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FORCE GENERATION IN MALE BASKETBALL PLAYERS

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Vertical jump performance is of a high importance in order to achieve sporting success in both team and individual sports. The purpose of our study was to describe the force generation in basketball players. An additional purpose was to compare SJ and CMJ force generation among male basketball players and non-trained males. Basketball players jumped higher produced higher peak force and higher power than non-trained males in SJ and CMJ, however both had the same impulse time.

KEY WORDS: Strength, power, vertical jump

INTRODUCTION: Vertical jump ability has provoked significant interest among sports scientists for several reasons. First, vertical jumping ability plays an important role in performance levels in many sports and recreational activities, second, because different kinds of vertical jump have become biomechanical and neurophysiological models of muscle study and finally, vertical jumps are a very popular test to assess muscle power (Ugarkovic, Matavulj, Kukolj, & Jaric, 2002).
Each person's ability to jump depends on a combination of physical attributes such us force, power, anthropometric factors etc, nevertheless it is very important to identify critical factors that determine the performance (Bobbert, Gerritsen, Litjens, & Van Soest, 1996). There are not much physically sound reasons about the biomechanical and anthropometric factors that determine jumping performance. Some reports indicate that the height reached in a vertical jump depends mainly on the strength generated during the impulse phase of the jump and the rate of force development (Aragón Vargas & Gross, 1997a, 1997b).
The aim of this study was to describe the force generation curve during a vertical jump in basketball players. Another objective was to describe the differences in the force generation curves during a vertical jump between basketball players and non-trained subjects (but physically active) to detect the main differences between trained and non-trained subjects when they are generating force during a vertical jump.

METHODS: Twenty two males volunteered to participate in this study. Ten of them were Basketball players (Liga Española de Baloncesto Amateur – EBA league), and the other twelve were Physical Education students. Subjects´ characteristics are given in Table 1.
The study was approved by the UCAM ethics committee and all subjects signed an informed consent form prior to the start of testing procedures.
The jumping test consisted of a maximal vertical squat jump (SJ) in a static semi squat position with a knee flexion of 90º. The subjects then performed a maximal countermovement jump (CMJ) starting from a standing position with a downward movement, which was followed immediately by a maximal vertical jump. The subjects kept their hands on their hips throughout the jumps, in order to avoid the possible contribution of the arms to the jump. Both jumps were performed on a force platform (Dinascan/ IBV. 8.1. Valencia. Spain) and samples were taken at 500 Hz. Three maximal jumps were recorded in all cases and the best trial according to jump height was used for further analysis. From the force plate recordings the following variables were calculated: the jump height, in cm (JH); the maximal force developed during the jump, in N (Fmax); the mean power output (Pmean) in W; the positive and negative mechanical impulse, in N.s (MI); the duration of the vertical impulse phase (Ti), in s; the time taken to achieve maximal force (TFmax), in s; the maximal rate of force development (RFDmax), in $N.s^{-1}$. The mean power output was obtained by dividing the change in potential energy (mgh, where *m* is the body mass, *g* the acceleration of gravity and *h* the flight height) by the time needed to jump (impulse time). Statistical analyses were

performed using SPSS package (15.0 version; SPSS, Inc., Chicago, IL, USA). Standard statistical methods were used for the calculation of the mean and standard deviations. All data is expressed as mean ± standard deviation. The Student T-test for independent samples was used to determine whether there is a significant difference between basketball players and physical education students. The $p \leq 0.05$ criterion was used for establishing statistical significance.

Table 1
Anthropometric characteristics of basketball players and physical education students

	Basketball players	Physical education students
Age (yrs)	24.0 ± 2.98	22.9 ± 2.5
Mass (kg)	92.7 ± 9.2	71.4 ± 9.5
Height (cm)	195.1 ± 7.2	177.0 ± 9.0

RESULTS: Squat Jumps (SJ): Basketball players exhibit higher values in jump height than physical education students (p<0.001, Fig.1).The mean power was higher in basketball players than in physical education students p<0.001) that also showed higher maximal peak power (p<0.001, Fig2.)
Basketball players produced higher positive mechanical impulses than physical education students (p<0.001).
There were no significant differences in impulse time between basketball players and physical education students. Basketball players generated more Fmax than physical education students (p<0.01).
RDFmax was higher in basketball players than in physical education students (p<0.05).
Countermovement Jumps: Basketball players obtained higher levels in vertical jump height than physical education students (p<0.001, Fig.1).

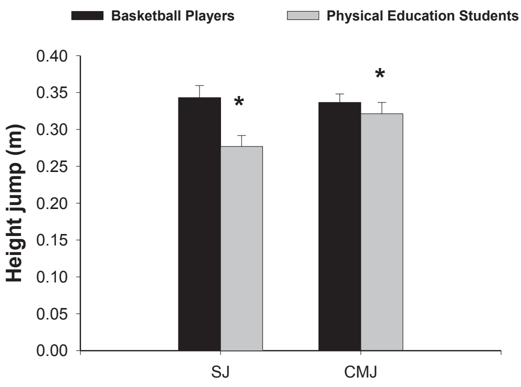

Figure 1: Differences in Jump Height in squat jump (SJ) and countermovement jump (CMJ) between basketball players and physical education students. *p< 0.001

The mean power was higher in basketball players than in physical education students (p<0.005). This is also the case with the instantaneous peak power (p<0.001, Fig.2).
The positive mechanical impulse developed during countermovement jumps was greater in basketball players than in physical education students (p<0.001). There was no difference in force application time between basketball players and physical education students.
Basketball players developed larger maximal force (Fmax) than physical education students (p<0.001). RDFmax was higher in basketball players than in physical education students (p<0.001).

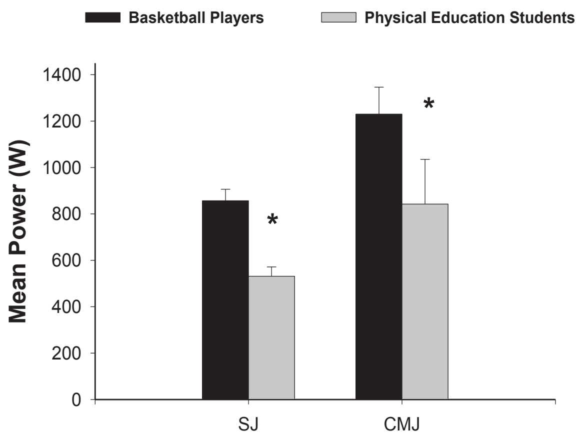

Figure 2: Differences in mean power in squat jump (SJ) and countermovement jump (CMJ) between basketball players and physical education students. *p< 0.001

DISCUSION: This study agrees with previous studies that showed that power trained athletes jump higher than physical education students (Driss, Vandewalle, Quievre, Miller, & Monod, 2001; Greene, McGuine, Leverson, & Best, 1998), but we did not find the same results as published by Viitasalo, Rahkila, Osterback, & Alen (1992). They reported jumps heights higher than 60cm while we found mean values of 35cm. This difference could be explained by the different methods of testing carried out, or alternatively, because Viitasalo et al. players were in the first national division and our subjects are playing in EBA.
In addition basketball players exhibited a larger mean power than physical education students, which concurs with other studies (Kollias, Hatzitaki, Papaiakovou, & Giatsis, 2001), however we obtained mean power values of 1230 W in countermovement jump, which is smaller than those reported by other authors (Manchado, Hoffmann, Valdivieso, & Platen, 2007; Mc Innes, Carlson, Jones, & McKenna, 1995).
Basketball players obtain greater values of Fmax, in accordance to previous studies (Kollias, et al., 2001), but the impulse time was not different for physical education students, that relates to previous studies with volleyball players (Ferragut Fiol, Cortadellas Izquierdo, Navarro de Tuero, & López Calbet, 2002). This issue is very important because it reflects that basketball players spend the same time developing force levels, but they are capable of generating higher force values in the same interval of time.

CONCLUSION: The result of this study shows that basketball players reach a greater jump height in vertical jump, since basketball players can develop higher force values in lesser time. This enables them to improve the power generated during jumps and for this reason they can jump higher. This is an important issue for coaches who can spend time developing training routines helping to minimise impulse time during jumps, when the time shown by professional players shows little variation to that of non-trained players.

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