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Artículo Original

# Optimization of Sports Performance: Analysis of the use of ergogenic nutritional aids by elite athletes representing Peru at an international level

## *Optimización del Rendimiento Deportivo: Análisis del uso de ayudas nutricionales ergogénicas por atletas de élite representando al Perú a nivel internacional*

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**ABSTRACT**

In this cross-sectional descriptive study, the relationship between knowledge and consumption of ergogenic nutritional aids was evaluated in Peruvian athletes featured in the Lima 2019 Pan American Games. A total of 238 athletes from the Peruvian Sports Institute were surveyed using a questionnaire of 23 interrogations. The results revealed a high level of knowledge, with 99.6% of respondents familiar with ergogenic nutritional aids, and 93.7% admitting their use. The main motivation for consumption was guidance from nutritionists (38.1%), followed by recommendations from trainers (24.2%). A significant and positive relationship was identified between knowledge and consumption of ergogenic nutritional aids. A disparity in consumption was observed between genders, with men having a higher average intake and knowledge compared to women. Likewise, it was highlighted that with age both consumption and knowledge of these ergogenic nutritional aids increased. This analysis provides valuable insight into the dynamics of the use of ergogenic nutritional aids in high-performance athletes in the Peruvian context, highlighting the influence of health professionals and coaches on consumption decisions.
**Keywords:** Ergogenic nutritional aids, exercise, sports nutrition, doping.

**RESUMEN**

En este estudio descriptivo de corte transversal, se evaluó la relación entre el conocimiento y el consumo de ayudas nutricionales ergogénicas en deportistas peruanos destacados en los Juegos Panamericanos Lima 2019. Un total de 238 atletas del Instituto Peruano del Deporte fueron encuestados mediante un cuestionario de 23 preguntas. Los resultados revelaron un elevado nivel de conocimiento, con un 99,6 % de los encuestados familiarizados con las ayudas nutricionales ergogénicas, y un 93,7 % admitió su consumo. La principal motivación para el consumo fue la orientación de nutricionistas (38,1 %), seguida de recomendaciones de entrenadores (24,2 %). Se identificó una relación significativa y positiva entre el conocimiento y el consumo de

ayudas nutricionales ergogénicas. Se observó una disparidad de consumo entre géneros, siendo los hombres quienes presentaron un mayor promedio de ingesta y conocimiento en comparación con las mujeres. Asimismo, se destacó que con la edad aumentó tanto el consumo como el conocimiento de estas ayudas nutricionales ergogénicas. Este análisis proporciona una visión valiosa sobre la dinámica del uso de ayudas nutricionales ergogénicas en atletas de alto rendimiento en el contexto peruano, resaltando la influencia de profesionales de la salud y entrenadores en las decisiones de consumo.

**Palabras clave:** Ayudas nutricionales ergogénicas, ejercicio, nutrición deportiva, doping.

## INTRODUCTION

With the beginning of the Olympics, the ancient Greeks established a standard of excellence that permeated all aspects of life, particularly in the field of sports, where the search for the greatest number of medals became a reflection of the cult of perfection. At this time, notable intellectual figures such as Socrates, Hippocrates and Galen directed their efforts towards improving the physical performance of athletes, recognizing the critical influence of quantity and quality nutrition on said performance. This early paradigm marked the beginning of scientific exploration to optimize sports performance (Grivetti and Applegate, 1997).

Since then, research has focused on the identification of substances capable of modulating performance, leading to the development of nutritional aids, known as ergogenic nutritional aids. These compounds are designed to improve various aspects of sports performance, including strength, speed, energy, reduction of fatigue and acceleration of recovery. Its use has experienced exponential growth, both among elite athletes and in the general population dedicated to sports (Porrini and Del Bo', 2016).

Elite athletes, subjected to intensive training and constant travel to participate in national and international competitions, face nutritional challenges. To counteract these problems, many athletes resort to the consumption of ergogenic nutritional aids, sometimes authorized and other times not (Grand View Research, 2014).

The selection of ergogenic nutritional aids experiences significant variations throughout the different phases of training, given that each stage demands specific adaptations in body compositions. These modifications are achieved through tight manipulation of nutrient consumption, along with the strategic inclusion of ergogenic nutritional aids. It is imperative to emphasize the importance of having rigorous knowledge supported by scientific evidence regarding the selection and avoidance of products, since this not only maximizes physical performance, but also contributes to the overall health and well-being of athletes (Maughan *et al.,* 2018).

In light of the growing interest and prevalence in the consumption of ergogenic nutritional aids, it is essential that athletes and those who incorporate these products into their routine comprehensively understand the associated effects. Numerous scientific studies have identified that inappropriate use of these aids could trigger serious health consequences. For example, research has shown that inappropriate administration of certain ergogenic nutritional aids is asso-

ciated with potential risks, such as liver and kidney damage. Furthermore, it has been observed that some of these substances can negatively influence metabolism, increasing the predisposition to metabolic conditions, such as diabetes (Willick *et al.,* 2016). It is therefore crucial that those who make use of these aids in their training regimen have evidence-based knowledge, supported by current scientific literature, to optimize both their performance and long-term well-being.

Additionally, it is crucial to highlight that various ergogenic nutritional aids can be classified as prohibited substances, which increases the probability of positive results in doping tests. This risk is particularly significant for elite athletes involved in national and international competitions. The detection of prohibited substances could not only compromise sporting integrity, but could also have detrimental repercussions for their professional careers. Recent research has highlighted the importance of rigorous surveillance and informed decision-making to avoid potential adverse consequences for athletes' careers (World Anti-Doping Agency, 2024). This evidence-informed approach is essential to safeguard both the reputation and sustainable success of elite athletes.

This research has provided an enlightening insight into the ergogenic nutritional aids that are consumed by elite athletes in Peru. Furthermore, it has explored and analyzed the correlation that exists between the level of knowledge of these athletes about these aids and the effectiveness in their use. These findings not only contribute to the current understanding of consumption practices among elite athletes in the country, but also highlight the importance of informed knowledge in optimizing sports performance through the appropriate use of ergogenic nutritional aids.

## MATERIAL AND METHODS

The population of interest comprised a total of 604 athletes representing various national Federations who stood out enough to qualify and participate in the Lima 2019 Pan American Games. To determine the representative sample, an approach with a confidence level of 95% was applied and a margin of error of 5%, resulting in a sample size of 238 athletes. These participants were selected through non-probabilistic sampling.

Data collection was carried out through an online survey consisting of an instrument with 23 questions. Before application, the instrument was subjected to validation by expert judgment to ensure its suitability. The validation of the instrument used in the research was carried out in collaboration with five nutritionists specialized in the field of sports performance. In order to ensure the rigor of this process, they were provided with the project's consistency matrix, the questionnaire and a detailed table outlining the evaluation criteria to exhaustively evaluate the questionnaire and make relevant observations if necessary. The survey was administered using a form in Google Drive, and the collected responses were entered into the Excel program. Subsequently, a comprehensive statistical analysis was performed using SPSS v26.

The research was carried out under strict adherence to international and local ethical principles, including the Declaration of Helsinki. Protocols were implemented to safe-

guard the safety and well-being of participants, respecting their autonomy and dignity. Informed consent was obtained voluntarily and comprehensively prior to participation.

The confidentiality and privacy of the information collected was guaranteed. An independent ethics committee supervised the study to ensure ethical and scientific compliance. Integrity and respect for the rights of the participants were prioritized in all stages of the research.

## RESULTS AND DISCUSSION

In the study of elite athletes, a varied demographic distribution was found in terms of age and educational level. No significant differences were observed in the distribution according to sex. These results highlight the demographic diversity among elite Peruvian athletes and underscore the portance of considering factors such as age and educational level when developing training, support and supplementation strategies for athletes nationwide (Table 1).

**Table 1.** Age, sex and education of elite athletes who compete at international level representing Peru.

| Age Range | n | % | sex | n | % | Education | n | % |
|---|---|---|---|---|---|---|---|---|
| 15 to 20 years | 50 | 21.0 | Man | 112 | 47.1 | Primary school | 2 | 0.8 |
| 21 to 25 years | 107 | 45.0 | Woman | 126 | 52.9 | High school | 46 | 19.3 |
| 26 to 30 years | 71 | 29.8 | | | | Institute | 32 | 13.4 |
| 31 to 35 years | 7 | 2.9 | | | | University | 155 | 65.1 |
| 36 to 40 years | 2 | 0.8 | | | | Others | 3 | 1.3 |
| 40 to 45 years | 1 | 0.4 | | | | | | |
| **Total** | 238 | 100.0 | | 238 | 100.0 | | 238 | 100.0 |

The analysis reveals a significant diversity in the participation of athletes by federation, with handball and hockey standing out, suggesting a notable interest in these sports. Water sports, such as artistic swimming and surfing, also feature prominently, possibly due to geographical factors. Although soccer is widely popular globally, its representation in research is lower, possibly due to the specificity of the sample or the limited availability of athletes. Although some sports have lower representation, such as athletics, walking, rowing and beach volleyball, these results provide a solid understanding of sports participation in the sample studied (Table 2).

**Table 2.** Athletes by federation who participated in the research.

| Sports | n | % | Sports | n | % |
|---|---|---|---|---|---|
| Handball | 23 | 9.7 | Squash | 5 | 2.1 |
| Hockey | 18 | 7.6 | Table tennis | 5 | 2.1 |
| Soccer | 14 | 5.9 | Artistic gymnastics | 5 | 2.1 |
| Artistic Swimming | 12 | 5 | Softball | 5 | 2.1 |
| Surf | 11 | 4.6 | Athletic-marathon | 4 | 1.7 |
| Judo | 11 | 4.6 | Nailed | 4 | 1.7 |
| Karate | 11 | 4.6 | Water skiing | 3 | 1.3 |
| Weightlifting | 11 | 4.6 | Shouting-shotgun | 2 | 0.8 |
| Wrestling | 11 | 4.6 | Shouting-pistol | 2 | 0.8 |
| Athletics | 10 | 4.2 | Candle | 2 | 0.8 |
| Volleyball | 9 | 3.8 | Bowling | 2 | 0.8 |
| Rugby | 9 | 3.8 | Greco-Roman fight | 2 | 0.8 |
| Swimming | 8 | 3.4 | Athletic-walking | 1 | 0.4 |
| Taekwondo | 7 | 2.9 | Rowing | 1 | 0.4 |
| Boxing | 7 | 2.9 | Beach volleyball | 1 | 0.4 |
| Badminton | 6 | 2.5 | Other | 10 | 4.2 |
| Vasca ball | 6 | 2.5 | | | |
| | | | **Total** | 238 | 100 |

Regarding the frequency of training, athletes mostly perform daily training, which suggests a constant commitment to their physical preparation and sports performance. This finding is consistent with the intensity of training, where it is observed that the majority of athletes dedicate 2 to 4 hours a day to their preparation, which indicates a significant commitment to their training. We can highlight the high percentage of athletes who know and consume ergogenic nutritional aids. This phenomenon may be related to the search to improve physical performance and muscle recovery, especially considering the high level of demand for daily training observed in the sample.

No less important is to note that a small percentage of athletes do not consume ergogenic nutritional aids. I will not delve into the reasons, but, we could infer a variety of reasons, such as personal preferences, concerns about the safety or effectiveness of supplements, or restrictions. financial (Burke, 2019).

These findings suggest that Peruvian elite athletes who compete internationally maintain a high training frequency and extensive use of ergogenic nutritional aids, which may reflect their commitment to sports performance and the search for optimization in their physical preparation (Table 3).

**Table 3.** Frequency of training and use of ergogenic nutritional aids by elite athletes who compete at an international level representing Peru.

| **Training Frequency** | | | **Ergogenic nutritional aids** | | |
|---|---|---|---|---|---|
| | **n** | **%** | | **n** | **%** |
| Weekly | | | Acquaintance | | |
| Daily | 218 | 9.6 % | Yes | 237 | 99.6 % |
| Inter daily | 20 | 8.4 % | No | 1 | 0.4 % |
| **Total** | 238 | 100.0 % | **Total** | 238 | 100.0 % |
| Daily | | | Consumption | | |
| 2 to 4 hours daily | 114 | 29.8 % | Yes | 223 | 93.7 % |
| 5 to 7 hours daily | 124 | 2.9 % | No | 15 | 6.3 % |
| **Total** | 238 | 100.0 % | **Total** | 238 | 100.0 % |

Regarding motivation, it is observed that the majority of athletes indicated that they were motivated by nutritionists and trainers to consume ergogenic nutritional aids. This finding suggests the influence of health and sports professionals on athletes' supplementation decisions. In terms of the source of information, it was found that the majority of athletes received recommendations from nutritionists for the consumption of ergogenic nutritional aids, followed by trainers and doctors. These results reinforce the idea that health and sports professionals play a central role, which is why it is of utmost importance that they are trained in sports supplementation issues, and in this way provide recommendations based on evidence and adapted to the individual needs of each athlete (Gaceck, 2024). Importantly, a significant percentage of athletes indicated that they motivated themselves to consume ergogenic nutritional aids, suggesting that supplementation-related decision making among some athletes is not externally influenced.

Table 4 shows the diversity of sources of motivation and indications regarding the consumption of ergogenic nutritional aids, underlining the importance of professional and personalized guidance in this crucial aspect for sports performance and health.

**Table 4.** Motivation and indications regarding the consumption of sports supplements by elite athletes who compete at an international level representing Peru.

| Motivation | n | % | Indications | n | % |
|---|---|---|---|---|---|
| Auspices | 3 | 1.3 | Companions | 4 | 1.7 |
| Companions | 36 | 15.1 | Coach | 36 | 15.1 |
| Trainers | 58 | 24.4 | Internet | 7 | 2.9 |
| Internet | 6 | 2.5 | Medics | 10 | 4.2 |
| Medics | 5 | 2.1 | Nutritionist | 158 | 66.4 |
| Nutritionist | 91 | 38.2 | Others | 3 | 1.3 |
| Others | 2 | 0.8 | Yourself | 10 | 4.2 |
| Yourself | 37 | 15.5 | Seller | 10 | 4.2 |
| **Total** | 238 | 100 | **Total** | 238 | 100 |

Regarding the frequency of consumption of ergogenic nutritional aids among Peruvian elite athletes, a varied distribution is observed, with a considerable proportion of athletes consuming ergogenic nutritional aids twice a day and once a day, this indicates a frequent practice. of supplementation among the sample of athletes.

Regarding the achievement of expected effects, the majority of athletes reported having experienced the expected effects of supplement consumption, while a small percentage indicated not having experienced such effects. However, a significant group of athletes reported being undecided about whether they had experienced the expected effects, suggesting possible variability in the perception of the effects of supplementation among athletes.

These results suggest that the consumption of ergogenic nutritional aids is a common practice among Peruvian elite athletes, and the majority of them report experiencing the expected effects associated with such supplementation. However, it is important to take into account individual variability in the perception of effects and the possible influence of other factors, such as the quality and dosage of supplements, on athletes' experience (Table 5).

**Table 5.** Frequency of consumption of sports supplements and achievement of expected effect.

| Consumption frequency | n | % | Expected effects | n | % |
|---|---|---|---|---|---|
| Twice a day | 78 | 32.7 | Maybe | 51 | 21.4 |
| Rarely often | 16 | 6.7 | Yes | 177 | 74.4 |
| Three or more times a day | 54 | 22.9 | No | 10 | 4.2 |
| Three times a week | 19 | 8.1 | | | |
| Once a day | 70 | 29.6 | | | |
| **Total** | 238 | 100 | | 238 | 100 |

Regarding the opinion on the need to consume supplements, it is observed that the majority of athletes are in favor of the consumption of ergogenic nutritional aids, while a small percentage expressed an opinion against. Additionally, a significant group of athletes indicated that they sometimes agree with the need to consume supplements. This suggests that there is a variety of opinions among athletes regarding the need for supplementation. Regarding the willingness to review the label of supplements, it is observed that a considerable proportion of athletes expressed willingness to carry out such a review. However, a significant number indicated no interest in checking supplement labels. This suggests a lack of awareness or interest among some athletes regarding the importance of understanding the components and dosage of the ergogenic nutritional aids they consume (Peeling, 2019).

In summary, the results in Table 6 reflect a diversity of opinions among Peruvian elite athletes regarding the need and willingness to review the label of ergogenic nutritional aids. These findings underline the importance of education and awareness on the proper use of ergogenic nutritional aids in sports.

**Table 6.** Opinion on the need for consumption and review of the label of supplements for sporting success.

| Opinion | Label Review | | Consumption necessity | |
|---|---|---|---|---|
| | n | % | n | % |
| Yes | 166 | 69.7 | 128 | 53.8 |
| No | 11 | 4.6 | 110 | 46.2 |
| Sometimes | 61 | 25.6 | | |
| **Total** | 238 | 100 | 238 | 100 |

The data obtained on the consumption and knowledge of the functions of various ergogenic aids among the elite athletes who participated in our study, we can observe that most ergogenic aids have a significant consumption rate, with percentages that vary from 1.3 % to 84.5 %. The most consumed supplements include protein, pre-workout and rehydration drinks.Taking into account the level of knowledge about the functions of these ergogenic aids, the percentages vary widely. Some aids, such as chewable gums and other supplements, have 100 % awareness, suggesting a widespread understanding of their purpose. However, other aids, such as amino acids and glutamine, show relatively low knowledge (0.0 % and 19.3 %, respectively), leading to the conclusion that there is a knowledge gap that must be filled by expert professionals. on these topics.Furthermore, a discrepancy between consumption and knowledge is observed in some cases. For example, while protein is widely consumed, there is a considerable percentage of people who are unaware of its functions (10.1 %). Similarly, there is a high consumption of rehydration drinks (55.9 %), but a significant percentage of people who do not know their functions (26.9 %), these results highlight the importance of improving education about the functions and effects of ergogenic aids among athletes. The discrepancy between consumption and knowledge highlights the need for educational programs aimed at athletes and those who work with them, such as coaches and health professionals (Nutrition and athletic performance, 2016). Finally, Table 7 provides a detailed overview of the consumption and knowledge of ergogenic aids, which may have important implications for sports education and practice.

Regarding the consumption of ergogenic nutritional aids, a significant difference is observed between men and women ($t(238) = 1.978$, $p = 0.049$). Men have a significantly higher average level of consumption ($M = 7.95$, $SD = 3.11$) compared to women ($M = 7.11$, $SD = 3.43$). This suggests that men tend to consume more nutritional ergogenic nutritional aids than women in this sample. In relation to knowledge about ergogenic nutritional aids, a significant difference was also found between men and women ($t(238) = 2.182$, $p = 0.030$). Men show a significantly higher average level of knowledge ($M = 9.66$, $SD = 3.99$) compared to women ($M = 8.51$, $SD = 4.14$). This indicates that men have a higher level of knowledge about ergogenic nutritional aids compared to women in this sample. These results suggest that there is a disparity in the consumption and knowledge of nutritional ergogenic nutritional aids between elite Peruvian men and women athletes.

This difference could be influenced by a variety of factors, such as differences in education and guidance received, as well as individual perceptions of the effectiveness and safety of these ergogenic nutritional aids.

The results of the Pearson correlation between knowledge and consumption of ergogenic nutritional aids, as well as the correlation between these variables and the age of Peruvian elite athletes who compete at an international level, a significant and positive correlation is observed between knowledge and the consumption of ergogenic nutritional aids ($r = 0.749$, $p < 0.001$). This indicates that as knowledge about these aids increases, their consumption among athletes also tends to increase.

**Table 7.** Consumption and knowledge about the functions of ergogenic aids.

| Supplements | Consumption (n=238) | | | | Knowledge (n=238) | | | |
|---|---|---|---|---|---|---|---|---|
| | Yes | | No | | Yes | | No | |
| | n | % | n | % | n | % | n | % |
| Creatine | 89 | 37.4 | 149 | 62.6 | 205 | 86.1 | 33 | 13.9 |
| Glutamine | 37 | 15.5 | 201 | 84.5 | 46 | 19.3 | 192 | 80.7 |
| Protein | 201 | 84.5 | 37 | 15.5 | 214 | 89.9 | 24 | 10.1 |
| Beta alanine | 78 | 32.8 | 160 | 67.2 | 151 | 63.4 | 87 | 36.6 |
| Weight gainer | 34 | 14.3 | 204 | 85.7 | 224 | 94.1 | 14 | 5.9 |
| Prework | 157 | 66 | 81 | 34 | 220 | 92.4 | 18 | 7.6 |
| Iron | 95 | 39.9 | 143 | 60.1 | 220 | 92.4 | 18 | 7.6 |
| Maltodextrin | 28 | 11.8 | 210 | 88.2 | 136 | 57.1 | 102 | 42.9 |
| Chewable gums | 3 | 1.3 | 235 | 98.7 | 238 | 100 | 0 | 0 |
| Amino acids | 44 | 18.5 | 194 | 81.5 | 0 | 0 | 238 | 100 |
| Protein bars | 41 | 17.2 | 197 | 82.8 | 150 | 63 | 88 | 37 |
| Sport gel | 8 | 3.4 | 230 | 96.6 | 185 | 77.7 | 53 | 22.3 |
| Zinc | 70 | 29.4 | 168 | 70.6 | 181 | 76.1 | 57 | 23.9 |
| Magnesium | 81 | 34 | 157 | 66 | 171 | 71.8 | 67 | 28.2 |
| Calcium | 70 | 29.4 | 168 | 70.6 | 180 | 75.6 | 58 | 24.4 |
| B- Complex | 21 | 8.8 | 217 | 91.2 | 138 | 58 | 100 | 42 |
| Re-Hydrating Beverages | 133 | 55.9 | 105 | 44.1 | 174 | 73.1 | 64 | 26.9 |
| Multivitamins | 67 | 28.2 | 171 | 71.8 | 154 | 64.7 | 84 | 35.3 |
| Energizers | 13 | 5.5 | 225 | 94.5 | 119 | 50 | 119 | 50 |
| Others | 11 | 4.6 | 227 | 95.4 | 238 | 100 | 0 | 0 |

Furthermore, significant positive correlations were found between the age of the athletes and both consumption ($r = 0.264$, $p < 0.001$) and knowledge ($r = 0.234$, $p < 0.001$) of ergogenic nutritional aids. This suggests that, in general, younger athletes tend to have lower levels of consumption and knowledge of these aids compared to older athletes.

These findings suggest the importance of considering age as an influential factor in the consumption and knowledge of ergogenic nutritional aids among Peruvian elite athletes. Furthermore, they highlight the relevance of knowledge as a significant predictor of the consumption of these aids, underlining the need to promote education and awareness about their appropriate use in the sports field.

## CONCLUSIONS

The study provides a comprehensive view on the consumption of ergogenic nutritional aids and the perception of Peruvian elite athletes who compete at an international level. The patterns of training and supplement

consumption revealed a high frequency of daily training among athletes, with the majority dedicating between 2 and 4 hours a day to their physical preparation. Likewise, a wide use of ergogenic nutritional aids was observed, especially among those who train daily, highlighting a preference for the consumption of ergogenic nutritional aids once a day. Regarding the motivation and guidance of athletes for the consumption of supplements, the influence of nutritionists and trainers for the consumption of ergogenic nutritional aids was determined, which underlines the importance of expert guidance in this area. An important point to highlight is the variety of opinions regarding the need and interest in reviewing the label of ergogenic nutritional aids among athletes. However, a significant positive correlation was identified between knowledge and supplement consumption, highlighting the importance of knowledge as a predictor of consumption. Taken together, our results highlight the complexity and importance of considering various factors, such as age, sex, educational level, and level of knowledge, when analyzing the consumption of ergogenic nutritional aids among Peruvian elite athletes. These findings provide a solid basis for future research and for the development of support and guidance strategies for athletes at the national and international level.

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