RELATIONSHIP BETWEEN ON-ICE SKATING PERFORMANCE AND OFF-ICE RUNNING PERFORMANCE TESTS OF YOUNG HOCKEY PLAYERS

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Abstract

The aim of the study was to determine whether there is a relationship between the off-ice running performance and on ice skating performance of juniors hockey players (n = 20, height = 182.3±4.9 cm, weight = 81.5±6.7 kg, age = 18.44±0.70 years; defenders = 8, height = 184.0±3.8 cm, weight = 84.2±6.5 kg, age = 18.60±0.59 years; attackers = 12, height = 181.2±5.4 cm, weight = 79.6±6.7 kg, age = 18.33±0.77 years) in a competitive year 2014/2015. The on-ice skating performance was measured by ice skating on distance of 40m, Illinois agility ice-skating test and ice skating beep test. The off-ice running performance was measured by running on distance of 40m, Illinois agility run test and running beep test. Statistical analysis was conducted by using the software IBM® SPSS® Statistics V19. In case of test running on distance of 40m, we recorded a large linear relationship (r = 0.86, p< 0.05). The coefficient of determination r^2 reached 0.74 which also shows that this test is a powerful predictor of performance on ice in ice skating on distance of 40 m. Comparing the results of running beep test and ice-skating beep test we have seen also a large linear relationship (r = 0.87, p< 0.05). The coefficient of determination r^2 = 0.76 shows that the test is also a powerful predictor of performance on ice in the case of a beep test. In the case of Illinois agility run test, we recorded negative medium linear relationship (r = -0.49, p<0.05). The coefficient of determination r^2 = 0.24 shows that the test is not a powerful predictor of performance on ice in the case of Illinois agility ice-skating test.

Key words: *running on distance of 40 m, Illinois test, beep test*

Introduction

According to Šimonek & Zrubák (2003) Ice hockey is characterized by high intensity of physical activity lasting about 50 seconds to 1 minute, with multiple repetitions. The individual players alternate regularly, most often three or four in the formation. Over one-third in three formations for each player, representing around 6-7 of intense activities, among which is rest about 250 seconds when playing at 4 formation and respecting the time when the game is interrupted. Based on research, it was found that during the match defender has skated about 5 km and forward 7 km. In each alternation player skates an average of 500 to 600 m (maximum 900, minimum 200 m). The average speed is about 15km.h^{-1} and maximum 38km.h^{-1}. Assuming a regular alternation of three complete formations on the single player it is from 15 to 20 minutes of the game Pavliš et al. (2002), Laczo (2011). Montgomery (1988) support these contentions in reporting that ice hockey is characterized by high intensity intermittent skating, rapid changes in velocity and duration, and frequent body contact. The typical player performs for 15 to 20 minutes of a 60-minute game. Each shift lasts from 30 to 80 seconds with 4 to 5 minutes of recovery between shifts. The intensity and duration of a particular shift determines the extent of the contribution from aerobic and anaerobic energy systems. We agree with Moravec et al. (2004), that final game performance in ice hockey is influenced by a lot of factors. Some are trainable, some inborn (Pupišová & Pupiš, 2015). The current level of sport performance is primarily influenced by factors of techniques, conditioning preparedness, tactics, psychology, somatic factors and internal conditions (Korčok & Pupiš, 2006; Seidl Pupiš & Suchý, 2015). Šimonek & Zrubák (2003), Výboh et al. (2005). Pavliš et al. (2003) indicate that the contents of conditioning training off the ice are mainly exercises specialized on development of motor skills. With regard to ice hockey obtains preference development of speed, high-speed-power, power, power-endurance and coordination abilities. The general character of this type of training only during the transitional and preparation period. Many authors have dealt with the relationship between performance on the ice and off the ice test results (Janot et al., 2015; Behm et al., 2005; Farlinger et al., 2007). They agree in the opinion that there is a relationship between them but not proven strength of this relationship. Bracko & George (2001) indicate that understanding the origin of this relationship is important for coaches when evaluating and selecting players based on their level of ability. Most of the research has focused on testing off- ice with a focus on anaerobic endurance. Janot, Beltz & Dalleck (2015) found that 40-yd dash (36.58m), VJ, 1.5 mile (2.4km) run, and % drop were significant predictors of skating performance for repeat skate (slowest, fastest, and average time) and 44.80 m speed time, respectively.

Behm et al. (2005) recorded used off- ice test 40-yd dash (36.9m), concentric squat jump, drop jump, 1 RM leg press and flexibility and balance ratio. They recorded significant correlations (p<0.005) between skating performance and the sprint a balance tests. Farlinger et al. (2007) found while many off-ice tests correlated with on ice skating, measures of horizontal leg power (off-ice sprint and 3 hop jumps) were the best predictors of on ice skating performance. The

reason for this research was to determine whether running off- tests can predict on ice skating performance in junior ice hockey players. We assumed that strong indicators of on ice skating performance would be tests: running on distance of 40m, a test of agility - Illinois and beep test. In the study we focused on the junior's age group (16-20 years), which in terms of physical maturity of the players is like the senior category. In terms of intensity and the deployment in the game junior category equalizing with senior, what increases the demands on the players' fitness. For these reasons, it is necessary to focus on the complexity, volume and intensity of training load in pre-season and competitive period. The study presents the results of research aimed at compare the level of selected speed capability of juniors hockey players in terms of players' positions of the team HC'05 Banská Bystrica in a competitive year 2014/2015.

Methods

Characteristics of the research file

The group consisted of hockey players of junior team HC'05 Banská Bystrica (n = 20) height = 182.3±4.9 cm, weight = 81.5±6.7 kg, age = 18.44±0.70 years; defenders = 8, height = 184.0±3.8 cm, weight = 84.2±6.5 kg, age = 18.60±0.59 years; attackers = 12 height = 181.2 ±5.4 cm, weight = 79.6±6.7 kg, age = 18.33±0.77 years) in a competitive year 2014/2015. Team played in the examined period in the top Slovak league in junior category organized by the Slovak Ice Hockey Federation. In terms of holding the stick it was in the team 17 left-handers and 3 right-handers. The file consisted of players who devoted ice hockey an average of 7.9±1.0 years. In the previous year 2013/2014 competitive team ranked in highest hockey league of juniors third place.

Organization of measurements

The diagnostics was conducted on February 2nd 2015 in competitive year 2014/2015 at the premises of the ice stadium in Banská Bystrica in the morning. Diagnostics of speed abilities was realized at the gym on elastic polyurethane surface, which was slip.

Realization of measurements

To verify the assumptions, we used standardized test - run to 40m with changes of direction on-ice and off-ice (Figure 1). Tested player started on mid-height start to the opposite plate on sound signal of the coach where a player had to both feet cross the line and also touch it. Changing direction is always conducted face to the coach.

The time was measured with an accuracy of0.01 s. We evaluated and wrote down the best time of two attempts.

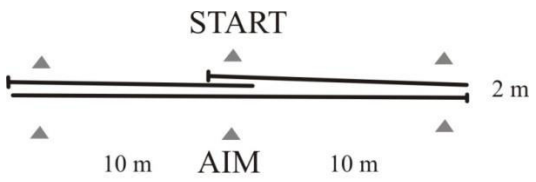

Figure 1 Schematic test run to 40 meters with change of direction (www.hockeyslovakia.sk)

The second test was an Illinois agility run test and Illinois agility ice-skating test. The player started from mid-height start, ran forward from the starting line then between stands by slalom and ran to the finish line. If the player threw any stand attempt was invalid. In the case of test on ice was performing in the same way but on skates. The time was measured with an accuracy of0.01 s. The third test was a running beep test and ice-skating beep test. This test involves continuous running between two lines 20m apart in time to recorded beeps. For this reason the test is also often called the 'beep' or 'bleep' test. The participants stand behind one of the lines facing the second line, and begin running when instructed by the recording. The speed at the start is quite slow. The subject continues running between the two lines, turning when signaled by the recorded beeps. In the case of test on ice was performing in the same way but on skates. The time was measured with an accuracy of 0.01 s.

Statistical analysis

We chose the following descriptive statistics characteristics – for measurements of central tendency we used the arithmetic mean (x) and for measures of variability the standard deviation (SD). We used a minimum (min) and maximum (max) value of examined indicators. For statistical significance of detecting linear relationship between the monitored parameters (running on distance of 40 m and Ice-skating on distance of 40 m; Illinois agility run test and Illinois agility ice-skating test; beep test off-ice and beep test on-ice) was used Pearson correlation coefficient (r) by determining the strength of association (relationship), respectively, effect size. Coefficient was interpolated: from 0.1 - small relationship, from 0.3 - medium relationship, from 0.5 - large relationship (Cohen, 1988, 1992). The probability of type I error (alpha) was set at 0.05 in all statistical analyses. Statistical analysis was performed through software IBM® SPSS® Statistics V19 (Statistical Package for the Social Sciences).

Results

In Table 1 we present the correlation between variables on ice and off-ice. We recorder significant ($p<0.05$) large linear relationship in two variables from three observed. In case of test running on distance of 40 m, we recorded a large linear relationship ($r = 0.86$, $p<0.05$). The coefficient of determination r^2 reached 0.74 which also shows that this test is a powerful predictor of performance on ice in ice skating on distance of40 m figure 2. Table 2 shows means, standard deviations, and ranges for these variables. In the case of test running on distance of 40 m defenders have achieved the best time 8.29±0.12 s, compared with the whole file about 0.19 s. Also for Illinois agility run test reached defenders best time 16.20±0.15 s, compared with the full set about 0.23 s. The defenders achieve the best performance also in the case of the beep test off-ice 712.50±34.54 m, compared to the whole file about 16 m. In the case of Illinois agility run test, we recorded negative medium linear relationship ($r = -0.49$, $p<0.05$). The coefficient of determination $r^2= 0.24$ shows that the test is not a powerful predictor of performance on ice in the case of Illinois agility ice-skating test figure 3. Comparing the results of running beep test and ice-skating beep test we have seen also a large linear relationship ($r = 0.87$, $p < 0.05$).

Table 1 Relationship matrix for on-ice and off-ice testing variables

	Running on distance of 40 m	Illinois agility run test	Running beep test
Ice skating on distance of 40 m	*0.86*	*x*	*x*
Illinois agility ice-skating test	*x*	*- 0.49*	*x*
Ice skating beep test	*x*	*x*	*0.87*

Table 2Mean off-ice and on-ice variable responses for forwards (n = 12), defenders (n = 8), and combined (n = 20)

Variables		Forwards		Defenders		Combined	
		Mean	SD	Mean	SD	Mean	SD
Off-ice variables	Running on distance of 40 m	*8.61*	*0.21*	*8.29*	*0.12*	*8.48*	*0.25*
	Illinois agility run test	*16.58*	*0.36*	*16.20*	*0.15*	*16.43*	*0.36*
	Running beep - test	*685.83*	*33.97*	*712.50*	*34.54*	*696.50*	*35.88*
On-ice variables	Ice skatingon distance of 40 m	*8.46*	*0.16*	*8.29*	*0.10*	*8.39*	*0.17*
	Illinois agility ice-skating test	*15.52*	*0.41*	*15.64*	*0.23*	*15.57*	*0.36*
	Ice skating beep - test	*709.17*	*43.00*	*723.75*	*26.00*	*715.00*	*32.00*

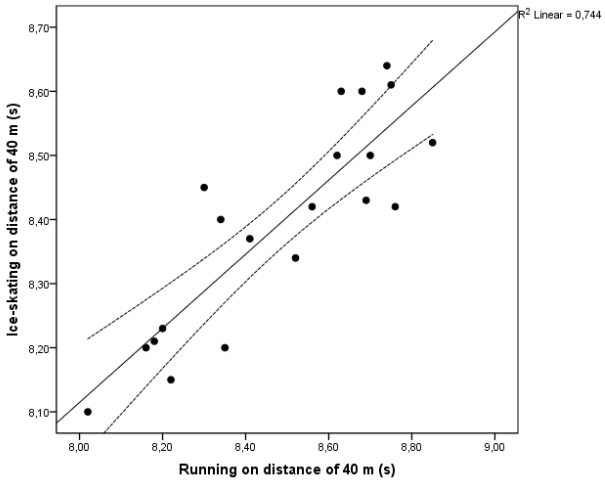

Figure 2 Large linear relationship(r =0.86, p <0.05) between running on distance of 40 m(s) and Ice-skating on distance of 40 m (s)

The coefficient of determination r^2 = 0.76 shows that the test is also a powerful predictor of performance on ice in the case of a beep test figure 4.

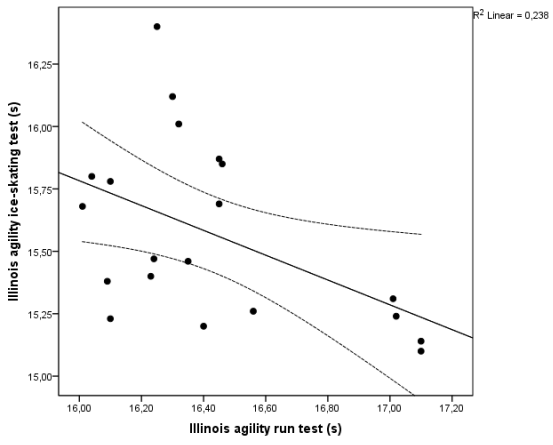

Figure 3 Negative medium linear relationship (r = -0.49, p < 0.05) between Illinois agility run test (s) and Illinois agility ice-skating test (s)

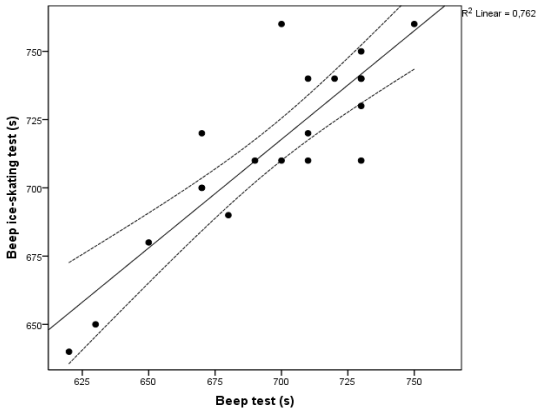

Figure 4 Large linear relationship (r = 0.87, p < 0.05) between beep test off-ice and beep test on-ice (s)

The average value of measurement for ice skatingon distance of 40 m of the research file was 8.39±0.17 the best recorded time was 8.10 s, the lowest time was 8.64 s. The average value of measurement for ice skatingon distance of 40 m among the defenders was 8.29±0.10 s and forwards 8.46±0.16 s. From the perspective of time of whole file, achieved better average time defenders about0.10 s, the forwards worse about0.07s compared to the whole file. The average value of the measurement in test Illinois agility ice-skating test of the whole file was 15.57±0.36 s, the best recorded time was 15.1 s, the lowest 16.4 s. The average value of the defenders was 15.64±0.23 s and forwards15.52±0.41 s. In terms of the average time of the whole file forwards achieved better average time 15.52±0.41s about0.05 s, the defenders worse time 15.64±0.36 s about0.23 s. The average value of the measurement in ice skating beep-test of the whole file was

715.00±32.00s, the best recorded time was 640 s, the worst760 s. The average value of the defenders was 723.75±26.00 s and forwards 709.17±43.00 s. In terms of the average time of the whole file forwards achieved better average time 709.17±43.00s about 5.83 s, the defenders worse time 723.75±26.00 s about 8.75 s.

Discussion and conclusion

Diagnostics of motor performance of hockey players is connecting theory and practice. For successful realization the evaluation of the diagnostic process is necessary to respect certain principles of measurement. We pay attention to selection of appropriate test battery standard external conditions the motivation of the players and the most important principle is how we will evaluate the results obtained. Outcome measures we realized in accordance with the methodology of the literature Tóth et al. (2010). We used standardized tests approved by the Slovak Ice Hockey Association and have been mandatory for all Slovak hockey clubs in this age category. Players have been noted about tests, we explained the testing, make the results valid. When evaluating the discipline run to 40m with changes of direction and Test agility – Illinois and beep test would be more appropriate to measure times by using the software photocells.

We used measurement with handheld stopwatches and results were rounded one tenth. I agree with Pivovarniček et al. (2014) and Suchý, Pupiš & Brunerová (2014), the diagnostic of motor abilities could be a decisive factor in the level of the individual, particularly limitation of movement abilities, for coaches and realization teams of sports teams. On the other hand, even an excellent level of motor abilities is not automatically reflected in the individual game performance and game performance teams. Insufficient level of motor abilities limits the gaming performance, particularly at the top level, where details decided matches.
In several studies was proven relationship between test results off-ice and dry on-ice. There are still deficiencies in area of determination of the strength of that relationship and determining the most appropriate off-ice tests, which can be used to anticipate the performance on ice. By research of relationship of speed measured on the ice and off-ice dealt Farlinger & Fowles (2008) and came to the following conclusions. Only 30 m sprint test ($r = 0.56$, $p = 0.01$) and Edgren side shuffle ($r = - 0.46$, $p < 0.04$) tests were off-ice, which significantly correlated with improvement in speed skating on ice. Krause et al. (2012) reported the results of a test run for 40 yards to anticipate performance in skating forward. With this issue dealt in his research also Behm et al. (2005).

He tried to determine the strength of relationship between speed skating and the measurement results of specific tests off-ice. One result of the study is that there is a significant correlation between the results of speed test off-ice and the speed performance on-ice, as in our study, where was confirmed the statistically significant correlation for tests running on distance of 40 m and beep test. Farlinger et al. (2007) found that the best predictors of performance on-ice are speed tests and a 3 hop jump. The issues of impact on the performance of ice and on ice dealt in the study Janot, Beltz & Dalleck (2015). They concluded that significant factors for the anticipation of skating performance in terms of speed tests are: Cross 40 yards and vertical jump. They pointed to the fact that training time is now limited which increases the importance of testing off-ice. Thanks to the results of tests off-ice, which are less financial and operational demanding, coaches can map players and choose suitable candidates for training on ice. However, there are also many skills that we cannot test off-ice such as skating technique, shooting and passing. It is essential to mention the limits of the research.

Researched skills on the ice and off the ice are only partial indicators of a complex speed, speed-strength and endurance performance of hockey player. For evaluation of the complex speed of hockey players will need to be evaluated also other components that contribute in the individual game performance of players. Equally some limitation is the one-time testing and the related limitation regarding to the reliability of the results.

The one-time testing may be affected by external conditions, but also by the current internal layout of tested player. However we based on time limited organizational options of the research file. Using off-ice testing has its importance because of monitoring players' performance and predicting their performance on-ice. Our research has confirmed that, tests run on distance of 40 m and beep test are significant predictors of performance on-ice. The test results will help coaches select appropriate players for the preparation on-ice.

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ODNOS IZMEĐU TESTOVA IZVEDBE KLIZANJA NA LEDU I IZVEDBE TRČANJA IZVAN LEDA MLADIH HOKEJAŠA

Sažetak
Cilj istraživanja bio je utvrditi postoji li veza između izvedbe trčanja izvan leda i klizačke izvedbe na ledu junior hokejaša (n = 20, visina = 182,3 ± 4,9 cm, masa = 81,5 ± 6,7 kg, starost = 18.44 ± 0,70 godina; branitelji = 8, visina = 184,0 ± 3,8 cm, težina = 84,2 ± 6,5 kg, starost = 18,60 ± 0,59 godina; napadači = 12, visina = 181,2 ± 5,4 cm, težina = 79,6 ± 6,7 kg, starost = 18.33 ± 0,77 godina) u natjecateljskoj godini 2014/2015. Nastup klizanja na ledu je bio mjeren klizanjem na ledu na udaljenosti od 40 m, Illinois testom okretnosti i Beep testom klizanja na ledu. Izvedba trčanja izvan leda je mjerena trčanjem na udaljenosti od 40m, Illinois testom okretnosti i Beep testom. Statistička analiza je provedena pomoću softvera IBM ® SPSS® Statistika V19. U slučaju testnog trčanja na udaljenosti od 40 m, zabilježili smo veliki linearni odnos (r = 0,86, P 0,05). Koeficijent determinacije r2 dosegao je 0,74 što pokazuje da je ovaj test snažan prediktor uspješnosti u klizanju na ledu na udaljenosti od 40 m. Uspoređujući rezultate Beep testa trčanja i Beep testa klizanja smo vidjeli da je također veliki linearni odnos (r = 0,87, P 0,05). Koeficijent determinacije r2 = 0,76 pokazuje da je test također snažan prediktor uspješnosti na ledu u slučaju Beep testa. U slučaju Illinois testa okretnosti zabilježili smo negativnu srednje linearnu vezu (r = -0,49, p<0.05). Koeficijent determinacije r2 = 0,24 pokazuje da test nije snažan prediktor uspješnosti na ledu u slučaj Illinois testa okretnosti na ledu.

Ključne riječi: trčanje na udaljenosti od 40 m, Illinois test, Beep test

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