Exercise Behaviors and Nutrition Knowledge and Practices Among Trained Athletes: A Cross-Sectional Study

Direct Original Research

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Abstract

Introduction: Nutrition plays a key role in enhancing performance and improving recovery for athletes at all levels. The aim of this cross-sectional study was to collect current data on aspects related to exercise behaviors and nutrition knowledge and practices in trained athletes in the United States.

Methods: Purposive sampling was utilized to recruit trained athletes from the target population. A questionnaire was developed and piloted to establish validity and reliability as no validated questionnaire was available. Content, face, and construct validities both as test-retest and internal consistency reliability were ensured when developing the final questionnaire. A total of 818 responses were collected for the final questionnaire. After removing incomplete responses and not trained athletes, a total of 667 responses were analyzed. Descriptive statistics were used to summarize data. A chi-square test of independence was performed to examine relationships between selected variables.

Results: Details on frequency, intensity, time, and type of exercise were summarized for the respondents. Nutrition knowledge and frequency of nutritional product use was also summarized. A majority responded as having basic or average nutrition knowledge. There was a significant relationship between selected variables with lower level and frequency of muscle soreness associated with higher frequency of engagement in recovery activities, higher level and frequency of muscle soreness associated with higher average intensity of both cardio- and strength-based exercise sessions, and a higher level of nutrition knowledge associated with a higher implementation of nutritional focus before, during, and after exercise (p = <.001 for each pairing).

Conclusions: The results of the present study provide valuable information on aspects related to exercise behaviors and nutrition knowledge and practices in trained athletes. Future research should continue to investigate the use of supplements for athletic performance as well as investigate distinct nutrition knowledge compared to self-reported level of knowledge of nutrition.

Key Words: supplementation, training measures, performance.

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Introduction

Nutrition plays a key role in athletic performance[1,2]. Studies on the topic are heterogeneous; however, research has found that athletes use supplements more frequently than the general population and supplements are used more often in those who compete at higher levels[3] with the main goals of achieving a specific performance benefit or more effective training gains[1]. The term "athlete" is used worldwide to indicate a given population, with a defining characteristic being a goal of improving athletic performance. Previous research has often focused on nutrition knowledge and practices in specific populations (e.g., Division 1 athletes, coaches, a targeted sport) limiting generalizability of the results[4]. Currently there is a lack of information on exercise behaviors and nutrition knowledge

and practices in "trained athletes," defined as someone engaged in regular, systematic training and competitions with a goal to improve performance, which can be further stratified by volume of exercise and level of competition[5]. To address these gaps in knowledge and provide knowledge with greater generalization, a questionnaire was developed to collect cross-sectional data on these factors to further understand the characteristics of the population, identify patterns, and establish evidence for future research.

Methods

Protocol

The following protocol outlined by Carmines and Zeller[6], a questionnaire was developed and piloted to establish validity and reliability as no validated questionnaire was available. Content, face, and construct validities both as test-retest and internal consistency reliability were ensured when developing the final questionnaire. The pilot and final questionnaires were administered August-September 2019 and January-February 2020, respectively. Participants were recruited from the target population by advertising to local, regional, and national athlete Facebook pages and Slow Twitch (international online forum for cyclists and triathletes). The Institutional Review Board approved the study and informed consent was collected for all participants.

Participants

A total of 818 responses were collected for the final questionnaire. After removing incomplete responses and not trained athletes, a total of 667 responses were analyzed. Participants included professional (1.1%), amateur elite (25.8%), and regular non-competitive (73.1%) athletes. The sample was composed of Caucasian (91.0%), Black/African America (1.0%), Hispanic/Latino (3.4%), Asian/Asian American (2.1%), Native Hawaiian (0.2%), and other/prefer not to say (2.3%) athletes. Both male (n = 336) and female (n = 324) athletes were represented with seven preferring not to say. Ages included 18-29 (12.1%), 30-39 (25.5%), 40-49 (27.7%), 50-59 (20.4%), 60+ (13.9%) and prefer not to say (0.4%). Level of education included Associates/Bachelors (44.9%), Masters (11.7%), Doctorate/Professional (37.6%), High School (5.4%), and prefer not to say (0.4%).

Statistical Analysis

Descriptive statistics were employed to summarize responses to questions on exercise behaviors and nutritional knowledge and practices for the population. No subgroup analysis was performed at this time. Statistical association between selected variables was made using chi-squared test of independence. Data were analyzed using SPSS (Version 29.0.1.0) with a significance set at $p < 0.05$.

Results

Exercise Behaviors

The most common duration of exercise session reported was 45-60 minutes (55.2%), followed by 90 minutes (29.4%). Several respondents reported performing multiple workout sessions in a day on a frequency of 1-2 days per week (38.5%), followed by 3-4 days per week (22.5%). Most respondents reported the average level of physical intensity of their cardio exercise sessions to be moderate (5 RPE) or moderate-to-high (6-7 RPE), 32.2% and 42.3% respectively. There was a similar distribution of responses with regards to the average level of physical intensity of strength-based exercise sessions. All respondents reported cardio-based exercise sessions were a regular part of their routine, whereas 10.5% (N=70) reported to not regularly engaging in strength-based exercise sessions. Half (48.8%) create their own training plan with nearly an equal amount (44.2%) following a training plan online or from a coach. Frequency of tracking specific training measures is presented in Table 1. A majority (63.0%) reported muscle tightness/soreness from regular workouts/training on an occasional basis. Light muscle soreness was most common (65.2%), followed by moderate muscle soreness (26.9%). Most respondents compete at a recreational/local level in running (68.7%) and cycling (52.1%), with weightlifting/CrossFit (44.5%), swimming/water sports (38.4%) and multisport/endurance races (35.1%) also being relatively common. At the state/national/international levels, participation in multisport/endurance races was the most common (30.2%).

Nutrition Knowledge and Practices

Most respondents reported having basic or average nutrition knowledge. Areas of limited or no knowledge included the role of amino acids (33.8%) and minerals (32.5%) in performance/recovery. Areas of in depth or advanced knowledge included the role of protein in performance/recovery (28.9%), proper pre-exercise nutrition (27.6%), and proper training nutrition (27.6%). Most did not follow any specific diet plan (40.5%) or followed their own (51.5%). A slight majority (38.4%) indicated never exercising fasted. Only 2.8% and 13.6% of respondents indicated they 'always' or 'often' follow that pattern, respectively. The majority focus on exercise hydration at a moderate level pre-exercise

(52.9%), high level during-exercise (53.1%), and moderate level post-exercise (49.2%). Table 2 summarizes frequency of use of specific nutritional products.

Table 1. Frequency of tracking specific training measures

Frequency of Tracking Specific Training Measures	Step Count	Heart Rate Zones	Distance	Speed/Pace	HRV	Calories
Never	39.5	11.1	2.1	2.0	30.6	26.1
Rarely	13.7	9.6	1.5	1.8	15.9	21.0
Occasionally	10.8	15.4	7.1	9.0	18.8	16.5
Often	13.9	28.3	26.3	31.1	18.0	18.4
Always	22.1	35.5	63.0	56.1	16.8	18.0

HRV = Heart Rate Variability; Data presented as percentage of respondents.

Table 2. Frequency of use of specific nutritional products.

Product	Daily	Often	Occasionally	Rarely	Never
Multi-Vitamin	34.0	9.0	10.7	15.3	31.0
Specific Vitamin/Mineral	32.5	13.8	10.5	13.1	30.1
Herbal Supplements	6.8	5.1	13.5	16.7	58.0
Protein Shake/Powder	13.7	17.7	18.6	20.1	29.9
Sports/Protein Bar	5.9	21.0	34.2	23.9	15.0
Amino Acids	7.8	11.3	16.5	14.3	50.2
Electrolytes	16.2	38.9	25.3	10.7	8.9
Caffeine (Coffee/Tea)	63.9	13.7	6.6	7.5	8.3
Sports/Energy drink	7.6	21.6	26.2	21.9	22.6
Energy Gels or Similar	1.8	22.2	48.6	20.2	20.7

Table 3. Results of chi-square test of independence.

Relationships of Factors Related to Exercise	
Level of muscle soreness*frequency of recovery activities	
Yoga/stretching	X^2 (20, N = 667) = 542.797, p = <.001
Foam rolling	X^2 (20, N = 667) = 678.819, p = <.001
Compression therapy	X^2 (20, N = 667) = 393.304, p = <.001
Other rehab[1]	X^2 (20, N = 667) = 680.592, p = <.001
Frequency of muscle soreness*frequency of recovery activities	
Yoga/stretching	X^2 (15, N = 667) = 104.309, p = <.001
Foam rolling	X^2 (15, N = 667) = 85.991, p = <.001
Compression therapy	X^2 (15, N = 667) = 68.580, p = <.001
Other rehab[1]	X^2 (15, N = 667) = 101.846, p = <.001
Level of muscle soreness*average intensity of cardio-based exercise sessions	X^2 (20, N = 672) = 696.192, p = <.001
Level of muscle soreness* average intensity of strength-based exercise sessions	X^2 (24, N = 594) = 686.377, p = <.001
Frequency of muscle soreness* average intensity of cardio-based exercise sessions	X^2 (15, N = 666) = 673.720, p = <.001
Frequency of muscle soreness* average intensity of strength-based exercise sessions	X^2 (15, N = 594) = 659.018, p = <.001
Relationships of Factors Related to Nutrition	
Sport nutrition knowledge*exercise hydration	
Pre-exercise hydration	X^2 (9, N = 667) = 458.649, p = <.001
During-exercise hydration	X^2 (9, N = 667) = 384.039, p = <.001
Post-exercise hydration	X^2 (9, N = 667) = 460.750, p = <.001
Sport nutrition knowledge*frequency of exercise nutrition	
Pre-exercise nutrition	X^2 (9, N = 667) = 594.378, p = <.001
During-exercise nutrition	X^2 (9, N = 667) = 571.783, p = <.001
Knowledge of proper recovery nutrition *frequency of post-exercise nutrition	
Hydration	X^2 (9, N = 667) = 392.056, p = <.001
Overall nutrition	X^2 (9, N = 667) = 524.082, p = <.001

[1] Cryotherapy, massage, etc.

Relationships Between Factors Surveyed

A chi-square test of independence was performed to examine the relationship between various factors surveyed related to exercise and nutrition. The relationship for all pairings of variables were significant (Table 3). Lower levels and frequency of muscle soreness were associated with higher frequency of engagement in post-exercise recovery activities, higher levels and frequency of muscle soreness were associated with higher average intensity of both cardio- and strength-based exercise sessions, and a higher level of self-reported exercise nutrition knowledge was associated with a higher level of focus on it before, during, and after exercise.

Discussion

Knowledge of nutrition is a key factor influencing dietary behavior and, as a result, can significantly affect athletic performance. Thus, high-quality research is needed in this area. The present study is timely in providing important insight into the exercise behaviors and nutrition knowledge and practices of trained athletes. Numerous studies have focused on nutrition status and knowledge in Division 1 athletes[7], whereas the current study focused on a wider range of the athletic population, particularly at a more common competitive level. In the present study, specific details of the athlete's exercise behaviors such as type, duration, intensity, and frequency of exercise sessions were obtained, which allows for greater generalizability of the findings than previous research. The present study did not investigate the influence of age, level of education, or level of competition on nutrition knowledge; however, previous studies have found no significant influence from these factors[8].

The present study supports previous research indicating athletes have low nutrition knowledge, putting them at risk for inappropriate dietary choices that could decrease performance and increase risk of injury[9,10,11]. The current study expanded upon these previous findings by highlighting specific areas where knowledge is lacking including the role of amino acids and minerals in performance and recovery, aligning with previous research indicating these areas are commonly misunderstood topics[12].

Higher levels of nutrition knowledge have been associated with improved diet quality[8], and interventions focused on enhancing nutrition knowledge have been shown to result in improved dietary intake[13]. Previous studies have identified a negative relationship between nutritional knowledge and supplement use[14]; however, the present study found the opposite. Athletes often receive most of their dietary information from social media and the internet, information that may not always be accurate or helpful for performance[12]. Collectively, these findings highlight the crucial role of knowledge in optimizing nutrition for athletes[15] and emphasize the need for greater nutritional education in the athletic population as research has shown that athletes with less nutrition knowledge tended to overestimate their competence[12]. Strengths of the present study include a large sample size, diverse sports representation, and use of a validated assessment tool. Limitations include the predominance of Caucasian respondents restricting generalizability and additional factors such as socioeconomic status were not examined.

Conclusions

Overall, the present study provides valuable insight into knowledge and behaviors related to exercise and nutrition in trained athletes. These results can be used to inform areas of education needed in the athletic population and to improve performance. Future research should continue to investigate the use of supplements for athletic performance as well as investigate distinct nutrition knowledge compared to self-reported level of knowledge of nutrition.

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