12 (2) (2025) 263 - 267

Journal of Physical Education, Health and Sport

https://journal.unnes.ac.id/journals/jpehs

Biomechanical Analysis of Drag Push Movements in Indoor Hockey

Muhamad Farhan Pratama[1]✉, Agus Rusdiana[2], Tian Kurniawan[3], Iwa Ikhwan Hidayat[4]

Sports science study program, Faculty of Sports and Health Education, Universitas Pendidikan Indonesia, Jalan Dr. Setiabudhi No. 229, Bandung 40154, Jawa Barat, Indonesia[1234]

History Article

Received November 2025
Approved November 2025
Published vol 12 no 2 2025

Keywords

Biomechanics; Drag Push Indoor Hockey; Kinematics

Abstract

The study was an attempt to analyse the biomechanical aspects of drag push movements in professional and amateur indoor hockey players. This study was a cross-sectional assay in which a sample of 10 (five professional and five amateur) athletes were included. Analysis were concentrating on several kinematic variables including ball speed, foot support width, distance between the ball and front foot, drag trajectory length, drag phase duration and average drag velocity. A high-speed camera, Kinovea motion analysis software and speed gun were used to collect data. Results from the analysis revealed that two primary variables were significantly different between groups, the drag time differed significantly: 0.30 seconds for the professional group and 0.42 seconds for the amateur group ($p = 0.046$). Strange enough, average drag speed was even elevated to 1.68 m/s in amateur athletes (vs a value of 1.30 m/s in professionals), though being not significant ($p = 0.839$) and also not translated into increased ball speed gained with each OF shot, and drag distance ($p = 0.005$). The ball speed swung by professional and amateur players was virtually higher in the former, but it did not reach a statistical significance. These results support the knowledge that drag push power depends on the capacity of efficiently linking the coordination to optimize drag trajectory. According to these findings, the current study recommends that training programs for amateur hockey players should pay more attention on enhancing dynamic skills for better drag push performance in indoor-hockey.

How to Cite

Pratama, M. F., Rusdiana, A., Kurniawan, T., & Hidayat, I. I. (2025). Biomechanical Analysis of Drag Push Movements in Indoor Hockey. Journal of Physical Education, Health and Sport, 12 (2), 263-267.

✉ Correspondence Author:
E-mail: muhamadfarhan8990@gmail.com

p-ISSN 2354-7901
e-ISSN 2354-8231

INTRODUCTION

Indoor hockey is a modification of field hockey that has been adapted to indoor playing conditions (Strzelczyk & Jan, 2009). This sport is played in an arena with a smaller field, measuring approximately 36–44 meters long and 18–22 meters wide, and equipped with walls on the right and left sides to keep the ball within the playing area. Each team has six players, including a goalkeeper, resulting in a faster pace of play, higher intensity, and more limited space for movement compared to field hockey (Hermann et al., 1991). Such conditions demand greater precision in technical skills, more controlled ball handling and faster reaction time from the player (Hasnor et al., 2018). Furthermore, playing in a smaller field then, teamwork, precise passing as well submission of basic techniques such as push and drag-push play very important role to decide the successfulness of game strategy (Honório et al., 2022). The ultimate goal of this game is to score goals when the ball enters the enemy's goal area (Kim, 2020).

In biomechanical analysis, the drag technique is explained by the coordination of kinematic movement in different body segments, where the biggest contribution comes from muscles of shoulder, hip, leg and wrist (Gómez et al., 2012). Biomechanical analysis of movement can be used to identify numerous performance-related factors, such as the working angle of joints, patterns of force distribution and linear and angular velocity produced during the execution of a movement (Hood et al., 2012). In application, the biomechanics are significant in accepting proper energy transfer from body to ball through the stick. The effectiveness of the muscle energy transferring will finally affect the shot quality in relation to drag push speed and accuracy (Prasetyo Utomo et al., 2019).

The drag push is one of the basic hockey techniques and has a great value when passing or shooting (also during penaly shot situations) over short (long) distances (Antonov et al., 2020). This methodology is often preferred because it is able to produce high ball speed and accuracy, which has led to be one of the most effective goal scoring methods (Mosquera et al., 2007). Several earlier biomechanical studies have revealed that a wide range of technical variables, including the stick-hand angle, drag -path length and foot support width are found as primary indicators contributing to the success of the drag push (Viswanath, 2019). More over it is known from previous studies that an extension of the drag path by a larger distance between the foot position and the ball can enhance performance of this movement (Kerr & Ness, 2006). According to Salman & Haryono (2023), when drag push the position of the maksimum ball speed Indonesian hockey was influenced by widht of foot position as well as gap between foot and ball on both long and short drag.

Although several previous studies have addressed biomechanical aspects such as drag-flick, push-in, single-group analysis, or simply described kinematics without comparison at the athlete level, to date, no study has specifically analyzed the differences in drag-push technique between professional and amateur athletes in the context of indoor hockey. In fact, indoor hockey is characterized by a narrower field, higher intensity, and also requires more precise ball control to create biomechanical movements that differ from field hockey. Therefore, the researchers aim to present a novel approach by making this study the first to compare drag-push kinematic variables across two levels of indoor hockey athletes. This contribution simultaneously fills a gap in previous research and also provides a deeper understanding of how an athlete›s experience level influences the effectiveness of drag-push mechanics

Therefore, a biomechanical analysis of drag-push movement in professional and amateur players is necessary to analyse technical differences that could lead to greater effectiveness in the execution of this movement, as well as for achieving higher speeds with the thrown ball. The findings from this study may not only contribute to scientific theories of sports biomechanics, but also offer practical implications for coaches to develop more adequate training contents, design effective smart coaching strategy, and elevate proficiency of the drag-push skill in indoor hockey.

METHOD

Material and methods this was a cross-sectional, quantitative research with comparative approach which utilized a sample-taking method (Setia, 2016). The design was selected to enable the collection of data at one point in time, which means that cross-sectional studies allowed researchers to observe and directly compare differences between professional and amateur indoor hockey athletes in terms of their biomechanical characteristics of drag push movement without requiring multiple repeated observations over months or years.

Participants used in this study were 10 individual participants consisted of five professional athletes who had competed for West Java Province team and all the way to national, as well as, else five amateur athlete that were actively involved in Student Activity Unit. The professional subject category was restricted to the players who had been playing with at least a national profile for about 2 years, and trained for a minimum of three times week. On the other hand, the amateur category encompassed recreational or club players who have never played in official playoffs and had trained no more than three days per week (Rafi et al., 2018).

The study instruments included a high-speed video camera (60 fps), and kinovea motion analysis software for recording and analyzing our biomechanical variables in drag push action, and speed gun to measure the ball speed. Kinovea was selected as this software can accurately measure body movement from video, and also provides quantitative analysis of joint angles, linear velocity, time to phase of movement and stick angle in relation to the field surface (Nor Adnan et al., 2018).

Figure 1 Players were asked to execute three times the Drag Push motion as if they were in a game. The efficiency of the Drag Push was assessed by both the temporal and spatial characteristics of the resultant ball movement. The trials with the best performance were then analyzed using Ki-novea software, considering the following variables: foot position width, drag distance (DD), foot-to-ball distance (FBD), time to perform the drag (Drag time), average of drag speed and ball speed.

Then, the drag push test results of the subjects that had been documented in accordance with the standards we tested were analyzed using Kinovea software. After obtaining values for each phase studied, the data results were compared using the independent sample t-test in IBM SPSS STATISTICS 25 software.

RESULTS AND DISCUSSION

This is the first study which intends to compare between professional and amateur indoor hockey with respect to biomechanical aspect of drag push skill from the few essential key kinematic variables. Data were analyzed for ball speed, foot position width, distance between the ball and the front foot, drag distance, drag time and average drag speed.

Table 1. Anthropometry

Item	Profesional		Amateur	
	Mean	SD	Mean	SD
Age (years)	19,80	1,304	19,60	1,517
Height (cm)	169,60	1,517	164,40	5,814
Weight (kg)	59,40	3,647	58	4,243
BMI (kg/(m2))	20,6	1,1327	21,5	1,703

Anthropometry indices show that professional and amateur athletes have similar physical structural models of the body, they can both be described as relatively uniform in body constitution categories. The mean ages of professional athletes is 19.80±1.30 years and for amateur athlete it is 19.60±1.51years (0.20 different). In that of stature, in the professional group was greater than that in amateur one as 169.60±1.51 centimeters were and 164.40±5.81 were, respectively. The weights of the two groups were similar (59.40± 3.64 kg in professional and 58±4.24 kg in amateur players respectively). BMI derived from these parameters also did not differ significantly; therefore, anthropometric factors were not a major discriminator for the two groups in general.

A comparative analysis of the kinematic components of the drag push technique shows varying performance differences between professional and amateur athletes. With regard to speed of the ball, professional sportsmens averaged a speed of 51.80 m/s while amateurs produced 33.60 m/s This difference is huge practically but

Figure 1. Drag push movement

it was proved that statistically! there could be no fantastic difference with a P value of 0.642 The scale foot position width also presented a similar behavior, with average of 45.08 cm in professional athletes and 47.72 cm for amateurs (p = 0.854), revealing that fundamental parameters of posture were essentially the same between the evaluated groups. Likewise, in relation to the distance of the ball and front foot, the professionals recorded 106.2 cm and the amateurs 96.7 cm (p=0.699). For the dynamic variables, however, a very different pattern was observed. Professional players displayed a better drag distance (166.25 cm in the pros vs 162.53 cm in amateurs) and on significance testing of 0,005) we got a real difference. The drag time also differed significantly: 0.30 seconds for the professional group and 0.42 seconds for the amateur group (p = 0.046). Strange enough, average drag speed was even elevated to 1.68 m/s in amateur athletes (vs a value of 1.30 m/s in professionals), though being not significant (p = 0.839) and also not translated into increased ball speed gained with each OF shot. Taken together, such evidence suggests that the key advantage of professional athletes is their capability to control dynamic variables (notably, drag path length and pull time efficiency). Both factors correspond directly to the effectiveness of drag push move, thus also reflecting why this higher quality end result was more constant and effective in professional than amateur players.

Table 2. Kinematic Variables of the Two Sample Groups

Variable Drag Push	Profesional		Amateur		t-score	sig
	Mean	SD	Mean	SD		
Ball Speed (m/s)	51,80	2,490	33,60	2,966	10,5	0,642
Foot Position Width (cm)	45,08	15,88	47,72	13,08	-0,286	0,854
Distance Between Ball and Front Foot (cm)	106,2	13,7	96,7	14,5	1,061	0,699
Drag Distance (cm)	166,25	15,32	162,53	39,92	0,194	0,005*
Drag Time (s)	0,30	0,02	0,42	0,33	-1,101	0,046*
Average Drag Speed (m/s)	1,30	0,19	1,68	0,22	-2,930	0,839

The strongest distinction between professional and amateur athletes in the current investigation was found with respect to drag distance and drag duration as measures of movement mechanics efficiency. Professional performers showed greater drag distances, suggesting that they could make better use of the acceleration phase of the ball release. This is in agreement with Kerr & Ness (2006), who state that greater drag path allows greater efficient momentum transfer, and also result in radically increasing the ball speed.

The lesser drag duration in professional group indicates their capability to minimize the resistance imposed between the stick and the ball while pulling. This is an example of more synchronous body-body coordination. OR/T later produces energy transfer in a slower and less efficient manner due to higher friction. These findings agree with the observation of Salman & Haryono (2023) that efficiency of pull phase is a critical factor to determine ball final speed.

Warm up of amateurs had a higher average drag speed, but did not directly translate into a higher the ball speed. This suggests that an increase in segmental speed is not sufficient for successful application of the drag push. Rather, drag push performance is affected by the production of movement coordination and trunk stability control as well as directed momentum application. (Gómez et al., 2012) that describes how too much movement or too little movement of a segment can produce optimal mechanical output in hitting actions dependant on the appropriateness of coordination patterns.

The fact that the feet position width and ball-front foot distance were not significantly different between two groups implies that overall, players have learned these fundamental postural aspects. The use of these postural features to enhance pulling performance is, however, more advanced in the elite athlete. This is presumably due to greater training intensity, better coaching quality, and more specific activities in complex game situations.

Overall, the differences between professional and amateur athletes in this study show that the quality of the drag push technique is not only determined by strength or speed of movement, but by biomechanical efficiency, which includes drag path length, movement alignment, and pull timing control. These variables determine how effectively the body's energy is transferred to the ball.

CONCLUSION

The present study presents clear biomechanical variations between professional and amateur players during the execution of drag push technique in indoor hockey. Thus, professional athletes generate longer drag trajectories and shorter pull time, two parameters that directly translate mechanical efficiency at the expense of improved shot quality. In the variable, other measures like feet positioning width, dis-

tance between ball and front foot or drag speed were not different between the conditions, hence it is dynamic measures that are focused on. This also demonstrates that the capacity to coordinate body movements and move energy effectively is a crucial factor that differentiates the performance of the two athlete groups.

REFERENCES

Antonov, A., Zoteva, D., & Roeva, O. (2020). Influence Of The "Push & Flick" Methodology On The Accuracy Of The Indoor Hockey Penalty Corner Shooting. Journal of Applied Sports Sciences, 4(1). https://doi.org/10.37393/jass.2020.01.5

Gómez, M., De Subijana, C. L., Antonio, R., & Navarro, E. (2012). Kinematic pattern of the drag-flick: A case study. Journal of Human Kinetics, 35(1). https://doi.org/10.2478/v10078-012-0076-7

Hasnor, K. N., Hizan, H., Shahril, M. I., Kosni, N. A., Abdullah, M. R., & Mat-Rasid, S. M. (2018). Notational analysis on tactical passing skills used by collegiate players in an indoor hockey MASUM tournament. Journal of Fundamental and Applied Sciences, 10(1S).

Hermann, V. B., Eggers-Ströder, G., & Steiner, D. (1991). Indoor hockey: injuries and prevention. Sportverletzung Sportschaden : Organ Der Gesellschaft Für Orthopädisch-Traumatologische Sportmedizin, 5(2). https://doi.org/10.1055/s-2007-993568

Honório, S., Batista, M., Santos, J., Serrano, J., Petrica, J., Almeida, J., & Camões, M. (2022). Small-sided games for technical and tactical development in young rink hockey players. Retos, 43. https://doi.org/10.47197/RETOS.V43I0.87819

Hood, S., McBain, T., Portas, M., & Spears, L. (2012). Measurement in sports biomechanics. Measurement and Control (United Kingdom), 45(6). https://doi.org/10.1177/002029401204500604

Kerr, R., & Ness, K. (2006). Kinematics of the field hockey penalty corner push-in. Sports Biomechanics, 5(1). https://doi.org/10.1080/14763141.2006.9628224

Kim, Y. Do. (2020). Hockey: A Global History. Journal of Sport History, 47(2). https://doi.org/10.5406/jsporthistory.47.2.0171

Mosquera, R. P., Molinuevo, J. S., & Román, I. R. (2007). Differences between international men's and women's teams in the strategic action of the penalty corner in field hockey. International Journal of Performance Analysis in Sport, 7(3). https://doi.org/10.1080/24748668.2007.11868411

Nor Adnan, N. M., Ab Patar, M. N. A., Lee, H., Yamamoto, S. I., Jong-Young, L., & Mahmud, J. (2018). Biomechanical analysis using Kinovea for sports application. IOP Conference Series: Materials Science and Engineering, 342(1). https://doi.org/10.1088/1757-899X/342/1/012097

Prasetyo Utomo, E., Widyah Kusnanik, N., & Y, F. (2019). Analysis of Biomechanics Slap Hit and Push in The Field Hockey. https://doi.org/10.2991/icssh-18.2019.4

Rafi, M., Nurhayati, T., & Sari, D. M. (2018). Heart Rate Profile of Professional and Amateur Football Athletes in Bandung. Journal of Medicine & Health, 2(2). https://doi.org/10.28932/jmh.v2i2.1019

Salman, S., & Haryono, T. (2023). Kinematic Analysis of the Drag Push Technique on Ball Speed in Indoor Hockey. Jurnal Pendidikan Jasmani Dan Olahraga, 8(2). https://doi.org/10.17509/jpjo.v8i2.56236

Setia, M. S. (2016). Methodology series module 3: Cross-sectional studies. Indian Journal of Dermatology, 61(3). https://doi.org/10.4103/0019-5154.182410

Strzelczyk, R., & Jan, K. (2009). Characteristics of Differences in Energy Expenditure and Heart Rate During Indoor and Outdoor Field Hockey Matches. Physical Culture and Tourism, 16(2).

Viswanath, S. (2019). Biomechanical and Performance of Field Hockey Players in Penalty Corner Push-In. Cikitusi Journal for Multidisciplinary Research.