Establishment of Puck Control Standards for Ice Hockey Players Ages 6–15

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ABSTRACT

Expert judgment in skill assessment via observational methods can introduce bias based on the evaluator. In the field of ice hockey, the development of standards rooted in scientifically derived tests remains a challenge. Hence, this study aims to define precise standards for ice hockey players aged from 6 to 15 years. Given the diverse skill set required in ice hockey, our work focuses on one of the basic skills – puck control. Employing Rasch and Mokken analyses, we designed an assessment tool in the form of a Guttman scale, ranking item difficulty, to evaluate puck control abilities of ice hockey players. This paper delineates the standards for puck control in ice hockey, specifically for players aged from 6 to 15 years in the Czech Republic, rated on a scale from 1 to 17. The standards have been tailored for cohorts of players aged between 6 and 7 years, between 8 and 9 years, between 10 and 11 years, between 12 and 13 years, and between 14 and 15 years. The standards are set to 0, 2, 4, 6, and 9 items, respectively.

Keywords: Rasch model; Guttman scale; Mokken analysis; Items

INTRODUCTION

Producing competitive players necessitates a tailored approach to training. Essential to this is the provision of relevant feedback for effective training strategies. Evaluating individual skills requires the development of tests grounded in scientific principles (Chmelíř & Perič, 2018). These tests serve as benchmarks, enabling the establishment of comparative standards. Such an approach augments training methodologies, emphasizing the need for consistent implementation (Kostka, 1963). Subsequently, it allows for assessing players against scientifically derived standards.

Ice hockey comprises a large number of skills, among which we concentrate on one essential aspect – puck control. Puck control is acknowledged as a foundational skill in ice hockey (*Hockey Canada*, c2022; Pavliš et al., 2003; Pavliš et al., 2009; *USA Hockey*, c2023), hence stickhandling technique receives much attention in training discussion worldwide (Bukač, 2014).

Our objective is to devise and employ an assessment tool to define puck control standards in ice hockey for players aged from 6 to 15 years in the Czech Republic.

Defining these standards and structuring cohorts necessitates consideration of methodological guidance from ice hockey federations. Additionally, factors involving ontogenesis need to be taken into account. Anatomical, physiological, pedagogical, and psychological developmental variances alongside individual disparities also demand attention.

The maturation of the central nervous system plays a major role in this context (Vágnerová, 2012). Perič (2008) also highlights variations among players concerning their aptitude for learning movements and the quality of the movement execution.

Furthermore, establishing standards requires acknowledgment of motor learning patterns, where the mastery of a given motor skill undergoes continual changes during the learning process. Skill levels of players evolve over time and are influenced by their learning pace (Ghorbani & Bund, 2017).

METHOD

In defining the standards, we employed a newly devised assessment tool to evaluate puck control of ice hockey players, structured as a Guttman scale (*Český hokej*, c2017-2023). The development of the tool adhered to specific protocols, starting with a thorough literature review, confirming the lack of a similar tool in both Czech and foreign literature. Subsequently, experts were selected based on predefined criteria to compile an item bank.

Drawing from the literature review and expert consultations, a comprehensive item bank counting 74 items was created. Next, the item bank was calibrated, with a meticulous selection of experts according to given rules to evaluate the calibration, and 357 players were chosen to validate the items. Each participant underwent testing across all 74 items.

Following testing, data were collected and evaluated, utilizing Rasch and Mokken analysis techniques. Items inconsistent with the Rasch model were removed from the item bank in seven sequential rounds (de Ayala, 2009). After the removal rounds, a selection round was conducted to identify items for inclusion in the assessment tool. Following the selection, the items were once again analyzed, resulting in the elimination of one more item from the tool. Throughout each round, content validity was assessed, and reliability was calculated using Cronbach's alpha. Mokken analysis further supported the reliability values (Stochl et al., 2012). Outlined below is the developed assessment tool, comprising 17 items arranged in a Guttman scale based on item difficulty for practical use (*Český hokej*, c2017-2023) and correct execution[1]. To execute the items correctly (pass the item), players are required to skate as swiftly as possible. The cones used for practice must not exceed 5 cm in height.

1 In naming and describing the items, we aimed for simplicity and clarity, avoiding excessive use of coaching jargon to ensure accessibility for the general public, while considering language differences in English-speaking countries.

Item 1 – Narrow stickhandling, forehand fake (two-handed), stationary. This item involves narrow stickhandling with a forehand fake (reach) while maintaining stickhandling (twice stickhandling, one wide). Players execute a relaxed, continuous movement without stopping, performed three times in a row. The emphasis is on the sliding skills of the lower hand, focusing on fluidity rather than quantity of movements.

Item 2 – Skating forward, tight turn around cone to the left and to the right (twice, with four cones). Players begin with the puck, executing a tight turn around the cone to the left, moving swiftly to the next cone, then executing a tight turn to the right. This sequence is repeated twice, with players skating forward as fast as possible while handling the puck. For positioning of the cones, see Figure 1 – Cone layout.

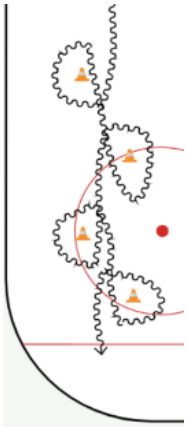

Figure 1. Cone layout

Item 3 – Forehand fake pass, backhand skating away. While stationary, players execute a fake pass on the forehand side, move the puck to the backhand side, and initiate skating away on the backhand side.

Item 4 – Narrow stickhandling, wide forehand (two-handed), skating forward. This item involves narrow stickhandling with a wide reach on the forehand side (only forehand) followed by back stickhandling (twice stickhandling, one wide). The emphasis is on relaxed, smooth, continuous movement without stopping, repeated three times consecutively; focusing on the sliding skills of the lower hand while skating forward.

Item 5 – Inside-edge forehand puck tuck between legs. While skating forward, players pass the puck from behind, through their legs, using an inside-edge kick of the skate to the stick.

Item 6 – Wide stickhandling, skating backward. While skating backward, players perform wide stickhandling (wider than shoulder width), maintaining smooth movement without stopping, repeated three times in a row as swiftly as possible.

Item 7 – Stickhandling behind the body, forward skating. Players execute stickhandling behind the body, extending to the side (forehand-backhand control), while moving straight forward, skating continuously.

Item 8 – Narrow stickhandling, lower-hand stick release to backhand, skating backward linear crossovers. While skating backward (linear crossovers), players perform narrow stickhandling, releasing the stick to one hand – the upper hand (twice stickhandling, one release). Emphasis is on

smooth, continuous movement, repeated three times in a row; focusing on the skill of releasing the lower hand, controlling the puck with one hand, and returning to both hands, all the while skating backward linear crossovers as swiftly as possible.

Item 9 – Leg slalom, forehand stickhandling slalom between cones alternate-side. Players navigate two rows of cones, one for legs and one for stickhandling, with five cones each, positioned approximately 2 m apart and 0.6 m wide. Players alternate skating slalom in the leg row and stickhandling slalom on the forehand side in the hand row, ensuring regular slaloming between legs and stickhandling while maintaining distinct rows for each. For cone layout, see Figure 2 – Alternate-side slalom.

Figure 2. Alternate-side slalom

Item 10 – Leg slalom, backhand stickhandling slalom between cones alternate-side. Players navigate two rows of cones, one for legs and one for stickhandling, with five cones each, positioned approximately 2 m apart and 0.6 m wide. Players maneuver in a slalom pattern in the leg row while executing stickhandling on the backhand side in the hand row. Players must not skate over to the hand row or perform stickhandling in the leg row. The task requires regular slaloming using feet and stickhandling using hands. For cone layout, see Figure 2 – Alternate-side slalom.

Item 11 – Stickhandling over lying stick (backhand to forehand, 1 out of 3 attempts). With a stick placed on the ice, players remain stationary and execute stickhandling (tossing the puck) over the lying stick from the backhand to forehand, maintaining control of the puck on the blade. Players must successfully complete this task at least once out of three attempts.

Item 12 – Leg slalom, forehand stickhandling slalom between cones same-side. Players navigate two rows of cones, one for legs and one for stickhandling, with five cones each, positioned approximately 2 m apart and 0.6 m wide. Players skate in a slalom pattern in the leg row while executing stickhandling on the forehand side in the hand row. Players must not skate over to the hand row or perform stickhandling in the leg row. This task demands consistent slaloming using feet and stickhandling using hands. For cone layout, see Figure 3 – Same-side slalom.

Figure 3. Same-side slalom

Item 13 – Leg slalom, backhand stickhandling slalom between cones, same-side. Players navigate two rows of cones, one for legs and one for stickhandling, with five cones each, positioned approximately 2 m apart and 0.6 m wide. Players skate in a slalom pattern in the leg row while executing stickhandling on the backhand side in the hand row. Players must not skate over to the hand row or perform stickhandling in the leg row. This task requires consistent slaloming using feet and stickhandling using hands. For cone layout, see Figure 3 – Same-side slalom.

Item 14 – Puck pickup with stick, catching by hand (1 out of 3 attempts). Players must pick up the puck from the ice solely with the stick and catch it. If the player fails to catch the puck due to glove interference (only hits the puck), it is considered a successful attempt. The player needs to achieve this successfully at least once out of three attempts.

Item 15 – Forward skating, fake move and pass, 360° turn, skating away on the other side, retaking the puck (three times). Players skate toward a cone, execute a fake move, pass the puck behind the cone, perform a 360° turn (simulating avoiding a defending player), skate to the other side of the cone, retrieve the puck, and continue to the next cone to repeat the sequence. This process is repeated three times. For cone layout and movement execution, see Figure 4 – Fake move 360°.

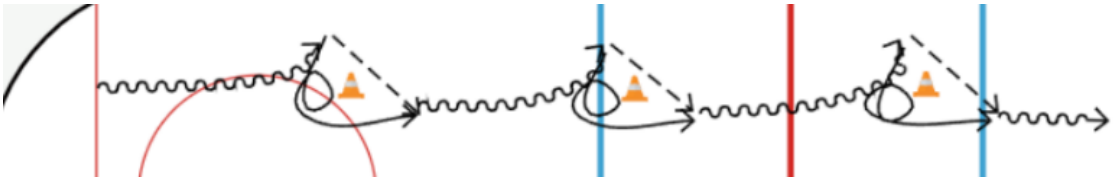

Figure 4. Fake move 360°

Item 16 – Varied leg and hand slalom on the forehand side. Players navigate two rows of cones, six for hands, five for legs, approximately 0.6 m wide. Players perform slalom skating in the leg row and stickhandling slalom on the forehand side in the hand row. Skating over to the hand row and stickhandling in the leg row are not allowed. This task necessitates consistent slaloming using legs and stickhandling using hands. For the irregular cone layout, see Figure 5 – Varied slalom.

Figure 5. Varied slalom

Item 17 – Varied leg and hand slalom on the backhand side. Players navigate two rows of cones, six for hands, five for legs, approximately 0.6 m wide. Players execute slalom skating in the leg row and stickhandling slalom on the backhand side in the hand row. Skating over to the hand row and stickhandling in the leg row are not allowed. This task necessitates consistent slaloming using legs and stickhandling using hands. For the irregular cone layout, see Figure 5 – Varied slalom.

In defining standards, it was essential to consider the recommendations provided by ice hockey associations and federations worldwide. These recommendations offer guidance regarding age groups and the commencement of skill acquisition, particularly in the field of puck control. These recommendations are globally remarkably similar, differing only in minor variations in terminology and the start of more intricate skill acquisition. Our standardization process in puck control for ice hockey players aged from 6 to 15 years took these global patterns into account.

Selecting appropriate hockey clubs for data collection was vital for our research. Only clubs encompassing all youth categories up to 16 years of age were included. Subsequently, players were chosen based on both calendar age and sport age criteria. Players had to meet both criteria, including an uninterrupted sport age in comparison to their peers, barring any major disruptions in regular training (except for common illnesses). Selected players adhered to training plans (length and number of training units per week, training content) according to the methodological materials recommended by the Czech Hockey Federation for the respective age cohort.

The age of selected players ranged from 6 to 15 years, following methodological recommendations. In keeping with these recommendations, organized training typically starts toward the end of preschool age or at the beginning of junior school age, aligning with skills acquired at the third stage of motor learning by the end of school age. Defining standards for cohorts within a two-year span appeared the most appropriate choice. Our goal was to include as many players as possible, evenly distributed across all age cohorts. Considering practical experience and application of the defined standards, age cohorts were established at two-year intervals, since players participate in official games as members of one team. Hence, standards were defined for players up to 7 years of age (U7), 9 years of age (U9), 11 years of age (U11), 13 years of age (U13), and 15 years of age (U15).

For statistical analysis, we employed MS Excel and basic descriptive statistics (mean, standard deviation, median).

RESULTS

Data were collected from 1,102 players aged from 6 to 15 years, evenly distributed across age categories with approximately 200 players per category.

Table 1. Standards

Completed items	Number of U7 players	Number of U9 players	Number of U11 players	Number of U13 players	Number of U15 players
0	92	47	22	8	1
1	33	54	36	21	5
2	40	73	31	20	8
3	7	31	25	18	13
4	1	25	34	20	4
5	7	6	11	11	3
6	0	8	35	31	12
7	0	4	14	10	9

8	0	1	20	29	26
9	0	3	23	29	38
10	0	0	2	5	13
11	0	1	8	14	31
12	0	0	2	2	11
13	0	0	1	3	1
14	0	0	2	0	5
15	0	0	0	0	1
16	0	0	0	0	1
17	0	0	0	0	0
Total players	180	253	266	221	182
Mean	0.96	2.15	4.56	5.73	8.2
Median	0	2	4	6	9
Standard deviation	1.25	1.9	3.24	3.3	3.25

These data constituted the basis for defining puck control standards among ice hockey players aged from 6 to 15 years in the Czech Republic.

DISCUSSION

Our study aimed to establish standards for puck control in ice hockey in the Czech Republic. The standards were set across age categories up to 7 years (U7), up to 9 years (U9), up to 11 years (U11), up to 13 years (U13) and up to 15 years (U15). Based on reviewed literature (Hockey Canada, c2022; USA Hockey, c2023) and practice requirements, the standards were not delineated for each individual year of age but rather for cohorts spanning two years, aligning with the common practice in youth competitions, where players might compete with those a year older (*Český hokej*, c2017-2023). The chosen two-year range of the cohorts adheres to global norms and methodological recommendations in ice hockey.

Furthermore, the practical differences in puck control mastery between players with a one-year age difference are relatively minimal, particularly in the early stages of systematic training. Their contribution to practice is deemed negligible. Hence, we believe that defining standards for cohorts with a two-year interval is appropriate for both our study and practical implementation. This approach can be recommended for further research with a similar focus.

We believe that a cohort size of approximately 200 players suffices for defining standards. Given that youth teams generally comprise 10 to 17 players (*Český hokej*, c2017-2023), our sample for standard definition encompasses more than ten teams with complete rosters. Teams typically commence with a player count closer to the minimum and expand thereafter. Therefore, we consider our sample to be adequate for establishing general standards.

Although our study aimed to define puck control standards, it is worth noting that publications on ice hockey standards often emphasize the health of players (Andrews et al., 2022; Ziadia et al.,

2023) or their physical abilities (Stastny et al., 2023; Vigh-Larsen et al., 2020) rather than specific skills. A similar trend is present in other sports as well. In the domain of motor learning, the focus is primarily on the methodology of setting standards (Lindsay et al., 2022; van Abswoude et al., 2021). This emphasis arises from the ease of data collection through standardized tests. In our view, it is therefore necessary to develop skill-based tests tailored to individual sports, particularly team sports, and utilize these scientifically based tests to establish standards suitable for evaluating athletes and providing relevant immediate feedback.

CONCLUSION

Based on data collected from 1,102 players aged from 6 to 15 years, we established puck control standards for each cohort. The cohorts comprised players aged from 6 to 7 years, from 8 to 9 years, from 10 to 11 years, from 12 to 13 years, and from 14 to 15 years, respectively. For each cohort, data were collected from approximately 200 players, ensuring comparable representation across all age groups.

The standards are set at 0, 2, 4, 6, and 9 completed items out of 17 in total for each cohort, arranged from the youngest to the oldest players.

The anticipated skill levels align with expectations for beginners as they start to play hockey and acquire foundational skills. A turning point occurs with the cohort ages from 10 to 11 years. According to conventional recommendations, the training of players up to the age of 11 years should emphasizes skating and the puck control. However, the progression remains steady, increasing by approximately two items per cohort, without a significant leap, persisting through the cohort of ages from 12 to 13 years.

Our findings suggest that the skill levels of players in both the cohort of ages from 12 to 13 years and particularly the cohort of ages from 14 to 15 years do not reach the anticipated levels. Despite the expectation that the oldest cohort would have mastered all puck control skills, our research indicates that their performance falls slightly below the mid-point of the scale, rather than approaching the highest skill level.

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All authors reviewed the results and approved the final version of the manuscript.

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