INTERCONNECTION OF SPEED, SPEED-STRENGTH AND STRENGTH ABILITIES OF PROFESSIONAL HOCKEY PLAYERS ON-ICE AND OFF-ICE

Zankavets U.E., Popov V.P.
Belarusian State University of Physical Culture

Abstract. _Purpose:_ determination of correlation between speed, speed-strength and strength abilities of professional hockey players off- and on-ice.
Subjects: 65 professional ice hockey players from the Belarusian Extraleague (25 defencemen, 40 forwards), aged 16-33 years, were tested.
Results: A very strong correlation was found between off-ice speed in the test 30 meters sprint and on-ice speed in the test 27.5 meters sprint skating forward (R= 0.91). A strong correlation was found between speed-strength (the broad jump test) and speed abilities off-ice (R= - 0.84) and on-ice (R= - 0.77). A moderate correlation was revealed between maximal isometric strength (isometric mid-thigh pull test) and speed abilities of ice hockey players off-ice (R= - 0.54) and on-ice (R= - 0.64).
Conclusion: The revealed relationships between 11 indicators of speed, speed-strength and strength abilities supplement the ideas of transference of physical abilities from off-ice to on-ice.
Key words: ice hockey, testing, physical abilities, transference

Introduction

Ice hockey is a physically demanding sport characterized by short bouts of intense anaerobic work with lots of starts and stops, as well as change of direction [59]. This makes speed, strength and speed-strength some of the most important abilities for an ice hockey player [59]. Most of the hockey teams around the world include in their training plans both on-ice and off-ice practices.

For any strength & conditioning coach working with a hockey team, a logical question arises: will off-ice workouts help ice hockey players during a hockey game? Is there a so-called "transfer" of physical abilities from the gym or track to the ice? To find the answer on this question, a study on interconnection of speed, speed-strength and strength abilities of professional hockey players on-ice and off-ice was conducted.

Methods

To determine correlation between speed, speed-strength and strength abilities of professional hockey players an off and on ice testing was conducted. A standard warm-up was performed before each testing. All the subjects were familiar with all the testing procedures listed below.

Speed abilities testing

To assess off-ice speed a widely used test, 30 meters sprint from a standing start, was chosen [14, 17, 22]. Time was recorded using the Swift timing gates (Swift Performance, Goonellabah, Australia). The first gates were placed on the starting line, the second gates – on the 5 meters mark, the third gates – on the 20 meters mark and the fourth gates – on the finish line. It allowed to measure full distance (0–30 meters sprint) as well as starting (0–5 meters sprint) and distance speed (20–30 meters sprint).

Same approach was used during the on-ice testing. The total distance varied a little bit, because in the North American hockey 30-yd distance is used for speed testing [HockeyTech. – Mode of access: http://www.hockeytech.com. – Date of access: 12.06.2015], which equals 27.5 meters. Time was recorded using the Swift timing gates. The first gates were placed on the starting line, the second gates – on the 5 meters mark, the third gates – on the 17.5 meters mark and the fourth gates – on the finish line. It allowed to measure full distance (0–27.5 meters sprint) as well as starting (0–5 meters sprint) and distance speed (17.5–27.5 meters sprint). The subjects wore their full hockey equipment including the stick while performing the test. The first two attempts were made while skating forward, the next two sprints were made while skating backwards. The best result out of two was recorded.

Speed-strength testing

To assess off-ice speed a standard broad jump test was used [13, 22]. The subject positions both feet behind the line, quickly bents legs, swings arms back and forth and initiates the jump. The result was measured as the distance from the jump line to the nearest heel strike. Each subject made three attempts, the best one was recorded. If the subject skid while landing, the attempt was not count, an additional one was given.

Strength testing

Evaluation of strength abilities of the subjects was conducted using a dynamometer during the isometric mid-thigh pull test. A previous study with participation of elite soviet swimmers showed that results of this test can predict total strength potential of an athlete [3]. The subject stands up on the platform of the dynamometer with the feet shoulder width apart, bends the knees to 120 degree angle, with the straight arms grasps the bar, which is connected to the platform. The length of the bar is adjusted individually to the mid-thigh level of the subject. Keeping the spine and head in the neutral position and the arms straight, the subject pushes the feet into the platform, simultaneously pulling the bar as hard as possible for 2 seconds. Each subject made two attempts, the best was recorded.

Statistical analysis

The methods of statistical analyses were selected in accordance with the recommendations, designed for pedagogical sciences [49]. Analysis was performed using the SPSS Statistics v.23.0 software (IBM).

The relationship between variables was determined using the Pearson product-moment correlation coefficient. For interpretation of the correlation analysis results the Chaddock scale was used [10] (the table 1).

Table 1. The Chaddock scale for interpretation of correlation analysis results

Absolute Value of Correlation	Interpretation
0.00 – 0.30	negligible correlation
0.30 – 0.50	weak correlation
0.50 – 0.70	moderate correlation
0.70 – 0.90	strong correlation
0.90 – 1.00	very strong correlation

Subjects

65 professional ice hockey players, aged 16-33 years, took part in this study. All of them played in the Extraleague (the top division of Belarusian professional hockey). 25 athletes play on the defenceman position, 40 – on the forward position.

Results

The testing results are listed in the table 2.

Table 2. The testing results

Test	1	2	3	4	5	6	7	8	9	10	11
Mean value	1.16	1.17	4.13	1.43	1.41	5.01	1.19	1.26	4.53	233.92	241.5
Standard error	0.01	0.01	0.04	0.02	0.01	0.04	0.01	0.02	0.05	6.34	3.1

Notes: 1 – on-ice 0–5 meters sprint skating forward (sec); 2 – on-ice 17.5–27.5 meters sprint skating forward (sec); 3 – on-ice 0–27.5 meters sprint skating forward (sec); 4 – on-ice 0–5 meters sprint skating backwards (sec); 5 – on-ice 17.5–27.5 meters sprint skating backwards (sec); 6 – on-ice 0–27.5 meters sprint skating backwards (sec); 7 – off-ice 0–5 meters sprint (sec); 8 – off-ice 20–30 meters sprint (sec); 9 – off-ice 0–30 meters sprint (sec); 10 – isometric mid-thigh pull test using dynamometer (kg); 11 – broad jump (cm).

The correlation matrix is reflected in the table 3:

Table 3. Correlation of testing results

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	1										
2	0.72	1									
3	0.90	0.93	1								
4	0.69	0.62	0.71	1							
5	0.58	0.64	0.69	0.53	1						
6	0.69	0.72	0.78	0.83	0.88	1					
7	0.58	0.60	0.66	0.54	0.31	0.46	1				
8	0.67	0.81	0.86	0.6	0.61	0.71	0.61	1			
9	0.74	0.86	0.91	0.67	0.61	0.74	0.73	0.96	1		
10	-0.55	-0.65	-0.64	-0.52	-0.58	-0.63	-0.27	-0.56	-0.54	1	
11	-0.59	-0.73	-0.77	-0.59	-0.63	-0.72	-0.54	-0.86	-0.84	0.54	1

Notes: 1 – on-ice 0–5 meters sprint skating forward (sec); 2 – on-ice 17.5–27.5 meters sprint skating forward (sec); 3 – on-ice 0–27.5 meters sprint skating forward (sec); 4 – on-ice 0–5 meters sprint skating backwards (sec); 5 – on-ice 17.5–27.5 meters sprint skating backwards (sec); 6 – on-ice 0–27.5 meters sprint skating backwards (sec); 7 – off-ice 0–5 meters sprint (sec); 8 – off-ice 20–30 meters sprint (sec); 9 – off-ice 0–30 meters sprint (sec); 10 – isometric mid-thigh pull test using dynamometer (kg); 11 – broad jump (cm).

Isometric mid-thigh pull test results showed moderate correlation with all speed (R= -0.52 – -0.65) and speed-strength (R=0.54) indicators. Only off-ice starting speed is an exception. It can be explained by the fact that strength abilities were measured during isometric activity, this type of muscle contraction may have no relation to off-ice starting speed. However, attention should be paid to a significant influence of maximal isometric strength on speed abilities on- and off-ice.

Broad jump is of special interest because it is a widely used test for speed-strength assessment. Statistical analysis confirmed a presence of a statistically moderate connection between broad jump results and starting speed on-ice (R= -0.59) and off-ice (R= -0.54). Surprisingly, a stronger correlation was found with distance speed (R= -0.73 on-ice; R= -0.86 off-ice). Besides, strong relations found with on-ice 27.5 meters sprint skating forward (R= -0.77), skating backwards (R= -0.72) and off-ice 30 meters sprint (R= -0.84).

Very strong correlation was registered between 30 meters off-ice sprint and on-ice 27.5 meters sprint skating forward (R=0.91). Also, strong correlation found between 30 meters off-ice sprint and technically specific on-ice 27.5 meters sprint skating backwards (R=0.72). It permits to assume that speed abilities of ice hockey players can be efficiently developed off-ice.

Besides, strong correlation between on-ice 27.5 meters sprint skating forward and skating backwards (R=0.78) deserves attention. Obviously, the subjects who participated in this research, are professional ice hockey players with corresponding level of skating technique both forward and backward. Based on these results, it can be concluded, that ice hockey players, who skate fast forward, are able to skate fast backwards too. The opposite is also true.

Discussion

The obtained in this study results contradict with opinion of some hockey experts, who had noted an absence of correlation between speed of ice hockey players off- and on-ice [17, 47]. In a similar way, Runner et al. found only weak correlation between off-ice 40-yd sprint and on-ice 90-yd sprint skating forward (R=0.46), and on-ice 90-yd sprint skating backwards (R=0.37) in 40 elite male Division I ice hockey players [57]. Furthermore, Virgile compared broad jump performance of defencemen and forwards at the 2014 NHL training camp with subsequent games played in the following 4 NHL seasons, and found weak correlation (r=0.35) [58]. Williams and Graua reported no relationship between broad jump and different game performance variables (offensive/defensive point share, relative point share and point share per game) in 12 male ice hockey players (17.92±0.90 years) [60].

On the contrary, Behm with colleagues found moderate relationship between off-ice 40-yd sprint and maximum skating speed (R=0.51) of 30 male secondary school and junior hockey players (19.8±3.5 years) [50]. Bracko and George registered strong correlation between off-ice 40-yd sprint and on-ice 44.8 meters sprint (R=0.72) of 61 youth female ice hockey players (12.18±2.05 years) [51]. A study by Burr et al. identified broad jump as a significant predictor for overall hockey potential for forwards and defencemen [52]. Farlinger, Kruisselbrink and Fowles in a research included 36 male competitive hockey players (16.3±1.7 years) found strong relationship between on-ice 35 meters sprint and off-ice 30 meters sprint (R=0.78), and broad jump (R= -0.74) [53]. Haukali and Tjelta tested 15 male Norwegian elite junior ice hockey players (16.4±0.6 years) and registered strong correlation between off-ice 36 meters sprint and on-ice 36 meters sprint (R= 0.81) [54]. Janot with colleagues in a study included 19 male (21.3±1.1 years) and 11 female (19.4±0.8 years) NCAA Division III ice hockey players found moderate relationship between off-ice 40-yd sprint and on-ice Blatherwick's 15.2 meters full speed test (R=0.64), as well as strong relationship between off-ice 40-yd sprint and on-ice 44.8 meters sprint (R=0.78) [55]. Krause et al. reported moderate correlation between broad jump and on-ice 34.5 meters sprint (R=0.52), as well as strong correlation between off-ice 40-yd sprint and on-ice 34.5 meters sprint (R=0.81) in 38 high school male hockey players (16.4±1.1 years) [56]. Edman and Esping reported strong correlation between broad jump and on-ice 17.5 meters sprint (R= -0.73, p=0.006) of 11 Swedish male ice hockey players (17.8±0.8 years) [59].

Large sample of the tested subjects (65 professional ice hockey players from the top division of Belarusian hockey) and valid and reliable registration devices used in our research (which had been used in previous studies [3, 48]) permit to affirm that speed and speed-strength abilities can be transferred from off-ice to on-ice performance. The degree of transfer will depend on a phase of training and fitness level of an ice hockey player.

Conclusion

The revealed relationships between 11 indicators of speed, speed-strength and strength abilities supplement the ideas of transference of physical abilities from off-ice to on-ice. The programming of the off-ice training process should take into account the development of which physical abilities off-ice leads to the greatest transfer to on-ice performance. This knowledge helps to design efficient workouts for hockey players.

Conflict of interests

The authors declare that there is no conflict of interests.

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