Muscular Power of Leg Extensor Muscles in Young Top-level Table Tennis Players

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Abstract: **Introduction.** Table tennis is an individual and asymmetric sport in which a great number of shots are performed at high speed developing high levels of muscular power. The aim of this study was to determine the power of leg extensor muscles in young top-level table tennis players. **Methods.** A total of 63 players (38 males and 25 females), aged between 10 and 13 years and members of Spanish National Team have been included in the study. After 15-min of easy cycling (cycloergometer Monark 810) subjects randomly carried out three attempts on SJ test and three more on CMJ test (Newtest® contact map). A rest period of two minutes was established between attempts. The test was executed for both jumps following the original protocol. The measured variables were jump height (cm), flight time (ms), power (W), and elasticity index. A t-test for independent samples was performed to examine statistical differences between sex groups. **Results**. All variables measured on SJ and CMJ tests showed higher values in female than in male players (with exception of the flight time). Also, data related to CMJ were higher than those registered in SJ, independently from the sex factor (see table below). The elasticity index was higher in female players than in male players. **Conclusions.** Although within the tested age interval, sex differences in generating muscle power are not clear, higher values in female players have been registered for all variables measured, with exception of the elasticity index.

Keywords: Table Tennis, Muscular Power, Leg Extensor Muscles, Young Players.

1. INTRODUCTION

Table tennis is an individual and asymmetric sport in which a great number of shots are performed at high velocity developing high levels of muscular power.

Although the end of the shot implies an important shoulder, arm and wrist muscles activation, it starts at the lower limbs level, where the action of extensor muscles plays a key role.

Moreover, players develop a great number of quick displacements and changes of direction during the match generating high levels of mechanical power with lower limb extensor muscles. For this reason, muscular power or mechanical power are essential variables for assessing performance in table tennis.

Jump test have been frequently use to evaluate peak power output from this muscles [1]. Indeed, several authors have registered data concerning vertical jump parameters in senior table tennis players, reaching to establish differences between offensive and defensive players [2].

However, there is a lack of information about mechanical power generated by leg extensor muscles of young table tennis players. These data may serve as criteria for young players' selection and for evaluating muscular strength development during training process.

Thas, the aim of this study was to evaluate the muscular power of leg extensor muscles in young top-level table tennis players considering sex as a factor.

2. METHODS

Subjects.

A total of 63 table tennis players (38 males and 25 females), aged between 10 and 13 participated in this study. All players were members of the National Sport Technification Program developed by the Spanish Table Tennis Federation at the moment of the study.

A written informed consent was obtained from parents or tutors of all subject prior to participation in this study that was also approved by the *Ethic Commite* of the University of Seville, Spain. The general characteristics of subjects are summarized in Table 1.

Table 1. General characteristics of the subjects.

	Age (years)	Body mass (kg)	Height (cm)	Body mass index ($Kg \cdot m^{-2}$)
Males (n=38)	11.32±1.82	41.61±1.84	149.1±12.16	18.36±2.51
Females (n=25)	11.56±1.94	44.36±11.21	150.6±10.89	19.25±3.22
Total (n=63)	11.41±1.85	42.70±11.58	149.7±11.60	18.71±2.82

Data are expressed as mean ± standard deviation (SD).

Test procedure

After 15-min of easy cycling (cycloergometer Monark 810®, Stockholm, Sweden) three squat jumps (SJ) and three counter movement jumps (CMJ) were performed in random order on a jumping mat connected to an electronic timer (Newtest Oy® - Powertimer®, Oulu, Finland). Two min rest period between attempts

was established. Test was executed following the original protocol for both jumps [1]. In any case, the best attempt (highest jump) was registered. In both SJ and CMJ, variables measured were jump height (JH; cm), flight time (FT; ms), power (W), and elasticity index (CMJ – SJ *100 / SJ) [1].

Statistical analyses.

Standard statistical methods were used for calculating mean values and standard deviations (SD). The Kolmogorov-Smirnov test was applied to determine the nature of data distribution. Since a normal distribution was confirmed, a t- test for independent samples was performed to examine statistical differences between sex groups. The confidence interval was established at 95%.

3. RESULTS

As it can be seen in Table 2, both JH and FT variables were higher in female players than in male players ($p \leq 0.05$).

Table 2. Data from vertical jump test.

	SJ		CMJ	
	JH (cm)	FT (ms)	JH (cm)	FT (ms)
Males (n=38)	15.8±4.2	357.2±44.4	16.9±4.8	369.0±49.9
Females (n=25)	19.4±6.7*	395.5±52.1*	21.0±6.1*	423.0±50.1*
Total (n=63)	17.6±5.0	377.0±49.3	19.0±5.2	394.8±49.9

*$p \leq 0.05$ (t-test between sex groups).

Similarly, female players were able to generate higher mechanical power than male players (822.0 ± 268.7 W and 759.3 ± 465.6 W for female and male players, respectively) (Figure 1).

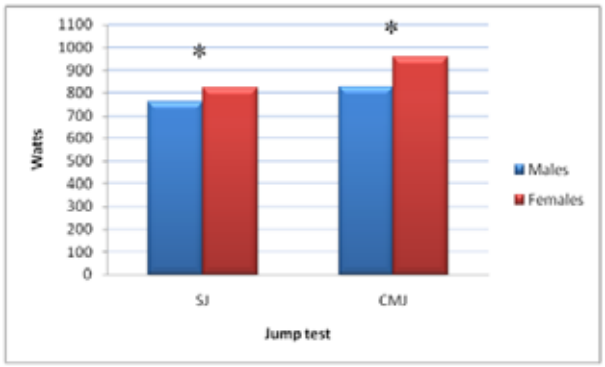

Figure 1. Mechanical power of leg extensor muscles developed in jump test. *$p \leq 0.05$ (t-test between sex groups).

On the other hand, elasticity index assessed in both groups revealed a no statistical differences, but approached statistical significance (7.1 ± 3.2 and 8.2 ± 2.8 for male and female players, respectively; $p=0.063$) (Figure 2).

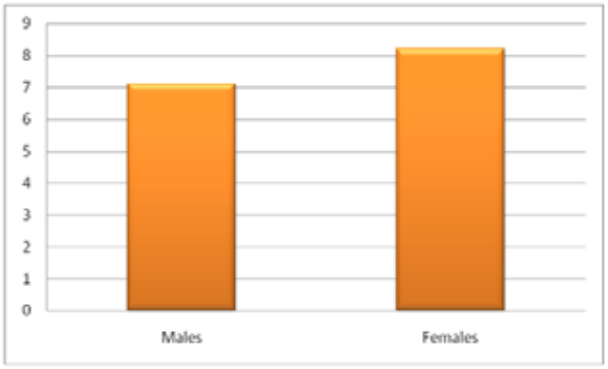

Figure 2. Elasticity Index

4. CONCLUSIONS

The most relevant result found in this study is related to the differences between male and female young table tennis players regarding jump capacity. This led to higher JH and FT in SJ and CMJ for female players. Although there is no evidence one cam speculate that withim the tested age range, females can exhibit higher madurative state than males. Moreover, sex differences in segmental coordination can play an important role in vertical jump performance, a factor not considered in this study.

In general, values related to JH are in consonance with the results of González et al. [4] who registered mean JH for SJ and CMJ of 18.3 cm and 21.6 cm, respectively, for students of both sex and ages between 10 and 12 years. In this sense, Pérez-Gómez et al. [5] found JH for SJ and CMJ of 18.8 and 22.4 cm, respectively, in female gymnasts aged 10-11. By sex, these authors found JH of 17.7 cm in SJ and 20.5 cm in CMJ for female students and 19.0 and 22.8 for male student. Data of males are higher than those found in the present study, where male table tennis players only reached JH of 15.8 cm in SJ and 16.9 cm in CMJ. Lack of control in testing protocol and differences in knee flexion angles at the start of SJ and at the end of eccentric phase of CMJ can be decisive factors for explaining these differences [6].

Mechanical power was higher in female than in male table tennis players, according to higher JH and FT for this sex group. Also, female players showed higher body mass values than males, resulting in higher levels of mechanic power.

Regarding to elasticity index, there are no statistical differences between sex groups. Nevertheless, we found high values (7.1 and 8.2 for male and female players), especially when they are compared with those registered

by Gonzalez et al. [4] who reported indexes of 3.3 in students aged between 10 to 12. These differences can be originated by the above-mentioned factors by a little countermovement in SJ performance.

In any case, the real efficacy of these muscular tests for selecting young sport talents can be questioned considering the results obtained by Castillo et al. [7] who found similar SJ and CMJ between young soccer players and age-matched students, and taking into account the difficulties for to carry out SJ and CMJ test in the correct form.

Although at this age range sex differences in muscle power generation are not clear, we registered higher values in female players for all variables measured, with exception of elasticity index.

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