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ORIGINAL ARTICLE

Comparative Study of the Capacity of Pelvic Floor Contraction in Volleyball and Basketball Athletes

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ABSTRACT

High impact sports can produce exaggerated and frequent increase of the intra-abdominal pressure, one of the triggering factors of stress urinary incontinence (SUI) in athletes. The study was carried out with 20 athletes; 10 of these being basketball and 10 volleyball athletes. The study was quantitative, observational, cross on and comparative, in which the ability of contraction of the pelvic floor (PF) among athletes in volleyball and basketball was compared, and later correlated with symptoms of stress urinary incontinence. The evaluation of the athletes was composed of a questionnaire, the functional evaluation of the pelvic floor (FEPF) and assessment of the ability of contraction of the PF through the Fênix Electromyographic Biofeedback®. Statistically significant differences were not observed after the evaluation regarding the ability of contraction of the pelvic floor between basketball and volleyball athletes, but both groups presented athletes with reports of involuntary loss of urine due to physical exertion, with higher ratio in the group of basketball athletes.

Keywords: physiotherapy, urinary incontinence, high impact.

INTRODUCTION

The ever increasing number of women who practice sport activities imposes new challenges to the scientific community concerning the research on the effects of this activity on the female organism. However, to the female professional athletes physical activities can bring a special risk, due to negative effects to the reproductive system, such as menstrual irregularities (secondary amenorrhea, oligoamenorrhea, short luteal phase and anovulation) and to the musculoskeletal system, in which, besides the injuries common to the athletes, high impact exercises may lead to weakening of pelvic musculature, predisposing them to SUI[1].

According to the *International Continence Society* (ICS), urinary incontinence (UI) is defined as any complaint of involuntary urinary loss, which can be considered a common problem among women, with a rate prevalence which ranges from 10% to 55% and age between 15 and 60 years[1,2].

Approximately 200 million people in the world present some kind of UI, the most frequent being the SUI, defined as complaint of involuntary urine loss during physical exertion, sneezing, coughing or physical activity. However, according to the ICS terminology and standardization, the SUI can be considered as a symptom, a sign, an urodynamic observation or the combination of these factors[2].

SUI represents a great barrier to women's participation in sport activities, interferes in their health, well-being and self-esteem. In athletes, the highest prevalence is found among young nulliparous female elite athletes who usually practice sports which involve high impact[1,2].

SUI is not only a geriatric problem, once its prevalence in middle-aged women is of 30%, and this value increases to 47% in women who regularly exercise, with the activities which mostly cause urinary loss being jumps with open legs (30%), jumps with united legs (28%), running (30%) and sports with high impact on the ground (14%)[3].

Among the modalities, the SUI prevalence rate ranges from 10% in swimming (low impact modality), reaching up to 40% to athletics and aerobic activities (high impact), leading 20% of these athletes to give up their activities and 40% to change modality[1].

However, urinary loss is not related to menstrual irregularities, weight or height of the female athletes, neither to duration of the match, since high impact exercises are the ones which increase the most the intra-abdominal pressure due to the diaphragm and abdominal muscles contraction, justifying hence the prevalence of SUI, compared to other sport activities[1].

It is known that the abdominal musculature strength tends to be high in athletes; this can be both due to demands from the sports modality to this musculature and due to general physical training which these female athletes are submitted to. If the musculature of the pelvic floor is weak in relation to the high intra-abdominal pressure which is created, urinary loss episodes can occur when these women are submitted to physical exertion, even in the absence of other risk factors[3]. Therefore, in the high impact activities there will be higher demand of continence and support from the pelvic floor muscles, which should be prepared and strengthened, preserving their function and consequently avoiding SUI[3].

Some sport modalities are classified according to the risk to the PF muscles, being the modalities assessed for this study volleyball and basketball, which are considered high risk. Thus, research which aids the professionals in the prescription of sport activities for women is necessary in order to prevent complications and promote suitable treatments. Since the benefits of physical activities are already well-known, we must study in more detail the disorders occurred in the female population practitioners of sports and/or physical activities in order to have early diagnose as intervention[4,5].

The sport modalities in the present study, besides being considered high impact, can produce exacerbated and frequent increase in the intra-abdominal pressure, one of the triggering factors of stress urinary incontinence in athletes. Therefore, the present investigation justifies by the need to assess the capacity of the pelvic floor contraction in order to analyze which Sport modality will cause greater disorders to the pelvic structures, enabling the performance of prevention investigations. This study has the general aim to compare the capacity of contraction of the pelvic floor among athletes practitioners of volleyball and basketball, and to correlate them with the development of stress urinary incontinence. Its specific aims are: to perform the FEPF test for assessment of the capacity of contraction of the pelvic floor of the athletes; to assess the capacity of contraction of the pelvic floor of the athletes through the Fênix Electromyographic Biofeedback®; to statistically compare the results of the assessment between two modalities in the study; to relate the capacity of contraction of the pelvic floor with symptoms of stress urinary incontinence from the results of the assessment.

MATERIALS AND METHODS

The research was approved by the Ethics and Research Committee of the University of the Amazon, according to protocol # 189.157/08. The Free and Clarified Consent Form – TCLE was applied to all participants of the research, according to resolution 196/96 of the National Health Board (2000), so that all information concerning the subjects could be preserved in the assessment process.

The study was quantitative, observational transversal and comparative where the capacity of contraction of the pelvic floor among volleyball and basketball athletes was compared and later correlated with symptoms of stress urinary incontinence.

The present study was held in the Physiotherapy Clinic (Cafisio), situated on the Senador Lemos Avenue, number 129, in the Day and night shifts, from August to November, 2008, from Mondays to Saturdays except for Sundays and holidays, after approval from the owner of the clinic.

The research sample was composed of female volleyball and basketball athletes with more than one year of training, who accepted to participate in the study and were submitted to a physiotherapeutic evaluation. Inclusion criteria were: to be female volleyball and basketball athletes, aged between 16 and 26 years of age, to have over one year of professional training, to be nulliparous, to be sexually active and to have not had gynecological surgical procedure, and all athletes who did not meet all the inclusion criteria were excluded.

The study population consisted of 37 basketball athletes and 42 volleyball athletes both female. Eight basketball athletes were excluded from the study (five – virgins; three – multiparous) and 19 did not accept to participate in the research and/or did not go to the site of evaluation. 12 athletes were excluded from the volleyball group (six – virgins; four – multiparous; two – gynecological surgery) and 20 did not accept to participate in the research and/or did not GO to the site of evaluation.

The research was conducted with 20 athletes divided in two groups (volleyball, n = 10 and basketball, n = 10) professional participants of their specific modality for over one year. An assessment specific to the pelvic floor was performed, which was composed of data of the athletes, functional evaluation of the pelvic floor (FEPF) and evaluation of the capacity of contraction of the pelvic floor through the Fênix Electromyographic Biofeedback®.

The research was previously established by the researchers with the approval of the advisor professor. Initially, informative lectures were given to the athletes, in which each participant received information about the aims of the research, procedures to be performed, instructions on the importance of the PF, consequences and its dysfunctions, used material and equipment. The Free and Clarified Consent Form was signed and data were collected through a physiotherapeutic evaluation in which the inclusion and exclusion criteria were assessed. Weight and height were verified with the use of an anthropometric scale (*Welmy 110®*). The body mass index (BMI = weight/height^2) was calculated from these data, having table 1 as score.

Subsequently, tests to verify the capacity of contraction fo the pelvic floor were performed through the use of the FEPF scale and the Fênix Electromyographic Biofeedback®.

The measurement of the level of muscular contraction of the PF through the FEPF scale was performed by a single and the same examiner during the physiotherapeutic evaluations, following this standardization: patient positioning at dorsal decubitus, abducted hips, flexed knees and feet on the ground. The therapist used procedure gloves and lubricant gel Ky®, split the small labia apart with one of the hands and with the other performed bidigital introduction in the examined genitalia, and the patient was told to perform perineal contraction, where the capacity of contraction as well as its duration time were assessed (figure 1). The contraction classification followed the scale presented by Ortiz (1996) demonstrated in the table below (table 2).

The Biofeedback is an apparatus for reeducation which is used to measure inner physiological effects as a learning device as well as in the strengthening of the muscles of the pelvic floor, since it offers parameters of a maximum contraction. It also provides awareness on a muscle little exercised such as the elevator muscle of the anus[9-11].

The Biofeedback apparatus leads to the learning through self-correction in a natural way. It can be active (commanded by the patient), in which the starting point in the central nervous system is the central lobe, or even passive (by the electrostimulation) in which the starting point is the sphincter pelvic floor. Previously, by the Biofeedback use, the patient should be informed on basic anatomic notions of the PF function as well as the vesicosphincter balance [11].

Subsequently, the specific computer program Fênix Electromyographic Biofeedback®, which contains an intracavity electrode for measurement of the capacity of contraction of the PF in μV was used as an evaluation device. This program

Table 1. Classification of the Body Mass Index.

Low Weight	BMI < 20
Normal	20 ≤ BMI < 25
Overweight	25 ≤ BMI < 30
Obese	BMI ≥ 30

Source: Data of the Anjos, 1992.

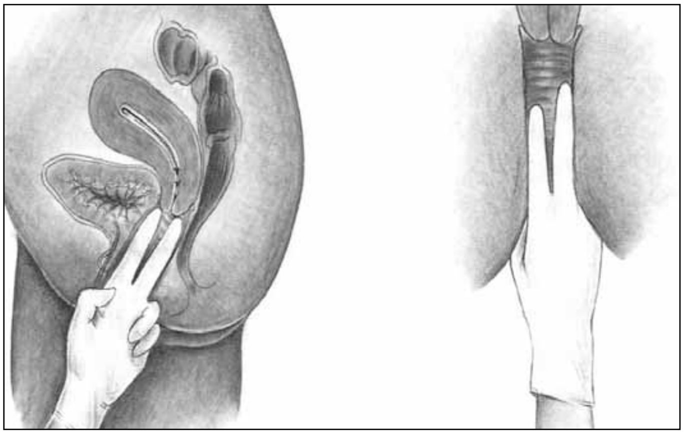

Figure 1. Functional Evaluation of the Pelvic Floor.

Table 2. Scale of the functional level of the pelvic floor.

LEVEL O	With no objective perineal function, not even to palpation.
LEVEL 1	Absent objective perineal function, contraction recognized only to palpation.
LEVEL 2	Weak objective perineal function, contraction recognized to palpation.
LEVEL 3	Present objective perineal function and opposing resistance not kept for more than five seconds to palpation.
LEVEL 4	Present objective perineal function and opposing resistance kept for more than five seconds to palpation.

is reliable since it monitors the use of the abdominal musculature because it presents abdominal electrodes attached to a computer program which detects the abdomen musculature contraction, which could provide a false result. It also presents as advantage the non-use of other accessory muscles.

The *BioEstat,* version 5.0 and *Microsoft Excel* 2007 program was applied for statistics evaluation. Significance level was pre-established at 95% and $\alpha = 0.05$ as level of decision for rejection of the nullity hypothesis. The sample was composed of 20 women, volleyball (n = 10) and basketball practitioners (n = 10). In order to evaluate the reaction of the PF musculature when the FEPF method was applied, the non-parametric Mann-Whitney test was used[12]. Parametric Student's t test was applied for assessment of the results obtained by the Biofeedback method, in order to verify the differences between means. The statistically significant differences are indicated with an asterisk (*).

RESULTS

The research was composed of a sample of 20 female athletes, mean age of 21.3 years with standard deviation of 2.4 years, ranging from 17 to 25 years. Regarding the BMI, it obtained mean of 22.6 and standard deviation of (SD) 3.2, ranging between 18 and 30. Regarding the time of training (years), mean of 7.2 and SD of 3.9, ranging between one and 14 years were obtained. Weekly load (hours) presented mean of 5.2, with SD of 1.7, ranging from two to eight weekly hours.

Comparative analysis between volleyball and basketball athletes showed that the FEPF variable for basketball athletes had mean of three, with SD of 0.5, ranging between three and four; while in the volleyball athletes the mean was of the FEPF was of four, having SD of 0.5, ranging between three and four. In the FEPF result, the P-value of = 0.7055 was obtained which is non-significant and therefore it did not show tendency, that is to say, there is not difference in the levels of functional evaluation of the PF concerning the sport modality.

In the evaluation of the capacity of contraction of the PF of the athletes with the electromyographic Biofeedback, the basketball modality obtained mean of 21, with SD of 1.5, ranging between 18 and 22µV; while in the volleyball modality the mean was of 20,with SD of 0.8, ranging between 19 and 21µV. In the result of the evaluation of the capacity of contraction of the PF the non-significant P-value = 0.8569 was obtained; therefore, there is not difference between the results obtained by the electromyographic Biofeedback concerning the sport modality. In the BMI evaluation, the basketball athletes obtained mean of 23.3, with SD of 3.8, ranging from 19.2 to 30.1kg/m^2, while the volleyball athletes obtained mean of 21.9, with SD of 2.5, ranging from 18.9 to 27.7, with P-value = 0.2816, hence with no statistical significance.

The time of training variable (years), in the basketball athletes presented mean of five years with SD of four years, ranging from one to 11 years; in the volleyball athletes the mean was of nine years, with SD of three years, ranging from one to 14 years, with P-value = 0.0416, that is to say, presenting statistical significance. Concerning the weekly load (hours) of the basketball athletes, mean of six hours was observed, with SD of one hour, ranging from three to eight hours; while in the volleyball athletes, the mean was of five hours, the SD was of two hours, ranging from two to eight hours, with P-value = 0.4546, that is to say, with no statistical significance.

Figure 2 shows the comparison between the means of the functional evaluation of the PF (FEPF) of the athletes in the modalities of the study.

Figure 3 presents the comparison between means of the evaluation of the capacity of contraction of the PF (Fênix Electromyographic Biofeedback®) of the athletes in the modalities of the study.

According to figure 4, it was observed that out of 10 basketball athletes, 5 had reported involuntary urine loss during physical exertion corresponding to 50% of the sample of the study, while the remaining 5 basketball athletes reported having never had involuntary urine loss. Regarding the volleyball athletes, it was observed that 3 of them out of a total of 10, have already had involuntary urine loss during physical exertion, corresponding to 30%, since the remaining did not demonstrate to have had involuntary urine loss, as can be observed in Figure 5.

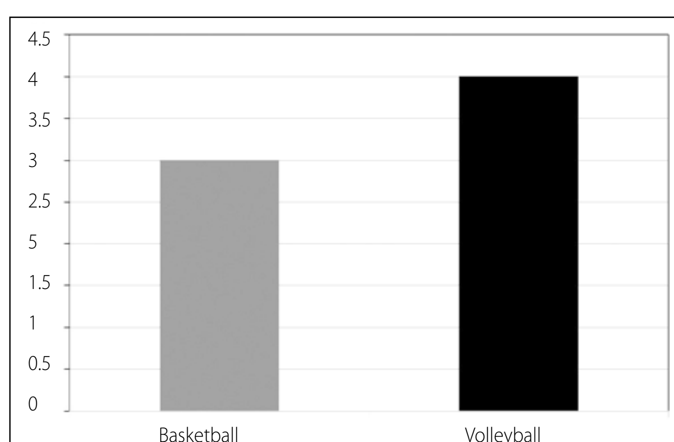

Figure 2. Means of the FEPF among basketball and volleyball athletes.
Source: Data of the researcher (2008).

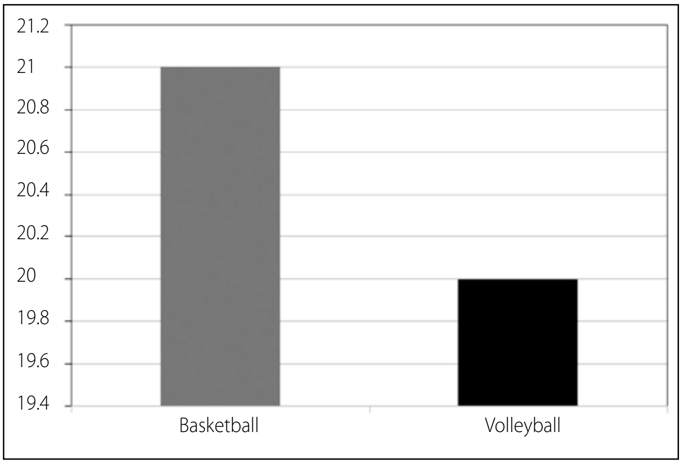

Figure 3. Means of the Biofeedback between basketball and volleyball athletes.
Source: Data of the researcher (2008).

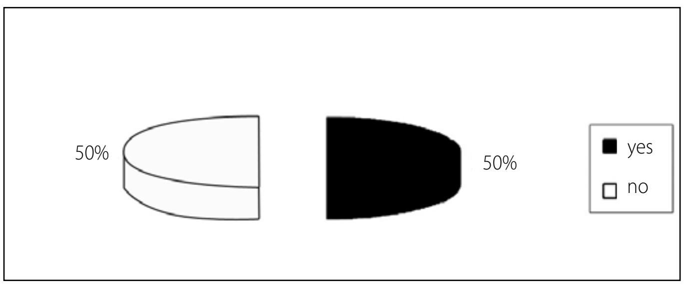

Figure 4. SUI ratio in the basketball athletes.
Source: Data of the researcher (2008).

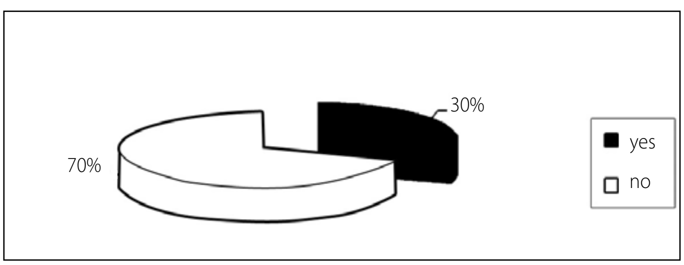

Figure 5. SUI ratio in the volleyball athletes.
Source: Data of the researcher (2008).

DISCUSSION

Currently, physical activity practice has become more frequent in women's lives; however, the sudden increase of intra-abdominal pressure associated with practice of any sport can be a risk factor for the development of stress urinary incontinence[13,14].

Exercises which require a lot of physical exertion (aerobic) and demand high impact can cause excessive increase of the intra-abdominal pressure, overloading the pelvic organs which are pressed downwards, causing hence damage to the muscles of the PF, especially high impact sport modalities, such as volleyball and basketball[15].

Thus, the study had the aim to verify the difference in the capacity of contraction of the PF among female volleyball and basketball athletes. Therefore, it was observed through the FEPF that the mean of the capacity of contraction of this musculature in volleyball athletes was higher than in the basketball athletes; however, it does not present statistically significant difference. Differently from the FEPF, the evaluation with the Fênix Electromyographic Biofeedback® showed that the mean found in the basketball athletes was higher than in the volleyball athletes; however, there was not statistically significant difference.

The digital vaginal palpation represents the commonest and mostly used method of evaluation of the PF musculature since it is minimally invasive, well-tolerated and does not require special equipment; however, it does not provide data which can be quantified and recorded [16]. Thus, such characteristics justify the use of this evaluation method in the study; nevertheless, in order to offer higher accuracy to the evaluation, the Fênix Electromyographic Biofeedback® was also used.

The Fênix Electromyographic Biofeedback® is a reliable equipment and important evaluation instrument which records objective, reproducible and reliable values, besides providing visual feedback to the patient, since it monitors the use of the abdominal musculature through abdominal electrodes attached to a computer program which detects the contraction of the abdomen musculature, which could give a false result. Additionally, it has the advantage of not using other accessory muscles, being a learning tool, self-correction in a natural way, which can be active (commanded by the patient) or passive (by electrostimulation)[11,16]. Due to all these advantages, the equipment was chosen and used for assessment of the capacity of contraction of the PF in athletes of the chosen sport modalities. Nonetheless, these evaluation methods used in the study were not well-tolerated by the population in the study, limiting hence the sample evaluated, due to factors such as: age, nulliparity, lack of active sexual life and especially refusal to participate in the study.

Physical exercises can bring a special risk to the professional athletes due to the negative effects in the reproductive system, such as menstrual irregularities and in the musculoskeletal system in which besides the injuries common to the athletes, high impact exercises may lead to the weakening of the pelvic musculature, predisposing them to the SUI[17]. However, this muscular weakening was not evident in the present study, since both the mean of the FEPF and of the Fênix Electromyographic Biofeedback® demonstrated good capacity of contraction of the PF, not corroborating the highlighted study, which make us believe that other factors may be associated with predisposition to SUI.

In a study performed, it was verified that the capacity of contraction of the PF muscles is influenced by the position at which the subject is, being the dorsal decubitus the one which provides the highest capacity of contraction and progressively decreases at the sitting and orthostatic position. Therefore, the position justifies the reason why despite presenting good contraction of the PF capacity, the athletes still presented urine loss[18].

It was demonstrated according to an investigation that the UI prevalence is directly proportional to the BMI. However, it is not the case in this study, since the participants are athletes and their BMI means are within the normality parameters, since the basketball modality presented mean of 23.3kg/m^2 and volleyball modality 21.9kg/m^2[19].

There is a tendency to weakness of the lower abdominal wall due to obesity, sedentarism, age and loss of muscular tonus. However, these factors do not play influence on athletes, suggesting hence other reasons, such as higher training of the upper abdominal muscles, severity and increase of intra-abdominal pressure acting on the lower region[3].

The PF is constantly required during running, jumping repetitive activities as well as activities which involve increase of the intra-abdominal pressure. About 67% to 76% of their fibers are type I, that is, slow contraction fibers, rich in mitochondria, which contract by oxidative mechanism and are responsible for the maintenance of the muscular tonus in the vesical neck. Therefore, factors which compromised its oxygen supply, such as muscle fatigue, promote decrease of its contractile capacity, causing the recruiting of the type II fibers (fast contractions), which do not have the same capacity of maintenance of the muscle tonus of the PF, compromising the continence mechanism[1,9].

The correlation of the support played by the PF and the increase of intra-abdominal pressure with sports which include repetitive jumps or exercises of maximum abdominal contraction is an important factor in the SUI onset[9].

The increase of intra-abdominal pressure doe not consist in the only risk factor to SUI in athletes, since muscular fatigue of the PF usually caused by long periods of training, with no space to recovery and repeated weekly times, would increase the predisposition to SUI. It was evidenced in the study a statistically significant difference (P-value = 0.0416), concerning the time of training (years) between the modalities, in which the basketball athletes presented mean of five years and the volleyball athletes mean of nine years. However, the weekly load presented higher mean for basketball, in six weekly hours, and the lower mean to volleyball of five weekly hours; nevertheless, this variable did not present statistically significant difference (P-value = 0. 4546)[20].

Urinary loss usually related to age and multiparity, has been questioned by studies which demonstrate its frequent onset in athlete, youngster, in good physical status, nulliparous, practitioners of high impact exercises women which involve increase of intra-abdominal pressure. However, the understanding on the causes of SUI in female athletes is still discussed[21].

In the present study, regarding the onset of urinary loss by the athletes, which could be found both in the basketball and volleyball groups, athletes with involuntary urinary loss during physical exertion, corresponding to 50% of the basketball athletes and 30% of the volleyball athletes could be found. Such findings are according to some studies, since both sport modalities are considered of high impact characterizing hence by many jumps and motor actions related to the maximum abdominal contraction, which increase the intra-abdominal pressure, playing direct impact on the PF, making the athlete more prone to urinary losses[22,23].

In another study it was observed that the strength of the impact directed to the PF muscles during activities such as 'running', is of three to four times the body weight, 'jumping' is of five to 12 times, 'falling after high jump' is of nine times, 'higher jumping' is of 16 times and 'practicing pole vault' of nine times[1].

The author observed in some research that in a group, more than 30% of women practitioners of high impact physical activity referred urinary leaking, In another study, it was determined the prevalence of SUI symptoms in a group of 156 women, elite athletes, nulliparous, mean age of 19.9 years and from many sport modalities, who answered a standardized questionnaire about the onset of urinary leaking during physical activity practice and in daily tasks. The answers of 144 women (92%), showed that 28% of the athletes reported involuntary urine loss, with proportion of 67% for gymnastics, 66% for basketball, 50% for tennis, 42% for skiing, 29% for trekking, 19% for volleyball, 10% for swimming and 0% for golf. The activities which provided the most urine loss were the ones which include jumps, high impact landings and running. These data, as in the study, demonstrate that women who practice high impact physical activity report involuntary urine loss during physical exertion, in higher proportion to basketball athletes when compared to volleyball athletes[24].

In another study it was verified that 20% of the women who presented involuntary urinary loss episodes during physical exertion, tend to abandon this activity due to this fact alone. However, the literature states that the athletes who report involuntary urinary loss should be encouraged to continue with their regular exercises, associating them to training of the PF muscles, with physiotherapeutic guidance[24,25].

The functional evaluation and capacity of contraction of the PF did not present statistically significant difference concerning the capacity of contraction of the PF among basketball and volleyball athletes; however, both modalities reported athletes with involuntary urinary loss during physical exertion, with greater proportion in the basketball athletes group.

All authors have declared there is not any potential conflict of interests concerning this article.

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