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THE EFFECTS OF SHORT-TERM PROPRIOCEPTIVE TRAINING ON THE PERFORMANCE OF ICE-SKATING ELEMENTS IN CHILDREN AGES 6-8

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Original research:

Abstract
Proprioception is defined as the ability to understand the position of the body in space and it is independent of consciousness. Proprioceptive abilities are developed through training by having the sensory neurons establish quality and unconscious reactions in unpredicted situations. (Tuthill & Azim, 2018). The participant sample is made up of female children who are beginners at skating sports. The research was conducted on a sample of 60 participants (n=60) between 6 and 8 years of age (mean±SD: 7.48±0.33), and the following average body mass (mean±SD: 27.76±2.11 kg). The goal of the research was to determine the effects of additional proprioceptive training on the performance of basic skating elements and their successfulness in children between 6 and 8 years of age. Variables for estimating the success of motion structures in skating were represented in this research by grades for the level of success in performing skating elements given by three independent judges. The estimate of success involved the grade for Skating forward (SFWD), the grade for Skating forward in a figure-eight pattern (SFFE), the grade for Skating forward in a slalom (SFWS), grade for Skating forward on one leg (SFOL), and the grade for Skating forward in a crossover (SFWC).

Keywords: movement, structure, program, beginners, winter sports

Introduction

We define ice skating as "the skill of movement across frozen surfaces with the help of a device we call the skate, which is appropriately fixed to the foot or to the walking surface of shoes ", which dates all the way back to the prehistoric era (Strabić, 2013). The basic ice-skating techniques are identical for all the disciplines on ice, which includes speed skating, ice hockey, and figure skating. By its structure, skating is an acyclical, poly-structural sport with constant changes in the direction of movement, jumps, pirouettes, spins, steps, and difficult biomechanical requirements on the human body. The technique of skating includes elements of starting from a standstill, sliding off, and changing direction, and they are determined by a time dynamic and involve the time of impact on the surface, the time of skating, as well as the speed and direction of the push (Allinger et al., 1997).
The activities of ice skating in young children have great health effects on their aerobic capabilities, social integration, and recreation (Keller, et al., 2014), but they are also extremely difficult when it comes to maintaining balance, dynamic control, and the development of stability (Hoffman, et al., 1993; Keller et al., 2014). The control of dynamic balance is the most important parameter for the successful performance of skating elements without falling. The uniqueness of children between 5 and 12 is that their neuromuscular system isn't developed enough, especially through the deficit of maturation of postural dynamic control during movement (Keller, et al., 2014). The reason for the above, along with a reduced proactive balance capacity, is also the lack of capacity and the ability to compensate for the reduced stability through the usage of reactive balance (Largo, et al., 2001). Maintaining stability and balance of the body in young children are based mostly on processing visual signals, while adults prioritize the usage of the proprioceptive systems (Riach & Hayes, 1987).
Proprioception is defined as the ability to understand the position of the body in space and it is independent of consciousness. Proprioceptive abilities are developed through training by having the sensory neurons establish quality and unconscious reactions in

unpredicted situations (Tuthill & Azim, 2018). Until now, it is unknown whether an ice-skating learning program is superior for balance development in children compared to the combination of such a program with proprioceptive training. Because of the specific speed of adoption, the basic skating elements are taught with children between 6 and 8 (Savelsbergh et al., 2010), and the process, its speed, and learning dynamic are influenced not only by the anthropological characteristics of the skaters, but also the quality of their base motor ability - balance. The process of developing motor skills is the specific goal within the overall teaching and training process (Horga, 1993). The appropriate choice of exercise and teaching methods has an important role, just like the understanding of age characteristics of children in the middle childhood period, i.e. from the time of exiting kindergarten and the first year of school, all the way to adolescence (ages 5-12). It's characteristic for all the abilities and traits to unfold in a harmonic manner, there are no major leaps in development as a whole, nor are major leaps in individual traits or abilities (Findak, Metikoš and Mraković, 1992). By analyzing the existing research on the topic of the effects of the training process in young skaters in Bosnia & Herzegovina, we notice a deficit in the existence of scientific valorization of the above. Furthermore, there are no skater selection systems or any systematic development programs aimed at furthering the anthropological status of the skater. All of the above suggests that the process of learning the basic skating techniques can have a different dynamic depending on the quality of the choice of methods and the type of work, and the training process itself influences the changes in the anthropological space of children.

The goal of this research was to determine the effects of the proprioceptive training program as an additional form of exercise on the efficiency of performing skating techniques in young beginner-level skaters between 6 and 8 years. The 8-day proprioceptive training program, which was conducted as part of the basic training, was based on the realization of the contents of balance and proprioception exercises both on and off the ice. The research interest is to use an experimental method to determine, in an exact manner whether, and in which part, the conducted additional program has any effects on basic technique training in non-skaters, and which methods should be used for the greatest transformative effect and improvement of the speed of adoption and successful performance of basic skating techniques in girls who are beginner skaters.

Methods

Participants

The participant sample was made up of female children who are beginners at skating sports. The research was conducted on a sample of 60 participants (n=60) between 6 and 8 years of age (mean±SD: 7.48±0.33), and the following average body mass (mean±SD: 27.76±2.11 kg). This research was conducted in accordance with the rules outlined in the Helsinki declaration and with the approval of every individual parent. The parents have provided written confirmation of voluntary participation in the realization of this research, and they could drop out of the research at any time.

Experimental training program

The conducted additional proprioceptive training program lasted for 8 days, and a total of 6 training sessions were conducted. Tasks of the program were conducted in the introductory part after warmups. The additional training time lasted 20-30 minutes. In order to make the realization of the additional training program easier, the participants were divided into 6 smaller groups of 10 participants who have conducted the additional training model based on proprioceptive contents (table 1). The proprioceptive model of additional training had a load progression from simple to more complex exercises. The conducted program consisted of the following: i) exercising balance positions before going out on the ice; ii) exercising on skates off the ice with the goal of creating unstable positions; iii) the exercise intensity was increased through exercise duration and the progression of the difficulty of performance iv) conducting proprioception exercises on one or two legs with a full range of motion with either open or closed eyes.

Testing and measuring skating variables

Variables for estimating the success of motion structures in skating were represented in this research by grades for the level of success in performing skating elements given by three independent judges. The estimate of success involved the grade for Skating forward (SFWD), the grade for Skating forward in a figure-eight pattern (SFFE), the grade for Skating forward in a slalom (SFWS), grade for Skating forward on one leg (SFOL), and the grade for Skating forward in a crossover (SFWC). The grading procedure called for the three judges to independently grade the efficiency of skating elements in both the initial and the

Table 1. Contents, exercises, intensity, and characteristics of the conducted proprioceptive training

a) Exercises off the ice	Repetitions	Sets	Time duration
jumping from one foot to another and maintaining balance for 3 seconds	3-5	2-4	10-20 sec
running backward with jumping on one foot and holding for 3 seconds	3-5	2-4	10-20 sec
jumping off of both feet, rotating 360 degrees and landing on one foot	6-10	2-4	15-30 sec
standing on one leg, bending forward to touch the flood, and standing back up straight: (a) lifting an object off of the floor, (b) with eyes closed	2X8-12	2-4	40-180 sec
b) Exercises on the ice	Repetitions	Sets	Time duration
balancing forward - backward	6-10	2-5	8-35 sec
balancing left - right	6-10	2-5	8-35 sec
balancing in ballet positions	6-10	2-5	8-35 sec
balancing with partially and fully bent legs	10-12	2-4	30-65 sec
performing squats	8-10	3	
jumps off of both feet	6-10	2-4	
performing with manipulating various props	8-12	3	15-45 sec
performing with manipulating various props	8-12	3	15-45 sec
performing with an additional balance disruption (partner)	8-12	3-5	35-85 sec
c) Exercises with a partner	Repetitions	Sets	Time duration
while facing the partner, holding hands and maintaining a balanced position	4-8	2-4	15-35 sec
performing with additional balance disruption (pushing with palms with a partner)		2-4	10-20 sec
standing on one leg, bend forward, touch the ice and stand up straight again (while holding onto the partner with one hand)	4-8	3	15-30 sec
pushing a partner who is standing on one skate forward		2-4	10-20 sec

Table 2. Judging criteria for grading the level of success in performing the skating elements

Grade 5 (five)	The element was performed optimally so that there were no mistakes in the starting position, the position of the body, the legs, the arms, the esthetic performance of the exercise, the technical performance, the amplitude of movement, the speed, the rhythm, and the final position.
Grade 4 (four)	The element was performed optimally with minor mistakes in certain technical requirements for the starting position, the position of the body, the legs, the arms, the esthetic performance of the exercise, the amplitude of movement, the speed, the rhythm, and the final position. Maximum allowed number of minor mistakes 1-3.
Grade 3 (three)	The element was performed well with a small number of mistakes in certain technical requirements for the starting position, the position of the body, the legs, the arms, the esthetic performance of the exercise, the coordination of the performance, the amplitude of movement, the speed, the rhythm, and the final position, but the overall structure of the movements was not damaged. Maximum allowed number of minor mistakes 2-4.
Grade 2 (two)	The performance of the elements was damaged. There are mistakes in nearly all the mentioned technical requirements. The structure of the movements was also damaged.
Grade 1 (One)	The element was poorly performed with a large number of mistakes. There are major shortcomings in all the mentioned technical requirements. The structure of the movements is significantly damaged.

final testing with grades ranging from 1 (worst) to 5 (best), according to the criteria from table 2. Initial testing and grading were done on day 1. The warmups consisted of light stretching and gymnastic toning exercises, both for a duration of 5 minutes. After the initial introduction with the skating equipment, the participants have started to perform the elements on the ice. Prior to testing, the technique was both explained verbally and demonstrated prior to each skating test. The final testing was performed after 8 days following the same schedule. The judges have recorded the results for every participant in a prepared grading table.

Statistical analysis

By using the SPSS (21.0 IBM Corp. NY) and Excel (Microsoft Corp.) software package, we have performed the preparation and statistical analysis of the research results. Central tendency (arithmetic mean - Mean) and data distribution (standard deviation - SD) parameters were calculated for all the results. The estimate of data distribution normality was performed by using the Kolmogorov-Smirnov test. The dependent sample T-test was used to measure the difference between the initial and the final measurements, and the size of the effect of the conducted program was estimated by using Eta squares (η^2). Values of η^2 <0.01 have suggested a small influence; <0.06 a moderate influence, and >0.14 a large influence. (Pallant, 2007) The objectivity of skating variables measurement and the grading criteria were determined by using the Cronbach alpha coefficient (α_{cr}). Values of $\alpha_{cr}>0.9$ suggest a significantly high level of objectivity and harmonization of criteria. The level of statistical conclusion making was set to the conventional level of $p<0.05$.

Results

According to the calculated Cronbach alpha coefficients which ranged from $\alpha_{cr}=0.991$ to $\alpha_{cr}=0.996$, we have determined that there is a high level of objectivity in grading in all three judges for all five variables of skating elements (table 3). Significant differences in results between the initial and the final testing have been determined for the following skating elements (table 4): the grade for Skating forward (SFWD) (MD±SD: -3.38±1.00; $t(59)=-25.9$, $p<0.001$; CI95% (-3.64;-3.12); $\eta^2=0.47$), the grade for Skating forward in a figure-eight pattern (SFFE) (MD±SD: -3.35±1.30; $t(59)=-20.1$, $p<0.001$; CI95% (-3.71;-3.04); $\eta^2=0.41$), the grade for Skating forward in a slalom (SFWS) (MD±SD: -2.45±1.28; $t(59)=-14.8$, $p<0.001$; CI95% (-2.78;-2.11); $\eta^2=0.33$), grade for Skating forward on one leg (SFOL) (MD±SD: -2.78±1.18; $t(59)=-18.2$, $p<0.001$; CI95% (-3.08;-2.47); $\eta^2=0.38$), and the grade for Skating forward in a crossover (SFWC) (MD±SD: -2.20±1.25; $t(59)=-13.5$, $p<0.001$; CI95% (-2.52;-1.87); $\eta^2=0.31$).

Table 3. The evaluation of the objectivity of the judges' grading of skating elements

	α_{cr}
SFWD	0.996
SFFE	0.994
SFWS	0.991
SFOL	0.992
SFWC	0.994

α_{cr} – Cronbach alpha coefficient

Table 4. The results of differences between the initial and the final testing for the variables of the efficiency of performing skating elements

	MD	SD	95%CI					
			-	+	t	df	p	η^2
SFWD	-3.38	1.00	-3.64	-3.12	-25.9	59	<0.001	0.47
SFFE	-3.38	1.30	-3.71	-3.04	-20.1	59	<0.001	0.41
SFWS	-2.45	1.28	-2.78	-2.11	-14.8	59	<0.001	0.33
SFOL	-2.78	1.18	-3.08	-2.47	-18.2	59	<0.001	0.38
SFWC	-2.20	1.25	-2.52	-1.87	-13.5	59	<0.001	0.31

MD – mean difference; SD – standard deviation;
95%CI – 95% confidence interval
η^2 – Eta square; df – degrees of freedom

Discussion

The goal of the research was to determine the effects of additional proprioceptive training on the performance of basic skating elements and their successfulness in children between 6 and 8 years of age. The conducted program lasted for 8 days with a total of 6 training sessions. The results of the T-test for dependent samples were used to determine that the program of additional proprioceptive training has significantly furthered the efficiency of performing stylized skating movement structure. The results show statistically significant differences between the initial and the final measurements in all the ice-skating variables. It's clear that the proprioceptive program has its transformative efficiency because all the girls have successfully completed the 8-day ice skating training program.

The average increase in the value of results was 3.38 for Skating forward, 3.35 for Skating forward in a figure-eight pattern, 2.45 for Skating forward in a slalom, 2.78 for Skating forward on one leg, and 2.20 for Skating forward in a crossover. Based on the Eta square values, which ranged from 0.31. to 0.47, we can determine that the conducted program of a proprioceptive character had a large positive influence on the quality of performance and the speed of learning skating elements.

The specificity of the program enables the participants to be less concentrated on the order of performing movements, and to lean more on proprioceptive information, which is the reason for motoric successfulness in children and adolescents, according to Riach & Hayes (1987). Proprioceptive abilities are more expressed in older children, and older children have better motoric skills. It was exactly the conducted program based on proprioceptive training that contributed to the development of perception abilities in children, which has resulted in faster learning and quality performance of skating elements. Through the application of a proprioceptive model, there is an increase in concentration, precision, and the coordination of movement. A proprioceptive teaching model improves sensory information about the performance gained on the basis of proprioceptive processes during the performance itself. This phase of motoric learning prefers practicing variable forms of a certain motoric task, and the application of different tasks, as well as the variation in the conditions of performance with either open or closed eyes, on a dry or icy surface, on one or two legs, with a partner or individually, or by using various props. After several classes, a trail is formed in memory that contains the necessary information for initiating and directing movement, as well as a perceptive trail which contains information on how a movement should look like (visual information), and how the athlete should feel it (proprioceptive information) if the movement is performed correctly. When the movement is performed, several comparative processes are activated, and they analyze the difference between the current motion and the perceptive trail of the desired movement, and in the case of conflict between the information, the information from the central structures go back to the muscles and the movement is corrected. It's important for the coaches to know that feedback on the results of performance in children strengthens the perceptive trail, which has informational value for the athlete and enhances the learning process (Glencross, 1993).

Conclusion

Nowadays, there is an expansion of specialized motoric knowledge, especially those motoric programs which are in the function of various sports activities (Miletić et al., 2003). The basic goal of the research was to determine the efficiency of a proprioceptive training program on the successfulness of learning and perfecting of stylized skating structures in lower school-age children. A child's development, because of its uniqueness, requires an adequate upbringing and educational approach which is different in many regards to the approach to working with adults. That primarily means designing adequate programs in applied kinesiology and their thorough planning, programming, control, and valuation, all in a scientifically acceptable manner. The research results give a realistic insight into the process of basic motoric learning of skating and into the potential ways and means of improving the structure, contents, and organization of every class of ice-skating training. Successfulness in skating depends on the efficiency of motoric programs, i.e. the degree of their adoption and stability. A completely adopted motoric program for the realization of esthetic structures of movement (technique) usually enables the complete utilization of the biological potentials of young skaters. The information on the structure of movement first comes to the nervous system where it is processed and where, based on the set of data on the structure of movement and the structure of the situation, an appropriate program of action is created or activated. It results in the appropriate degree of efficiency or an effect that can be objectively registered. So, in the first part of motoric learning, regardless of the method through which the procedure is conducted, it's necessary to ensure the assumptions for the child to create an appropriate assumption of how the movement looks and how it should look, in accordance with their abilities to reproduce the movement task that is being learned. Proprioceptive training significantly improves the speed of learning and the efficiency of performing ice skating elements in young children.

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