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Posted Date: 14 July 2023

doi: 10.20944/preprints202307.0969.v1

Keywords: environment, health, psychogenic eating disorders

Article

Prevalence of Vegetarianism Among Regular Exercisers in Greek Gyms: A Pilot Study

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Abstract: Recent studies have shown that the prevalence of vegetarianism among the general population in western societies ranges between 2% and 9%. Information regarding the prevalence of vegetarianism among exercisers is lacking. The aim of the present pilot study was to determine the prevalence of vegetarianism among regular exercisers in Greek gyms, as well as assess their dietary habits, exercise habits, and attitudes toward health and environmental issues. 291 regular gym clients completed an anonymous descriptive online questionnaire containing 65 questions divided into five sections (demographic characteristics, dietary habits, physical activity, dietary supplements, environment). Thirty responders (10.3%) identified themselves as vegetarians, spanning the entire spectrum of vegetarianism, from raw vegan to semi-vegetarian. Compared to omnivores, vegetarians had lower body weight, were more concerned about their health and convinced about the health benefits of their dietary choices, were surrounded by more vegetarians socially, consumed fast food and ate out less often, used more dietary supplements, and were better informed about what a sustainable diet is (all $p < 0.05$). Vegetarians did not differ significantly from omnivores in demographic characteristics, alcohol consumption, smoking habits, prevalence of psychogenic eating disorders, or exercise practices (except for practicing more yoga/Pilates). In conclusion, we report, for the first time, a considerable prevalence of vegetarianism among regular exercisers in gyms. Our findings demonstrate important similarities and differences between exercising vegetarians and omnivores (partly at odds with those seen in the general population) and highlight nutritional and environmental issues on which both groups should be better educated.

Keywords: environment; health; psychogenic eating disorders

1. Introduction

Vegetarianism is a dietary pattern adopted by considerable parts of the human population worldwide for health-related, taste-related, religious, cultural, ethical, and environmental reasons. Well-planned vegetarian diets, ensuring the adequacy of nutrients that plant foods are generally low in, are considered appropriate for individuals during all stages of the life cycle and for athletes [1]. Additionally, plant-based diets are considered more environmentally sustainable than diets rich in animal products because of the need for fewer natural resources and lower environmental damage [1].

Several studies have examined the prevalence of vegetarianism in the general population. The highest values, 36% and 33%, have been reported in India [2,3]. Values in western countries are considerably lower: 3%–6% in the USA; 4%–8% in Canada; about 9% in Germany, Italy, and Great Britain; and 2%–4% in France and Austria [4–12]. In countries with even lower prevalence of vegetarianism, an upward trend has been reported, e.g., from 0.7% in 2007 to 1.8% in 2017 in Finland [13] and from 0.5% in 2005 to 1.2% in 2017 in Switzerland [14].

Athletes and, generally, exercisers represent a particular population group that follows dietary practices different from those of the non-exercising population to meet the increased physical demands of training and competition. Hence, the question arises as to the viability and prevalence of

 doi:10.20944/preprints202307.0969.v1

vegetarianism among this group. It has been suggested that adhering to a vegetarian diet is associated with good health and, thus, may be an equal alternative to an omnivorous diet for athletes [15]. A recent review notes a research gap concerning plant-based strategies for optimal adaptation to training and the need for further research on the effect of sustainable diets on athletes' health and performance [16]. The prevalence of vegetarianism among athletes is largely unknown [17]. Likewise, the prevalence of vegetarianism among exercising individuals (either competitive or recreational) has not been recorded to date. Therefore, the aim of the present pilot study was to explore the prevalence of vegetarianism among regular exercisers in Greek gyms, as well as assess their dietary habits, exercise habits, and attitudes toward health and environmental issues.

2. Materials and Methods

This is a descriptive cross-sectional study held during the COVID-19 countrywide lockdown period (specifically, in spring 2021) using a web-based questionnaire. Gyms in Athens (the capital, with a population of about 3,500,000), Thessaloniki (the second-largest city, with a population of about 1,000,000) and Xanthi (a middle-size city of about 70,000), Greece, that responded to our request sent emails to their clients, inviting them to complete an anonymous questionnaire via an internet link.

For the purpose of the study, a descriptive questionnaire, focusing on the prevalence of vegetarianism among regular exercisers in gyms, was created by the authors in Greek via the Google forms application. The questionnaire consisted of five sections. Section A included 11 items regarding demographic and anthropometric characteristics; section B included 36 items about dietary habits (including vegetarianism), attitudes, disorders, and social norms; section C included five items regarding physical activity; section D included five items about the use of dietary supplements; and section E included eight items concerning environmental issues. Consequently, the total number of items was 65. Because the questionnaire included no psychometric, Likert-style, questions, no validation was warranted.

Most of the items consisted of close-ended questions, some provided the option of multiple answers, and some provided the "Other" option for the participants to complete an answer that was not provided. The participants were asked to complete as many items as possible. They were informed, via an introductory text, that the study was a survey of dietary habits. To avoid possible bias (specifically, the possibility of a higher response rate from vegetarians), vegetarianism was not mentioned in the introductory text. In addition, responders were informed that participation in the study was optional, that the questionnaire was anonymous and that, by clicking the "Next" button, they consented to participate in the study.

The Kolmogorov-Smirnov and Shapiro-Wilk tests were used to assess the normality of distribution of continuous variables, depending on whether sample size was > 50 or ≤ 50, respectively. The distribution of most variables differed significantly from normal. Therefore, median and interquartile range were used for descriptive statistics. The non-parametric one-sample Wilcoxon signed-rank test and Mann-Whitney U test were used for inductive statistics. Finally, the χ^2 test was used to compare frequencies. All statistical analyses were performed using the SPSS, v. 25 (SPSS, Chicago, IL), and statistical significance was declared at $p < 0.05$.

3. Results

Of the 1,291 persons to whom the questionnaire was sent, 385 responded to the invitation; of those, 291 (75.6%) met the current WHO recommendations for at least 150 min of weekly moderate-intensity physical activity or 75 min of weekly vigorous physical activity or a combination of the two [18], according to their answers in section C of the questionnaire. Therefore, only those were considered regular exercisers and were entered in the analysis.

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3.1. Demographic characteristics

Demographic characteristics (included in section A of the questionnaire) of the participants (gender, age group, nationality, qualification level, occupation, family status, and religion) are presented in Table 1. Most participants were female (69.8%), of high qualification level (63.6%), single (63.9%), and with no children (70.1%). Anthropometric characteristics (also included in section A of the questionnaire) will be presented below, after the division of the sample into omnivores and vegetarians.

Table 1. Demographic characteristics of the participants.

	Participants (*n*)	**Participants (%)**
Gender		
Female	203	69.8
Male	88	30.2
Age group		
15-25	80	27.5
26-35	75	25.8
36-45	73	25.1
46-55	50	17.2
56-65	13	4.5
Nationality		
Greek	285	97.9
Albanian	3	1.0
No answer	3	1.0
Qualification level[1]		
1-5	106	36.4
6-8	185	63.6
Occupation		
Civil servant	46	15.8
Private employee	101	34.7
Freelancer	68	23.4
Student	54	18.5
Unemployed	6	2.1
Household	4	1.4
Retired	3	1.0
No answer	9	3.1
Family status		
Single	186	63.9
Married	82	28.2
Separated/divorced	20	6.9
Widow(er)	2	0.7
No answer	1	0.3
Children		
None	204	70.1
1	21	7.2
2	58	19.9
≥ 3	8	2.7
Religion		
Christian	238	81.8
Muslim	3	1.0
Other	2	0.6
None	45	15.5

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No answer	3	1.0

[1] Qualification level according to the European Qualifications Framework: 1, 2nd cycle of primary education; 2, 3rd cycle of primary education; 3, upper-secondary education; 4, upper-secondary education obtained through dual certification; 5, non-higher post-secondary; 6, licentiate degree; 7, master's degree; 8, doctorate (National Qualifications Framework | Eurydice, n.d.).

3.2. Dietary patterns

Table 2 presents the dietary patterns followed by the participants (section B of the questionnaire). Most were omnivores, with 10.3% of the sample identifying themselves as vegetarians. Among vegetarians, the most numerous type (43%) was semi-vegetarian (that is, centered on plant foods with the occasional inclusion of meat). None of the demographic characteristics of the participants listed in Table 1 was related to the choice of being a vegetarian, as revealed by χ^2 tests, all of which produced non-significant outcomes.

Table 2. Dietary patterns of the participants

	Participants (*n*)	**Participants (%)**
Omnivorous	261	89.7
Vegetarian	30	10.3
Type of vegetarianism		
	Vegetarians (*n*)	**Vegetarians (%)**
Raw vegan	1	3.3
Vegan	2	6.7
Lacto-vegetarian	1	3.3
Lacto-ovo-vegetarian	1	3.3
Pesco-vegetarian	8	26.7
Pollo-vegetarian	4	13.3
Semi-vegetarian	13	43.3

Following the division of the sample into omnivores and vegetarians, we calculated the anthropometric characteristics of the two groups, based on information provided in section A of the questionnaire (Table 3). Although vegetarians had significantly lower body weight, they did not differ significantly in body mass index (BMI) from omnivores. Most participants from both groups were normal weight (BMI ≤ 25 kg m^{-2}).

Table 3. Anthropometric characteristics of the participants (median and interquartile range).

	Omnivores	**Vegetarians**	***p*[1]**
Weight (kg)	67.0 (59.5 – 80.5)	61.5 (54.7 – 70.7)	0.022
Height (m)	1.70 (1.63 – 1.77)	1.66 (1.61 – 1.75)	0.107
Body mass index (kg m^{-2})	23.5 (21.3 – 26)	22.7 (20.4 – 24.3)	0.076

[1] According to the Mann-Whitney *U* test.

3.3. Dietary habits, attitudes, disorders, and social norms

Returning to the questions of section B of the questionnaire, participants were asked about the reason(s) for their choice to be omnivorous or vegetarian by being given the possibility of multiple answers. Their love of meat was the most cited reason by omnivores for not choosing a vegetarian diet (54%), followed by the difficulty to adhere to a vegetarian diet (36%), the belief that a vegetarian diet causes nutritional deficiencies (31%), lack of knowledge (5%), not considering a vegetarian diet tasty (4%), and considering it expensive (2%). On the other hand, among vegetarians, the belief that a vegetarian diet improves health was the most cited reason for choosing it (72%), followed by concern for animal welfare (31%), taste (26%), protection of the environment (10%), weight control (10%), and allergies to animal products (7%).

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Table 4 presents the weekly consumption of specific food groups by omnivores and vegetarians. As expected, vegetarians had significantly lower consumption of red meat and poultry than omnivores. Regarding plant foods, vegetarians had significantly higher consumption of legumes than omnivores. They had also higher median consumption of vegetables and fruits, although the difference from omnivores was not significant.

Table 4. Consumption (in times per week) of specific food groups by omnivores and vegetarians (median and interquartile range).

Food group	Omnivores	Vegetarians	p^1
Red meat	2 (1 – 3)	0 (0 – 1)	< 0.001
Poultry	2 (1 – 3)	1 (0 – 2)	< 0.001
Fish/seafood	1 (1 – 1)	1 (1 – 1)	0.623
Legumes	2 (1 – 2)	2 (1 – 2.5)	0.017
Vegetables	5 (3 – 7)	7 (2.5 – 7)	0.518
Fruits	6 (4 – 7)	7 (4 – 7)	0.525
Nuts	3 (1 – 5)	3 (1.75 – 5)	0.840

[1] According to the Mann-Whitney *U* test

Table 5 presents dietary habits of the two groups in terms of meal frequency and type. Vegetarians did not differ from omnivores in terms of daily main meals and snacks (all with a median of 2). However, there was a significant difference in the monthly frequency of fast-food consumption and eating out before the restrictive measures against COVID-19, with vegetarians having lower frequency of both. Alcohol consumption was similar (and low) in both groups. The most popular ways of cooking among vegetarians were (equally) boiling and baking (77%) and, among omnivores, baking (88%), with no significant difference between groups.

Table 5. Comparison of dietary habits between omnivores and vegetarians (median and interquartile range).

	Omnivores	Vegetarians	p^1
How many main meals do you usually eat a day?	2 (2 – 3)	2 (2 – 3)	0.622
How many times a day do you usually eat snacks?	2 (1 – 2)	2 (1 – 2)	0.741
How many times a month do you consume fast food?	2 (1 – 3)	1.5 (0.5 – 2)	0.004
How many times a month did you eat out before the COVID-19 restrictive measures?	3 (1 – 4)	1 (1 – 3)	0.004
How main alcoholic drinks do you consume on average weekly?	1 (0.5 – 3)	1 (0.5 – 2)	0.433

[1] According to the Mann-Whitney *U* test

Vegetarians believed that they followed a healthy diet to a greater degree than omnivores [8 (7 – 8) vs 7 (6 – 8) on a 10-point scale, $p = 0.033$]. Additionally, 43% of vegetarians believed that plant-based diets were healthier than mixed ones and 20% that they were not, while 37% did not know. The corresponding percentages for the omnivores were 10%, 49%, and 41%, the difference between groups being significant ($p < 0.001$). The distribution of answers to the question whether plant-based diets are more expensive than mixed ones did not differ between groups, the prevailing answer being negative (by 53% in vegetarians and 41% in omnivores).

Among the participants, 24 (8%) had been diagnosed with psychogenic eating disorders, with no significant difference between groups. These disorders were anorexia nervosa (in 9 participants), bulimia (also in 9), and binge eating disorder (in 6). The percentage of smokers was 30% among vegetarians and 27% among omnivores, with no significant difference between groups.

To examine whether the choice of being vegetarian or omnivorous was related to the social environment, we asked the participants about the presence of family or close friends who followed

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vegetarian diets. Indeed, vegetarians answered positively at a rate of 53%, as opposed to 27% by omnivores ($p = 0.003$).

Asked whether they believed that muscle mass can be increased without meat consumption, vegetarians answered "yes" by 67%, whereas omnivores did so by 45% (followed by "no," 26%, and "I do not know," 29%), the difference being significant ($p = 0.049$). To the question whether they would have a vitamin deficiency if they did not consume meat, most of the vegetarians answered "no" (60%), whereas most of the omnivores answered "yes" (56%), the difference being significant ($p = 0.002$).

3.4. Physical activity

According to the answers to the questions in section C of the questionnaire, exercise frequency did not differ between groups, being 4 (3 – 5) per week in both groups. There was also no difference in the average exercise time between groups, the mode being 31–60 min per session in both groups (chosen by 50% of vegetarians and 56% of omnivores). As for the types of exercise performed, there was no significant difference between vegetarians and omnivores in their engagement in endurance (57% vs 64%, respectively) or resistance exercise (50% vs 53%, respectively). In contrast, a difference was found in the percentages of participants attending yoga or Pilates classes (40% vs 22%, respectively, $p = 0.032$). Additionally, there was a significant difference between groups ($p < 0.001$) regarding the question whether a vegetarian diet reduces physical performance. Specifically, 20% of vegetarians answered "yes," 67% answered "no," and 13% answered "I do not know." The corresponding percentages among omnivores were 25, 34, and 41%.

3.5. Use of dietary supplements

Analysis of the answers to the questions in section D of the questionnaire showed a significant difference between groups in terms of whether they frequently used dietary supplements (66% vegetarians vs 43% omnivores, $p = 0.021$). The reasons for supplement use were improvement of health (chosen by 70% of users), improvement of performance (39%), and improvement of appearance (17%), with no significant differences between groups. There were also no significant differences between groups regarding the use of specific supplements, the most popular being vitamin C (by 44% of users), vitamin D (37%), magnesium (32%), iron (29%), amino acids/proteins (27%), and multivitamin/minerals (24%).

3.6. Environmental issues

Based on the answers to the questions in section E of the questionnaire, the overwhelming majority of the participants (94%) believed that the Earth's climate has been changing due to human activity in recent decades, with no significant difference between groups. Likewise, there was no significant difference between groups in their perception of how important the issue of climate change is, with 39% of the participants choosing the highest score offered.

Table 6 shows the percentages of positive answers to questions on environmental issues related to the diet. Significant differences between groups were found in the percentage of participants who knew what a sustainable diet is (in favor of vegetarians) and in the percentage of participants who would change their eating habits if they knew that this would help the environment (in favor of omnivores).

Table 6. Participants' opinions on environmental issues related to the diet

	Omnivores	**Vegetarians**	p^1
Participants who believe that people's food choices affect the environment	78%	90%	0.462
Participants who know what a sustainable diet is	45%	67%	0.022
Participants who would change their dietary habits if they knew that this would help the environment	77%	60%	0.035

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Participants who believe that the Mediterranean diet is a sustainable diet	72%	76%	0.789
Participants who believe that the food industry is degrading the ecosystems	73%	87%	0.233

[1] According to the Mann-Whitney *U* test

Finally, Table 7 presents which dietary pattern the participants considered best for the environment. The two groups differed significantly (p = 0.001), with the prevailing pattern among omnivores being a mixed diet and the prevailing pattern among vegetarians being a vegan diet. Notably, a considerable percentage in both groups did not have an answer to this question.

Table 7. Participants' opinion on which dietary pattern is best for the environment

Dietary pattern	Omnivores	Vegetarians
Vegan	6%	27%
Lacto-vegetarian	5%	7%
Semi-vegetarian	24%	17%
Mixed diet	45%	23%
I do not know	20%	27%

4. Discussion

In the present study, we examined, for the first time (to our knowledge), the prevalence of vegetarianism among regular exercisers in gyms and their opinions regarding a number of dietary and environmental issues. Our main finding is that 10% of the participants reported being vegetarian, spanning the entire spectrum of vegetarianism (from raw vegan to semi-vegetarian). This percentage is higher than the ones reported for the general population in western societies, which currently range from 2 to 9% (as presented in the introduction), and, specifically, Greece, where a value of 4% has been reported [19]. Hence, we hereby provide evidence for a higher prevalence of vegetarianism among regular exercisers, as compared to the population at large.

Of interest were the reasons cited by the vegetarians for their choice of dietary pattern. Their top reasons, that is, the belief that a vegetarian diet improves health and the concern for animal welfare, are the same as those cited by the participants in an older survey [20]. In accordance with their high regard for the health benefits of plant-based diets, the opinion that the latter are healthier than mixed ones was prevalent among vegetarians. Taste, ranking third among vegetarians, was the top reason among omnivores for not choosing a vegetarian diet, followed by a difficulty to follow and nutritional inadequacy. Thus, there seems to be a different hierarchy of criteria between vegetarians and omnivores. Notably, cost was not an important reason for omnivores not choosing vegetarian diets. This may be because vegetables and fruits are economical in Greece. In contrast, social influences may have played a role in the participants' choice of dietary pattern, since the presence of vegetarianism in the vegetarians' close environment was twice as high as that in the omnivores' environment.

The lack of differences between vegetarian and omnivorous exercisers regarding the demographic characteristics assessed in the present study (gender, age group, qualification level, occupation, family status, or religion) contrasts with several surveys conducted in the general population, in which women, young people, people with higher qualification (or educational, according to the authors) level were more likely to follow a vegetarian diet [7,9,13]. This discord points at a different profile of exercising vegetarians from that of vegetarians in the general population.

In terms of food group consumption, the most striking difference between groups lied in red meat and poultry consumption, rather than in seafood or plant-based food consumption, thus confirming the separation between vegetarian and omnivore. Interestingly, groups did not differ in weekly alcohol consumption, in contrast, again, with the aforementioned studies in the general population [7,9,13], in which vegetarians consumed less alcohol than omnivores. The prevalence of

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smoking was also similar between groups, in accordance with findings in the general population [14]. The differences between this study and those conducted in the general population are probably due to the generally healthier lifestyle of exercisers. On the other hand, a difference was found in the frequency of fast-food consumption and eating out, with omnivores having a higher frequency of both.

Two-thirds of vegetarians believed that muscle mass can be gained without eating meat. This was also the dominant opinion among omnivores, although at a significantly lower percentage. However, groups differed sharply as to whether not consuming meat would lead to vitamin deficiency, with "no" prevailing in vegetarians and "yes" in omnivores.

Our finding regarding the lack of differences between groups in terms of psychogenic eating disorders contrasts with those of other studies, in which vegetarians had higher eating-disorder psychopathology [8,21,22]. Because these studies have been carried out in the general population, it is possible that regular exercise prevents the occurrence of psychogenic eating disorders among vegetarians to a degree higher than that in omnivores.

Vegetarians and omnivores had similar exercise preferences (including frequency, duration, and choice of endurance and resistance training), differing only in their preference of yoga and Pilates (higher in vegetarians). In addition, the two groups differed in their answers as to whether vegetarianism diminishes physical performance: Although more responders answered "no" than "yes" in both groups, the percentage of vegetarians (67%) was double that of omnivores (34%), among whom more (41%) did not know. Indeed, vegetarianism is not considered an obstacle to sport performance and athletic achievement, although vegetarians need to be more vigilant about their diet, as compared to omnivores [23–26].

Our finding that relatively more vegetarian than omnivorous exercisers (66 vs 43%) were frequent consumers of dietary supplements agrees with the difference found in a sample of 220 distance runners, in which the prevalence of supplement use was 72% among vegans, as opposed to 51% overall [27]. This difference may be due to an underlying concern about the adequacy of vegetarian (especially vegan) diets in providing the necessary amounts of all nutrients [7]. Indeed, health improvement was the primary reason cited (by both vegetarians and omnivores in our study) for taking supplements.

Although both the vegetarian and omnivorous groups declared high interest in climate change and the environment, vegetarians seemed to be more knowledgeable about what a sustainable diet is, whereas omnivores were more willing to change dietary habits for the environment's sake. Additionally, groups differed sharply in their views of the dietary pattern that was best for the environment, with both groups favoring the dietary patterns of their own choice: mixed diets by 45% of omnivores and vegetarian diets by 51% of vegetarians (Table 7). The latter result agrees with the finding that the belief that vegetarianism is beneficial to the environment was the strongest predictor of vegetarianism [28]. As to which diet is actually best for the environment, this seems to be a hotly debated issue, with the answer probably being not universal but dependent on complex interactions of geographic, cultural, economic, political, sociologic, and behavioral factors [29,30]. Nevertheless, a possible consensus may be the modification of the (dominant) mixed diets by increasing plant-based foods and reducing meat and dairy products [30,31].

Our study sheds light on a poorly researched topic, that is, the prevalence and characteristics of vegetarianism among regular exercisers. For this reason, some of our findings could not be compared to those of other studies. A limitation of the present study was the relatively small sample size, mainly because of the low response rate to the invitation to fill the electronic questionnaire (30%). That was a difficult period, with recipients being away from the gyms and having many concerns (health, occupational, etc.) on their minds. Hence, we consider this a pilot study that may form the basis for a next study on a larger scale. Another limitation is that large part (43%) of the vegetarians were semi-vegetarians. Finally, there is the possibility of incorrect answers due to misinterpretation of a question or inaccurate recall. We hope that, in the future, it will be possible to conduct a more extensive and representative study in Greek gyms to better characterize vegetarianism among regular exercisers.

5. Conclusions

The present research shows a prevalence of vegetarianism among regular exercisers in Greek gyms that is higher than that in the general population. Compared to omnivores, vegetarians had lower body weight, were more concerned about their health, were more convinced about the health benefits of their dietary choices, were surrounded by more vegetarians socially, consumed fast food more sparingly, ate out less often, used more dietary supplements, were better informed about what a sustainable diet is, and had a higher environmental regard for vegetarianism. On the other hand, vegetarians did not differ from omnivores in demographic characteristics, alcohol consumption, smoking habits, prevalence of psychogenic eating disorders, or exercise practices (except for practicing more yoga/Pilates). These findings demonstrate important similarities and differences between exercising vegetarians and omnivores, some of which are at odds with those seen in the general population. Additionally, they highlight several nutritional and environmental issues on which both vegetarians and omnivores should be better educated.

Supplementary Materials: The complete dataset of the study.

Author Contributions: Conceptualization, GB; methodology, GB, AP, SKP, and VM; investigation, GB; formal analysis, GB, AP, and VM; writing – original draft, GB; writing – review and editing, GB, AP, SKP, and VM; supervision, AP, SKP, and VM. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of the School of Physical Education and Sport Science of the Aristotle University of Thessaloniki (approval # 58/3-2-2021).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The complete dataset of this study is openly available as supplementary material.

Acknowledgments: We thank Christina Karpouzi for assistance in finding participating gyms.

Conflicts of Interest: The authors declare no conflict of interest.

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