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# Characterization of body composition and hydration status in adolescent table tennis and basketball athletes from Chile

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## ABSTRACT

**Introduction:** The body composition and anthropometric characteristics of the players are factors that can influence sports performance. Additionally, body shape and size can provide a mechanical advantage during play. Furthermore, sports performance is negatively affected by dehydration, being responsible for the deterioration of the technical skills of athletes.

**Objective:** To characterize the body composition and hydration status in adolescent tennis and basketball players from Santiago de Chile

**Materials and Methods:** Descriptive study, in 20 athletes, of which 9 were table tennis players and 11 male basketball players from Santiago, Chile. Body composition was determined using the proposed Kerr and Ross method, body mass index, muscle/bone index and hydration status by Urine Specific Gravity. Each participant signed an informed consent. For statistical analysis, the p value was calculated using the Student t test at 5% significance.

**Results:** The body composition of the players evaluated was: Adipose tissue: 28.25%; muscle tissue: 46.08%; bone tissue: 10.25%; residual tissue: 9.65% and skin tissue: 5.75%. Bone tissue (p=0.000) and residual tissue (p=0.004) were greater in basketball players and adipose tissue was greater in table tennis players (p=0.040), presenting significant differences. The Urine Specific Gravity was 1.024 g*mL-1 ± 0.007 g*mL-1 and 70% of those evaluated were dehydrated.

**Conclusion:** The athletes evaluated were characterized by a high percentage of adipose tissue and a low level of hydration, a situation that affects sports performance. The work of the nutritionist is vital to promote adequate nutrition and hydration during training and competitions.

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## KEYWORDS

Athlete, tennis player, basketball player, body composition, hydration status.

## INTRODUCTION

Basketball is a team sport with 5 players per team[1,2], where the duration of each game can last 10 to 12 minutes per quarter with a total of four quarters per game[3]. Basketball has been part of the Olympic program since 1936, at the Berlin Olympic Games. On the other hand, table tennis is an opposition and racket sport that is played between two or four players and the duration of a table tennis match is between 10 to 25 minutes with an average play of approximately 10 to 15 seconds. Players hitting the ball more than 30 times per minute which travels at more than 120 km per hour and with rest times of less than 15 seconds[4]. This sport has been recognized as an Olympic sport since 1983.

Basketball is a high intensity sport due to the characteristics of this game such as accelerations, decelerations, jumps, linear sprints as well as changes in direction and jostling for position in rebounds, due to the defensive and offensive situations that the players perform repeatedly[5]. Therefore, strength, agility and speed are key components of good performance, due to the numerous movements made by players with short rest periods in between. During a basketball game, players can cover 5 to 6 km with average intensities higher than the lactate threshold and 85% of the maximum heart rate, so both the anaerobic and aerobic metabolic pathways contribute to energy needs[6]. The typical activities of a basketball game consist of approximately 1000 movements between running, jumping and pushing and 48.7% of all basketball activities include a combination of jumping and shooting movements. Players can perform more than 50 jumps during a match, more jumps per minute during a match compared to other team sports. Furthermore, in 40 minutes of play the player covers a distance of 4,000 to 5,000 m[7].

Table tennis uses varied changes in speed and direction resulting from the specific movements of this discipline, requiring flexibility, coordination of movements and great muscle strength, which induces high physiological and physical demands and a high contribution of cognitive resources[8]. These characteristics of table tennis make it an intense speed sport but with intermittent moments of movements. Consequently, these short, high-intensity periods associated with a long duration integrate anaerobic and aerobic pathways for energy production with phosphocreatine resynthesis during recovery periods[9].

Specific morphological and physical characteristics such as body composition, weight and height are important components of performance in different sports, significantly influencing sports results; therefore, anthropometric characteristics are part of the set of biological variables related to sports performance that must be analyzed[10]. Also, it is well established that greater muscle mass in a high-intensity athlete leads to increased strength and endurance and, therefore, improved performance. That is why knowledge and analysis of body shape is an important element in sport to know aspects that change with training and that allow identifying the morphological prototype of the elite player.

Dehydration caused by sweating is another factor that affects an athlete's performance, increasing physiological stress and the feeling of effort, decreasing resistance and aerobic capacity[11]. In hot and/or humid climates, team sports and racquet players have been observed to experience a loss of more than 2% of body fluids due to thermoregulation. If there is no adequate replacement of lost fluids, it can cause deterioration in resistance capacity and alterations in physiological and cognitive function, so the effects of dehydration during exercise can affect the cognitive performance and functional tasks of athletes[12].

That is why, according to what was stated, this study aims to characterize the body composition and hydration status in adolescent tennis and basketball players from Santiago de Chile, providing information that allows the planning of food and nutrition programs as well as specific training according to the individual characteristics of each player and their sporting discipline.

## MATERIAL & METHODS

### *Type of study and sample*

A cross-sectional quantitative study was designed, carried out during the months of August and December 2023 in table tennis and basketball players in Chile. Participants were selected through non-probabilistic convenience sampling. The sample was made up of 20 male table tennis and basketball players from the Metropolitan Region of Chile. Of the players, 9 corresponded to the table tennis discipline and 11 basketballs, with ages between 13 and 19 years old. The inclusion criteria were table tennis and basketball players who must train at least 5 times a week for 3 hours each session, have a minimum of four years of competition and training experience in the sport and must complete all of the evaluations carried out.

### *Data collection*

Weight was measured with a SECA scale, model 803, placed on a smooth, flat surface, and calibrated at zero. The individual had minimal clothing and was barefoot. Once situated in the center of the platform, he stood still with his weight evenly distributed on both feet facing forward. To measure height, a SECA stadiometer, model 213, was used, placing the individual standing, barefoot with the head oriented in the Frankfort plane, with the arms on both sides of the trunk, extended and with palms touching the outside of the thighs heels together touching the lower end of the vertical surface, with the inner edge of the feet at an angle of 45 to 60 degrees, occipital area, scapular, buttocks, back of the knees and calves touching the vertical surface of the stadiometer. To determine the nutritional status, the Body Mass Index (BMI=Weight in kg/Height$^2$ in m) was obtained.

Skinfolds were measured with a Gaucho Pro caliper with 0.5 mm precision. The perimeters were measured with a metallic, flexible but non-extendable Lufkin measuring tape with an accuracy of 0.1 cm. Bone diameters were measured with a FAGA short anthropometer with an accuracy of 0.1 cm. The measurement of anthropometric variables to determine body composition was based on the protocol developed by the International Society for the Advancement of Kinanthropometry (ISAK)[13]. The 5 components of body mass fractionation (muscle, adipose, bone, residual and skin tissue) were determined through the method proposed by Kerr and Ross[14]; whose results were calculated using a spreadsheet from the Microsoft office Excel program. The sum of 6 Skinfolds corresponded to: triceps, subscapular, supraspinal, abdominal, front thigh and medial calf. To calculate the muscle/bone index, muscle tissue was divided with bone tissue in kilograms. The anthropometric evaluation was carried out by an ISAK level 3 nutritionist.

Urine Specific Gravity was measured in duplicate using a digital refractometer (PAL-10S, Atago, Tokyo, Japan). Each player opened the container by depositing 100 cc of urine which came from the second stream, closing the bottle immediately to reduce the risk of contamination. If the difference between the first two measurements was greater than 0.0005, the third measurement was taken and the median was chosen. The urinary definition of hydration was as follows: Dehydration was defined as GEO ≥1.021; moderate dehydration was defined as GEO in the range of 1.010–1.020 and hydration was defined as GEO of ≤ 1.010[15].

### *Statistical analysis*

Numerical variables are presented as mean ± standard deviation. Body composition data are presented in percentage frequency measurements. The p value was calculated using the student t test to evaluate significant statistical differences. The level of significance was established at 5% ($p<0.05$). The values obtained were analyzed with the SPSS® statistical program, version 25.0.

### *Ethical considerations*

The personal data, safety and well-being of the participants were protected at all times. Each respondent agreed to participate voluntarily and signed an informed consent. This study was approved by the Ethics Review Committee of the Faculty of Health Sciences of the Bernardo O`Higgins University and was carried out in compliance with the Helsinki research ethics agreement.

## RESULTS

The results show a participation of basketball players of 55.5% in relation to tennis players (45.5%). The mean age of the total number of subjects studied was 15.75 ± 1.65 years, being higher in the table tennis players but not significantly (p=0.390). Anthropometric measurements of biceps skinfold (7.11±4.53; p=0.028); Iliac crest skinfold (18.16±8.67; p=0.009); supraspinal skinfold (14.83±8.86; p=0.030); abdominal skinfold (22.5±10.51; p=0.033); front thigh skinfold (17.22±8.48; p=0.011); medial calf skinfold (14.27±4.48; p=0.005); sum 6 skinfolds (96.38±49.38; p=0.017) and muscle/bone index (5.66±0.81; p=0.000) were higher in table tennis players, presenting significant differences in relation to basketball players. In basketball players, anthropometric measurements of biacromial breadths (39.20 ± 2.78; p=0.000); transverse chest breadths (27.04 ± 1.90; p=0.000); A-P chest depth breadths (17.34 ± 1.84) and biiliocrystal breadths (28.19 ± 2.08; p=0.000) were significantly higher compared to table tennis players. No significant differences were found in the rest of the anthropometric variables evaluated (Table 1).

Table N° 2 shows the body composition of the players according to the sport expressed in the compartments adipose

**Table 1.** Anthropometric characteristics of table tennis and basketball players presented in average and standard deviation (Average ± S.D.)

| Variable | Table tennis (N=9) | Basquetball(N=11) | Total (N=20) | p value |
|---|---|---|---|---|
| Age (years) | 16.11 ± 2.08 | 15.45 ± 1.21 | 15.75 ± 1.65 | 0.390 |
| Body weight (kg) | 70.24 ± 9.59 | 68.20 ± 10.65 | 69.12 ± 9.98 | 0.660 |
| Stature (cm) | 171.82 ± 5.39 | 177.70 ± 8.67 | 175.05 ± 7.80 | 0.094 |
| Sitting height (cm) | 88.71 ± 3.21 | 89.20 ± 4.99 | 88.98 ± 4.18 | 0.802 |
| Body Mass Index (kg/m$^2$) | 23.93 ± 4.16 | 21.52 ± 1.97 | 22.60 ± 3.29 | 0.105 |
| Sum 6 Skinfolds (mm) | 96.38 ± 49.38 | 55.59 ± 15.05 | 73.95 ± 39.74 | 0.017* |
| Muscle/bone index | 5.66 ± 0,81 | 3.92 ± 0,38 | 4.70 ± 1.06 | 0.000* |
| Triceps Skinfold (mm) | 14.38 ± 6.71 | 10.13 ± 2.71 | 12.05 ± 5.25 | 0.070 |
| Subscapular Skinfold (mm) | 13,16 ± 8.05 | 8.36 ± 2.33 | 10.52 ± 6.01 | 0.074 |
| Biceps Skinfold (mm) | 7.11 ± 4.53 | 3.72 ± 2.90 | 5.25 ± 3.52 | 0.028* |
| Iliac crest Skinfold (mm) | 18.16 ± 8.67 | 10.00 ± 3.32 | 13.67 ± 7.40 | 0.009* |
| Supraspinal Skinfold (mm) | 14.83 ± 8.86 | 8.18 ± 2.90 | 11.17 ± 7.00 | 0.030* |
| Abdominal Skinfold (mm) | 22.5 ± 10.51 | 13.86 ± 6.02 | 17.75 ± 9.22 | 0.033* |
| Front Thigh Skinfold (mm) | 17.22 ± 8.48 | 9.68 ± 2.19 | 13.07 ± 6.97 | 0.011* |
| Medial calf Skinfold (mm) | 14.27 ± 4.48 | 5.45 ± 3.57 | 9.42 ± 7.57 | 0.005* |
| Head Girths (cm) | 55.78 ± 1.36 | 56.32 ± 1.51 | 56.08 ± 1.43 | 0.419 |

p < 0.05: significant difference*.

**Table 1 continuation.** Anthropometric characteristics of table tennis and basketball players presented in average and standard deviation

| Variable | Table tennis (N=9) | Basquetball(N=11) | Total (N=20) | p value |
|---|---|---|---|---|
| Arm (relaxed) Girths (cm) | 29.26 ± 3.48 | 27.80 ± 2.66 | 28.46 ± 3.06 | 0.302 |
| Arm (flexed and tensed) Girths (cm) | 30.73 ± 2.77 | 29.39 ± 2.34 | 29.99 ± 2.56 | 0.255 |
| Forearm (maximum) Girths (cm) | 25.88 ± 1.73 | 25.72 ± 1.45 | 25.8 ± 1.54 | 0.823 |
| Chest (mesosternale) Girths (cm) | 91.98 ± 6.94 | 91.61 ± 6.71 | 91.78 ± 6.63 | 0.905 |
| Waist (Minimum) Girths (cm) | 79.56 ± 8.43 | 75.80 ± 6.46 | 77.49 ± 7.46 | 0.272 |
| Gluteal (hips) Girths (cm) | 97.12 ± 8.36 | 96.09 ± 6.14 | 96.55 ± 7.04 | 0.754 |
| Thigh (mid tro-tib-lat) Girths (cm) | 52.66 ± 6.87 | 50.95 ± 4.01 | 51.72 ± 5.39 | 0.495 |
| Calf (maximum) Girths (cm) | 35.51 ± 3.39 | 36.22 ± 2.61 | 35.90 ± 2.92 | 0.600 |
| Thigh (1 cm gluteal) Girths (cm) | 57.82 ± 7.38 | 56.57 ± 4.55 | 57.13 ± 5.85 | 0.647 |
| Biacromial Breadths (cm) | 33.32 ± 1.86 | 39.20 ± 2.78 | 36.56 ± 3.81 | 0.000* |
| Transverse chest Breadths (cm) | 22.57 ± 1.75 | 27.04 ± 1.90 | 25.03 ± 2.89 | 0.000* |
| A-P chest depth Breadths (cm) | 13.3 ± 2.36 | 17.34 ± 1.84 | 15.52 ± 2.89 | 0.000* |
| Biiliocristal Breadths (cm) | 22.45 ± 1.42 | 28.19 ± 2.08 | 25.61 ± 3.42 | 0.000* |
| Humerus Breadths (cm) | 7.00 ± 0.29 | 7.06 ± 0.36 | 7.03 ± 0.33 | 0.680 |
| Femur Breadths (cm) | 9.78 ± 0.50 | 9.81 ± 0.43 | 9.80 ± 0.45 | 0.889 |

$p < 0.05$: significant difference*.

**Table 2.** Body composition of the table tennis and basketball players presented in average and standard deviation (Average ± S.D.)

| Compartment | Table tennis (N=9) | Basquetball (N=11) | Total (N=20) | p value |
|---|---|---|---|---|
| Adipose tissue (kg) | 32.58%(22.44 ± 7.32) | 24.71%(16.88 ± 3.65) | 28.25%(19.38 ± 6.13) | 0.040* |
| Muscular tissue (kg) | 44.92%(30.07 ± 4.86) | 47.02 %(32.22 ± 5.66) | 46.08%(31.25 ± 5.29) | 0.381 |
| Bone tissue (kg) | 8.06%(5.36 ± 0.86) | 12.04%(8.19 ± 1.14) | 10.25%(6.92 ± 1.76) | 0.000* |
| Residual tissue (kg) | 8.68%(5.98 ± 1.44) | 10.45%(7.15 ± 1.23) | 9.65%(6.57 ± 1.45) | 0.044* |
| Skin tissue (kg) | 5.74%(3.76 ± 0.20) | 5.76%(3.88 ± 0.30) | 5.75%(3.83 ± 0.26) | 0,306 |

$p < 0.05$: significant difference*.

tissue, muscle mass, bone mass, residual mass and skin. Bone tissue (8.19±1.14; p=0.000) and residual tissue (7.15 ±1.23; p=0.004) were higher in basketball players, presenting significant differences. Unlike adipose tissue, which was significantly higher in table tennis players (22.44±7.32 kg; p=0.040). Muscular tissue (32.22kg±5.66; p=0.381) and skin tissue (3.88±0.30; p=0.306) were higher in basketball players but without significant differences.

Table N° 3 shows the variables associated with the hydration status of the players evaluated, with the table tennis players presenting higher values of Urine specific gravity (Table tennis: 1.027 $g*mL^{-1}$± 0.007 $g*mL^{-1}$; Basketball: 1.021 $g*mL^{-1}$± 0.006 $g*mL^{-1}$, p= 0.073) but without significant differences in relation to basketball players. Regarding the level of hydration according to the Urine specific gravity, 77.78% of the tennis players evaluated are dehydrated and in the case of bas-

**Table 3.** Variables associated with the hydration status of table tennis and basketball players

| Variables | Table tennis (N=9) | Basquetball (N=11) | Total (N=20) | p value |
|---|---|---|---|---|
| Urine Specific Gravity (USG) $g*mL^{-1}$ | 1.027 ± 0.007 | 1.021 ± 0.006 | 1.024 ± 0.007 | 0,073 |
| Classification | | | | |
| Moderate dehydration | 22.22% (2) | 36.36% (4) | 30% (6) | |
| Dehydration | 77.78% (7) | 63.64% (7) | 70% (14) | |

ketball players, 63.64% are in that state. None of the players evaluated were hydrated.

## DISCUSSION

The purpose of this study was to examine body composition and hydration status in adolescent male tennis players and basketball players. It is recognized that body composition and anthropometric characteristics are a relevant indicator of player performance, however very few studies have been carried out on Chilean adolescent athletes.

Muscle mass is directly involved in the production of force, which is essential in basketball players due to the sprints and jumps they must execute during a game. In addition, those players who have a greater amount of fat free mass can jump higher compared to with those players who have a higher proportion of fat mass. Body composition is associated with skill development, in which greater lean mass has been positively related to technical skill levels and those athletes who are in better physical shape tend to be more skilled[16]. Body mass is an aggravating factor in running speed, which means that heavier athletes have greater inertia due to greater amounts of fat, which reduces relative power because greater force production is required per kilogram of body weight lean mass to derive a change in flow rate. High levels of fat mass would not only affect performance by limiting movement speed but also by increasing the risk of injury in areas such as the knees[17].

In relation to the results obtained in this study regarding the anthropometric variables of the players evaluated, in adolescent basketball players from Hungary, a height of 184.5±11.7cm was observed, being greater than that of this study. Regarding adipose tissue, they presented 12.3 kg of body fat, which represents 17.4% of body fat. As for the lean body mass, it was 55.5 kilos, a value higher than what this study obtained, which could be explained because this mass included muscle, organs, and bone and not just muscle[18]. In 18-year-old players from Montenegro, the muscle mass was 44.09 kg, higher than what was found in this study, but it could be explained by the older age of this group and consequently by a greater state of maturity[19].

In 47 15-year-old adolescent basketball players, a higher height (182.69 ± 8.26 cm) was also reported than the group evaluated and a lower triceps skinfold whose value was 6.25 mm. The presence of greater adipose tissue in the arm area could inhibit the movement of the arm during the jump, which must be fast and powerful to reach the ball[20]. In another study carried out on 41 Italian basketball players, the height was lower than that presented in the study with a value of 166.1 cm but the triceps skinfold was 10.6 mm, similar to what was observed in this group of players evaluated. The percentage of fat mass was 16.2%, lower than what was reported in this study, a situation that could be explained by the use of other equations to calculate adipose tissue, as in this case the equations developed by Slaughter and colleagues were applied[21]. Similar values of our study in terms of height are those of 123 basketball players from Portugal in which the height was 173.32 ± 7.89 cm. It is known about the importance of tall stature in basketball players, who even tend to be taller than players in other games, demonstrating these differences between the table tennis and basketball players evaluated in this study[22].

In 28 Chilean male basketball players under 14 years of age, body composition was evaluated using Kerr's pentacompartmental model, the same model used in this study; where muscle tissue was 41.82%, adipose tissue 29.34%, bone tissue 12.83%, residual tissue 10.39% and skin tissue 5.62%; in which the results obtained from this study present better percentages of muscle and fat tissue[23]. A lower percentage of body fat and greater lean mass are favorable for the performance of basketball players, favoring a greater change of direction and vertical and standing long jump. That is why training undoubtedly plays a leading role in body composition, since it has been seen that basketball players who practice three or more times a week show higher values of muscle mass and lower levels of body fat.

Regarding the adipose mass in the table tennis players, they are higher than those described in other studies such as the cross-sectional study of Spanish table tennis players aged 10 and 11, which revealed that the percentage of fat mass in the children was of 12.2%[24]. Another study also in Spanish table tennis players in the Under-11 and Senior categories (over 18), the percentages of fat mass in men was 12.3 ± 5.3% [25]. In the study by Villouta et al, they evaluated 58 table tennis players from Chile between the ages of 14 and 16, reporting a percentage of adipose tissue of 16.6% and 10.7 kg of adipose tissue, values very different from those of this study because the calculation of adipose tissue was through the equation of Slaughert et al, which does not provide information on the rest of the compartments and therefore makes the comparison more complex. The results regarding the high percentage of adipose mass of the table tennis players could be explained by an inadequate diet, based on processed foods and sugary drinks resulting from an obesogenic environment, considering that they trained 5 times a week for at least 2 hours each session[26]. Regarding muscle tissue in table tennis players, the results are similar to those of 109 children between 11 and 12 years old from Spain whose percentage of muscle tissue was 43.8% observing normal values[26]. Even when the muscle mass of the table tennis athletes was in adequate ranges, the speed of movement and technical skills are mediated by greater muscle tissue that is associated with greater strength and therefore better economy of movement and reduction of fatigue, vital characteristics in this sport considering its nature of play and high coordination demands[27].

Team sports are often characterized as high-intensity intermittent sports that can cause significant fluid losses, demonstrating that losses of 2% of body mass can compromise performance and even affect cognitive function and specific physical and technical skills. In the case of basketball players, shooting performance can potentially be reduced with losses of between 2 to 4% of body mass[28]. The evaluated players all presented a degree of dehydration, a worrying situation due to the fact that dehydration can reduce the quantity and level of precision of the shots made at the basket as well as the specific technical gestures during a game[28]. Similar values to what was observed in this study are those reported in nine professional male tennis players who presented dehydration, whose average USG values were 1.026 ± 0.002 prior to the match[29]. Another study carried out on eight male adolescent tennis players indicated that the average GEO value was 1.017 ± 0.003, which despite being a lower value than what was found in this study, they are in a state of moderate dehydration[30]. All of this suggests that hydration educational interventions are a useful tool to improve the hydration status of athletes, given the negative performance and health effects of dehydration.

Our research had several strengths. The strength of the research is that it provides updated data on body composition and level of dehydration in adolescent Chilean table tennis and basketball players. A second strength of this study was that the anthropometric measurements were carried out by an ISAK level 3 nutritionist, applying standardized anthropometric techniques. Finally, the body composition of the players in this study was estimated using the Kerr method, based on a 5-component model, which allows determining adipose tissue, muscle tissue, residual tissue, bone tissue and skin tissue. The results found in this research are of great value but must be analyzed with caution, recognizing the limitations of this study. A limitation is the small sample size, which limits the generalization of the findings; however, it was determined by the defined inclusion criteria Another possible limitation of this study may be the failure to evaluate dietary intake through the 24-hour recall, which should be considered for future research and finally, it is important to note that since it is a cross-sectional study, it is not possible to infer causal relationships between body composition and hydration level.

## CONCLUSIONS

In conclusion, the present research was able to examine body composition and hydration status of basketball and table tennis players from the city of Santiago, Chile. The main findings of the present study were that both groups of athletes were characterized by high adipose tissue and a low level of hydration.

Body composition is one of the factors that affects sports performance, so having the anthropometric profile in young players provides information for a better level of technical preparation for these players during training and competitions.

The important role of the nutritionist in the multidisciplinary team is to ensure that adequate dietary recommendations are provided to athletes to meet their needs and objectives, through the design and planning of nutritional strategies before, during and after training and competition to enhance sports performance and optimal post-exercise recovery.

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