162 - THE INFLUENCE OF SHOES IN THE SOIL REACTION FORCE DURING THE PRACTICE OF HYDROGIMNASTIC EXERCISES

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Introduction

Researchers from different areas have focused on issues related to worker's health[17,13,19] through diagnosis and suggestions to reduce the negative consequences to the health and quality of life of professionals from different majors[11]. In the Physical Education area, specifically, this worry has increased due to the fact that these professionals are constantly exposed to situations that can cause small and, even bigger injuries in the structures.

In many motor activities of different movement situations there is the presence of soil reaction forces, resultant from the body contact with the surfaces. Those forces can result in possible physical aggressions, depending on factors as kind of surface, movement speed, way to step[8] , mass and acceleration[15, 7] ,as well as considering the characteristics of the person who practices the activity and the environmental demands. In hydrogimnastics, the exercises done by the teachers out of water are, many times, compound by jumps[9], and there is the need of analyzing quantitatively the overload present in these exercises, which can expose the teacher to high impact forces and cause disturbances pertaining the muscles and skeleton, chiefly in the inferior members and lumbar spine[9].

The specialized literature is extremely restricted in relation to the soil reaction forces in the practice of different hydrogimnastic exercises and about the way to practice them. Despite this modality presents great possibilities of movement and in some of them, a high soil reaction force [10,] just a few works explore this modality. Differently from activities as running, jogging, walking, basketball and handball, there are not specific shoes for the professionals who work with this modality, what is an important factor when the teacher shows his/her exercises. Among the factors that influence the load over the human body during activities as running, for example, there are - besides the kind of movement - the number of repetitions, the time and, also, the wear of shoes[1], which can overload the anatomical structures, causing discomfort, pain, and injury [14,16] if they are inadequate.

In face of these facts and according to the context presented, there is the concern about issues related to the work of the professionals who have the function of teaching hydrogimnastics classes, once their good physical condition is fundamental for the practice of the proposed activities. Thus, this study was aimed to analyze and compare the upright component of the soil reaction force, with and without the wear of sportive tennis shoes.

Materials and methods

The group of study was formed by 15 hydrogimnastic teachers, with average age around 245,20 years old; average weight of 574,12 119,53 N and average stature of 1,64 0,06m. The hydrogimnastic teachers considered in this study are female Physical Education students or professionals, which teach the modality since, at least, six months, in clubs or health clubs in Santa Maria - RS. The subjects' average time of working experience as hydrogimnastics teachers was about 2, 10 2, 41 years.

The practice of four hydrogimnastics exercises was required, keeping the same way of practicing generally done in their professional practice. These exercises were selected according to the real movements done by the teachers during the classes, and that considered the movements of either superior members or inferior ones in the same anatomical referent level. The movements done were: knee flexion (M1), which is done in around 90º without flexion or hyperextension of hips and the elbows flex in the sagittal level in 90º in simultaneous cycles to the leg movements; hip flexion (M2), which is the hip flexion in 90º without knee extension with the arms oscillating along the body in the sagittal level with the elbows in 90º in cycles in opposite to the leg movements; simultaneous hip abduction (M3), in which is done a simultaneous hip abduction of both members and the arms also do movements in the frontal level, that is, shoulders abduction and adduction simultaneously; and alternate hip abduction (M4), in which an alternate hip abduction of both members and the arms also do movements in the frontal level, that is shoulders abduction and adduction simultaneously.

The teachers did the exercises over two force platforms in two conditions: without the wear of tennis shoes and with the wear of tennis shoes. It was chosen a tennis shoes special for running with a shock absorber in the ankle area. The subjects did the movements in the cadence of 134 beats per minute (bpm). This standardization is due to the fact that the music defines, indirectly, the amount of effort applied to the exercise, because it has a regular rhythm and the movements are done in synchrony with the rhythm, besides that, according to Baum[2] the specific cadence is one of those used in hydrogimnastic classes.

The teachers did five attempts in each exercise, in two situations: barefoot and wearing tennis shoes. The number of attempts was established according to the procedure described by Melo[12].

For the kinetic data acquisition it was used two force platforms OR6-5 *AMTI*(*Advanced Mechanical Technology, Inc*) distant 5,5 m one from each other. The data were processed through a program developed in IDL (Interactive Data Language).

The variable studied related to the soil reaction force was defined likewise in Ribeiro's and Mota's [18] study: maximum upright force (Fzmax), which corresponds to higher upright force. All the assessed teachers were invited to participate in the experience and signed up a "Free and Clarified Consent Term" to participate in the study. It was filled in a form to get personal information such as name, gender, age, and time of experience. The subjects were instructed to wear clothes commonly worn during the classes. It was given a recuperative time in order to make the subject feels in condition to do the next series of movements.

For the measure of corporal weight, the subject was positioned with both feet over the platform I and kept him/herself in the anatomical position of reference. For the data of force assessment, the subject was positioned on the platforms I and II, with the right inferior member over the platform I and the left inferior member over the platform II. The subjects had enough time to adapt to the site and to the cadence established before the data collection. The platform rate of sample was 1000 Hz and the time of collection was 5 seconds for each attempt.

The data were submitted to descriptive statistic. The *Shapiro-Wilk* test showed that the data can be considered with normal distribution. The variable averages of the right and left feet, in different situations and superficies, were compared through the *t* test to verify if there were statistically meaningful differences between them. As the values of the members did not present statistically meaningful differences, they were analyzed together. For the comparison of averages between the situations (with nd without tennis shoes) it was used the *t* test. The level of meaning adopted for all the tests was 5%.

Results and Discussion

In the table 1 the average and the Fmax pattern deviation in the movements 1, 2, 3 and 4, with and without the wear of tennis shoes, are presented.

Table 1 - Average and the Fmax pattern deviation in the movements 1, 2, 3 and 4 with and without the wear of tennis shoes (PC).

Situation	M1	M2	M3	M4
Without tennis shoes	2,40±0,31*	2,45±0,26	1,70±0,23	2,36±0,25
With tennis shoes	2,49±0,28*	2,42±0,26	1,64±0,15	2,33±0,30

* Show statistically meaningful differences (p<0,05)

Through the analysis of the movement with the individuals with and without tennis shoes, only the M1 showed statistically meaningful differences. The Fmax was 4% higher with the wear of tennis shoes.

A study of Kruel et al[9,] made with hydrogimnastics teachers, presents medium values of the soil upright reaction force during the practice of some movements. The movements analyzed in the study presented average values between 2,03 PC and 2,95 PC. The authors found meaningful differences between these values and the ones of the walking, but they did not find meaningful differences between these values and the ones of the running. According to the authors, this fact shows that they can be considered as high impact values. However, comparing the values of that study with the classification suggested by Carpenter6, they are considered as low impact values. It is possible to notice that there is not still a consense for the values of force classification as low, medium and high impact values.

In face of the worry about the values found by Kruel et al[9] , Black, Tartaruga and Kruel[5] compared the upright force between two ways of doing the assessments: traditional way (which represents the way as the teacher gives his/her classes) and the modified way (in which the teacher should always keep one foot in contact with the soil). In order to do that, the exercises used were named as Kick to the front (kicking to the front and jump at the same time that raising the opposite arm to the front); Lobster (making jogging movement raising the knee and opposite arm); Squid (alternating the extended knee and opposite arm to the front); Scarf II (jumping and changing the position of the arms and legs in the anterior-posterior direction) and Pelican (flexing the knee touching the opposite hand to the foot). In that study, the running, the walking and the *jump test* were also assessed. The authors affirm that the values found for the walking (1,05 PC), running (2,29 PC) and *jump test* (4,27 PC) are in agreement with the literature. The values referent to the soil reaction force were 1,18 PC for the pelican, 1,20 PC for the Manta II, 1,19 PC for the Squid, 1,24 PC for the Kick and 1,26 PC for the Lobster, during the traditional way; and 1,14 PC, 1,14 PC, 1,12 PC, 1,16 PC and 1,19 PC for the modified way of the same exercises previously mentioned[5] . The values of soil reaction force found in all movements of this study were higher when they were compared to Black, Tartaruga e Kruel's[5] study. From the selected exercises, the Lobster is similar to the M2, and the Pelican to the M3. The M3 was the only movement that presented values inferior for the running. All the movements presented higher values of soil reaction force for the walking as well as for the running.

With the same objective of the study previously mentioned, it is possible to select the tennis shoes as one of the ways to minimize the impact, since according to Zaro et al[21], it is expected that during the gait the shoes cause the reduction of the first peak of force in relation to the same person walking on barefoot. The fact that the upright force is presented with higher magnitude, as, for example, during the practice of M1 with the wear of tennis shoes, can be due to their time of wear. As the tennis shoes provided by the researchers were new, they were not adjusted to the weight and the step of the subjects. Bianco et al[3] affirm that when the tennis shoes have from 500 Km to 1000 Km of wear, the impact tends to be lower.

Bianco et al[3] affirm that when movements are done on barefoot, higher loads are imposed to the locomotor system. This fact is opposite to the values found here, once in the M1 they were higher when, during the demonstration, the individuals wore tennis shoes. This fact helps Serrão, Sá e Amadio's[20] affirmations, which inform that the shoes are not the only structure involved in the mechanisms of movement generation and mechanical overload control. The fact that some subjects are not adapted to the practice of movements on barefoot, or many of them are not adapted to practice of movements with the wear of tennis shoes, can be justified in the inexistence of an only behavior regarding both situations.

Conclusion

It was not possible to find standardization of the values for the maximum upright force related to wearing or not wearing tennis shoes. The only movement that was statistically different with and without tennis shoes was the M1. This fact shows that there was not a uniform tendency of modification in the maximum upright force related to the wear or not-wear of tennis shoes. However, in most of the movements, differences when the teacher was demonstrating the movements with and without tennis shoes were not observed.

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THE INFLUENCE OF SHOES IN THE SOIL REACTION FORCE DURING THE PRACTICE OF HYDROGIMNASTIC EXERCISES

Abstract

This study was aimed to verify the soil upright reaction force, during the demonstration of four exercises with and without the wear of shoes. Fifteen female hydrogimnastic teachers that have given classes for, at least, six months participated in the study. For the assessment, two *AMTI* force platforms were used. For the data comparison, it was used descriptive statistics, *Shapiro-Wilk* and *t* test with meaning of 5%. There was not uniform tendency of modification in the maximum force related to wearing or not wearing tennis shoes. In most part of the analyses, differences when the teacher was demonstrating the movements with and without tennis shoes were not observed.

Keywords: influence of shoes; soil upright reaction force, hydrogimnastics exercises.

INFLUENCE DES CHAUSSURES DANS LA FORCE DE RÉACTION VERTICALE DU SOL PENDANT L'EXECUTION D'EXERCICES D'HYDROGYMNASTIQUE

Résumé

Ce travail a objectivé vérifier la force de réaction verticale du sol, pendant la démonstration de quatre exercices avec et sans l'utilisation des baskets. Ont participé 15 enseignants d'hydrogymnastique du sexe féminin qui donnent des cours au moins six mois. Pour l'évaluation s'est utilisé deux plateformes de force AMTI. Pour comparaison des dés s'est utilisé statistiques descriptive,Shapiro-Wilk et test t avec importance de 5%. N'a pas eu tendance uniforme de modification dans la force maxima en fonction de l'utilisation ou non des baskets. Dans la plupart des analyses n'ont pas été observées de différences en étant l'enseignant en démontrant les mouvements avec et sans des baskets.

Mots clés: influence des chaussures ; force de réaction verticale du sol, exercices de hydrogymnastique.

LA INFLUENCIA DEL CALZADO EN LA FUERZA DE REACCIÓN VERTICAL DEL SUELO DURANTE LAS ACTIVIDADES DE HIDROGIMNÁSTICA

Resumen

Este trabajo objetivó verificar la fureza de reacción vertical del suelo, durante la demostración de cuatro actividades con y sin zapatillas. Participaron 15 profesores de hidrogimnástica del sexo femenino que dan clases a por lo menos seis meses. En la evaluación fueron utilizadas dos plataformas de fuerza AMTI. Para comparar los datos se utilizó la estadística descriptiva *Shapiro-Wilk* y el test *t* con valor de 5%. No hubo tendencia uniforme de cambio en la fuerza máxima con el uso o no de zapatillas. En la mayoría de los análisis no se comprobó distinciones de movimiento cuando el profesor llevó o no zapatillas.

Palabras clave: influencia del calzado; fuerza de reacción vertical del suelo; actividades de hidrogimnástica.

INFLUÊNCIA DO CALÇADO NA FORÇA DE REAÇÃO VERTICAL DO SOLO DURANTE A EXECUÇÃO DE EXERCÍCIOS DE HIDROGINÁSTICA

Resumo

Este trabalho objetivou verificar a força de reação vertical do solo, durante a demonstração de quatro exercícios com e sem a utilização de tênis. Participaram 15 professores de hidroginástica do sexo feminino que ministram aulas a pelo menos seis meses. Para avaliação utilizou-se duas plataformas de força *AMTI*. Para comparação dos dados utilizou-se estatística descritiva, *Shapiro-Wilk* e teste *t* com significância de 5%. Não houve tendência uniforme de modificação na força máxima em função do uso ou não do tênis. Na maioria das analises não foram observadas diferenças estando o professor demonstrando os movimentos com e sem tênis.

Palavras-chave: influência do calçado; força de reação vertical do solo, exercícios de hidroginástica.