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**Impact of Explosive Strength of Lower Limbs on Skating and Running Speed on a 10 M Distance in 14-15 Years Old Ice Hockey Players**

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**Abstract**

The aim of our study was to determine the effect of a specific program of plyometric exercises on the speed of skating and running speed in 14-15 year old youth in ice hockey at a distance of 10 m. The experiment consisted of 39 ice hockey players aged 14-15 years, we included 33 players in the final results (M; 14.7y ± 0.7; 166.5cm ± 7.3; 53.4kg ± 6.9), we eliminated 6 players due to various injuries and absences on all tests performed. The experimental group consisted of (n = 18) players of the cadet team HC 05 Banská Bystrica playing the highest cadet competition in Slovakia. The control group consisted of (n = 15) players of the cadet team MHC Martin, who also played the highest Slovak competition. The experimental set included the experimental factor of a plyometric exercise, performed twice a week on Tuesdays and Thursdays, always before the training unit on ice for 8 weeks. We used the statistical program R for the processing of statistical data, where we determined the statistical significance using the two-factor method of analysis of variance two-way ANOVA $p < 0,05$. The results of tests of the skating speed sprint at a distance of 10 m (on ice) show that neither in the third test was a statistically significant difference $p \leq 0.05$ in either the experimental or the control group. However, after applying the training protocol of plyometric exercises in the experimental set during the first 8-week mesocycle where the experimental set of plyometric exercises was included in the experimental set, there was an improvement of 0.05 s between input and output testing. from the original 2.12 s. to 2.07 s. In the control file, there was a deterioration of 0.02 s between the input and output measurements. from the original 2.11 s. to 2.13 s.

**Keywords:** ice hockey, plyometric exercises, speed abilities.

## 1. Introduction

Ice hockey is one of the fastest team sports in the world. Speed and strength skills play a very important role, but we must not forget dexterity and flexibility, which help players prevent various injuries (Terry, Goodman, 2020). A characteristic feature of the current development of world hockey is the process of its further intensification, increased pace of play, which leads to more performed individual game activities and game combinations (Tóth, 2010). In this context, speed training is becoming even more important, which is one of the important factors in increasing the technical skills of a hockey player. The volume of intense activity performed by the player increases. The player's actions take place under increasing temporal and spatial pressure, which is one of the characteristic features of modern hockey.

In today's hockey, it is necessary to be able to quickly start and overcome various long distances, quickly change direction and speed of movement, perform technical and tactical tasks of

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the game, respond quickly to opponents and teammates, evaluate the situation in the game, adopt rational solutions and perform appropriate actions. Blanár (2019), Paľov (2016), Sobota (2015) worked on similar experiments with ice hockey players, where, among other things, they also tested the speed of skating and running speed in teenagers at a distance of 10 m. There are no more extensive researches in the given issue in science, taking into account the age of hockey players and various variants of test batteries.

## 2. Methods

**Research model:** In our research, we chose a field two-group time-parallel experiment in which we worked with a control (n = 15) and experimental group (n = 18). Input, output, and post-experimental tests were performed in 8-week intervals.

**Study group:**

**Table 1.** Basic indicators of experimental (n = 18) and control group (n = 15)

| | Experimental group | | | | Control group | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | SD | Min. | Max. | Mean | SD | Min. | Max. |
| Calendar year (years) | 14.8 | 0.6 | 14.2 | 15.4 | 14.6 | 0.8 | 14.1 | 15.4 |
| Body height (cm) | 165 | 8 | 156 | 173 | 168 | 6.5 | 158 | 175 |
| Body weight (kg) | 52.6 | 7.2 | 45 | 65 | 54 | 6.6 | 48 | 69 |
| BMI | 19.5 | 2.1 | 17.4 | 21.6 | 19.1 | 3.5 | 15.6 | 22.6 |

**Instruments:** The tests consisted of two tests off ice and one test on ice. Before each test, the players warmed up.

**Test 1** – countermovement jump (off ice)

Test characteristics: explosive force of the lower limbs

Test implementation: After adjusting the body height and weight and then placing the Myotest to the belt on the left side, the proband started in a standing position, arms sideways, head straight and motionless position for a short beep (sound signal) proband bends his knees loosely and sets off to jump with his arms at his hips as high as possible, taking the previous position after. Each proband had two trials, the better of the two trials was recorded in the evaluation.

**Test 2** – 10m sprint (off ice)

Test characteristics: acceleration speed at 10 m

Test implementation: It starts from a standing start. At the sign of the trainer, the proband runs out and overcomes the photocells, which are located at a distance of 10 m. Each proband had two trials, the better of the two trials will be recorded in the evaluation.

**Test 3** – forward skating for 10 m (on ice)

Test characteristics: explosive force of the lower limbs

Test implementation: It starts from a standing start. At the sign of the trainer, the proband skates and overcomes the photocells, which are located at a distance of 10 m. Each proband had two trials, the better of the two trials will be recorded in the evaluation.

**Data analysis:** In processing and evaluating the obtained research facts, we applied qualitative methods of comparison, analysis, synthesis, induction and deduction. From quantitative methods, we used basic statistical characteristics such as arithmetic mean, standard deviation, median, maximum and minimum in descriptive statistics. For the processing of statistical data, we used the statistical program R, where we determined the statistical significance using the two-factor method analysis of variance two-way ANOVA $p < 0.05$ (Chráska, 2007).

## 3. Results
### Test 1: countermovement jump (off ice)

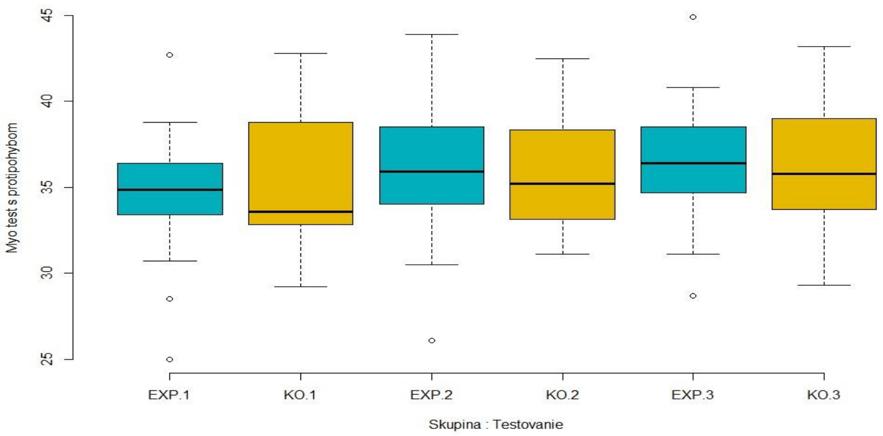


**Fig. 1.** Results of the countermovement jump test (off ice)
Note: EXP 1 – experimental set of input testing, EXP 2 – experimental set of output testing, EXP 3 – experimental set of post-experimental testing, KO 1 – control set of input testing, KO 2 – control set of output testing, KO 3 – control set of post-experimental testing

**Table 2.** Countermovement jump test results (off ice)

| Group | Testing | n | Mean (s) | SD (s) |
|---|---|---|---|---|
| EXP | Input | 18 | 34.50 | 4.00 |
| EXP | Output | 18 | 35.82 | 4.14 |
| EXP | Post-experimental | 18 | 36.26 | 3.76 |
| KO | Input | 15 | 35.34 | 3.84 |
| KO | Output | 15 | 35.84 | 3.50 |
| KO | Post-experimental | 15 | 36.49 | 3.77 |

Note: EXP – experimental group, KO – control group, n – number of probands

Our CMJ test results show that neither the experimental nor the control group showed a statistically significant difference $p \leq 0.05$ in 14-15 year old youth in ice hockey or in the first 8-week mesocycle with the experimental agent in the experimental group or in the second group. 8 week mesocycle without experimental factor. Between input and output testing in the experimental set, probands achieved an improvement of 1.32 cm. In the post-experimental period, the probands again achieved an improvement of 0.44 cm between the final and post-experimental testing. Probands in the control group achieved an improvement of 0.5 cm between input and output testing. In the post-experimental period between the final and post-experimental testing, they achieved an improvement of 0.65 cm. The results show that the probands in the experimental group during the first 8-week mesocycle with the experimental factor in the experimental group achieved more significant increases in the explosive power of the lower limbs than the probands in the control group.

**Test 2: 10m sprint (off ice)**

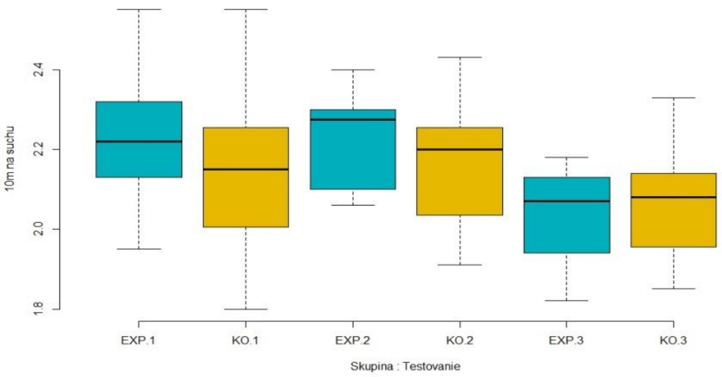


**Fig. 2.** Results of 10m sprint test (off ice)
Note: EXP 1 – experimental set of input testing, EXP 2 – experimental set of output testing, EXP 3 – experimental set of post-experimental testing, KO 1 – control set of input testing, KO 2 – control set of output testing, KO 3 – control set of post-experimental testing

**Table 3.** Results of 10m sprint test (off ice)

| Group | Testing | n | Mean (s) | SD (s) |
|---|---|---|---|---|
| EXP | Input | 18 | 2.22 | 0.14 |
| EXP | Output | 18 | 2.22 | 0.11 |
| EXP | Post-experimental | 18 | 2.03 | 0.11 |
| KO | Input | 15 | 2.14 | 0.19 |
| KO | Output | 15 | 2.15 | 0.15 |
| KO | Post-experimental | 15 | 2.06 | 0.14 |

Note: EXP – experimental group, KO – control group, n – number of probands

**Test 3.** 10m sprint (on ice)

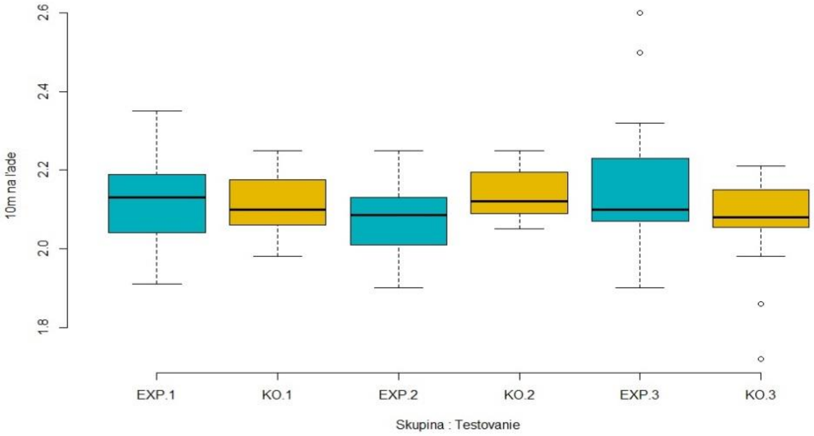


**Fig. 3.** Results of 10 m sprint test (on ice)
Note: EXP 1 – experimental set of input testing, EXP 2 – experimental set of output testing, EXP 3 – experimental set of post-experimental testing, KO 1 – control set of input testing, KO 2 – control set of output testing, KO 3 – control set of post-experimental testing

The results of the sprint test at 10 m (off ice) show that a statistically significant difference $p \leq 0.05$ was not demonstrated between the experimental and control groups in any of the three tests. In the experimental set there was no difference between input and output testing, probands achieved identical times of 2.22 s., Subsequently achieved a slight improvement only in post-experimental testing where they improved by 0.19 s. In the control file, there was even a slight deterioration between input and output testing from the original 2.14 s. to 2.15 s. Similar to the experimental group, as well as in the control group, there was an improvement only in the last post-experimental measurement, where the probands from the control group improved by 0.09 s. compared to the output measurement. Again, both in the first CMJ test and in the 10 m sprint test (off ice), thanks to the experimental factor of plyometric exercises, more significant increases in speed abilities were observed in probands in the experimental group.

**Table 4.** Results of 10m sprint test (on ice)

| Group | Testing | n | Mean (s) | SD (s) |
|---|---|---|---|---|
| EXP | Input | 18 | 2.12 | 0.11 |
| EXP | Output | 18 | 2.07 | 0.09 |
| EXP | Post-experimental | 18 | 2.15 | 0.17 |
| KO | Input | 15 | 2.11 | 0.08 |
| KO | Output | 15 | 2.13 | 0.06 |
| KO | Post-experimental | 15 | 2.06 | 0.12 |

Note: EXP – experimental group, KO – control group, n – number of probands

The results of tests of the skating speed sprint at a distance of 10 m (on ice) show that neither in the third test was a statistically significant difference $p \leq 0.05$ in either the experimental or the control group. However, after applying the training protocol of plyometric exercises in the experimental set during the first 8-week mesocycle where the experimental set of plyometric exercises was included in the experimental set, there was an improvement of 0.05 s between input and output testing. from the original 2.12 s. to 2.07 s. In the control file, there was a deterioration of 0.02 s between the input and output measurements. from the original 2.11 s. to 2.13 s. Post-experimental tests, on the other hand, show us an improvement in the control group and a deterioration in the experimental group.

## 4. Discussion

Brooks (1996), Caceka (2007), Horčička (2009), Pupišová (2013), Šimonek (2007), Vanderka (2006) and others have shown a positive effect of plyometric exercises on sports performance. Our CMJ test results (Table 2) agree with the results of Faigenbaum et. al. (2007) where he worked on research with 12-15 year olds, the experimental factor was also plyometric exercises for 8 weeks and a statistically significant difference $p \leq 0.05$ was not demonstrated, but his probands also improved.

Our results of the 10 m (off ice) sprint test (Table 3) coincide with the results of Kotzmanidis (2006), who worked on research with adolescent players. After applying a 10-week program of plyometric exercises, no statistically significant difference $p \leq 0.05$ was demonstrated in the 10 m sprint test. Our results show that even in the test of the running speed sprint at 10 m, a statistically significant difference $p \leq 0.05$ after the application of the 8-week training protocol of pylometric exercises in the experimental group was not demonstrated. Our results are partially consistent with those of Singh, et. al. (2018), who tested hockey players in two groups, did high to low plyometric exercises in one group and low to high in the other, while in the high to low group there was a statistically significant improvement in the 10m sprint test and in the low to high group the probands even worsened.

Our 10 m sprint test results (on ice) (Table 4) do not agree with Deahlin, et. al. (2017), who worked on a similar research with players of adolescent age (+2 years) who, after 8 weeks of training in plyometric exercises, showed a statistically significant difference $p \leq 0.05$ in the 10 m skating test.

## 5. Conclusion

The influence of plyometric exercises on the speed of skating has not been addressed by many authors so far. A few studies already exist, but more attention should be paid to this issue. Our results show that the 8-week training protocol of plyometric exercises in 14-15-year-old ice hockey players did not show a statistically significant difference p ≤ 0.05 in any of the tests. However, in each test between the input and output tests, the probands in the experimental group achieved a more significant improvement thanks to the training protocol with plyometric exercises.

**References**

Blanár, 2019 – *Blanár, M.* (2019). Faktory vplývajúce na rýchlosť korčuľovania v ľadovom hokeji [Factors influencing the speed of skating in ice hockey]. Vyd. Trenčín: HK Dukla Trenčín n. o. 80 p. [in Slovak]

Brooks at al., 1996 – *Brooks, G.A., Fahey, T.D., White, T.P.* (1996). Excercise Physiology: Human Bioenergetics and Its Applications. Vyd. Mountain View, California: Mayfield Publishing Co.

Cacek et al., 2007 – *Cacek, J., Lajkeb, P., Michálek, J.* (2007). Trénink síly [Strength training]. Atletika. Praha, č. 1., roč. 59. Pp. 17-20. [in Czech]

Faigenbaum, 2007 – *Faigenbaum, A.D.* (2007). Effect of a short-term plometric and resistance training program on fitness performance in boys age 12 to 15 years. *Journal of sport science and medicine*. 6(4): 519-525.

Deahlin et al., 2017 – *Deahlin, T.E., Haugen, C.O., Haugerud, S., Ronnestad, R.B.* (2017). Improvement of Ice hockey players on-ice sprint with combined plyometric and strength training. *International journal of sports physiology and performance* [online]. 12: 7, [cit. 2020.05.01]. [Electronic resource]. URL: https://journals.humankinetics.com/view/journals/ijspp/12/7/article-p893.xml?rskey=xiy78u&result=1

Horička, 2009 – *Horička, P.* (2009). Plyometrické cvičenia ako prostriedok rozvoja odrazovej výbušnosti [Plyometric exercises as a means of developing rebound explosiveness]. Športový edukátor. Nitra: KTVŠ PF UKF, Roč. 2, č. 2.

Chráska, 2007 – *Chráska, M.* (2007). Metody pedagogického výzkumu [Methods of pedagogical research]. Vyd. Praha: Grada Publishing, 116 p. [in Slovak]

Kotzmanidis, 2006 – *Kotzmanidis, Ch.* (2006). Effect of Plyometric Training on Running Performance and Vertical Jumping in Prepubertal Boys. *The journal of strength and conditioning research*. 20: 2. [cit. 2020.05.6]. [Electronic resource]. URL: https://www.researchgate.net/publication/7093911_Effect_of_Plyometric_Training_on_Running_Performance_and_Vertical_Jumping_in_Prepubertal_Boys

Pupišová, 2013 – *Pupišová, Z.* (2013). Rozvoj výbušnej sily dolných končatín a jej vplyv na efektívnosť štartového skoku v plávaní [Development of the explosive force of the lower limbs and its influence on the effectiveness of the starting jump in swimming]. Vyd. Krakov: Spolok Slovákov v Poľsku, 108 p. [in Slovak]

Singh et al., 2018 – *Singh, J., Appleby, B.B., Lavender, A.P.* (2018). Effect of Plyometric Training on Speed and Change of Direction Ability in Elite Field Hockey Players. *Sports*. 6: 6, [cit. 2020.05.06] [Electronic resource]. URL: https://www.researchgate.net/publication/328946 404_Effect_of_Plyometric_Training_on_Speed_and_Change_of_Direction_Ability_in_Elite_Field_Hockey_Players

Šimonek et al., 2007 – *Šimonek, J., Doležajová, L., Lednický, A.* (2007). Rozvoj výbušnej sily dolných končatín v športe [Development of the explosive power of the lower limbs in sport.]. Vyd. Bratislava: Slovenská vedecká spoločnosť pre telesnú výchovu a šport, 70 p. [in Slovak]

Terry, Goodman, 2020 – *Terry, M., Goodman, P.* (2020). Hockey anatomy. Vyd. Brno: Tisk centrum s.r.o. 227 p.

Tóth et al., 2010 – *Tóth, I. et. al.* (2010). Tréner ľadového hokeja [Ice hockey coach]. Vyd. Bratislava SZLH, FTVŠ UK, 393 p. [in Slovak]

Vanderka, 2006 – *Vanderka, M.* (2006). Teoretické východiská a možnosti využitia plyometrie v kondičnej príprave športovcov [Theoretical background and possibilities of using plyometry in fitness training of athletes]. Vedecký zborník atletika, 206 p. [in Slovak]