77 - MOTOR PERFORMANCE OF CHILDREN IN THE EXECUTION OF THE MOTOR TASK OF THE VERTICAL JUMP

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Introduction

The children are involved in a refinement and development process of the motor abilities, which if develop following a systematic order. It knows that the development of a motor standard is related to the development of acceptable ability levels and one efficient mechanics. Therefore, jumping in the adult person constitutes the consequence of the development and mature ness of the nervous and muscle-skeletal systems (SKINNER, 1998).

The jumping motor ability is considered of difficult execution, therefore, as Viel (2001) mentions, it requires a muscular conscription in a way of particular contraction that makes to occur, in a time extremely soon, a muscle cycle allonge-shortening.

The vertical jump, therefore, can be considered a complex motor standard and, as Gallahue and Ozmun (2003) the children acquire a bigger complexity in its motor standards after the cerebellum maturation. The vertical jump, particularly, constitutes a basic physical capacity. It treats about a motor task of high impact and, as Garret Jr, Kirkendall and cols. (2003) the exposition on the certain loads is essential in infancy, since the long bones growth is particularly related with the impacts so that it occurs the formation and reabsorption of osseous mass. However, these authors points that extreme activities with high load application or great number of repetitions can mean pathology.

In the motor performance comparison, authors as Haubenstricker et al. apud Garret Jr, Kirkendall and cols. (2003) affirm that in standardized tasks during infancy there's improvement with the age, and boys, in general, presents better performance than girls. However, this difference is sharper in tasks that require force, power and speed.

Biomechanics with its evaluation methods of the human movement can contribute of different forms with one better pedagogical process development directed to education of motor abilities. It can, for example, as Baptist (2004), guide and justify, for some situations, the application of the pedagogical progression principle, collaborate in the recognition of real mechanical loads imposed by the use of learning exercises and propitiate the register in such a way how much the examination, of ideal models of sport techniques that can be used in the education process. It still generates a bigger conscience in the education process.

In this context, the realizing of this study makes itself necessary and important, since it searches to evaluate the dynamic characteristics of the ground reaction force of 4 to 12 year-old children's vertical jump of the female and male sex. In more specific way, to compare the kinetic and space-timing variables among the feminine and masculine genders, as well as correlating such variables and analyze qualitatively he vertical and antero-posterior curves format by genders.

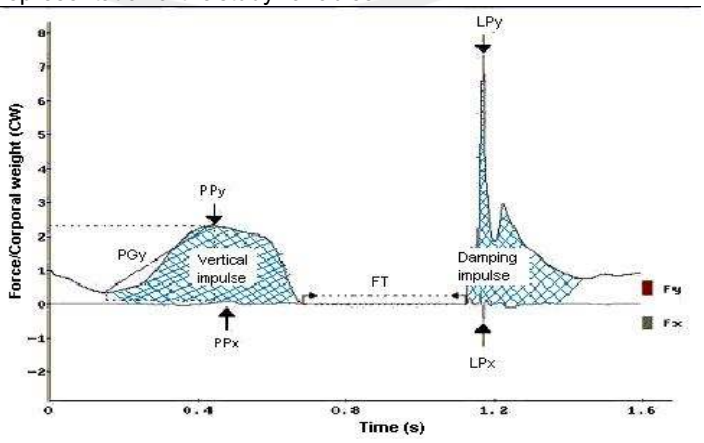
Material and Methods

This descriptive exploratory study was developed at the Biomechanics Laboratory of CEFID/UDESC. 52 children had participated, being 30 of the female sex with average age of 8±2,02 years and 22 children of the male sex with average age of 9±1,93 years, all students from two municipal schools of Florianópolis/SC, chosen of systematic accidental form.

After the approval of the UDESC Ethics Committee in Research, the schools controllers had been contacted and, by means of assent term duly filled and signed for the parents, the collections had been set appointments. At the collection day it was adopted the following sequence of procedures: a) the familiarization of the children with the environment, equipment and researchers; b) fulfilling by the researchers of the children personal identification data; c) identification of the children through codes, preventing the exposition of the personal identity; d) After receiving the necessary instructions and trying the execution of the jump, children had carried through three valid jumps (impulse and fall on the platform with both the feet); e) Acquisition of the data.

For the data analysis the following variables of study had been selected, as Figure 1: vertical propulsion peak (PPy), vertical landing peak (LPy), propulsion peak in "X" axis (PPx), landing peak in "X" axis (LPx), vertical propulsion gradient (PGy), flight time (FT), vertical impulse (Impy) and damping impulse (DIy).

Figure 1 Graphic representation of the study variables.



For the accomplishment of the study was used an AMTI platform force OR6-5 model, settled and leveled to the ground, to a 900 Hz sampling frequency. For the data processing the filter of Fast Fourier Transformed (FFT) was used with

opening window of 4%, equivalent to a 30 Hz frequency, for better reproducing the ground reaction force curves (FRS). This filter is based on the Fourier series adjustment for the entrance of the data and is assigned in the attempt to remove noises that occur in amplitude and frequency by the chance.

The force signal was acquired and processed in the Peak Motus system. The SAD 32 program was used for the data normalization by the corporal weight (CW) and for the variables calculation: flight time, gradient, force peaks and impulses.

For the data characterization was used descriptive statistics mean, standard deflection (SD) and variation factor (VF%). For data comparison between the female and male genders was used the test "t" of Student for independent samples; to verify the relation between the variables, the Spearman Brown correlation. The significance level adopted was 95%.

Results and Discussion

In Table 1, the following, there are laided out the comparisons values between the genders for the subjects in the present study.

Table 1 Comparison of the kinetic and space-timing variables values between the female and male genders.

Variables	Sex	n	mean	SD	VF%	Min	Máx	*t*	p
PPy	Fem	30	2,67	0,44	16,33	1,66	3,78	2,87	0,001*
(CW)	Male	22	2,36	0,27	11,38	1,88	2,89		
PGy	Fem	30	21,76	11,16	51,31	8,36	66,60	2,22	0,031 *
[CW/(N.s)]	Male	22	14,99	10,44	69,66	7,23	57,00		
Impy	Fem	30	0,39	0,05	13,85	0,24	0,47	-3,32	0,001*
[(CW/N).s]	Male	22	0,44	0,05	12,35	0,32	0,55		
LPy	Fem	30	4,82	1,92	39,87	2,68	10,53	-2,26	0,028 *
(CW)	Male	22	6,22	2,56	41,21	2,88	12,94		
FT	Fem	30	0,39	0,05	11,99	0,32	0,46	-0,43	0,667
(s)	Male	22	0,39	0,05	13,87	0,29	0,49		
Dly	Fem	30	0,34	0,05	15,86	0,21	0,47	0,75	0,457
[(CW/N).s]	Male	22	0,33	0,06	18,21	0,22	0,47		
PPx	Fem	30	0,06	0,07	120,75	0,01	0,33	1,17	0,246
(CW)	Male	22	0,04	0,03	67,87	-0,01	0,09		
LPx	Fem	30	0,18	0,25	139,46	-0,02	1,02	-0,18	0,856
(CW)	Male	22	0,19	0,17	85,63	-0,03	0,55		

In these results analysis is verified that as much the female sex subjects as of the male sex had presented average values next to the majority of the analyzed variables. However, it was observed to have significant statistics differences only in four variables: vertical propulsion peak (p=0,001), propulsion gradient (p=0,031), vertical impulse (p=0,001) and vertical landing peak (p=0,028).

In the values analysis it is verified that the girls had applied greater propulsive force peak (2,67±0,44 CW) in relation to the boys (2,36± 0,27 CW). They had reached also greater average for propulsion gradient variable (21,76±11,16 CW), that it is an variable that measures the force behavior of a determined time and may be used as a parameter of the jump power, which is calculated by the reason between the applied force and the time expense to reach this force. Although the girls have shown a more powerful jump the boys had greater impulse in the jump [0,44±0,05 (CW/N).s], when compared with the one reached by the girls [0,39±0,05 (CW/N).s].

The boys, although to apply minor force when stimulating themselves had the same remained time in air that the girls had, what goes to the meet of the Ferragut al. (2003) and Rodacki and Fowler (2002) studies, whose results verified that the force is not the greater indicating of the vertical jump performance.

Already in the jump landing phase, it is verified that the boys had gotten bigger average values for the vertical landing peak (6,22±2,56 CW). Such results seem to be harmful since, Fantini and Menzel (2001) when studying this motor task in athlete and not-athlete children and collating with literature, had found that force peaks bigger than five times the corporal weight during the landings increase the risk of injury for micro traumas.

When analyzing the ântero-posterior force values, perceived that the girls had presented the greatest averages for the force peak at the propulsion moment (0,06±0,07 CW), while that the boys, in the landing (0,19±0,17 CW). However, for both the gendres is noticed a trend of getting, the jump, in the horizontal line, therefore the increase of the FRS values in the horizontal axis, also leads a horizontal reaction in contrary direction. Soon, greater horizontal reach and loss of vertical reach.

In the comparison of the data variability in the genders, similar behavior for the same variables can be observed and this variability can be decurrent of the ability execution individuality of jumping vertically. How much the very high variability in the landing peak one admits that it is due to the bigger difficulty found for the children in this instant of "balancing again".

In Table 2, below the values found from the correlations realized between the different variables in the female and male genders are shown.

Table 2 - Results of the correlation test among the kinetics and space-secular variables in the female and male genders.

Correlated variables	Female		Male	
	r	p	r	p
Propulsion peak "y" x Vertical impulse "y"	-0,27	0,149	-0,23	0,308
Propulsion peak "y" x Propulsión gradient "y"	0,68	0,001 *	0,68	0,001 *
Propulsion gradient "y" x Vertical impulse "y"	-0,66	0,001 *	-0,29	0,185
Damping impulse "y" x Landing peak "y"	0,37	0,723	-0,16	0,468
Flyght time x Propulsion peak "y"	0,06	0,755	0,26	0,235
Flight time x Landing peak "y"	0,30	0,112	0,17	0,453
Flight time x Vertical impulse "y"	0,43	0,017 *	0,23	0,310
Flight time x Damping impulse "y"	-0,12	0,516	-0,08	0,702
Propulsion peak "y" x Propulsion peak "x"	0,10	0,614	0,14	0,535
Landing peak "y" x Landing peak "x"	0,65	0,001 *	0,72	0,001 *

Observing these data it is verified that the majority of the correlations was positive, indicating that a variable influences to another one of directly proportional form. It is perceived, however, that in both the groups the vertical propulsion

peak and the propulsion gradient had been correlated, meaning that when reaching a bigger propulsion peak in short space of time, greater will be the propulsion gradient and vice versa, considering the gradient a useful variable to indicate power. The positive correlation among the flight time and the vertical impulse (p=0,017), verified in the female sex, means, as proven for Ferragut et al. (2003), in a study with volleyball players, where the positive mechanical impulse, generated during the propulsive phase, allowed to explain 77% of the variability found in the flight heights.

Already the correlation found in the landing instant demonstrates again how much the peak and the way with that the individual lands are interdependent and confirm the children difficulty in returning to the static balance at the fall moment. And, as Gomes (2002) affirms, the balance constitutes an important factor in the execution of the vertical jump.

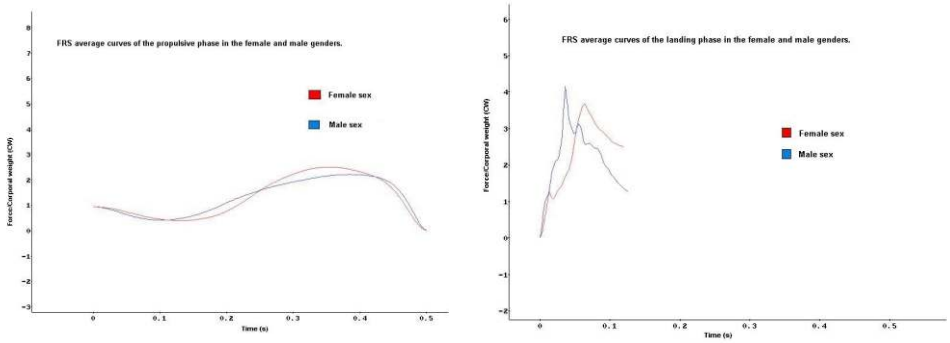


Figure 2 FRS average curves of the propulsive and landing phases in the female and male genders.

Analyzing qualitatively the FRS average curves format of the girls and boys in Figure 2, is perceived, clearly, that the girls had reached greater propulsion peaks and, consequently, greater propulsion gradients, when compared with the boys. It also perceives that the curve area of the boys is relatively bigger, what it means greater impulse values. It is still noticed that the girls give greater emphasis to the first phase of the impulse and the boys, to the finishing of the propulsion.

Conclusions

When compared the different variables between the genders, it was verified execution of a more powerful jump for the girls, but a jump with better propulsive technique for the boys. The boys had reached greater force peaks in the landing, what it denotes greater risk of articulate injuries and minor concern with the act to finish the jump.

In that it says respect to the relations found between the variables for the genders two significant correlations had been verified that had been common for both the genders: between the vertical propulsion peak and the propulsion gradient and between the vertical landing peak and the peak of landing in "X" axis. Such results indicate, respectively, the interdependence enters such pairs of variables based on the energy conservation principle.

How much the high variabilities found, it can be said that they denote the individual strategy of each child when executing the motor task of the vertical jump, based in the biological individuality principle.

In synthesis, independent of the sex all the children had presented high variabilities for all the variables of the final phase of the jump, inherent to the main objective of the vertical jump that translates itself on gaining height, generating unconcern in the form of landing.

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MOTOR PERFORMANCE OF CHILDREN IN THE EXECUTION OF THE MOTOR TASK OF THE VERTICAL JUMP

Abstract: The vertical jump consists in a basic, complex and high impact physical capacity. It is known that the exposition on the loads is essential in infancy, therefore is strong related to the long bones growth, however when practiced erroneously how much the loads and repetitions can generate problems. Thus, this study was fulfilled objectifying to evaluate the dynamic characteristics of the Ground Reaction Force (FRS) of 4 to 12 year-old children's vertical jump. Specifically: a) compare

the dynamic and space-timing variables between boys and girls; b) correlate such variables and c) analyze qualitatively the format of the vertical force curves. One selected for study the variables: propulsion and vertical landing peaks, propulsion and landing peaks in the horizontal direction, vertical propulsion gradient, flight time, vertical and of damping impulses. After the UDESC Ethics Committee approval had been selected, of systematic accidental form, 52 pertaining to school of the Florianópolis/SC public education net, being 30 girls (8±2,02 years) and 22 boys (9±1,93 years). In the data collection was used an AMTI-OR6-5 force platform integrated to the Peak Motus system, with sampling frequency of 900Hz. After identification and adaptation, the children had executed three valid vertical jump. In the data processing was used the system Peak Motus and program SAD32. In the data characterization, descriptive statistics was used; in the comparison between genders, Student test "t"; to verify the relation between variables, the Spearman Brown correlation. All the analyses with p0,05. In the comparison between genders, performance in the jump execution for the boys was evidenced better. There were significant correlations in the majority of the variables in the three jump phases, indicating the interdependence between the variables. The high variability of the data points with respect to the individual children strategy in the execution of this motor task. **Key-words:** Vertical jump, biomechanics, children.

LA PERFORMANCE MOTEURDES ENFANTS DAS LÉEXÉCUTION DE LA TÂCHE MOTEUR DU SAUT VERTICAL.

Résumé: Le saut vertical consiste en capacité physique d'impact de base, complexe et élevé. On le sait que l'exposition sur les charges est essentielle dans la petite enfance, est donc connexe fort à la longue croissance d'os, cependant une fois pratiqué incorrectement combien les charges et les répétitions peuvent produire des problèmes. Ainsi, l'objectif de cette étude était évaluer les caractéristiques dynamiques de la force terrestre de réaction (FRS) du saut vertical des enfants avec 4 à 12 ans. Spécifiquement: a) comparent les variables entre les garçons et les filles; b) corrèlent de telles variables et c) analysent qualitativement le format des courbes verticales de force. On a choisi pour l'étude les variables: propulsion et crêtes d'atterrissage, propulsion et crêtes verticales d'atterrissage dans la direction horizontale, gradient vertical de propulsion, temps de vol, verticale et d'atténuer des impulsions. Après que l'approbation du Comité d'éthique d'cUdesc ait été choisie, de la forme accidentelle systématique, 52 concernant l'école du filet d'éducation publique de Florianópolis/SC, étant 30 filles (années 8±2,02) et 22 garçons (années 9±1,93). Dans la collecte de données a été employé une plateforme de la force AMTI-OR6-5 intégrée au système Peak Motus, avec la fréquence de prélèvement de 900Hz. Après identification et adaptation, les enfants avaient exécuté le saut trois vertical valide. Dans l'informatique a été employé la crête Motus et programme SAD32 de système. Dans la caractérisation de données, des statistiques descriptives ont été employées; dans la comparaison entre les genres, essai "t" d'étudiant; pour vérifier la relation entre les variables, la corrélation de brun d'homme armé d'une lance. Toutes les analyses avec p0,05. Dans la comparaison entre les genres, l'exécution dans l'exécution de saut pour les garçons a été démontrée mieux. Il y a eu des corrélations significatives dans la majorité des variables dans les trois phases de saut, indiquant l'interdépendance entre les variables. La variabilité élevée des points de repères en ce qui concerne la stratégie individuelle d'enfants dans l'exécution de cette tâche de moteur.

Mots clés: Saut vertical, biomécanique, enfants.

RENDIMIENTO MOTOR DE NIÑOS EN LA EJECUCIÓN DE LA TAREA MOTORA DEL SALTO VERTICAL

Resumen: El salto vertical es una capacidad física básica, compleja y de alto impacto. La exposición a cargas es esencial en la infancia, pues tiene fuerte relación con el crecimiento de los huesos largos. Sin embargo, puede generar problemas cuando practicado erróneamente en cuanto a las cargas y repeticiones. Este estudio tuvo el objetivo de evaluar las características dinámicas de la Fuerza de Reacción de la Tierra (FRS) del salto vertical de niños de 4 hasta 12 años. Más específicamente: a)comparar las variables dinámicas y espacio-temporales entre géneros; b)correlacionar dichas variables y, c)analizar cualitativamente el formato de las curvas de fuerza vertical. Fueron seleccionadas las variables: cumbre de propulsión y del aterrizaje vertical, cumbres de propulsión y del aterrizaje en la dirección horizontal, gradiente de propulsión vertical, tiempo del vuelo, impulsos vertical y de amortización. Después de la aprobación del comité de ética de la UDESC, fueron seleccionados, de forma aleatoria sistemática, 52 estudiantes de la red pública de Florianópolis/SC, 30 niñas (8±2,02años) y 22 niños (9±1,93años). En la colección de datos se utilizó una plataforma de fuerza AMTI-OR6-5 integrada al sistema *Peak Motus*, con frecuencia de muestreo de 900Hz. Después de la identificación y adaptación, los niños ejecutaron tres saltos verticales válidos. En el procesamiento de los datos se utilizó el sistema *Peak Motus* y el programa *SAD32*. En la caracterización de los datos fue utilizada la estadística descriptiva; en la comparación entre los géneros, la prueba "t" del *Student* y para verificar la relación entre las variables, la correlación de *Spearman Brown*. Todos los análisis con p0,05. En la comparación entre los géneros, el rendimiento en la ejecución del salto para los niños fue mejor evidenciado. Hubo correlaciones significativas en la mayoría de las variables en las tres fases del salto, indicando la interdependencia entre las variables. El alta variabilidad de los datos demuestra la estrategia individual de los niños en la ejecución de la tarea motora.

Palabras claves: Salto vertical, biomecánica, niños.

DESEMPENHO MOTOR DE CRIANÇAS NA EXECUÇÃO DA TAREFA MOTORA DO SALTO VERTICAL

Resumo: O salto vertical constitui-se numa capacidade física fundamental, complexa e de alto impacto cuja exposição a cargas é imprescindível na infância, pois está intimamente relacionado ao crescimento dos ossos longos, que praticada erroneamente quanto a cargas e repetições pode gerar problemas. Assim, realizou-se este estudo objetivando avaliar as características dinâmicas da Força de Reação do Solo (FRS) do salto vertical de crianças de 4 a 12 anos. Especificamente objetivou-se: a) comparar as variáveis dinâmicas e espaço-temporais entre meninos e meninas; b) correlacionar tais variáveis e, c) analisar qualitativamente o formato das curvas de força vertical. Selecionou-se para estudo as variáveis: picos de propulsão, pico de aterrissagem vertical, picos de propulsão e pico de aterrissagem no sentido horizontal, gradiente de propulsão vertical, tempo de vôo, impulsos vertical e de amortecimento. Após a aprovação do Comitê de Ética da UDESC foram selecionados, de forma casual sistemática, 52 escolares da rede pública de ensino Florianópolis/SC, sendo 30 meninas (82,02 anos) e 22 meninos (91,93 anos). Na coleta de dados utilizou-se uma plataforma de força extensométrica AMTI-OR6-5 integrada ao sistema *Peak Motus,* com freqüência de amostragem de 900Hz. Após identificação e adaptação, as crianças executaram três saltos verticais válidos. No processamento dos dados utilizou-se o sistema *Peak Motus* e o programa *SAD32. Na* caracterização dos dados, utilizou-se estatística descritiva; e na comparação entre sexos, o teste "*t"* de *Student*; para verificar a relação entre as variáveis, a correlação de *Spearman Brown*. Todas as análises com p 0,05. Na comparação entre os sexos, constatou-se melhor performance na execução do salto para os meninos. Houve correlações significativas na maioria das variáveis nas três fases do salto, indicando a interdependência entre as variáveis. A alta variabilidade dos dados aponta para a estratégia individual das crianças na execução dessa tarefa motora. **Palavras-chave:** Salto vertical, biomecânica, crianças.