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Use of nutritional supplements and ergogenic aids in professional tennis players

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ABSTRACT

Introduction: Nutritional supplements and ergogenic aids (NS&EA) are used between training/matches with the goal of enhancing tennis performance. Scientific literature about prevalence and use of NS&EA in professional tennis players is scarce.

Objective: The aim of the study was to describe the NS&EA used by professional tennis players during a season.

Methods: Using a validated self-administered questionnaire, 62 professional male and 9 professional female tennis players (11% in their gender specific top 100 tennis world ranking (*i.e.*, ATP/WTA)) registered all the used NS&EA.

Results: Eighty-one percent of the participants declared taking at least one NS&EA. Strength and conditioning trainers (S&C) and tennis coaches were the professionals who recommended most of the NS&EA in the players outside the TOP-100 (OT100; 50.7% and 39.1%, respectively). However, sports nutritionist were the principal advisors in the top-100 tennis players (T100; 62.5%). Sports drinks were the NS&EA most commonly used by all participants (81.7%). T100 participants used caffeine ($p = 0.042$), creatine ($p = 0.001$), iron ($p = 0.013$) and CHO-protein mix ($p = 0.033$) significantly more frequently than OT100 players.

Conclusions: There is a high prevalence of NS&EA use among professional tennis players independently of their tennis ranking position. However, T100 tennis players have an increased use of certain substances such as caffeine, creatine, iron and CHO-Protein mix. For the rest of the studied NS&EA the use was similar between T100 and OT100 players. It is possible that the differences in NS&EA use between groups could be related to the different professionals in charge of nutritional advice in T100 vs OT100.

Key words: Nutrition. Tennis. Ergogenic aids.

RESUMEN

Introducción: los suplementos nutricionales/ayudas ergogénicas (NS&EA) son utilizados en los entrenamientos/partidos de tenis con el objetivo de mejorar el rendimiento. Sin embargo, la literatura científica se encuentra escasos documentos científicos sobre el uso de estas sustancias en tenistas profesionales.

Objetivo: describir el uso de NS&EA utilizados por tenistas profesionales durante una temporada.

Métodos: se utilizó un cuestionario validado y se evaluó a 62 tenistas profesionales hombres y 9 mujeres (11% entre los 100 mejores del mundo).

Resultados: el 81% de los participantes toman al menos un NS&EA. Los preparadores físicos (S&C) y entrenadores de tenis fueron los profesionales preferidos para recomendar NS&EA entre los jugadores fuera del TOP-100 (OT100, 50,7% y 39,1%,

respectivamente). Sin embargo, los nutricionistas deportivos fueron los principales asesores de los jugadores entre los 100 mejores del mundo (T100, 62,5%). Las bebidas deportivas fueron los NS&EA más utilizados entre todos los participantes (81,7%). Los tenistas T100 utilizaron cafeína ($p = 0,042$), creatina ($p = 0,001$), hierro ($p = 0,013$) y mezcla de CHO-proteína ($p = 0,033$) significativamente más frecuentemente que los jugadores OT100.

Conclusiones: existe una gran prevalencia de uso de NS&EA entre los tenistas profesionales. Además, los T100 presentan un mayor uso de ciertas sustancias tales como cafeína, creatina, hierro y CHO-proteína. Para el resto de los NS&EA estudiados, el uso fue similar entre los jugadores T100 y OT100. Finalmente, las diferencias en el uso de NS&EA entre grupos pudieran estar relacionadas con los diferentes profesionales escogidos para el asesoramiento nutricional en T100 vs. OT100.

Palabras clave: Nutrición. Tenis. Ayudas ergogénicas.

INTRODUCTION

In recent years, the interest of nutritional supplements (NtS) and ergogenic aids (EA) has dramatically increased in the sports arena. NtS are defined as concentrated sources of nutrients or other substances with a nutritional or physiological effect beyond what is supplemented by a normal diet (1), while EA are pharmacological agents used for the purpose of enhancing sports performance (2). Commercial brands have found a profitable market where high performance athletes (3), university students (4) and young amateur athletes (5) avidly supplement their diets with these type of products. Increasing prevalence of NtS and EA use among athletes has alerted health and sports authorities, since a non-negligible amount of NtS and EA are contaminated with harmful/banned substances (6). This could endanger athlete's health or cause competition ban if containing doping substances (7). Although the use of NtS and EA is generalized in all the spectrum of performance (i.e., from recreational to elite athletes), only a few EA (e.g., creatine, sodium bicarbonate, caffeine) have been demonstrated to result in enhanced sports performance (8).

Tennis is an intermittent sport which combines short-high intensity efforts with moderate to low intensity periods (i.e., active recovery between points and passive

recovery between games), over variable periods of time (i.e., 1-5 hours) (9). Tennis performance depends of the interaction among technical, tactical, physical and psychological factors (10) which includes nutritional aspects (2). In addition, environmental conditions (11) play a relevant role in tennis success. Recently, time-of-day has been proposed as a factor which could modify physical tennis performance (12). Top 100 tennis players compete on average 25 tournaments per year around the world (13). Travelling through different time-zones added to the high physical demands of professional tennis competition, represent a challenge in the sports nutrition field in order to find recovery strategies aimed to maintain the competitive level during the whole season. Although general guidelines for nutrition and recovery interventions in tennis have been developed (14), there are scarce evidence about nutritional interventions to improve tennis performance and/or recovery among matches and training sessions.

To our knowledge there are two recent reviews on the issue of nutritional supplements in tennis, one by Ranchordas et al. (15) and the other by Lopez-Samanes et al. (2). However, there are no reports of NtS and EA use specifically among professional tennis players. Thus, the first objective of this study was to describe the use of NtS and EA in males (i.e., ATP) and female (i.e. WTA) professional tennis players. The second objective of this study was to compare NtS and EA intake between tennis players inside and outside the top 100 world ranking. The present study is a retrospective-observational study, however, possible differences between the studied groups might represent nutritional/ergogenic factors which could be useful to characterize elite tennis players.

METHODS

Participants

Seventy-one professional tennis players, 62 male tennis players (87.3%) and 9 female tennis players (12.7%) accepted to participate in the study. Within volunteers, 5 tennis male players and 3 female players were in the top 100 worldwide ranking (T100) (age 29.1 ± 4.6 years, height 1.76 ± 0.08 m, body weight 74.1 ± 10.5 kg, age started tennis 6.4 ± 1.1 years, numbers of hours training tennis 15.5 ± 3.3 hours/week and number of hours of physical conditioning 11.0 ± 2.0 hours/week) whereas the remaining

participants (57 men and 6 women) ranked at position between 300-2000 at the ATP/WTA roster (OT100) (age 20.6 ± 4.2 years; height, 1.80 ± 0.07 m; body weight, 72.2 ± 7.2 kg, age at start of tennis training 6.6 ± 2.8 years, volume of training tennis 14.8 ± 5.9 hours/week and volume of physical conditioning 6.5 ± 3.3 hours/week). It is worth to mention that is considered as a professional, any tennis player who has achieved at least 1 ATP/WTA point (16). Thus, all players we tested were professional according to the ATP/WTA. The study complied with the declaration of Helsinki and was approved by the Bioethics Commission of the University of Murcia (Spain).

Experimental design

Fifty-two participants (73.2%) were recruited during two international tennis federation (ITF) Men's Futures Tournaments and one ITF Women's Futures Tournament with money-prices of \$10000 USD. Eleven players (15.5%) were recruited by telephone and nine volunteers through e-mail (11.3%). Participants recruited during the tournaments filled out a printed version of a closed nutritional/ergogenic product use questionnaire, whereas the rest of the participants filled out the electronic version sent by e-mail. For the volunteers recruited during the tournaments body weight and body-fat percentage were measured using a wall-mounted stadiometer (Seca 202, Seca Ltd., Hamburg, Germany) and an electronic scale which includes bioimpedance analysis for body composition (Tanita B-601, Tanita Corp., Tokyo, Japan). Regarding the volunteers contacted via phone/e-mail, body composition data were provided by one member of the player's technical staff using similar equipment.

Questionnaire

A 4-page questionnaire was developed to assess the frequency, dose and types of NtS and EA used by professional tennis players, based in two questionnaires previously validated (3,17). The questionnaire was divided in two different sections. The first section assessed the frequency and dose of NtS and EA taken by tennis players, as well as the reasons for taking them and who did advice its consumption (e.g., sports nutritionists, strength and conditioning coaches, coaches, athletic trainers, other players, etc.). The second part specifies the NtS and EA used by the athlete such as

minerals, energy drinks, protein and branched amino-acids (BCAA), vitamins, and short-chain or omega 3-fatty acids among others.

Statistical analysis

Data are presented as means and standard deviation (SD) for the participant's characteristics, whereas frequencies and percentages are used for the rest of the data. Shapiro-Wilk test a normal distribution of recorded data. Baseline characteristics comparisons between players inside and outside world ranking (T100 and OT100, respectively) were analysed using T-test for independent samples. Comparison of frequencies between T100 and OT100 players were assessed by chi-square (χ^2). Statistical significance was set as $P < 0.05$.

RESULTS

NtS and EA use among professional tennis players

Data revealed that 81.3% of the professional tennis players take at least one NtS or EA. The most frequently NtS and EA used by the studied athletes are displayed in [table I](#). In both groups sport drinks were the most used NtS (87.5% and 81.0% for T100 and OT100 groups, respectively). Supplementation with proteins and minerals were commonly used by T100 participants, since all the T100 participants supplemented their diet with proteins, whereas 80% of the T100 participants used minerals supplementation. On the other hand, OT100 participants showed lower frequencies of use for proteins (58%) and minerals (56%). In comparison to OT100 participants, T100 participants showed higher use of iron ($p = 0.013$), creatine ($p = 0.001$), caffeine ($p = 0.042$) and CHO-protein mix ($p = 0.033$). Use of legit ergogenic aids is displayed in [table II](#). Regarding the frequency of use of NtS and EA, a daily use of NTs or EA was reported in 87.5% of T100 players, and in 52.4% of OT100 players, whereas a weekly use of NtS or EA was reported in 25.0% of T100 players and 7.9% of OT100 players. It is remarkable that some NtS as sports drinks are commonly used daily, whereas some EA and mineral supplementation (e.g., iron) are used sporadically during the season.

Prescription/recommendation of NtS and EA

Data regarding the source of advice for prescription/recommendation of NtS and EA among participants is displayed in **table III**. Strength and conditioning coaches (S&C) (50.7%) and tennis coaches (39.1%) were the professionals who mainly recommended the NtS and EA use for OT100 players, while for T100 volunteers, NtS and EA were recommended mainly by a Sports Nutritionist (62.5%). Only among the OT100 players it was observed that family members, friends and internet web sites were information sources for NtS and EA use.

Reasons for NtS and EA use

Reasons for NtS and EA use are displayed in **table IV**. For both, T100 and OT100 participants, recovery between efforts (50.0% and 59.4% respectively) and increase of energy levels (50.0% and 43.5% respectively) were the main reasons behind the NtS and EA use. Aesthetics reasons (i.e. enhance body image) was reported as a reason to use NtS in 9.4% of the OT100 players, but in any of the T100 players.

DISCUSSION

Nutrition and training are determinant factors in the overall performance of tennis players. However, the scientific literature in the field of nutritional supplements and ergogenic aids applied to competitive tennis players is scarce. To our knowledge, this is the first study presenting a descriptive analysis of the consumption of NtS and EA in a group of professional tennis players. Prevalence of NtS and EA use in other sports has been previously reported, however none of them totally resembles the demands and particularities of tennis. Nevertheless, we found that the prevalence of NtS and EA use (81.7%) is in general agreement with data collected in studies conducted in athletes from several sports disciplines (18). Kondric et al. (19) reported in non-professional tennis players that 80% of the male participants and 100% of the female volunteers consumed NtS. However, in their paper, Kondric et al. did not provide data about which NtS were used, the person responsible for the prescription/recommendation of the NtS or the frequency of use. On the other hand, the finding that NtS or EA use is highly prevalent among athletes is not universal. While some studies report a high prevalence (97-98%) in the use of NtS or EA (20,21), other authors showed use between 51% and 59% (22,23). It is worth to mention that the previously cited studies

were conducted on athletes from different sports. The prevalence of NtS and EA use presently reported in professional tennis players is higher than the described in other intermittent sports such as basketball with (58%) (24). It seems that sports characteristics determine in part the use of NtS and EA. Thus, in cyclic sports of moderate-intensity long-duration, athletes seem to be more prone to use carbohydrates and vitamins (25), while athletes who take part in explosive intense sports where actions are short (i.e., Gaelic Football), seem to consume ergogenic aids such as caffeine and creatine (26). Our findings indicate that elite tennis players (i.e., top 100 world ranking) show a higher prevalence of ergogenic aids use than the rest of the professional tennis players, indicating possibly the availability of a different grade of nutritional advice.

Professional tennis players interact with tennis coaches, strength and conditioning coaches, nutritionists, physical therapists, physicians, and other players being those the main source of advice on nutritional/ergogenic supplements. Regarding the person responsible for recommendation/prescription of NtS and EA, our data from tennis players outside top 100 (OT100) are in agreement with previous investigations carried out in college athletes of several sports which indicated that strength and conditioning coaches are the main source of NtS/EA recommendation/prescription (27). However, for tennis players within the top 100 (T100), sports nutritionist, were the most consulted professional (Table IV). It is possible that the reason for the differences found in the person responsible for recommendation/prescription of NtS and EA among players inside and outside T100 could be simply availability, since T100 players with more professional success can use their larger economic resources to hire sports nutritionist for their team.

Sports drinks are the most common NtS used by professional tennis players, either in the T100 and OT100 participants. Surprisingly, the scientific literature is contradictory about the benefits of sports drinks on tennis performance. Some authors have reported positive tennis performance when providing sports drinks (28), whereas other authors did not find benefits (29). Some substances showed a higher prevalence of use among the T100 in comparison to OT100 tennis players. One of these substances is creatine (75% vs. 11.1%, $p = 0.001$), which has been recognized as an useful ergogenic aid to enhance sports performance both, in cyclical and intermittent sports (30). However, several authors have not found evidences of tennis performance

improvement after creatine use. Eijnde and co-workers studied the effects of creatine (i.e., 4 doses x 5 grams) or placebo in a group of tennis players in a double-blind, cross-over design (31). After compare serve accuracy and running velocity on a 70 m shuttle run test, they did not find differences between the creatine and placebo conditions. More recently, Pluim et al. (32) confirmed this findings, in a randomized and double-blind study. They provided a creatine loading dose of 0.30 grams/kg body weight/day and a maintenance dose of 0.03 grams/kg body weight/day, and compare the results from a complete specific tennis test-battery. The test included serve velocity, muscular strength, intermittent running speed pre-and post-intervention. Their results showed that creatine ingestion did not improve any of the variables measured. Thus, although creatine use is highly prevalent on professional tennis players, mainly those inside the T100, there is no hard evidence about its efficacy to improve tennis performance.

Caffeine is another substance that we found to be highly prevalent within the T100 tennis players group ($p = 0.042$), but no used so frequently in OT100 tennis players (Table II). Caffeine is a well-accepted ergogenic aid for improving sports performance (33). Early studies by Graham and co-workers revealed that doses between 3-6 mg/kg improved cycling endurance performance (34). By measuring contraction velocity during resistance exercise, we have recently reported that caffeine could also increase neuromuscular performance (35). Lastly, a number of studies using GPS tracking devices support that caffeine could increase the number of high-speed actions during intermittent sports (e.g., soccer) (36), the cited results could be interesting from the tennis performance perspective, since tennis is characterized by high intermittent bouts of effort. Evidence about the benefits of caffeine in tennis performance are building, since time of day (i.e., morning) shows a detrimental effect on some features related with tennis performance (12), and caffeine has been shown to counteract the effect of morning reduction of performance in athletes. Some studies have reported several benefits (i.e. increased handgrip force, running pace at high intensity and number of sprints during a simulated match) with caffeine ingestion (37) but other studies have not reported any benefit (38) on performance.

Iron supplementation use showed large differences in consumption between the T100 vs. OT100 (62.5% vs. 6.3%, $p = 0.013$). However, the iron use in the 3 of the T100 tennis players studied was the result of a medical prescription to treat haematological

conditions. Iron prescription is highly prevalent in female runners (39) and athletes from sports with a high aerobic demand. Specifically in tennis players, Ziemann et al. (40) reported that around 50% of young athletes present ferritin concentrations below the reference range. Thus, we could hypothesize that the higher prevalence of iron supplementation observed among T100 players could be related with the accessibility to medical screening and in consequence detection of iron deficiencies, which could be limited in players OT100.

Improvement of recovery between efforts and increase of energy levels were the most reported reasons among tennis players. This finding could be related to their demanding competition calendar, since during a regular season, professional tennis players inside top 100 compete in average in 25 tournaments. In some tournaments, they must compete twice per day to face the single and doubles matches. Thus, recovery between matches seems to be crucial to maintain performance. There is available a comprehensive review about this issue (14). It is remarkable that a non-negligible number of OT100 players include increases of lean body mass and enhancement of body image as reasons for NtS and EA use. Those reasons were not reported in any of the T100 players possibly indicating a different state of focusing and motivations between groups.

In summary, we present novel findings about the high prevalence of nutritional supplements and ergogenic aids use among professional tennis player. Sports drinks are the most common nutritional supplements used by players top 100 or below top 100 professional tennis players. In addition, we found that professional tennis players inside the top 100 ranking obtain recommendation/prescription mainly from sport nutrition professional, whereas the rest of players receive this advice from their coaches, due probably to budget constraints. As a result, professional tennis players within the 100 ATP use more creatine, caffeine iron and CHO-protein mix, than players below 100 ATP, in spite of the fact that scientific evidence supporting the use of creatine for tennis performance is lacking. The main reasons for tennis players to use supplements and ergogenic aid is to speed recovery between competitions which evidences the need for these aids for their demanding competition calendar.

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**Nutrición
Hospitalaria**

Table I. Most frequently used nutritional supplements and ergogenic aids among elite tennis players. T100, Top 100 players; OT100, outside top 100 players. Data are frequencies (percentage)

	T100 (n = 8)	OT100 (n = 63)
Sports drinks	7 (87.5%)	51 (81%)
CHO-protein mix	5 (62.5%)*	14 (22.2%)
Iron	5 (62.5%)*	4 (6.3%)
Mineral-vitamin complex	4 (50%)	18 (27.6%)
Caffeine	4 (50%)	7 (11.1%)
Protein shakes	2 (25%)	25 (39.7%)

*Significantly different to the OT100 group at $p < 0.05$.

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Table II. Use of legit ergogenic aids among professional tennis players. T100, Top 100 players; OT100, outside top 100 players. Data are frequencies (percentage)

	TOP 100 (n = 8)	OT 100 (n = 63)	p value
Creatine	6 (75%)*	7 (11.1%)*	0.001
Caffeine	4 (50%)*	7 (11.1%)*	0.042
L-Carnitine	0 (0%)	5 (7.93%)	0.412
L-Arginine	1 (12.5%)	3 (4.76%)	0.211
Sodium bicarbonate	0 (0%)	3 (4.76%)	0.532
B-Alanine	0 (0%)	2 (3.17%)	0.612

*Significantly different to the OT100 group at $p < 0.05$.

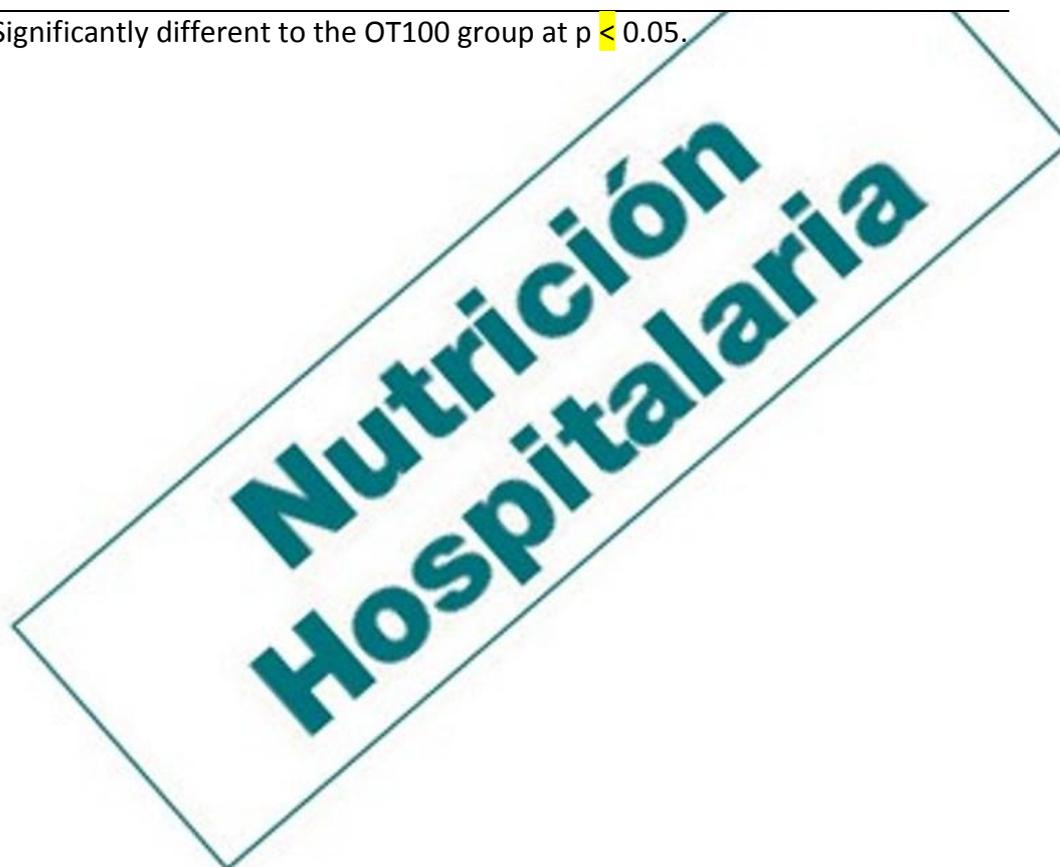


Table III. Source of advice for prescription/recommendation of nutritional supplements and ergogenic aids among professional tennis players T100, Top 100 players; OT100, outside top 100 players. Data are frequencies (percentage)

	<i>T100 (n = 8)</i>	<i>OT100 (n = 63)</i>
Sports Nutritionist	5 (62.5%)	6 (9.4%)
S&C Coach	3 (37.5%)	32 (50.7%)
Teammates	2 (25%)	10 (15.6%)
Medical Doctor	1 (12.5%)	14 (21.9%)
Tennis Coach	1 (12.5%)	25 (39.1%)
Physiotherapist	2 (25%)	8 (12.5%)
Family	0 (0.0%)	5 (7.8%)
Friends	0 (0.0%)	4 (6.3%)
Internet	0 (0.0%)	2 (3.1%)

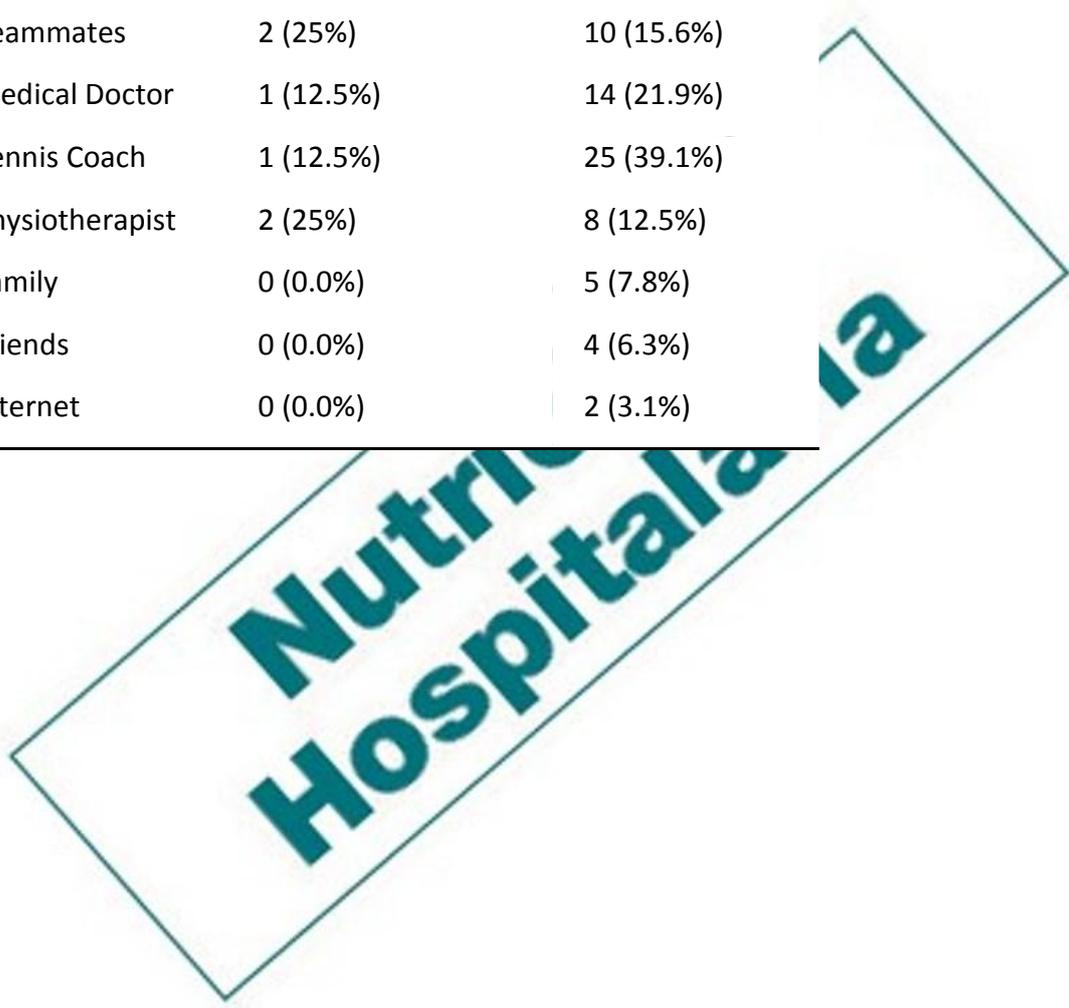


Table IV. Reasons for taking nutritional supplements and ergogenic aids among professional tennis players. T100, Top 100 players; OT100, outside top 100 players. Data are frequencies (percentage)

	TOP 100 (n = 8)	OT 100 (n = 63)
Recovery between efforts	4 (50%)	38 (59.4%)
Increase energy levels	4 (50%)	28 (43.5%)
Prevent nutritional deficiency	2 (25%)	6 (9.4%)
Health maintenance	1 (12.5%)	24 (37.5%)
Enhance immunity	1(12.5%)	4 (6.3%)
Medical indications	1 (12.5%)	2 (3.1%)
Increase lean body mass	0 (0%)	20 (31.3%)*
Enhance body image	0 (0%)	6 (9.4%)

*Significantly different to the OT100 group at $p < 0.05$.

