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EVALUATION OF NUTRITIONAL INTAKE AND ITS IMPACT ON PHYSICAL FITNESS OUTCOMES IN GYMNAST ATHLETES

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ABSTRACT

The nutritional condition of optimal physical fitness and performance in gymnastics is a major issue since it is a high-training load and high-strength-to-weight sport. This paper assesses the dietary consumption of gymnast athletes, and how it influences the chosen physical fitness measures. It was a descriptive and analytical cross-sectional study, where 100 competitive gymnasts aged between 15-25 years were used to collect data using dietary recall and standardized assessments of physical fitness. The nutritional intake was estimated on the basis of energy and nutrient sufficiency, whereas the physical fitness did measure strength, power, flexibility, and endurance. It was found that the rate of poor nutritional intake is very high in the case of gymnasts and that there is a strong correlation between the nutritional adequacy and physical fitness performance. When athletes consumed the amounts of specified foods, they showed high levels of fitness as compared to athletes whose nutritional status was moderate or severe. The testing of the hypothesis proved that the statistical significance of nutritional intake on results of physical fitness is significant. The results suggest the relevance of proper balanced nutrition in the venue of training adaptation, physical fitness, and general athletic development of gymnast athletes. The paper emphasizes that a systematic nutritional surveillance and education in gymnastics training programs are necessary.

Keywords: Nutritional intake, Physical fitness, Gymnast athletes, Energy adequacy, Sports nutrition

INTRODUCTION

Gymnastics is a power-aesthetic sport where a performer has to perform high amounts of strength, reactive power, flexibility, coordination and technical accuracy numerous times and at the same time remain with rather low body mass and good strength to weight proportion. These performance requirements are met by volume of training that tend to be

high even in adolescence which introduces a significant day-to-day variability in energy expenditure and recovery requirements. In this respect, the nutritional intake is not only a determinant of the body composition, but also a controllable influence up to major body physical fitness results, including explosive strength, muscular endurance, speed-strength, and injury resistance. Nevertheless, cultures in

gymnastics that prioritize leanness can also put at risk constraining eating habits, insufficient carbohydrate consumption, and low energy supply (LEA), which may affect the adaptations to the training, as well as health outcomes that eventually determine the performance pathways (Kuhlman et al., 2024; Angelidi et al., 2024).

Elite cohort data suggest that gymnasts might consume low amounts of total energy and certain micronutrients although there is a high energy density. Individually, female artistic gymnasts of National levels have been known to report low levels of energy consumption compared to the estimated energy requirement as well as insufficient levels of other nutrients that have applicability in bone and neuromuscular functions as calcium and magnesium (Jonnalagadda et al., 1998). Such deficiencies in the nutrients of interest, including calcium and iron, are also shown to be deficient in adolescent samples and can potentially be of particular importance to the growth, bone accrual, and oxygen transport capacity (Vicente et al., 2023). Notably nutritional intakes in gymnastics ought to be versus dietary standards, but also versus outcome in sports, which entails whether athletes can remain energized and retain carbohydrates to meet repeated high-intensity training, lean, and exhibit power.

Based on this, the current study formulates a new conceptualization of nutritional intake (energy, macro- and micronutrient adequacy, and dietary pattern characteristics) as a primary exposure and physical fitness outcomes (e.g., power, strength-endurance,

and flexibility as well as selected performance proxies) as endpoints. This study will help uncover the different manners in which nutrition-induced variability can be converted to quantifiable fitness variations in athletes who practice repeated power-based training after placing dietary intake in the context of the LEA/RED-S (Relative Energy Deficiency in Sport) risk landscape and known physiological requirements of repeated power-based training.

LITERATURE REVIEW

Energy intake, LEA, and performance-relevant outcomes

One of the fundamental topics in the modern studies of nutritional values among gymnasts is that LEA is very common, and it is usually caused by inadequate energy consumption in relation to the training requirements. Direct in situ measurement of intake and expenditure in several days in men collegiate gymnastics determined an extremely high percentage of athletes in LEA category, low carbohydrate consumption identified as a strong factor; correlations with the plyometric performance measures were also studied (Kuhlman et al., 2024). Cross-sectional relationships between energy availability and performance may be varied (in part, because small samples and short monitoring periods represent only portions of a complex concept), but nonetheless LEA is an important conceptual pathway since it is a mechanistically related concept to impaired recovery, endocrine perturbation, and changes in training adaptation (Angelidi et al., 2024).

Recent studies on the comparison of athletes with and without LEA in adolescent female gymnasts have broadened the scope of intake alone research by also profiling the intake patterns about LEA status (Eberhardt et al., 2025). All these studies would support the fact that LEA is not limited to only a discipline or sex and instead is more of an imbalance in structure between high training loads and the limitations of intake, often backed up by the pressures of weight and appearance.

Macronutrient patterns: carbohydrate adequacy and lean mass protection

The availability of carbohydrates is of particular importance in the gymnastics since the training is usually associated with repetitive high-intensity, highly-skilled, and great total session length. Artistic gymnasts have recorded more or less large proportions of carbohydrate intake per kilogram of body mass in a relative context of the aesthetic athlete comparisons; however, in the literature carbohydrate inadequacy persistently emerges in the context of a restricted energy expenditure by athletes on aesthetic athlete comparisons, or as an outcome of clean eating habits which serve to reduce the total carbohydrate inadvertently (Soric et al., 2008; Kuhlman et al., 2024). Inappropriate carbohydrate consumption can lead to a decrease in glycogen availability, an increase in perceived effort, and a decline in the quality of repeated performance- all of which are likely to decrease training stimulus to power and strength endurance in the long-term.

Protein intake has also been examined with respect not only to its ability to repair muscle

and retain lean mass but also with respect to its relationship to micronutrient status among the gymnasts. The same line of research by follow-up study of elite Japanese female rhythmic gymnasts found that, in pre-season weight-loss, athletes with a high degree of habitual protein intake experienced significantly lower rates of iron deficiency, which underscores how the macro-nutrient-based dietary intake can be co-varying with micronutrient adequacy and level of performance dictated by health concerns (Kokubo et al., 2016).

Micronutrient adequacy: bone health, iron status, and neuromuscular implications

Gymnast populations are always reported to have micronutrient gaps. Nutritional deficiencies, notably of calcium, zinc, and magnesium, despite an otherwise well-balanced diet and prevalent use of supplements, were found early in the work with national-team artistic gymnasts in the U.S. (Jonnalagadda et al., 1998). Still more recent teen data suggests that calcium levels and iron levels may be inadequate in young gymnasts and there are concerns, owing to the combination of growth, high-impact loading, and very intense training (Vicente et al., 2023). Fitness wise, low iron status may make oxygen transport impaired and can cause greater fatigue that may be limiting conditioning capacity and training tolerance. Other athletic populations have been studied regarding vitamin D and the relationship between muscles and injury prevention, and indoor athletes may be in high-risk positions concerning low vitamin D status, which may

have a plausible effect on the strength / power expression and musculoskeletal resiliency (Yoon et al., 2021).

Diet quality, nutrition knowledge, and intervention evidence

In addition to the totals of nutrients, the quality of the diet and the knowledge of the athlete influences the adequacy of intake. Research in gymnasts suggests that both narrow eating patterns and lack of understanding of the impact of RED-S may co-exist, which is especially common at elite blogs, which may be the source of the LEA risk and postpone early detection (Donti et al., 2025). There is still emergence of intervention evidence. The article published a nutrition education intervention among young female artistic gymnasts and reported low baseline energy and carbohydrate-energy levels and assessed the possibility of changing the intake and the markers with time with the help of structured education (Aguilo et al., 2021). A larger scope of nutrition education interventions in female players demonstrates that positive changes are usually present in terms of knowledge, whereas changes in food intake and body composition are less predictable and continuous- further highlighting the importance of context-specific and behaviorally specific interventions (Velo-Pulgar and Farran-Codina, 2025).

Research gap

Collectively, the literature suggests (i) the recurrent risk of LEA during gymnastics training, (ii) the frequent deficiency in carbohydrate and the most important micronutrients (including calcium and iron),

and (iii) the possibilities to relate said nutritional exposures in terms of how they contribute to the quality of training, recovery, and the quantifiable results of the fitness. Most of the studies are however, based on nutritional description or health risk markers, but not a direct mapping of nutritional intake profiles to sport-relevant physical fitness markers in the same design, especially across the disciplines and competitive levels of the gymnast sport. The gap justifies the necessity of empirical analysis of nutritional consumption patterns and their correlation with physical fitness levels of gymnast athletes.

Objective:

The major aim of the current research is to assess the nutrition intake of gymnast athletes in terms of total energy and distribution of macronutrients and micronutrient adequacy and diet quality and its effects on the following physical fitness outcomes; muscular strength, power, flexibility, endurance, and body composition. The research also seeks to determine the frequency of nutritional deficiencies and inadequate energy among athletes in the gymnastics field, to establish the relationship between eating habits and the difference in physical fitness results, and to produce pieces of evidence that can underpin nutrition-enhancing intervention to improve training adaptability, health, and GG results in gymnastics.

Methodology:

The sample population to be used in the study will be 100 gymnast athletes including both men and women who are aged 15-25 years. Purposive sampling will be the method of

selecting the sample where only actively operating gymnasts whose training experience is at least two years long and is participated in on a regular basis in competitive or structured training programs will be selected. The sampling methodology is deemed suitable because it allows the researcher to select respondents that will be included intentionally and have the required characteristic and exposure to measure the relationship between nutritional intake and physical fitness outcomes in gymnastics performers in the most reliable manner.

Results and Discussion

The gathered data were coded and analyzed in order to investigate the relation between the nutritional intake and the physical fitness outcomes in gymnast athlete. The adequacy of energy and macronutrient intake was determined as nutritional intake and the determination of physical fitness was done by conducting standardized performance tests. They were tested using inferential statistical tests to test the hypothesis presented.

There are three categories to which respondents were grouped based on dietary examination reveals inadequacy of total energy and macronutrient intake relative to the suggested sports nutrition requirements.

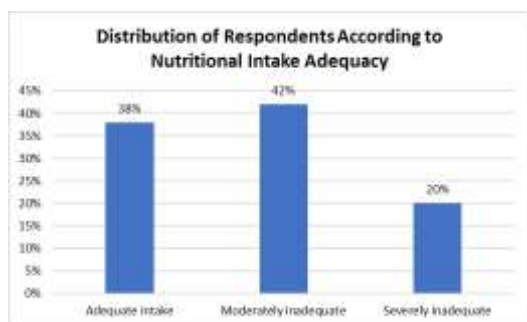


Fig. 1 Adequacy of Nutrition Intake

According to the table, 38 percent of gymnast athletes are shown to have consumed nutritionally adequate food, as the figure of 62 percent were found to be under moderate to severe inadequacy. This demonstrates that there is a general lack of nutritional intake amongst gymnasts, and adverse effects on quality of training and recovery.

Physical Fitness Classification of Performance.

Sports had three levels that were defined according to composite physical fitness scores that comprised of testing strength, power, flexibility and endurance.

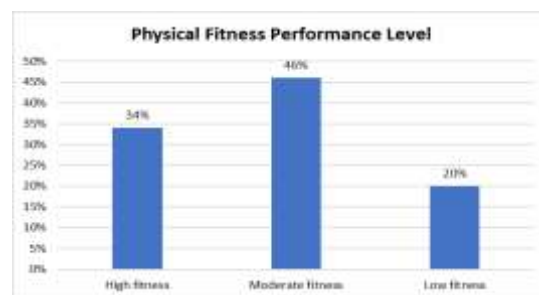


Fig. 2 Physical Fitness Performance Level

It is found that almost 50 percent of the respondents (46) exhibited moderate levels of fitness, and one-fifth were characterized by low fitness performance. The dispersion indicates the physical fitness results variability that could be caused by the variation in nutritional consumption and training adjustment.

Relationship of Nutritional Receiving and Physical Fitness.

In order to investigate the relation between nutritional intake adequacy and physical fitness outcomes, cross tabulation was used.

Table 1 Nutritional Intake Level and Physical Fitness Outcomes

Nutritional Intake Level	High Fitness	Moderate Fitness	Low Fitness	Total
Adequate intake	24	12	2	38
Moderately inadequate	8	26	8	42
Severely inadequate	2	8	10	20
Total	34	46	20	100

It is quite obvious that the high fitness category is dominated by gymnasts who have good nutritional intakes as indicated by the table. Conversely, extreme poor consumption is closely related with low performance in terms of physical fitness. This trend shows that nutritional adequacy and physical fitness outcomes have positive relations.

Hypothesis

H₀: There is no significant association between nutritional intake and physical fitness outcomes among gymnast athletes.

Table 2 Chi-Square

Test Statistic	Value
Chi-square (χ^2)	18.74
Degrees of freedom	4
Significance level (p-value)	0.001
Result	Significant

The p-value calculated is less than 0.05 and this means that the results of nutritional intake and physical fitness will be statistically significant. Thus, the null hypothesis is not accepted and the alternative hypothesis is

accepted. This proves that nutritional consumption plays a vital role in determining physical fitness performance of gymnast athletes.

The discussion indicates that nutritional deficiency intake is widespread among the gymnast athletes and this is strongly correlated with poor performance in physical fitness. Adequate dietary intake by an athlete continuously produced higher results in relation to the fitness parameters which adds to the significance of optimal nutrition to increase training adaptations, trainees physical performance, and long-term athletic growth in gymnastics.

Discussion:

The conclusions of the current research give a definite historical evidence of the contributions of nutritional intake to achieving fitness results in gymnast athletes. The comparison showed that gymnasts who were well-nourished in terms of energy and nutrition showed better physical fitness performance than women of an average or severe nutritional insufficiency, which is similar to the available movements on the impact of nutritional insufficiency on the training adaptation and performance in gymnastics and other aesthetic sports. As reported by previous research, poor carbohydrate and energy intake in gymnasts weakens energy and carbohydrate levels, energy restoration, and neuromuscular activities, thus restricting the strength, power, and endurance demonstrations in training and contests. On the same note, studies have highlighted the fact that the lack of

consumption of the essential micro-nutrients including calcium and iron can worsen the musculoskeletal condition and resistance against fatigue, which can ultimately influence fitness levels. The noted relationship between dietary adequacy and better fitness results in this paper is consistent with previous research studies that confirmed the correlation between sportspeople with balanced diets and better performance indicators as well as a low likelihood of performance deterioration. Therefore, these findings support the objectives of the study by showing that nutritional intake is a decisive factor of the physical fitness of gymnast athletes and that systematic nutritional surveillance and education in gymnastic training facilities.

Conclusion

This paper has concluded that nutrition consumption has an important role of influencing the physical fitness results of gymnast athletes. The findings have provided a clear indication that physical fitness performance of the gymnasts is reflected by their ample energy and nutrient intake as compared to moderate or severe inadequacy in their nutritional aspects. A large percentage of athletes were identified as lacking proper intake of nutrients through their dietary level which could adversely influence strength, power, endurance and general training adaptation. The statistically significant correlation between nutritional consumption and the benefits of physical fitness proves the idea that optimal nutrition is the vital element of athletic performance in gymnastics and proves the assumption that deficiency in

nutrition may become an obstacle to the increased performance in the short run and the development of athletic performance in the long run.

Recommendations

Resting on the results, it is suggested that nutrition evaluation and regular nutritional monitoring should be included in the gymnastics training programs as the part and parcel of the athlete development. There should be conducted structured nutrition education interventions to enhance enlightenment on energy demands, macronutrient equilibrium, and micronutrient sufficiency among the gymnast athletes. The synergistic work with the professional sports nutritionists is recommended to plan the personalized meal plans in accordance with the training load and competition. Also, communication between coaches and support staffs must be sensitized to identify the indicators of nutritional inadequacy and low energy availability, and must create an atmosphere of good health, optimum performance, and long-term athletic career.

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