S.; Jeukendrup, A. E. Carbohydrates for training and competition. Journal of Sports Sciences. Vol. 29. Sup1. 2011. p.17-27.

5-Dominski, F.H.; Serafim, T.T.; Andrade, A. Produção de conhecimento sobre Crossfit®: revisão sistemática. Revista Brasileira de Prescrição e Fisiologia do Exercício. São Paulo. Vol. 12. Num. 79. 2018. p. 962-974.

6-Drake, N.; Smeed, j.; Carper, M.J.; Crawford, D.A. Effects of Short-Term CrossFit™ Training: A Magnitude-Based Approach. Journal of Exercise Physiology Online. Vol. 20. Num.2. 2017. p.111-133.

7-Escobar, K.A.; Morales, J.; Vandusseldorp, T.A. The effect of a moderately low and high carbohydrate intake on crossfit performance. International journal of exercise science. Vol. 9. Num. 4. 2016. p.460-470.

8-Glassman, G. Understanding CrossFit. East Valley Crossfit Newsletter. Vol.1. 2007. p.1-115.

9-Gogojewicz, A.; Śliwicka, E.; Durkalec-Michalski; K. Assessment of dietary intake and nutritional status in CrossFit-trained individuals: A descriptive study. International journal of environmental research and public health. Vol. 17. Num.13. 2020. p.4772. 2020.

10-Gorissen, S.H.; Crombag, J.J.; Senden, J.M.; Waterval, W.H.; Bierau, J.; Verdijk, L.B.; Van Loon, L.J. Protein content and amino acid composition of commercially available plant-based protein isolates. Amino Acids. Vol.50. Num.12. 2018. p.1685-1695.

11-Ivy, J.L. Regulation of muscle glycogen repletion, muscle protein synthesis and repair following exercise. Journal of Sports Science & Medicine. Vol.3. Num.3. 2004. p.131-138.

12-Kerksick, C.M.; Wilborn, C.D.; Roberts, M.D.; Smith-Ryan, A.; Kleiner, S.M.; Jäger, R.; Collin, R.; Cooke, M.; Davis, J.N.; Galvan, E.; Greenwood, M.; Lowery, L.M.; Wildman, R.; Antonio, J. Kreider, R. B. ISSN exercise &

sports nutrition review update: research & recommendations. Journal of the international society of sports nutrition. Vol.15. 2018. p.1-57.

13-Kramer, S.J.; Baur, D.A.; Spicer, M.T.; Vukovich, M.D.; Ormsbee, M.J. The effect of six days of dietary nitrate supplementation on performance in trained CrossFit athletes. Journal of the International Society of Sports Nutrition. Vol. 13. Num.39. 2016. p.1-7.

14-Moore, D.R.; Robinson, M.J.; Fry, J.L.; Tang, J.E.; Glover, E.I.; Wilkinson, S.B.; Todd, P.; Tarnopolsky, M.A.; Phillips, S.M. Ingested protein dose response of muscle and albumin protein synthesis after resistance exercise in young men. American Journal of Clinical Nutrition. Vol.89. Num.1. 2009. p.161-168.

15-Moran, S.; Booker, H.; Staines, J.; Williams, S. Rates and risk factors of injury in CrossFit: a prospective cohort study. J Sports Med Phys Fitnes. Vol.57. Num.9. 2017. p.1147-1153.

16-Mountjoy, M.; Sundgot-Borgen, J.; Burke, L.; Carter, S.; Constantini, N.; Lebrun, C.; Meyer, M.; Sherman, R.; Steffen, K.; Budgett, R. Ljungqvist, A. The IOC consensus statement: beyond the Female Athlete Triad-Relative Energy Deficiency in Sport (RED-S). British Journal of Sports Medicine. Vol.48. Num.7. 2014. p.491-497.

17-Phillips, S.M.; Van Loon, L.J. Dietary protein for athletes: from requirements to optimum adaptation. Journal of Sports Sciences. Vol.29. Sup1. 2011. p.S29-S38.

18-Souza, R.A.S.; Silva, A.G.; Souza, M.F.; Souza, L.K.F.; Roschel, H.; Silva, S.F.; Saunders, B.A. Systematic Review of CrossFit® Workouts and Dietary and Supplementation Interventions to Guide Nutritional Strategies and Future Research in CrossFit®. International journal of sport nutrition and exercise metabolism. Vol. 31. Num. 2. 2021. p. 187-205. https://doi.org/10.1123/ijsnem.2020-0223

19-SBME. Modificações dietéticas, reposição hídrica, suplementos alimentares e drogas: comprovação de ação ergogênica e potenciais riscos para a saúde. Modificações dietéticas, reposição hídrica, suplementos alimentares e drogas: comprovação de ação ergogênica e potenciais riscos para a saúde. Revista Brasileira de Medicina do Esporte. Vol. 15. Núm. 3. p.2-12. 2009. https://doi.org/10.1590/S1517-86922009000400001

20-Sprey, J.W.; Ferreira, T.; de Lima, M.V.; Duarte Jr, A.; Jorge, P.B.; Santili, C. An epidemiological profile of CrossFit athletes in Brazil. Orthopaedic journal of sports medicine. Vol.4. Num.8. 2016. p.1-8.

21-Takai, F.Y.; Andrade, G.M.; Oliveira, L.C.; Abreu, W.C. Universitários praticantes de musculação realizam consumo irregular de macronutrientes ao longo do dia com ingestão predominante de proteínas de fonte animal. Saúde e Desenvolvimento Humano. Vol. 9. Num. 1. 2021. p.1-11.

22-Thomas, D.T.; Erdman, K.A.; Burke, L.M. American college of sports medicine joint position statement. nutrition and athletic performance. Medicine and science in sports and exercise. Vol.48. Num.3. 2016. p.543-568.

23-Tibana, R.A.; Almeida, L.M.; Prestes, J. Crossfit® riscos ou benefícios? O que sabemos até o momento. Revista Brasileira de Ciência e Movimento. Vol.23. Num. 1. 2015. p.182-185.

24-Tibana, R.A.; Almeida, L.M.; Prestes, J. Quantificação da carga da sessão de treino no Crossfit® por meio da percepção subjetiva do esforço: um estudo de caso e revisão da literatura. Revista Brasileira de Ciência e Movimento. Vol.25. Num.3. 2017. p.5-10.

25-Wolfe, R.R. Update on protein intake: importance of milk proteins for health status of the elderly. Nutrition Reviews. Vol.73. Suppl_1. 2015. p.41-47.

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