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Standing Long Jump Performance Quality: Age and Gender Differences

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Abstract

The primary aim of this research was to determine age and gender differences in the quality of fundamental motor skill performance – the standing long jump. The research was conducted on the sample of 72 preschool children (31 girls and 41 boys) aged 5 – 7 years, all attending preschool in Čakovec. General characteristics of the standing long jump skill were assessed using Roberton and Halverson method (1984). Data was collected by video recording the standing long jump from a side angle. The level of motor skills was evaluated by three independent judges. Age and gender differences were calculated by the analysis of variance (ANOVA). The results of the analysis showed significant statistical differences in jumping skills between younger (5-6 years) and older (6-7 years) group in all the variables. No considerable differences were found in the quality of the standing long jump performance between boys and girls.

Key words: *preschool children; Roberton and Halverson method; video recording.*

Introduction

Motor development is a continuous process through which a child acquires movement patterns and skills. The development of motor competence is dependent upon and influenced by the growth and maturity characteristics of the child (morphological, physiological and neuromuscular), as well as environmental factors (specific practice, rearing atmosphere, play opportunities and objects) (Malina, 2004). The level and the quality of fundamental motor skills in preschool age children are significant for fulfilling existential and essential needs, as well as for satisfying diverse biotic and civilization needs. At the same time, they are also a decisive growth and development factor for all the characteristics and capabilities, especially the ones which can be influenced the most at an early age, including the overall health of a child (Findak et al., 2000). At this age it is very important to direct special attention to satisfying and developing fundamental motor skills which enable children to overcome space, obstacles, resistance and to manipulate objects.

Contemporary motor development specialists (Branta et al., 1984; Roberton, 1977, 1982, 1989; Roberton et al., 1980; Seefeldt & Haubenstricker, 1982) have significantly contributed to the understanding of the underlying correlates associated with the process of changes in motor behaviour, especially those pertaining to the fundamental movement skill development. Two approaches to fundamental movement skill evaluation have emerged from these studies: the composite and the component approach. Ulrich and Branta (1988, p. 203) stated that "while each approach has its strengths and weaknesses, the resultant performance descriptions are more similar than they are different. Each has been used successfully in research and clinical application". Despite the differences, proponents of both approaches agree on three crucial issues, that is, there is high variability among individuals with regard to: a) the age at which development of a specific motor skill emerges, b) the speed of development, and c) the amount of time necessary to mature (Branta et al., 1984). The component approach describes the changes in the configuration of body parts (components) and is based on the premise that there are sequential changes in the configuration of body parts. Unlike the component approach, the composite approach evaluates the body as a whole. This method assigns an overall stage classification score (stage 1 through stage 5). Thus, body configuration for each stage describes the movements of arms, legs, trunk, and head for a given level of performance (Painter, 1994). The standing long jump has been included in numerous motor and physical fitness batteries with the primary purpose of determining jumping ability in relation to maximum distance. Research on the early childhood years, however, has changed the focus to the development of process characteristics. Frequently, the performance of the standing long jump is a problem for children due primarily to the angle of projection and the required coordination of arm action with leg movements. Mastery of the standing long jump is usually not observed before age 6 and sometimes even in adolescence and adulthood (Gabbard, 2000).

The primary aim of this research was to determine age and gender differences in the quality of the performance of a fundamental motor skill – the standing long jump.

Methodology

Research was conducted on 72 preschool children from Čakovec (31 girls and 41 boys) between 5-7 years of age. Since age differences were established, the sample was divided into younger (5-6 years) and older (6-7 years) age group. The Roberton & Halverson (1984) scale was applied to evaluate the developmental characteristics of the standing long jump (table 1). The scale consists of a series of verbally expressed components, graded so that each component indicates a certain level which differs by the level of acquired movement structure, in this case the standing long jump, from the previous one, starting from the smallest (grade 1) to the highest (grade 3, 4 or 5). Six

Table 1. *Developmental Sequence (Components) for the Standing Long Jump*

Take-off: Leg action component	
1	One foot leads in the asymmetrical take-off.
2	Both feet leave ground symmetrically, but hips or knees or both do not reach full extension by take-off.
3	Take-off is symmetrical, with the hips and knees fully extended.
Take-off: Trunk action component	
1	The trunk leans forward less than 30° from the vertical. The neck is hyperextended.
2	The trunk leans forward less than 30°, with the neck flexed or aligned with the trunk at take-off.
3	The trunk is inclined forward 30° or more at take-off, with the neck flexed.
4	The trunk is inclined forward 30° or more. The neck is aligned with the trunk, or slightly extended.
Take-off: Arm action component	
1	The arms move in opposition to the legs or are held at the side, with the elbows flexed.
2	The shoulders retract, the arms extended backwards in winging posture at take-off.
3	The arms are abducted about 90°, with the elbows frequently flexed, in a high or middle guard position.
4	The arms flex forward and upward with minimal abduction, reaching incomplete extension overhead by take-off.
5	The arms flex forward, reaching full extension overhead by take-off.
Flight and landing: Leg action component	
1	The legs assume asymmetrical run pattern in flight, resulting in a one-footed landing.
2	The legs assume asymmetrical run pattern but swing to a two-footed landing.
3	During flight, the hips and knees flex in a synchronous fashion. The knees then extend for a two- footed landing.
4	During flight, flexion of both knees precedes hip flexion. As the hips flex, the knees extend, reaching forward to a two- footed landing.
Flight and landing: Trunk action component	
1	The trunk maintains its forward inclination of less than 30° in flight, then flexes for landing.
2	The trunk corrects its forward lean of 30° or more by hyper extending, then flexes forward for landing.
3	The trunk maintains the forward lean of 30°or more from take-off to mid-flight, then flexes forward for landing.
Flight and landing: Arm action component	
1	The arms move in opposition to legs as if children were running in flight and on landing.
2	Shoulders retract and arms extend backwards (winging) during flight, and move forward (parachuting) during landing.
3	During flight, the arms assume high or middle guard position and may move backwards in a windmill fashion. Parachuting is used during landing.
4	The arms lower or extend from the flexed position overhead, reaching forward at landing.

variables consisted of the following components: take-off leg action (LEGTOF), take-off trunk action (TRUTOF), take-off arm action (ARMTOF), flight and landing leg action (LEGFL), flight and landing trunk action (TRUFL) and flight and landing arm action (ARMFL). Children were video-taped from a side angle of the jumping position at a distance of 5 meters. Every examinee performed one jump. Also, the length of the jump was measured (JUMP). Data were evaluated afterwards by viewing the recorded jump performance in slow motion. The performance was evaluated for each component separately. The level of knowledge was estimated by three experts, physical education professors, for each subject and for each component. The examiners were precisely informed about the evaluation criteria and during the evaluation procedure they were independent. Estimation was performed at the same time and at the same place for all examinees. Objectivity of examiners was determined by the correlation coefficient between the score that the examiners assigned to each examinee and the average correlation between the examiners. The reliability coefficients were also calculated for the three examiners. The basic statistics parameters were calculated for all the variables. Normal distribution of variables was tested by Kolmogorov-Smirnov test. Gender and age differences were calculated using a multivariate analysis of variance (MANOVA) and for determining statistical significance of differences in each variable between groups of subject, univariate analysis of variance (ANOVA) was used.

Results

The average correlation between the examiners (table 2) was in the range from .79 for the variables *flight and landing trunk action* (TRUFL) and *flight and landing arms action* (ARMFL) up to .92 in the variable *take- off trunk action* (TRUTOF). The values of Cronbach alpha coefficients ranged from 0.91 for the variable *flight and landing trunk action* (TRUFL) and *flight and landing arms action* (ARMFL) up to 0.96 in the variable *take-off trunk action* (TRUTOF) and *take-off arms action* (ARMTOF), which indicates a very high correlation significance. Calculated reliability coefficients (table 2) showed a high level of reliability, which is another confirmation of the examiners' objectivity during their evaluation. The obtained values of Cronbach alpha coefficients enabled the use of the results in further analysis.

Table 2.*Objectivity and reliability coefficients of the three examiners on the six components of the standing long jump*

VARIABLES	Aver. Inter-item. Corr.	Cronbach α
LEGTOF	.82	.93
TRUTOF	.92	.96
ARMTOF	.91	.96
LEGFL	.86	.94
TRUFL	.79	.91
ARMFL	79	.91

Legend: LEGTOF – take-off legs action; TRUTOF – take-off trunk action; ARMTOF – take-off arms action; LEGFL – flight and landing legs action; TRUFL – flight and landing trunk action; ARMFL– flight and landing arms action; Aver. Inter-item Corr. – average correlation between examiners; Cronbach α –coefficient of reliability.

Basic descriptive parameters are presented in tables 3 and 4. Even after cursory examination, it can be observed that the younger age group had lower average values in all the variables compared to the older age group. Larger dispersions of the results according to standard deviations were noticed in both groups in variables *take-off trunk action* (TRUTOF) and *take-off arms action* (ARMTOF). The lowest average rating (1.87) was achieved by the younger age group in the variable *flight and landing trunk action*. Descriptive indicators for male and female participants showed similar values of arithmetic means and larger dispersion of results in the components *take-off trunk action* (TRUTOF), *take off arms action* (ARMTOF) and *flight and landing leg action* (LEGFL).It is evident that the distributions of most variables, except for the *jump length* (JUMP), were significantly different from a normal distribution (tables 3 and 4).

Although all results were not normally distributed and certain dispersions were larger than others, Petz (1997) states that it is possible to use parametric statistics if distributions are proper (they need not be completely symmetrical, but may not be bimodal or U - shaped), and with sufficiently large samples, which are the same or similar size. As the subsamples in this study were very similar, further analysis applied parametric tests for determining the differences. For distributions that were not normally distributed, the consistency of results was additionally verified with the nonparametric *Mann-Whitney U* test. In all the subsamples only the variable *jump length* (JUMP) had a normal distribution (tables 3 and 4).

The significance of differences in individual developmental components of the standing long jump, according to age and gender, were calculated with MANOVA. The results revealed that there was a significant effect of age ($F = 5.269$; $p <.000$), but not of gender ($F = 1.759$; $p <.112$) nor the interactional effect of gender and age ($F = .812$; $p<.581$). Univariate analysis of variance (table 3) determined statistically significant differences between the participants according to age in all variables, namely: *take-off legs action* (LEGTOF: F=6.684; p= .012), *take-off trunk action* (TRUTOF: F=13.622; p=.000), *take-off arms action* (ARMTOF: F=10.960; p=.001), *flight and landing legs action* (LEGFL: F=16.142; p=.000), *flight and landing trunk action* (TRUFL: F=16.805; p=.000), *flight and landing arms action* (ARMFL: F=17.184; p=.000) and *jump length* (JUMP: F=34.743; p=.000). Also, using the *Mann Whitney U* test significant differences were determined according to age in all variables (LEGTOF: p= .01; TRUTOF: p=.001; ARMTOF: p=.001; LEGFL: p=.000; TRUFL; p=.000; ARMFL: p=.000).For the differences between genders, univariate analysis of variance (table 4) showed statistically significant difference only in the variable *jump length* (JUMP: F=9.755; p= .003) while in the other variables (LEGTOF: F=1.09; p= .300; TRUTOF: F=2.03; p=.158; ARMTOF: F=.00; p= .993; LEGFL: F=.47; p=.493; TRUFL: F=3.07; p=.084; ARMFL: F=.07; p=.789) there was no significant difference between girls and boys. Additional verification of *Mann Whitney U* test yielded the same results suggesting there were no significant differences in variables (LEGTOF: p= .48; TRUTOF: p=.98; ARMTOF: p=.15; LEGFL: p=.62; TRUFL: p=.75; ARMFL: p=.27).

Table 3. *Differences between younger and older age group in the quality of the acquired standing long jump*

	YOUNGER AGE GROUP (N=32)			OLDER AGE GROUP (N=40)				
VARIABLES	MEAN	SD	K-S test	MEAN	SD	K-S test	F-test	p
LEGTOF	2.06	.71	p<.05	2.47	.64	p<.01	6.68	**.012**
TRUTOF	2.40	1.04	p<.10	3.17	.90	p<.01	13.62	**.000**
ARMTOF	2.68	1.17	p<.01	3.57	1.15	p<.01	10.96	**.001**
LEGFL	2.25	.91	p<.01	3.10	.98	p<.01	16.14	**.000**
TRUFL	1.87	.70	p<.05	2.50	.71	p<.01	16.80	**.000**
ARMFL	2.50	.88	p<.01	3.30	.75	p<.01	17.18	**.000**
JUMP	81.37	17.36	p<.20	99.87	12.62	p>.20	34.74	**.000**

Legend: MEAN – arithmetic mean; SD– standard deviation; K-S – Kolmogorov- Smirnov test normality of distribution; F – test – value of univariate test; p – level of significance

Table 4. *Differences between girls and boys in the quality of the acquired standing long jump*

	GIRLS (N=31)			BOYS (N=41)				
VARIABLES	MEAN	SD	K-S test	MEAN	SD	K-S test	F-test	p
LEGTOF	2.22	0.71	p<.05	2.34	0.69	p<.01	1.09	.300
TRUTOF	2.74	1.15	p<.15	2.96	0.94	p<.10	2.03	.158
ARMTOF	3.29	1.27	p<.01	3.09	1.22	p<.05	.00	.993
LEGFL	2.74	1.09	p<.15	2.75	1.00	p<.01	.47	.493
TRUFL	2.12	0.84	p<.05	2.29	0.71	p<.01	3.07	.084
ARMFL	3.00	0.93	p<.10	2.90	0.88	p<.01	.07	.789
JUMP	87.41	18.09	p>.20	94.85	16.47	p>.20	9.755	**.003**

Legend: MEAN –arithmetic mean; SD– standard deviation; K-S -Kolmogorov - Smirnov test normality of distribution; F - test–value of univariate test; p – level of significance

Discussion

On the basis of the conducted analyses and the obtained results, it is evident that there is a significant difference in the knowledge level of performance of the standing long jump in all components. Obtained rating values in younger group were mainly located in the area of lower values (1.87-2.68), while the values of the older age group were in the area of average values (2.47-3.57). Also, the younger age group showed a lower quality of acquired knowledge on all components by one level or grade, except on the component *take-off legs action* where both groups were at the level of performing both feet take-off, with insufficiently extended legs. The obtained results were consistent with the results of previous research. For instance, Gabbard (2000) suggests that successful performance level of the standing long jump is not recorded up to 6 years of age, and a similar sequence continues in adolescence and adulthood, mostly in the form of limited arm swing and incomplete leg extension at take-off (Haywood and Getchell, 2001). Qualitative improvements in jumping vary among children. For example, Clark and Phillips (1985) observed that 30% of the 3 to 7 year-olds had the same level of leg and arm action. Some had more advanced leg action than arm action, but some had more advanced arm than leg action. If one component was more advanced than the other, it was usually by one step, but some children were two steps more advanced in one component than the other.

Several developmental sequences were noticed in the observational studies of the standing long jump (Clark and Phillips, 1985; Roberton, 1984).The long jump requires that the body be propelled forward and upward. This necessitates that the centre of gravity be slightly ahead of the base of support at take-off, which may create difficulty in maintaining forward balance; there is a strong tendency for the novice to step out with one foot to avoid falling. Such reflection causes asymmetrical leg action at take-off, flight and landing (Haywood and Getchell, 2001). To improve this leg action, the jumper needs to first make a symmetrical, two-footed take-off, flight and landing; and second, fully extend the ankles, knees and hips at take-off, following a deep preparatory crouch. The trunk leans forward at least 30 degrees from the vertical. Average values of the younger age group (1.87) showed a trunk position at an angle less than 30 degrees from the vertical line. According to Clark et al. (1989), the trunk of the beginners shows a tendency towards the vertical jump and also, by age 3 children can change their trunk angle at take-off to make either a vertical or a horizontal jump.

There is a lack of effective arm action in the initial jumping patterns. As a general rule, leg action is considerably more advanced than arm movements in the early stages of jumping. With maturity, arm movements are used effectively to aid in take-off propulsion and in maintaining stability through flight and upon landing (Gabbard, 2000). Average value of ratings for the younger group shows a lower level of arms action in the relation to the older group. Thus, the younger group has shoulders retract, arms extend backwards in winging posture at take-off, while in the older age group the arms are abducted about 90 degrees, with the elbows frequently flexed, in high or middle guard position. From the obtained results it can be seen that children aged 6-7 years do not have efficient arms action in terms of strong swing from backwards to overhead position which would help in the efficient performance of the standing long jump. There are differences in the developmental sequence for the arm action: progress from no arm action to limited arm swing; to extension, then partial flexion; and to extension, then complete arm swing overhead. With maturity and practice, greater coordination of arm and leg movement is achieved and results in a mature movement pattern. Research studies on adult examinees (Herzog, 1986; Ashby & Heegaard, 2002) noted the efficiency of arms action on the length of the jump. Subjects, whose arms action was enabled during the performance of the standing long jump, achieved greater length compared to those whose arms action was disabled. Also, the efficient arms action helps to keep the balance during flight and bringing the body into ideal position for landing.

Gender differences in the quality of the standing long jump acquisition were not obtained, which is consistent with the results of the research conducted on a sample of 7 year-old children (Mohammadezaden et al., 2007). A longitudinal study (Haubenstricker et al., 1999), where the level of knowledge was assessed with composite model, showed that there was no difference between genders in achieving advanced levels of the standing long jump, i.e. both genders showed equal progression from the 1st to 5th level of knowledge.

Significant difference in the variable *jump length* in favour of boys may be explained by the results of previous studies (Demura et al., 1990) where boys were superior in the results of the standing long jump. Also, a comprehensive meta-analysis (Ikeda and Aoyagi, 2008) showed that girls were superior at the age of 2 years and boys at the age of 6 years. It seems the differences are conditioned by different interests for physical activities and play and also by different social expectations (Malina & Bouchard, 1991).

Conclusion

The research conducted on a sample of 72 preschool children examined age and gender differences in the quality of the acquired knowledge of the standing long jump. The level of motor knowledge was evaluated by a component approach, which assessed the performance of the standing long jump for each component separately. Component approach provides a more precise description of the developmental changes compared to the composite approach. Thus, the progress in each component can be precisely determined, enabling better monitoring of the individual progress of each child. The results obtained in the research showed significant differences by age in all components. Average values of ratings showed that 5 to 6 year- old children had a lower level of adoption for the standing long jump compared to 6 to 7 year- old children on average by one level in all components. The lowest level of acquisition was obtained for the component flight and landing trunk action which showed that for children it is demanding to project their body forward and up at a certain angle. Gender differences in the adoption quality of the standing long jump were not observed, which is consistent with the previous research. Evaluation of motor knowledge in preschool children enables higher quality organization of kinesiological activities intended for children at that age. The obtained data indicate that preschool teachers and generalist teachers should have an individualized approach in the adoption process and the improvement of motor knowledge.

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Dobne i spolne razlike u kvaliteti usvojenosti skoka u dalj iz mjesta

Sažetak

Osnovni je cilj ovog istraživanja utvrditi dobne i spolne razlike u kvaliteti usvojenosti motoričkoga znanja – skoka u dalj iz mjesta. Istraživanje je provedeno na 72 djece (31 djevojčici i 41 dječaku) u dobi od 5 do 7 godina polaznicima dječjega vrtića u Čakovcu. Primijenjena je skala (Roberton i Halverson, 1984) za procjenu razvojnih karakteristika skoka u dalj iz mjesta. Podaci su prikupljeni snimanjem videokamerom koja je bila postavljena s bočne strane. Procjenu razine znanja napravila su tri stručnjaka. Razlike između spola i dobi izračunate su univarijatnom analizom varijance (ANOVA). Rezultati su pokazali statistički značajnu razliku između mlađe i starije dobne skupine u svim varijablama. Značajne razlike između djevojčica i dječaka u kvaliteti izvedbe skoka u dalj iz mjesta nisu zapažene.

Ključne riječi: *djeca predškolske dobi; Roberton i Halverson metoda; snimanje videokamerom.*