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The Assessment of Climbing Skills in Four-Year-Old Children

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Abstract

The aim of the study was to examine the characteristics of climbing skills among four-year-old children. The fundamental movement pattern of climbing was evaluated because of its role in the process of motor development. 107 children performed a climbing test, where specially adapted 275 cm high and 90 degree set vertical ladder with 15, 30 and 45 cm distance between horizontal bars was used. The climbing time, as a measure of climbing effectiveness was correlated with climbing proficiency, the body characteristics and data obtained by accelerometers. Climbing proficiency variables were established for the purpose of this study. Climbing time in the main climbing task (climbing ladder 90 degrees, 15 cm) was statistically significantly correlated with climbing proficiency ($r=-0.713$, $p< 0.001$) and with body height ($r=-0.230$, $p=0.026$), however, it was not significantly correlated with the daily amount ($r=-0.425$, $p=0.101$) and intensity ($r=0.086$, $p =0.750$) of physical activity. Climbing proficiency is the most important factor of climbing effectiveness. Children have to master the proficiency of climbing skills through specially designed physical activity programmes with proper skill instructions and in environments that stimulate the development of various forms of climbing skills.

Key words: *child; early childhood; motor development; physical activity; vertical ladder.*

Introduction

Children develop and enhance their motor skills and abilities through their daily activities while they perform fundamental movement patterns (FMPs) such as walking, running, throwing, rolling, crawling and, among others, climbing, that are considered the basic units of voluntary motor control to be present throughout one's

life-span (Saakslahti et al., 1999; Konczak, 2005; Williams & Monsma, 2006). Early childhood is an essential time for the development, acquisition and adoption of FMPs which allow children to interact with and explore their environment (Hardy et al., 2010; Pišot et al., 2010). Physical activity in the period of early childhood is made up of different forms of activities combined in the framework of FMPs. In addition to the health benefits, physical activity is reflected in offering possibilities for acquiring and adopting various forms of human movement patterns and gaining rich motor experiences. During physically active play and through interaction with the environment, children progressively gain control of their bodies and ultimately master a range of different motor skills (Cote, 1999; Little & Wyver, 2008). The mastery of fundamental movement skills in the process of motor development has been purported as contributing to children's physical, cognitive and social development and is thought to provide the foundation for an active lifestyle (Strong et al., 2005; Lubans et al., 2010). Movement patterns and motor skills that have not been mastered at an early age may remain unlearned due to the development of bad habits, self-consciousness or fear of injury (Gallahue et al., 2011). Early childhood physical activity guidelines indicate that the development of basic movement patterns and skills should be a key component of early childhood education programmes (Lubans et al., 2010; Volmut et al., 2013).

Climbing, as one of the FMPs, is described as movement taking place in the direction opposite to gravitational forces in which humans actively use the upper part of the body (Pistotnik et al., 2002; Möscha, 2004; Chapman, 2008). It has played an important role in the origins of both human locomotion and human bipedalism (Watanabe, 1971; Hanna & Schmitt, 2010). In literature, the FMP of climbing in several of its natural forms is mentioned as a very important pattern for coherent body and motor development (Lubans et al., 2010; Pistotnik et al., 2002). It is especially appropriate for developing the muscle strength of the upper part of the body, which is extremely important for spinal and body posture development (Starc et al., 2010). The nature of modern lifestyle is one of the causes why climbing has become one of the most disadvantaged FMP. Acquired and sufficiently developed FMPs are, in addition to ensuring coherent body and motor skills development, extremely important in preventing injuries due to falls. Reports on injuries of children and adolescents in Slovenia and the European Union show that falls from a variety of objects at different heights (chairs, tables, stairs, playground equipment, etc.) are the fourth leading cause of death and injury of children and a cause for more than a half (52.7 %) of hospitalisations due to injuries (Rok Simon, 2007). As a result of falls, loco-motor injuries are becoming ever more serious. Due to the fear of falls and injuries, over-protective parents, educators and teachers rarely include climbing in the daily physical activity of children (Plevnik, 2011).

Many health problems known as degenerative diseases of the loco-motor system occur as a result of physical inactivity and are already evident during childhood (De Inocencio, 2004; Briggs et al., 2009). Studies report that the level of physical activity

is positively associated with motor proficiency, which is further inversely associated with sedentary activity in children (Wrotniak et al., 2006; Raudsepp & Pall, 2006; Hinkley et al., 2008; Cliff et al., 2009). Motor skills assessment tools for children, which represent the evaluation and research tool for establishing motor efficiency and proficiency, do not include the FMP of climbing (Cools et al., 2009). The FMP of climbing is therefore, because of the difficulty in measurement and evaluation, one of the least studied FMPs. The objective of this study was to examine the characteristics of climbing skills among four-year-old children.

Methods

Subjects

One hundred and seven four-year-old children (52 boys and 55 girls) from a population of five hundred and seventy children from the municipality of Koper (Slovenia) were included in the study. The parents' written consent had been provided.

Variables and Measurement Procedure

The data was collected in a one and a half month period during which two to four children attended measurements on a daily basis. Data was collected by trained researchers. Among other measurements included in the research, children performed three different climbing tasks on a specially adapted 275 cm-high vertical ladder which allowed climbing 15, 30 and 45 cm distance between horizontal bars (Figure 1), wherein climbing task CLI 90° 15 cm represented the main testing task. This climbing task was chosen because the ladder in this task is the most frequent and applicable climbing ladder in kindergartens and schools. The climbing task began on the signal "go", a child had to touch the highest ladder and the task stopped when the child touched the floor with the first leg. Climbing time was used as a quantitative criterion of climbing effectiveness (Williams et al., 2006).

Figure 1. Climbing ladder in all three forms of the testing task: CLI 90° 15 cm, CLI 90° 30 cm and CLI 90° 45 cm (from left to right)

The FMP of climbing is not included in motor skill assessment tools for children (Cools et al., 2009). In order to evaluate the role of climbing proficiency, we defined four qualitative variables of the FMP of climbing, which were subjectively estimated on a 3 point scale, where point 1 signified the lowest and point 3 the highest value (Plevnik et al., 2012) (Table 1).

Table 1.
The qualitative variables of climbing proficiency

CLIMBING PROFICIENCY VARIABLES AND CRITERIA	POINTS
CLIMBING RHYTHM	
Climbing includes stops and changes of rhythm	1
Climbing is mainly rhythmic without stops	2
Climbing is very rhythmic	3
LOOKING IN THE DIRECTION OF MOVEMENT	
Child observes floor, hands and feet, child´s look is all around the room	1
Child observes hands and feet, occasionally the direction of climbing	2
Child observes only the direction of climbing	3
GRASPING METHOD	
Child uses undergrip and helps also with other parts of the body	1
Child uses under- or overgrip, the grip is opened or closed	2
Child mainly uses overgrip and closed grip	3
THE USAGE OF A DIAGONAL RECIPROCAL MOVEMENT ACTIVATION PATTERN	
Never – rarely	1
Sometimes	2
Often - always	3
POINTS TOGETHER	4-12

Intrarater agreement was calculated for all qualitative variables (Kappa coefficient higher than 0.589). Furthermore, points were classified into three groups of climbing proficiency, namely climbing proficiency GROUP 1 (4-6 points), climbing proficiency GROUP 2 (7-9 points) and climbing proficiency GROUP 3 (10-12 points), where group 3 represented the most proficient climbers.

After the main study, a sub-sample of 19 children selected using the random number generator method wore a vertical accelerometer (Actigraph GT1M, manufactured by Actilife, USA) on their right hip for five consecutive days (3 weekdays, Saturday and Sunday). A representative sub-sample of 19 children for the whole group was selected because of limitations with research equipment. Correlations between physical activity and climbing times were based on the sub-sample. The cut-off points for sedentary behaviour, light, moderate and vigorous physical activity levels were set at values SED<151 cpm; MVPA>1680 cpm (van Cauwenberghe et al., 2010). The methodology for measurements with accelerometry, recommended by Ward et al. (2005), was used.

Data Analysis

The data were analyzed with the statistical program IBM SPSS 20.0, using the descriptive statistics methods for describing the characteristics of the sample. The

Spearman correlation was used to analyse the correlation between climbing times and climbing proficiency variables. The Pearson correlation was used to analyse the correlations between climbing times, body characteristics and accelerometers data. The t-test for independent samples was used to test differences in climbing times between boys and girls. One-way ANOVA followed by Bonferroni´s post-hoc comparisons test were performed to analyse differences between groups of different climbing proficiency. Assumptions for statistics tests were controlled, no outliers were found. Data from accelerometers were downloaded to a computer and organized using Matlab and Microsoft Excel. The statistical significance was set at $P<0.05$.

Results

One hundred and seven children performed the climbing tasks. Body characteristics of the sample are described in Table 2.

Table 2.

Descriptive characteristics of the main sample

	Pooled data (Mean ± SD)	Boys (Mean ± SD)	Girls (Mean ± SD)	p_{GENDER}
Body Height (cm)	107.8 ± 4.5	107.5 ± 4.7	108.1 ± 4.3	0.741
Body Weight (kg)	18.5 ± 2.6	18.5 ± 2.5	18.5 ± 2.7	0.758
Body Mass Index (kg/m^2)	15.9 ± 1.5	16.0 ± 1.4	15.8 ± 1.5	0.452

CLI 90° X cm – Climbing time at 90 degree angle and X cm distance between the bars

Seventy-two percent of children included in the research had a normal BMI according to the WHO recommendation standards for European children, while 5% were thin, 17% overweight and 6% obese. There were no statistically significant differences in the BMI between boys and girls (Figure 1). The WHO recommendations for children aged 5-19 were chosen because BMI recommendations for younger European children do not exist.

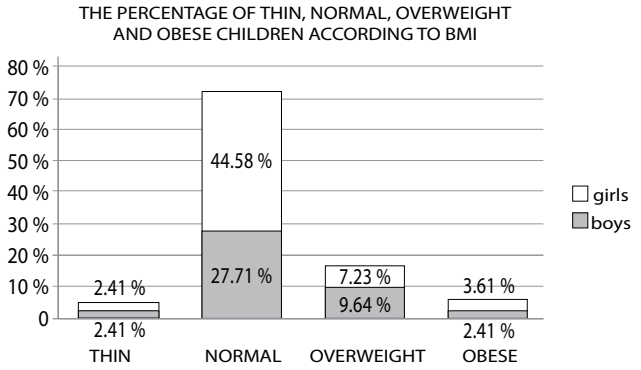

Figure 1. The percentage of thin, normal, overweight and obese children according to body mass index (adapted from WHO for Europe BMI percentiles for boys and girls age 5-19 (2007)).

Boys and girls did not statistically significantly differ by gender in their climbing times, although a tendency between gender can be seen (Table 3). As there was no statistically significant difference according to gender boys and girls represent one group of subjects in further evaluations. The climbing time differed with extended heights between bars, i.e. it was reduced as the distance between bars was extended. This could be explained by more rhythmically pretentious motor task when bars were set closer or with anthropometrically more suitable setting of climbing equipment.

Table 3.

Descriptive characteristics of climbing time in the main sample

	Pooled data (Mean ± SD)	Boys (Mean ± SD)	Girls (Mean ± SD)	p_{GENDER}
CLI 90° 15 cm (sec)	40.6 ± 17.0	37.8 ± 13.5	43.2 ± 19.4	0.124
CLI 90° 30 cm (sec)	35.8 ± 12.4	34.6 ± 12.5	36.8 ± 12.4	0.388
CLI 90° 45 cm (sec)	38.4 ± 12.1	40.3 ± 17.0	36.7 ± 13.1	0.263

CLI 90° X cm – Climbing time at 90 degree angle and X cm distance between the bars

Children's climbing times and the implementation of different climbing tasks are statistically significantly positively correlated (r(CLI 90° 15 cm, CLI 90° 30 cm)=0.776, p<0.001; r(CLI 90° 15 cm, CLI 90° 45 cm)=0.490, p<0.001; r(CLI 90° 30 cm, CLI 90° 45 cm)=0.624, p<0.001). Children who were better at climbing at one climbing task also performed better at other climbing tasks. Children´s past experiences of climbing were not assessed. Each child performed each climbing task once in the same sequence.

Climbing Proficiency and Climbing Efficiency in 4-year-old Children

Considering climbing proficiency variables and criteria, we arranged children in climbing proficiency groups. The majority of the children were classified into group 1, which was somewhat expected for this age of the children. During the study some children from the main sample did not successfully complete one of the climbing tasks, either because of their fear or inability to climb, or due to lack of strength (Figure 2).

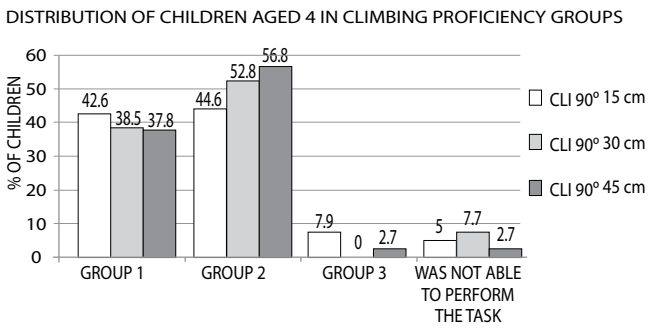

Figure 2. Distribution of children in climbing proficiency groups

The differences in climbing times among climbing proficiency groups were tested. In climbing tasks CLI 90° 15 cm and CLI 90° 30 cm statistically significant differences among groups were calculated (Table 4).

Table 4.

Differences in climbing times according to three groups of climbing proficiency (M ± SD)

	GROUP 1	GROUP 2	GROUP 3	p_{GROUP}	Effect Size ω^2
CLI 90° 15 cm (sec)	52.2 ± 18.2	33.0 ± 7.7	24.0 ± 9.2	< 0.001	0.37
CLI 90° 30 cm (sec)	47.1 ± 11.5	29.0 ± 7.6		< 0.001	0.45
CLI 90° 45 cm (sec)	36.1 ± 14.0	44.8 ± 19.7	55.3 ± 21.7	0.096	

The group effect was significant in CLI 90° 15 cm condition, and post-hoc revealed significant differences between group 1 and 2 ($p<0.001$) and between group 1 and 3 ($p<0.001$).

Climbing times, as the quantitative measure are statistically significantly associated ($r = -.713$, $p<0.001$) with climbing proficiency, as the qualitative measure of climbing effectiveness among children at the age of four.

Climbing Efficiency and Body Characteristics in 4-year-old Children

In climbing tasks CLI 90° 15 cm and CLI 90° 30 cm the climbing time was statistically significantly negatively correlated with body height, while body weight was statistically significantly negatively correlated with climbing time in CLI 90° 30 cm (Table 5). In climbing tasks CLI 90° 15 cm and CLI 90° 30 cm higher children had better climbing effectiveness.

Table 5.

Pearson correlation (r) among Body Height (cm), Body Weight (kg) and climbing times in 3 different climbing tasks

	CLI 90° 15 cm	CLI 90° 30 cm	CLI 90° 45 cm
Body Height (cm)	r=-0.230; **p=0.026**	r=-0.315; **p=0.002**	r=-0.108; p=0.310
Body Weight (kg)	r=-0.202; p=0.051	r=-0.259; **p=0.011**	r=-0.105; p=0.320

CLI 90° X cm – climbing time at a 90 degree angle and X cm distance between the ladder rungs

Climbing Efficiency, Amount and Intensity of Daily Physical Activity in 4-year-old Children

Children in the sub-sample did not statistically significantly differ by gender in the intensity neither in the amount of physical activity, so in continuation they represented one group of subjects (Table 6).

Table 6.

Descriptive characteristics of a sub-sample (M ± SD)

	Pooled data (n = 17)	Boys (n = 9)	Girls (n = 10)	p_{GENDER}
Physical activity (cpm)	702.7 ± 182.7	686.4 ± 165.7	716.5 ± 204.7	*0.935*
Sedentary (min)	252.5 ± 75.2	246.0 ± 75.0	258.3 ± 79.0	*0.733*
Moderate and vigorous physical activity (min)	74.3 ± 22.9	73.1 ± 19.0	75.4 ± 27.0	*0.831*

cpm – counts per minute

The amount, the intensity of daily physical activity of children and climbing time were low correlated and not statistically significant. Because of the study and method limitations, these results offer only an insight into associations between physical activity and climbing effectiveness.

Discussion

The aim of this study was to examine the characteristics of climbing skills among four-year-old children while climbing a vertical ladder and find out its correlations with climbing efficiency, climbing proficiency, body characteristics and the level of physical activity.

Monitoring the development of climbing and also other FMPs is crucial for the adoption of motor competencies in early childhood as well as later in adulthood. Climbing proficiency statistically significantly correlated with the climbing time and at the same time represents the most important factor for climbing effectiveness at the age of four. The results from other studies (Mermier et al., 2000) suggest that the training component uniquely explains more than 55 % of the total variance in climbing performance in the adult period. In order to develop a proper climbing technique, children should be encouraged to follow qualitative factors of climbing proficiency. Plevnik and Pišot (2011) suggested that faster climbers use the proper climbing technique, which is highly correlated with climbing efficiency. The majority of the sample distributed in climbing proficiency group 1 and 2. This is somehow expected (Gallahue et al., 2011), namely as early childhood is also a period of FMPs acquisition. It would be interesting to assess the longitudinal changes in climbing proficiency development and these can be objectives for further investigations in the field of climbing skills assessment. Children naturally develop a rudimentary form of FMPs, but a mature form of FMP proficiency is more likely to be achieved with appropriate practice, stimulation, feedback and instruction (Gallahue et al., 2011; Wickstrom, 1977). Therefore, the acquisition of climbing and especially climbing proficiency requires a more structured play and organized activities with appropriate instructions for climbing skills. From the results of our study, it is evident that children included in the research, had already developed the first forms of the climbing proficiency technique. For four-year-old children it is urgent that climbing skills programmes also include appropriate instructions for developing a climbing technique at the next proficiency level. The results of this study suggest that children who were fast at climbing at one climbing task were also fast at climbing at other climbing tasks. The results of three climbing tasks were statistically significantly correlated. Climbing different obstacles and using different climbing equipment stimulates positive motor transfer (Hikosaka et al., 2002). This is why stimulating children to climb a variety of different tools and obstacles could have a positive impact on the development of the FMP of climbing and on many of its natural forms. Shonkoff and Phillips (2000) indicate that children who do not receive adequate motor skill instruction and practice

may demonstrate developmental delays in their gross motor ability. Therefore, due to the fact that, today, children do not experience many climbing movements, proper instructions for climbing as well as a stimulating climbing environment, designed for children in the period of early childhood, is very important.

Body characteristics and the process of growth among children at the age of four represent one of the factors, important for climbing effectiveness. Mermier, Janot, Parker and Swan (2000) found that specific anthropometric characteristics are important, but not necessary to excel in adult sport rock climbing. The anthropometric and flexibility components explained 0.3 % and 1.8 % of the total variance in climbing performance respectively. Body height at the climbing tasks CLI 90° 15 cm and 30 cm significantly correlated to the time of climbing, although the correlations were low. Higher children achieved the results in a faster time. At the climbing task CLI 90° 45 cm body height and weight were not significantly correlated with climbing time. To explain the influence of motor abilities on climbing effectiveness motor abilities test should be performed as well.

Findings obtained from different research studies (Wrotniak et al., 2006; Fischer et al., 2005; Williams et al., 2006) emphasize that the time which children spend in moderate and vigorous physical activity area is very important for a sufficient level of motor proficiency and for the acquisition of motor skills and patterns. However, the amount and intensity of physical activity among preschool children nowadays are lower than recommended (Cardon & De Bourdeaudhuij, 2008; WHO, 2010). The results of our study indicate that neither the amount of time of moderate and vigorous physical activity nor the intensity of daily physical activity are correlated to climbing time on a 275 cm high specially adopted vertical ladder in different climbing tasks. Accelerometry is a useful research technique for assessing daily physical activity; however, it has its limitations and favours gross movements such as running and jumping. Another method for assessing PA should be used to find possible correlations between PA and climbing effectiveness.

Kindergarten teachers reported that the FMPs of crawling and climbing were some of the most neglected activities in children's play and other daily movements (Playday, 2007; Plevnik, 2011). With regular physical activity, even on a non-structured basis, children can develop body characteristics and at the same time they unconsciously develop and acquire different motor skills and gain motor experiences if they are integrated in a proper (climbing) environment and experience appropriate stimulations. It is not reasonable to believe that the sufficient level and intensity of physical activity in itself will enhance the climbing skill (Logan et al., 2011). Only a climbing encouraging environment and inclusion of climbing tasks in many forms in physically active programmes will promote the development of climbing skills. Educators, teachers, and parents have to be aware of the positive impacts of proper climbing proficiency and climbing experiences on a child's future physical development and health. Thus, they could offer children a stimulating environment

with several climbing opportunities and opportunities for acquiring proper climbing techniques.

Conclusions

The results of our study offer an insight into the understanding of climbing skills development and suggest that climbing proficiency plays the most important role in climbing effectiveness at the age of four. Offering a stimulating climbing environment and climbing development programmes to children represent the first steps of acquisition and adoption of climbing skills. By understanding associations between climbing efficiency and development of climbing skills, body characteristics and physical activity we can provide movement programmes that would stimulate a coherent development of climbing skills during early childhood. In our study we did not consider that different natural forms of the climbing pattern occur in childhood, therefore, it would be advisable also to include other forms of climbing in further research to assure a holistic approach in the climbing patterns development study. Because of the difficulty in measurement and weaknesses of the method of evaluation applied more studies need to be done to evaluate the development of climbing skills and to improve the suggested evaluation methodology. The results of this study can be used as a basis for further studies on the field of evaluating climbing development. Authors also recommend that the evaluation of climbing skills should be included in the main movement skills assessment batteries.

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References

Briggs, A. M., Smith, A. J., Straker, M. L., & Bragge, P. (2009). Thoracic spine pain in the general population: Prevalence, incidence and associated factors in children, adolescents and adults. A systematic review. *BMC Musculoskeletal Disorders*, 10:77.

Cardon, G. M., & De Bourdeaudhuij, I. M. M. (2008). Are preschool children active enough? Objectively measured physical activity levels. *Research Quarterly for Exercise and Sport, 79*(3), 326-332.

Chapman, A. (2008). *Biomechanical Analysis of Fundamental Human Movements.* Champaign, IL: Human Kinetics.

Cliff, D. P., Okely, A. D., Smith, L., & Mckeen, K. (2009). Relationship between fundamental movement skills and objectively measured physical activity in pre-school children. *Pediatric Exercise Science*, *21*(4), 436–439.

Cools, W., De Martelaer, K., Samaey, C., & Andries, C. (2009). Movement skill assessment of typically developing preschool children: A review of seven movement skill assessment tools. *Journal of Sports Science and Medicine, 8,* 154–168.

Cote, J. (1999). The influence of the family in the development of talent in sport. *The Sport Psychologist*, *13*(4), 395–417.

De Inocencio, J. (2004). Epidemiology of musculoskeletal pain in primary care. *Archives of disease in childhood, 89,* 431–434.

Fischer, A., Reilly, J., Kelly, L.A., Montgomery, C., Williamson, A., Paton, J. Y., et al. (2005). Fundamental movement skills and habitual physical activity in young children. *Medicine & Science in Sports & Exercise*, *37*(4), 684–688.

Gallahue, D. L., Ozmun, J. C., & Goodway, J. (2011). *Understanding motor development: infants, children, adolescents, adults.* New York: McGraw-Hill Higher Education, London: McGraw-Hill.

Hanna, J. B. & Schmitt, D. (2011). Interpreting the role of climbing in primate locomotor evolution: Are the biomechanics of climbing influenced by habitual substrate use and anatomy? *International Journal of Primatology*, *32*, 430–444.

Hardy, L.L., King, L., Farrell, L., Macniven, R., & Howlett, S. (2010). Fundamental movement skills among Australian preschool children. *Journal of Science and Medicine in Sport*, *13*(5), 503–508.

Hikosaka, O., Nakamura, K., Sakai, K, & Nakahara, H. (2002). Central mechanisms of motor skill learning. *Current Opinion in Neurobiology*, 12, 217-222.

Hinkley, T., Crawford, D., Salmon, J., Okely, A. D., & Hesketh, K. (2008). Preschool children and physical activity: a review of correlates. *American Journal of Preventive Medicine*, *34*(5), 435–41.

Konczak, J. (2005). On the notion of motor primitives in humans and robots. In L. Bertjouze, F. Kaplan, H. Kozima, Y. Yano, J. Konczak, G. Metta, et al. (Eds.), *Proceedings of the Fifth International Workshop on Epigenetic Robotics: Modeling Cognitive Development in Robotics Systems* (pp. 47–53). Lund University Cognitive Studies, 123. Lund: LUCS.

Little, H., & Wyver, S. (2008). Outdoor Play: Does Avoiding the Risks Reduce the Benefits? *Australasian Journal of Early Childhood*, *33*(2), 33–40.

Logan, S. W., Robinson, L. E., Wilson, A. E., & Lucas, W. A. (2011). Getting the fundamentals of movement: a meta-analysis of the effectiveness of motor skill interventions in children. *Child: care, health and development*, 38, 305-315.

Lubans, D. R., Morgan, P. J., Cliff, D. P., Barnett, L. M., & Okely, A. D. (2010). Fundamental movement skills in children and adolescents: review of associated health benefits. *Sports Medicine*, 40(12), 1019–1035.

Mermier, C. M., Janot, J. M., Parker, D. L., & Swan, J. G. (2000). Physiological and anthropometric determinants of sport climbing performance. *British Journal of Sport Medicine, 34*, 359-366.

Möscha, L. (2004). *Plezanje kot igra*. Ljubljana: Založba Modrijan.

Pišot, R., Šimunič, B., Šarabon, N., Cankar, G., Jelovčan, G., Plevnik, M., et al. (2010). Gibalno kompetenten otrok – zdrav in uspešen otrok. In J. Dolinšek (Ed.), *Otrok in šport,*

Obravnava otrok z drisko, Šokovna stanja v otroškem obdobju/XX. srečanje pediatrov in VII. Srečanje medicinskih sester v pediatriji (pp. 15–26). Maribor: Univerzitetni klinični center.

Pistotnik, B., Pinter, S., & Pori, M. (2002). *Gibalna abeceda (naravne oblike gibanja).* Ljubljana: Fakulteta za šport, Inštitut za šport.

Playday. (2007). *Our streets too!* London: National Children's Bureau: Department for Culture, Media and Sport.

Plevnik, M. (2011). Fundamental motor patterns in kindergarten. In D. Milanović & G. Sporiš (Eds.), *Proceedings book of 6th International Scientific Conference on Kinesiology* (pp. 297–299). Zagreb: University of Zagreb, Faculty of Kinesiology.

Plevnik, M., & Pišot, R. (2011). Factors of accordant climbing in 4 year old children. In: M. Mikalački & G. Bala (Eds.), *Proceedings of 2nd International Scientific Conference Exercise and Quality of Life* (pp. 189–195). Novi Sad: Faculty of Sport and Physical Education.

Plevnik, M., Gerževič, M., & Pišot. R. (2012). Assessment of fundamental movement pattern of climbing in the period of early childhood. In R. Pišot et al. (Eds.), *A child in motion for healthy aging/The 7th International Scientific and Expert Symposium Child in Motion* (pp. 142–146). Koper: University of Primorska, Scientific and research centre of Koper, University Press Annales.

Raudsepp, L., & Pall, P. (2006). Relationship between fundamental motor skills and outside school physical activity of elementary school children. *Pediatric Exercise Science*, *18*, 426–35.

Rok Simon, M. (2007). *Poškodbe otrok in mladostnikov v Sloveniji: analiza podatkov o umrljivosti in obolevnosti* (Research report). Ljubljana: Inštitut za varovanje zdravja RS.

Saakslahti, A., Numminen, P., Niinikoski, H., Rask-Nissila, L., Viikari, J., Tuominen, J. et al. (1999). Is physical activity related to body size, fundamental motor skills, and CHD risk factors in early childhood? *Pediatric Exercise Science*, *11*, 327-340.

Shonkoff, J. P., & Phillips, D. A. (Eds.). (2000). *From Neurons to Neighborhoods: The Science of Early Childhood Development.* Washington, DC, USA: National Academies Press.

Starc, G., Strel, J., & Kovač, M. (2010). *Telesni in gibalni razvoj slovenskih otrok in mladine v številkah.* Ljubljana: Univerza v Ljubljani, Fakulteta za šport.

Strong, W. B., Malina, R. M., Blimkie, C. J., Daniels, S. R., Dishman, R. K., Gutin, B. et al. (2005). Evidence based physical activity for school-age youth. *Journal of Pediatrics*, *146*(6), 732–737.

Van Cauwenberghe, E., Labarque, V., Trost, S. G., De Bourdeaudhuij, I., & Cardon, G. (2011). Calibration and comparison of accelerometer cut points in preschool children. *International Journal Of Pediatric Obesity*, 6(2-2), E582–E589.

Volmut, T., Pišot, R., & Šimunič, B. (2013). Objectively measured physical activity in children aged from 5 to 8 years. *Slovenian Journal of Public Health*, *52*(1), 9-18.

Ward, D. S., Evenson, K. R., Vaughn, A., Rodgers, A. B., & Troiano, R. P. (2005). Accelerometer use in physical activity: best practices and research recommendations. *Medicine & Science in Sports & Exercise*, 37:S582.

Watanabe, H. (1971). Running, Creeping and Climbing: A New Ecological and Evolutionary Perspective on Human Locomotion. *Mankind*, *8*(1), 1–13.

Wickstrom, R. L. (1977). *Fundamental motor patterns.* Philadelphia: Lea in Febiger.

Williams, H., & Monsma, E. V. (2006). Assessment of gross motor development. In B. A. Bracken & R. J. Nagle (Eds.), *Psychoeducational Assessment of Preschool Children, Fourth Edition* (pp. 397-433). NJ, Hillsdale: Lawrence Erlbaum Associates.

Williams, H. G., Pfeiffer, K. A., O´Neill, J. R., Dowda, M., McIver, K. L., Brown, W. H., et al. (2006). Motor Skill Performance and Physical Activity in Preschool Children. *Obesity*, *16*, 1421–1426.

World Health Organization. (2007). *BMI for age (5-19 years).* Switzerland: World Health Organization.

World Health Organization. (2010). *Global recommendations on physical activity for health.* Switzerland: World Health Organization.

Wrotniak, B. H., Epstein, L. H., Dorn, J. M., Jones, K. E., & Kondilis, V. A. (2006). The relationship between motor proficiency and physical activity in children. *Pediatrics*, *118*(6), e1758–65.

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Procjena vještine penjanja u četverogodišnjaka

Sažetak

Cilj ovoga istraživanja bio je proučiti obilježja vještine penjanja među četverogodišnjom djecom. Osnovni uzorak pokreta bio je procijenjen zbog njegove uloge u procesu motoričkog razvoja. 107 djece bilo je podvrgnuto testu penjanja za koji su se koristile posebno prilagođene vertikalne ljestve visine 275 cm i 90 stupnjeva sa 15, 30 i 45 cm razmaka između horizontalnih prečki. Vrijeme penjanja, kao mjera učinkovitosti penjanja, korelirano je s vještinom penjanja, tjelesnim karakteristikama i podacima dobivenih akcelerometrima. Varijable za vještinu penjanja uspostavljene za ovo istraživanje. Vrijeme penjanja kod glavnog zadatka penjanja (penjanje na ljestve pod 90 stupnjeva i s razmakom od 15cm) statistički je značajno korelirano s vještinom penjanja ($r = -0,713$, $p<0,001$) i s tjelesnom visinom ($r = -0,230$, $p = 0,026$). Međutim, nije značajno korelirano s dnevnom količinom ($r = -0,425$, $p = 0,101$) i intenzitetom ($r = 0,086$, $p = 0,750$) fizičke aktivnosti. Čimbenik vještine penjanja najvažniji je za učinkovitost penjanja. Djeca moraju steći iskustvo u vještini penjanja putem posebno oblikovanih programa fizičkih aktivnosti i primjerene obuke koja se održava u okolini koja stimulira razvoj različitih oblika vještina penjanja.

Ključne riječi: *dijete; fizička aktivnost; motorički razvoj; rano djetinjstvo; vertikalne ljestve.*

Uvod

Djeca razvijaju i unapređuju svoje motoričke sposobnosti u dnevnim aktivnostima, izvođenjem osnovnih kretnji u obrascu (dalje u tekstu FMP) poput hodanja, trčanja, bacanja, kotrljanja, puzanja i, između ostalog, penjanja, što smatramo osnovnim elementima dobrovoljne motoričke kontrole prisutne u čovjekovu životu (Saakslahti i sur., 1999; Konczak, 2005; Williams i Monsma, 2006). Vrijeme ranog djetinjstva ključno je za razvoj, stjecanje i usvajanje FMP-a koje djeci omogućuju interakciju i istraživanje okoline (Hardy i sur., 2010; Pišot i sur., 2010). Fizička aktivnost u ranom djetinjstvu sastoji se od različitih oblika aktivnosti u kombinaciji s okvirom FMP-a. Uz zdravstvenu korist, fizička aktivnost očituje se i u pružanju mogućnosti za stjecanje i usvajanje različitih vrsta uzoraka kretanja i u usvajanju bogatog motoričkog iskustva. Za vrijeme fizički aktivne igre i interakcije s okruženjem djeca postupno preuzimaju

kontrolu nad svojim tijelima i usavršavaju raznovrsne motoričke vještine (Cote, 1999; Little i Wyver, 2008). Usvajanje osnovnih vještina pokreta u razdoblju razvoja motorike podrazumijeva velik doprinos fizičkom, kognitivnom i društvenom razvoju djece, pa se smatra osnovicom aktivnoga životnog stila (Strong i sur., 2005; Lubans i sur., 2010). Uzorci pokreta i motoričke vještine koji nisu usvojeni u ranom djetinjstvu mogu ostati nenaučeni zbog utjecaja loših navika, samosvijesti ili straha od ozljede (Gallahue i sur., 2011). Smjernice za fizičku aktivnost u ranom djetinjstvu ukazuju na to da bi razvoj osnovnih uzoraka pokreta i vještina trebao biti ključna sastavnica programa obrazovanja djece u ranoj dobi (Lubans i sur., 2010; Volmut i sur., 2013).

Penjanje, jedna od FMP-a, opisuju se kao pokret koji se izvršava u smjeru suprotnome od sila gravitacije, a u kojem se ljudi aktivno koriste gornjim dijelom tijela (Pistotnik i sur., 2002; Möscha, 2004; Chapman, 2008). Penjanje je imalo važnu ulogu u razvoju ljudske pokretljivosti i ljudskog bipedalizma (Watanabe, 1971; Hanna i Schmitt, 2010). U literaturi se FMP penjanja u nekoliko prirodnih oblika spominje kao važan uvjet skladnog tjelesnog i motoričkog razvoja (Lubans i sur., 2010; Pistotnik i sur., 2002). Iznimno je važno za razvoj mišićne mase gornjeg dijela tijela, što je osobito važno za razvoj kralježnice i tjelesnog držanja (Starc i sur., 2010). Način modernog života jedan je od razloga zbog kojeg je penjanje postalo jedna od FMP-a koja se gubi. Usvojene i dovoljno razvijene FMP zaslužne su za skladan razvoj tjelesnih i motoričkih vještina, i vrlo su važne u prevenciji ozljeda kod padova. Izvještaji o ozljedama djece i odraslih u Sloveniji i Europskoj uniji pokazuju da su padovi s objekata na različitim visinama (stolice, stolovi, stube, oprema na igralištima itd.) četvrti glavni uzrok smrti i ozljeda djece, i da uzrokuju više od pola (52,7 %) hospitalizacija uzrokovanih ozljedama (Rok Simon, 2007). Zbog posljedica padova lokomotoričke ozljede postaju sve ozbiljnije. Zbog straha od pada i ozljeda zaštitnički usmjereni roditelji, nastavnici i učitelji rijetko uvrštavaju penjanje na popis dnevnih fizičkih aktivnosti djece (Plevnik, 2011).

Mnoštvo zdravstvenih problema poznatih kao degenerativne bolesti lokomotornog sustava posljedica su fizičke neaktivnosti, a zamjećuju se već u djetinjstvu (De Inocencio, 2004; Briggs i sur., 2009). Studije pokazuju da je razina fizičke aktivnosti pozitivno povezana s motoričkom sposobnošću, što u suprotnom čini poveznicu sa sjedećim aktivnostima djece (Wrotniak i sur., 2006; Raudsepp i Pall, 2006; Hinkley i sur., 2008; Cliff i sur., 2009). Alati za procjenu motoričkih vještina djece, alat za procjenu i istraživanje motoričke učinkovitosti i vještine, ne uključuju FMP penjanja (Cools i sur., 2009). FMP penjanja je, prema tome, zbog težine mjerenja i procjene, jedna od FMP-ova koja je najmanje proučavana. Cilj ovog istraživanja bio je proučiti karakteristike vještine penjanja među četverogodišnjacima.

Metode

Ispitanici

U istraživanje je bilo uključeno 107 četverogodišnjaka (52 dječaka i 55 djevojčica) iz populacije od 570 djece u općini Koper (Slovenija). Za sudjelovanje u istraživanju roditelji su dali pisano odobrenje.

Varijable i procedure mjerenja

Podaci su prikupljeni u razdoblju od dva i pol mjeseca za vrijeme kojega je dvoje do četvero djece sudjelovalo u dnevnim mjerenjima. Podatke su prikupljali kvalificirani istraživači. Uz ostala mjerenja u istraživanju, djeca su izvela i tri različita zadatka penjanja na posebno prilagođenim 275 cm visokim vertikalnim ljestvama s 15, 30 i 45 cm razmaka među horizontalnim prečkama (Slika 1). Zadatak penjanja CLI 90° 15 cm u testu je bio glavni zadatak. Taj je zadatak odabran zato što se u tom zadatku ljestve najčešće koriste, a i primjenjiv je u vrtićima i školama. Zadatak penjanja započinjao je na znak „kreni". Dijete je trebalo dodirnuti najvišu točku ljestvi. Zadatak je završio kada bi dijete dodirnulo pod prvom nogom. Vrijeme penjanja bilo je kvantitativni kriterij za učinkovitost penjanja (Williams i sur., 2006).

Slika 1.

FMP penjanja nije uključen u procjenu motoričkih vještina djece (Cools i sur., 2009). Da bismo mogli procijeniti ulogu vještine penjanja, definirali smo četiri kvalitativne varijable za FMP penjanja, koje su subjektivno procijenjene na skali od 3 stupnja gdje je 1 bod predstavljao najnižu, a 3 najvišu vrijednost (Plevnik i sur., 2012) (Tablica 1).

Tablica 1.

Za sve kvalitativne varijable izračunata je pouzdanost ocjenjivača (Kappa koeficijent viši je od 0,589). Nadalje, bodovi su klasificirani u tri grupe vještine penjanja, odnosno vještina penjanja SKUPINA 1 (4-6 bodova), vještina penjanja SKUPINA 2 (7-9 bodova) i vještina penjanja SKUPINA 3 (10-12 bodova). Skupina 3 predstavljala je najvještiju skupinu penjača.

Nakon glavnog istraživanja poduzorak od 19 djece, odabran metodom nasumičnog generiranja brojeva, nosili su vertikalni akcelerometar (Actigraph GT1M, izrada Actilife, SAD) na desnom boku i to pet dana za redom (3 radna dana, subota i nedjelja). Reprezentativni poduzorak od 19 djece odabran je zbog ograničenja u istraživačkoj opremi. Korelacije između fizičke aktivnosti i vremena penjanja utemeljene su na poduzorku. Granične vrijednosti za sjedilačko ponašanje i razinu blage, srednje i jake fizičke aktivnosti određene su na sljedeći način: SED<151 pokret u minuti; MVPA>1680 pokreta u minuti (van Cauwenberghe i sur., 2010). Metodologija za mjerenja s akcelerometrom korištena je prema preporuci Ward i sur. (2005).

Analiza podataka

Podaci su analizirani uz pomoć statističkog programa IBM SPSS 20.0, korištenjem deskriptivne statističke metode za opisivanje karakteristika uzorka. Spearmanova korelacija korištena je kako bi se analizirala korelacija između vremena penjanja i varijabli vještine penjanja. Pearsonova korelacija korištena ja kako bi se analizirale korelacije između vremena penjanja, tjelesnih karakteristika i podataka od akcelerometra.

T-test za nezavisne uzorke korišten je kako bi se ispitale razlike u vremenima penjanja između dječaka i djevojčica. Jednosmjerna ANOVA i Bonferroni post-hoc usporedni testovi napravljeni su kako bi se analizirale razlike između skupina različite vještine penjanja. Pretpostavke za statističke testove kontrolirane i netipične vrijednosti nisu nađene. Podaci iz akcelerometra spremljeni su na računalo i organizirani korištenjem Matlab i Microsoft Excela. Statistička značajnost određena je na $P<0,05$.

Rezultati

Testu penjanja podvrgnuto je 107 djece. Tjelesne karakteristike uzorka opisane su u Tablici 2.

Tablica 2.

72% djece uključene u istraživanje imalo je normalan BMI prema preporukama Svjetske zdravstvene organizacije (dalje u tekstu WHO) za europsku djecu, 5% djece bilo je mršavo, 17% prekomjerne tjelesne težine, a 6% pretilo. Statistički značajnih razlika u BMI nije bilo između dječaka i djevojčica (Slika 1). WHO preporučuje korištenje parametara za djecu u dobi od 5 do 19 godina jer preporuke za mlađu europsku djecu ne postoje.

Slika 1.

Djevojčice i dječaci nisu se statistički značajno razlikovali po spolu prema vremenu penjanja, iako se tendencija među spolovima može vidjeti (Tablica 3). S obzirom na to da nije postojala statistički značajna razlika između spolova, dječaci i djevojčice predstavljaju jednu skupinu ispitanika u daljnjim procjenama. Vrijeme penjanja razlikovalo se kod povećane udaljenosti među prečkama, odnosno bilo je skraćeno kako se razmak među prečkama povećavao. Objašnjenje tog fenomena može se naći u ritmički pretencioznim motoričkim zadacima kada su prečke bliže jedna drugoj ili u antropometrijski primjerenijem okruženju za opremu za penjanje.

Tablica 3.

Vrijeme penjanja i primjena različitih zadataka penjanja statistički su značajno korelirani ($r(CLI\ 90°\ 15\ cm, CLI\ 90°\ 30\ cm)=0,776$, $p<0,001$; $r(CLI\ 90°\ 15\ cm, CLI\ 90°\ 45\ cm)=0,490$, $p<0,001$; $r(CLI\ 90°\ 30\ cm, CLI\ 90°\ 45\ cm)=0,624$, $p<0,001$). Djeca koja su imala bolje rezultate na jednom od zadataka penjanja, također su bila bolja i u drugim zadacima penjanja. Prijašnja iskustva djece u penjanju nisu bila procijenjena. Svako je dijete jednom izvelo svaki zadatak penjanja u istom nizu.

Vještina penjanja i učinkovitost penjanja četverogodišnjaka

S obzirom na varijable vještine penjanja i kriterije, djeca su bila raspoređena u skupine prema vještini. Većina djece bila je uvrštena u skupinu 1, što je bilo donekle i očekivano za ovu dobnu skupinu djece. Za vrijeme ispitivanja neka djeca iz glavnog

uzorka nisu uspješno izvršila zadatke penjanja zbog straha, nemogućnosti penjanja ili nedostatka snage (Slika 2).

Slika 2.

Ispitivane su razlike u vremenu penjanja među skupinama određenima prema vještini penjanja. Kod zadatka penjanja CLI 90° 15 cm i CLI 90° 30 cm izračunate su statistički značajne razlike među skupinama (Tablica 4).

Tablica 4.

Učinak grupe bio je značajan u CLI 90° 15 cm uvjetu, a post-hoc test otkrio je značajne razlike između skupine 1 i skupine 2 ($p<0.001$), kao i između skupine 1 i skupine 3 ($p<0,001$).

Vrijeme penjanja kao kvantitativno mjerenje statistički je značajno povezano ($r=-0,713$, $p<0,001$) s vještinom penjanja kao kvalitativnim mjerilom vještine penjanja među četverogodišnjacima.

Učinak penjanja i tjelesne karakteristike četverogodišnje

Kod zadataka penjanja CLI 90° 15 cm i CLI 90° 30 cm vrijeme penjanja je statistički značajno negativno korelirano s tjelesnom visinom, dok je tjelesna težina statistički značajno negativno korelirana s vremenom penjanja kod zadatka CLI 90° 30 cm (Tablica 5). U zadacima penjanja CLI 90° 15 cm i CLI 90° 30 cm viša djeca imala su bolji učinak penjanja.

Tablica 5.

Učinkovitost penjanja, količina i jačina dnevnih fizičkih aktivnosti četverogodišnje djece

Djeca iz poduzorka nisu se statistički razlikovala prema spolu kod jačine niti kod količine fizičke aktivnosti pa u nastavku predstavljaju jednu skupinu ispitanika (Tablica 6).

Tablica 6.

Količina i jačina dnevne fizičke aktivnosti djece i vrijeme penjanja imaju malu korelaciju koja nije statistički značajna. Zbog istraživanja i ograničenja metode, rezultati daju samo uvid u povezanost između fizičke aktivnosti i učinkovitosti penjanja.

Rasprava

Cilj istraživanja bio je proučiti karakteristike vještine penjanja među četverogodišnjom djecom dok se penju na vertikalne ljestve i pronaći korelacije s učinkovitošću penjanja, vještinom penjanja, tjelesnim karakteristikama i razinom fizičke aktivnosti.

Praćenje razvoja penjanja i ostalih FMP-a nužno je za usvajanje motoričkih kompetencija u razom djetinjstvu i kasnije u starijoj dobi. Vještina penjanja statistički značajno korelira s vremenom penjanja i u isto vrijeme predstavlja najvažniji čimbenik učinkovitosti penjanja kod četverogodišnjaka. Rezultati ostalih istraživanja (Mermier i sur., 2000) sugeriraju da čimbenik treniranja objašnjava gotovo 55 % ukupne varijance kod penjanja odraslih. Kako bi razvila pravilnu tehniku penjanja, djeca bi trebala biti poticana na praćenje kvalitativnih čimbenika vještine penjanja. Plevnik i Pišot (2011) sugeriraju da brži penjači koriste pravilnu tehniku penjanja, što visoko korelira s učinkom penjanja. Većina uzorka svrstana je u skupinu 1 i skupinu 2 prema sposobnosti penjanja. To je donekle bilo i očekivano (Gallahue i sur., 2011), posebno zato što je rano djetinjstvo također razdoblje u kojemu se usvaja FMP. Bilo bi zanimljivo procijeniti longitudinalne promjene u razvoju vještine penjanja, što može postati predmet daljnjih istraživanja u području procjene vještine penjanja. Djeca prirodno razvijaju osnovni oblik FMP-a, ali razvijeniji oblik FMP vještine vjerojatnije će biti usvojen pravilnim vježbanjem, simulacijom, povratnom informacijom i uputama (Gallahue i sur., 2011; Wickstrom, 1977). Prema tome, usvajanje vještine penjanja i posebno vještog penjanja zahtijeva strukturiranu igru i organizirane aktivnosti s primjerenim uputama za vještinu penjanja. Iz rezultata našega istraživanja očito je da su djeca koja su bila uključena u istraživanje već razvila prve oblike tehnike penjanja. Nužno je da se u programe za četverogodišnjake uključe, uz vještinu penjanja, i primjerene upute za razvoj te vještine na sljedećem stupnju. Rezultati ovoga istraživanja upućuju na to da su djeca koja su bila brza u jednom od zadataka penjanja bila brza i u ostalim zadacima penjanja. Rezultati triju zadataka penjanja statistički značajno koreliraju. Penjanje na različite prepreke uz pomoć različite opreme za penjanje stimulira pozitivan motorički transfer (Hikosaka i sur., 2002). Zbog toga poticanje djece na penjanje na različite sprave može imati pozitivan učinak na razvoj FMP-a u penjanju i ostalim prirodnim oblicima. Shonkoff i Phillips (2000) upućuju na to da djeca koja nisu dovoljno izložena primjerenom učenju razvoja motoričkih vještina mogu pokazivati kašnjenja u razvoju grube motorike. Prema tome, s obzirom na činjenicu da današnja djeca nisu izložena mnogim gibanjima koja podrazumijevaju penjanje, pravilno podučavanje penjanja kao i poticajnu okolinu za penjanje djece nužno je ostvariti u ranome djetinjstvu.

Tjelesne karakteristike i proces rasta kod četverogodišnje djece predstavlja jedan od čimbenika važnih za učinkovito penjanje. Mermier, Janot, Parker i Swan (2000) došli su do spoznaje da su specifične antropometrijske karakteristike važne, ali ne nužne za isticanje kod penjanja na stijene odraslih osoba. Čimbenici antropometrije i fleksibilnosti objasnili su 0,3 % i 1,8 % ukupne varijance kod izvođenja penjanja. Tjelesna visina i zadatak penjanja CLI 90° 15 cm i 30 cm značajno su korelirali s vremenom penjanja, iako su korelacije bile vrlo niske. Viša djeca došla su do rezultata u kraćem vremenu. Kod zadatka penjanja CLI 90° 45 cm tjelesna visina i težina nisu značajno korelirale s vremenom penjanja. Kako bi se objasnio utjecaj motoričkih

vještina na učinkovitost penjanja, trebao bi biti proveden i test motoričkih vještina.

Nalazi iz različitih istraživanja (Wrotniak i sur., 2006; Fischer i sur., 2005; Williams i sur., 2006) naglašavaju da je vrijeme koje djeca provedu u srednje i jakoj fizičkoj aktivnosti vrlo važno za dostizanje dostatne razine motoričkih vještina i za usvajanje uzoraka motoričkih vještina. Međutim, količina i intenzitet fizičke aktivnosti među vrtićkom djecom danas znatno su manji od preporučenih (Cardon i De Bourdeaudhuij, 2008; WHO, 2010). Rezultati našega istraživanja upućuju na to da ni količina ni vrijeme provedeno u srednjeumjerenoj fizičkoj aktivnosti, ni intenzitet dnevne fizičke aktivnosti ne koreliraju s vremenom penjanja na 275 cm visokim posebno namijenjenim vertikalnim ljestvama za izvođenje određenih zadataka penjanja. Akcelerometrija je korisna tehnika istraživanja procjene dnevne fizičke aktivnosti. Međutim, ima i ograničenja i ide u prilog grubim pokretima poput trčanja i skakanja. Druga metoda procjene PA trebala bi se koristiti kako bi se pronašle moguće korelacije između PA i učinkovitosti penjanja.

Odgajatelji u vrtićima izvještavaju da su FMP puzanja i penjanja među najzanemarivanijim aktivnostima u dječjoj igri i ostalim kretanjima tijekom dana (Playday, 2007; Plevnik, 2011). S normalnom fizičkom aktivnošću, čak i nestrukturiranom, djeca mogu razviti tjelesne karakteristike i u isto vrijeme podsvjesno razviti i usvojiti različite motoričke vještine, kao i motorička iskustva ako se uključe u primjereno (penjačko) okruženje i dožive primjerene simulacije. Nije opravdano vjerovati da će zadovoljavajuća razina i intenzitet fizičke aktivnosti poboljšati vještinu penjanja (Logan i sur., 2011). Samo okruženje koje potiče i uključuje zadatke penjanja u raznim oblicima fizički aktivnih programa moći će promovirati razvoj vještine penjanja. Pedagozi, nastavnici, roditelji trebaju biti upoznati s pozitivnim učincima pravilne vještine penjanja i iskustva penjanja na razvoj i zdravlje djeteta. Prema tome, mogli bi ponuditi djeci u motivirajućem okruženju nekoliko mogućnosti za penjanje i za usvajanje pravilnih tehnika penjanja.

Zaključci

Rezultati ovoga istraživanja nude uvid u razumijevanje razvoja vještine penjanja i poručuju da vještina penjanja ima najvažniju ulogu u učinkovitosti penjanja u dobi od četiri godine. Pružanje motivirajuće okoline za penjanje i programi za penjanje predstavljaju prve korake za usvajanje i prihvaćanje vještine penjanja. Ako razumijemo poveznice između učinkovitog penjanja i razvoja vještina penjanja, tjelesnih karakteristika i fizičke aktivnosti, možemo ponuditi programe gibanja koji će potaknuti skladan razvoj vještina penjanja u ranom djetinjstvu. U ovome istraživanju nismo uzeli u obzir prirodan razvoj raznih oblika penjanja u djetinjstvu, pa bi stoga bilo uputno uključiti i druge oblike penjanja u daljnja istraživanja, kako bi se osigurala cjelovitost u istraživanju razvoja obrazaca penjanja. Zbog težine mjerenja i nedostataka metode koja je bila primijenjena u ovome istraživanju potrebno je provesti još istraživanja kako bi se procijenio razvoj vještina penjanja i kako bi se poboljšala

metodologija istraživanja. Rezultati ovoga istraživanja mogu se koristiti kao osnova za daljnja istraživanja u području procjene razvoja penjanja. Autori također preporučuju da se procjena vještina penjanja uvrsti u baterije testova osnovnih vještina kretanja.

Zahvala

Autori zahvaljuju djeci i njihovim roditeljima na suradnji u ovome istraživanju. Također zahvaljujemo svim istraživačima koji su nam pomogli u istraživanju postavljene hipoteze.