Physiological Demands of Playing Field Hockey Game at Sub Elite Players

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Abstract. The purpose of this study was to identify the physiological demands and distance covered during national competitive 2016. Method used 9 female players including 2 backs, 3 halves, 4 forwards. Data was collected by measuring heart rate, blood lactate, distance covered and time spent walking/running. Data was analysed using mean, standard deviation, and range. Results found that the mean heart rate and blood lactate concentration during warm up were 96.4±12.7 bpm and 1.7±0.8 mmol•L⁻¹; at the end of the first half of the match was 171.2±6.3 bpm and 5.2±3.1 mmol•L⁻¹; prior to start at the second half was 130.8±3.8 bpm and 3.7±3.6 mmol•L⁻¹; and the end of the second half was 157.4±12.7 bpm and 5.8±0.2 mmol•L⁻¹. A mean of total distance covered during the complete field hockey game was 4372.5±263.9 m. Mean value of time spent walking and running were 41.42 minutes and 28.18 minutes, respectively. Conclusion of this study was female field hockey players have lower heart rate, blood lactate concentration, distance covered and time spent walking/running than other players in the literature reviews. Implication of this study can be used to evaluate the training program in order to improve performance enhancement of the players.

1. Introduction

The exercise intensity in hockey can be gauged from a motion analysis of match play. This analysis can be used to highlight the frequency and level of activity cycles during games and the recovery periods punctuating the bouts of physical activity. In the field hockey game, the duration of the game and the distance run by field hockey players demand a high aerobic contribution to the energy supply. Field hockey also involves short, more intense periods of running which required to run greater distances in the game might use equal proportions of aerobic and anaerobic energy. Contributions of the phosphate, lactic and aerobic energy systems to the field hockey game were 30%, 20%, and 50%, respectively [1]. With its demand for continuous activity, field hockey appears to be aerobically demanding, but also requires frequent, though brief, anaerobic efforts. The mean energy expenditure of 9 elite male field hockey players in South Africa during a match play was 74.2±63.0kJ·min⁻¹ (X±SD) [2]. The centre/midfield position demanded the greatest degree of energy expenditure (83.3kJ·min⁻¹) while left wing demanded the least (61.1kJ·min⁻¹).

Data on distance covered by male field hockey players during the second World Cup in 1973 [3]. On average players were active for 20:06 minutes (30% of match time) and in that time covered 5.6km. Defenders were reported to cover less distance (5.1km) and midfield players a greater distance (6.4km)
than the mean. These values were lower compared to a national soccer midfielder and a national male lateral defender during both training and official soccer games [4] and elite soccer players from the first Portuguese League (11190m). The mean distance covered by soccer players during a national level games was approximately 10000m [5], and this value was comparable to that reported for top level soccer players (10800m) [6].

Hockey players were reported to make more light than strenuous movements (69% compared with 31%) [7]. Centre-forwards were noted to make the highest number of strenuous movements (36%) while the activities of defenders and halves consisted mainly of light movements (70%). The “heavy” movements would call for great muscular effort in hitting the ball strongly, whereas light movements would encompass push passing for precision and dribbling. Of all the activity on the ball, 61% lasted between 0.5 and 2.0 seconds, and only 5% lasted more than 7 seconds.

The mean lactate accumulation of Indian male field hockey players at the end of match was 4.2mmol·L⁻¹ (junior players) and 5.6mmol·L⁻¹ (senior players) [8]. The value for Indian junior players was comparable to University and National League Female Water Polo players [9]. The value for senior players was comparable to Indian National Kabbadi players [10]. A mean value between 7-8mmol·L⁻¹ was reported for soccer players during a national level game [5], 1.4-8.1mmol·L⁻¹ for pre-pubescent soccer players, and 3.9mmol·L⁻¹ for elite outfield soccer players [11].

The average game heart rate of the players was 157bpm for Indian national male senior field hockey players [8]. This value was comparable to the mean heart rate of South African field hockey players at the end of the game (158.6bpm) [2]. These values were higher than the mean heart rate of University and National League Female Water Polo players (148bpm) [9], and the mean heart rate of Indian National male Kabbadi players [10] at the end of the games. A mean value of approximately 170bpm was reported for soccer semi-professional players, university players and recreational players [12].

Performance analyses of international men’s and women’s field hockey indicated that field hockey players made between 600 and 800 changes of velocity per game [13]. On average, a field player can be expected to sprint further than 30 metres on only 13 occasions during a game.

Although some research has been conducted into physiological responses to playing field hockey, there has been only limited investigation in Asia, especially in South East Asia, including Indonesian field hockey players. Therefore, the purpose of this study is to identify the physiological demands and distance covered during competitive at the provincial level in Indonesia.

2. Methods

2.1. Subjects
A group of 9 players from the 16 members of the university female field hockey squad who were participating at the national hockey tournament in Indonesia, including 9 female players including 2 backs, 3 halves, 4 forwards, volunteered to participate in this study, with playing experience ranging from 1-3 years.

2.2. Procedures
Heart rates (bpm) were measured by using PE 3000 heart rate monitors (Polar Electro, Finland) during play in a field hockey game. Before warming up, athletes were fitted with the heart rate monitor and the receiver was looped through the belt at the back of the players’ clothing (to protect it from contact with a ball, stick, or other players). Heart rates were averaged over each minute of play and recorded manually soon after finishing the game.

Blood lactate (mmol·L⁻¹) was measured with Accusport Blood Lactate Analysers (Boehringer Mannheim, Germany) operated according to the manufacturer’s instructions. The Accusport was operated from within an insulated container. The tester always wore gloves while collecting and handling blood samples, which were collected following a warm up and at the end of each half of a complete hockey game.
The fingertip sample site was cleaned with alcohol swab, wiped dry with tissue, and massaged to promote blood flow. A unistick sample gun (Owen Mumford, England) was used to collect a drop sized blood sample by placing it firmly against the athlete’s finger on the planned puncture point, and depressing the raised trigger. The tester applied the tip of a capillary tube (Analox Instruments Ltd) to the drop of blood, at an angle 45°, and allowed it to fill automatically. Blood was withdrawn from the capillary tube using a Microman pipette (Gilson, France), and expelled to cover the yellow sample pad on the accusport strip. The puncture point was covered with tape, and all sampling materials were stored in secure containers for disposal.

Distance covered (m) during play in a field hockey game was monitored by using a video camera. An athlete was monitored continuously during play for a complete game. The other athlete was monitored in a separate game. Distance covered was analysed by manually recording the players’ movement pattern onto a scale drawing of the hockey field. Distance was measured from the scale drawing by using a Silva Opsiometer.

Time spent walking/running (minutes) during play in a field hockey game was monitored by using a video camera. Three athletes (a forward, a half and a back) were monitored continuously during play for a complete game. Time spent walking/running was analysed by manually recording the players’ movement using a stopwatch (Nielsen-Kellerman). Times were recorded for the amount of time spent walking and for all time at more than walking pace (jogging, running, sprinting) during a complete field hockey game.

2.3. Statistical analysis
Statistical analysis of the data was conducted using the Microsoft Excel computer system. All data were reported as Mean±Standard Deviation (X±SD) and Range.

3. Results and discussion

3.1. Result
The mean value for age, height, mass and BMI of the East Java female field hockey players in the present study were 20.3±2.2 years with range of 19-21 years, 157.6±6.1 cm with range of 150.5-168cm, 53.4±3.4 kg with range of 48-66kg, and 21.6±1.3 kg·m² with a range of 19-23 kg·m², respectively.

The mean value for heart rate of the players in this study during a warm up was 96.4±12.7 bpm with a range of 75-127bpm. The mean value for heart rate at the end of the first half of play was 171.2±6.3 bpm with a range of 152-179bpm. The mean value for heart rate prior to starting the second half was 130.8±3.8 bpm with a range of 117-147bpm. The mean value for heart rate at the end of the second half of play was 157.4±12.7 bpm with a range of 135-177bpm. Heart rate responses to playing field hockey are shown in Figure 1.

![Figure 1. Mean heart rate responses of the athletes during playing field hockey](image-url)
The mean value for blood lactate concentration of the players in the recent study following a warm up was 1.7±0.8 mmol·L⁻¹ with a range of 1.3-2.2 mmol·L⁻¹. The mean value for blood lactate concentration at the end of the first half of play was 5.2±3.1 mmol·L⁻¹ with a range of 3.8-6.8 mmol·L⁻¹. The mean value for blood lactate prior to start at the second half was 3.7±3.6 mmol·L⁻¹ with a range of 2.9-6.5 mmol·L⁻¹. The mean value for blood lactate concentration at the end of the second half of play was 5.8±0.2 mmol·L⁻¹ with a range of 2.4-6.7 mmol·L⁻¹.

The mean value for total distance covered by the players during a complete game of the field hockey was 4372.5±263.9 m with a range of 3431.5 – 3669.3m. The mean value for distance covered by the players during the first half of a field hockey game was 2467.6±262.9m with a range of 2243.9 – 2927.6m. The mean value for distance covered by the players during the second half of a field hockey game was 1904.4±187.3m with a range of 1517.3 – 2113.5m.

The mean value for time spent walking by the players during the field hockey game in the present study was 41.42 minutes with a range of 38.26 – 42.16 minutes. The mean value for time spent at more than walking pace (jogging, running, and sprinting) by the players during a complete field hockey game was 28.18 minutes with a range of 25.42 – 30.12 minutes.

3.2. Discussion
The mean heart rate of the players at the end of the second half game in the present study was 10bpm lower than the mean heart rate at the end of the first half of the game. These values were also lower than that observed in Indian and South African male field hockey players [2, 8]. In comparison to other team sports, the mean heart rate of National League female water polo players [9] and Indian National Kabbadi [10] were approximately 20bpm lower than the mean heart rate of the players in the present study.

The mean blood lactate concentration of the players after completing the field hockey game in this study was lower than Indian national and junior male field hockey players [8]. The mean blood lactate concentration at the end of the second half the game was slightly higher compared to the mean blood lactate concentration at the end of the first half of the game. In comparison to other team sports, the mean blood lactate concentration of the players in this study was lower than national soccer player [5] and Indian national kabaddi players [10].

The mean total distance covered of the players in the present study was lower than male field hockey players [3]. The mean distance covered of the players during the second half of the game was approximately 230m less than during the first half of the game. This is confirmation that the players were less active during the second half of the game. In comparison to other team sports, the mean value for distance covered of the players in this study was lower than national male soccer players [5, 6]. This was most likely due to most of the comparison values being obtained on male players; and to the extreme environmental conditions which existed when the games were monitored in the present study were played.

4. Conclusion
The female field hockey players in the present study have lower values for heart rate, blood lactate concentration, and distance covered during the game compared to other field hockey players from literature reports. This is possibly because the field hockey players in this study are females (compared to male field hockey players from other studies).

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