RELATIONSHIP BETWEEN BIOCHEMICAL VARIABLES AND PERFORMANCE INDICATORS IN FIELD HOCKEY PLAYERS

Ms. Khushbu Sisodiya, Ph.D. Scholar
Dr. Brij Kishore Prasad, Associate Professor
Dept of Health Science, LNIPE, Gwalior (M.P.)

Abstract

The present research study explored the relationship between key biochemical markers and performance indicators in elite female hockey players. Twenty players, ages 18 to 25, from the Madhya Pradesh Hockey Academy, Gwalior, (M.P.) were evaluated throughout standardised performance tests, such as the RAST Test for anaerobic speed and the Yo-Yo Intermittent Recovery Testing for aerobic capacity. At baseline and after training, blood samples were taken to assess lipid profiles, white blood cell (WBC) measure, platelet count, haemoglobin (Hb), and C-reactive protein (CRP). The results of the Pearson correlation analysis showed that aerobic performance (Yo-Yo test distance) was significantly positively correlated with haemoglobin and high-density lipoprotein cholesterol (HDL-C), while the results of C-reactive protein (CRP), triglycerides, total cholesterol, and low-density lipoprotein cholesterol (LDL-C) were negatively correlated. Anaerobic sprint performance (RAST test timings) substantially improved with increased haemoglobin and HDL-C, but it deteriorated with increasing CRP and total cholesterol. White blood cell and platelet levels had no notable correlations with performance. The results highlight the significance of monitoring specific biochemical markers in an individual's health and performance management, indicating that better lipid profiles and diminished inflammation correlate with greater endurance and sprint performance in hockey players.

Keywords: Female Athletes, Aerobic, Anaerobic, Haemoglobin (Hb), C-Reactive Protein (CRP) and Lipid profile.

Introduction

In elite-level field hockey, the performance is largely affected by various physiological and biochemical factors. In addition to receiving the best possible physical training, sustained high-intensity effort throughout a game depends on the underlying metabolic mechanisms that support endurance, recuperation, and training adaptability. The correlations of important biochemical variables can therefore be considered to be able to provide an insight into the physiological state of the athlete in relation to the relevant performance indicators, helping them to maximise their training, lower their risk of injury, and ultimately achieve peak performance. (Jeukendrup & Gleeson, 2004)

Numerous biochemical markers, including haemoglobin, C-reactive protein (CRP), platelets, white blood cell counts, and lipid profiles, have been examined. CRP is a widely used biomarker for inflammation that provides insight into the body's reaction to exercise stress and what can be recovered from after training.(Malm & Yu, 2012) Field hockey requires both aerobic capacity and endurance, which are directly impacted by haemoglobin, the protein that carries oxygen. (Wehrlin et al., 2006) According to Brenner et al. (2017), variations in white blood cell (WBC) counts during intense exercise can therefore act as a precursor to immune system reaction and a possible predictor of overtraining or injury risk. Finally, platelet counts have an impact on tissue repair and blood coagulation, which may be relevant to muscle adaptation and recuperation (Ziegler et al., 2018). Finally, endurance athletes depend on lipid profiles, which show how the body uses energy to sustain high energy production and overall performance. (McArdle et al., 2015)

Through an assessment of the correlation between these biochemical factors and performance indicators, including aerobic capacity, endurance, and recovery, this study seeks to advance our understanding of the physiological modifications that field hockey players experience during training and competition. In order to determine how these changes in biomarkers relate to athletic results, the performance indicators will be assessed using standardized tests. These tests will take the form of the Yo-Yo Test, which measures aerobic capacity and endurance, and the RAST Test, which measures anaerobic capacity and speed.

Although the growing importance of biochemical markers in sports science is becoming more widely acknowledged, little is known about how they all work together to affect performance indicators in top hockey players. Prior research has either investigated isolated biochemical factors or concentrated on endurance or team sports broadly, sometimes neglecting the distinct physiological requirements and competitive environment of hockey. Limited studies have carefully examined the interactions among several biochemical indicators and their influence on both aerobic and anaerobic performance in this sport. This correlation-based study seeks to analyse the relationships between key biochemical markers and performance outcomes in elite female hockey players, providing insights to inform targeted interventions for athlete development and performance optimisation.

Methodology

The study involved 20 female field hockey players from the Madhya Pradesh Hockey Academy (MPHA) in Gwalior, (M.P.), India, aged between 18 and 25 years. Participants were required to have at least two years of competitive field hockey experience and be engaged in regular training for a minimum of three times per week. Exclusion criteria include any chronic illnesses, recent injuries, or use of supplements that may influence biochemical markers.

a. Yo-Yo Test for Aerobic Capacity and Endurance: The Yo-Yo Intermittent Recovery Test (Level 1) was employed to assess the aerobic capacity and endurance of the participants. This test involves a series of shuttle runs between two markers set 20 meters apart, with a specific audio cue dictating the pace. The test continues until the participant can no longer maintain the required pace. The total distance covered was recorded as the primary performance metric.
b. Rast Test for Anaerobic Capacity and Speed: The Rast Test was conducted to assess anaerobic performance and speed. This evaluation comprises six 35-meter sprints, with each sprint followed by a 10-second rest interval. The time taken for each sprint was recorded, and the average sprint time was calculated to determine the participant's anaerobic capacity.
c. Blood samples will be collected from each participant at three time points: baseline (prior to the start of training) and after the training sessions (post-exercise). The

samples was analysed for the following biochemical markers:

i. C-Reactive Protein (CRP): A marker of inflammation.
ii. Haemoglobin (HB): To assess oxygen-carrying capacity.
iii. White Blood Cell Count (WBC): To evaluate immune response.
iv. Platelet Count: To investigate recovery and injury healing.

d. Lipid Profile: Including total cholesterol, HDL, LDL, and triglycerides, to assess energy metabolism.
e. All blood samples were processed in a certified laboratory following standard protocols for serum separation and biochemical analysis. Appropriate ethical approvals were obtained, and informed consent was secured from all participants before their inclusion in the study. This comprehensive methodology allowed for the investigation of the relationship between biochemical variables and performance indicators in elite female field hockey players. Samples were analysed using standard laboratory techniques.

Data were analysed using statistical software. Descriptive statistics were calculated for all variables, and correlations between biochemical variables and performance indicators were assessed using the Correlation Coefficient. A significance level of $p < 0.05$ was set for all tests.

Findings and Results

TABLE 1
CORRELATIONS BETWEEN BIOCHEMICAL VARIABLES AND YO-YO TEST DISTANCE (N = 20)

Biochemical Variable	Pearson r	Sig. (2-tailed)
CRP (mg/L)	-0.52*	0.019
Haemoglobin (g/dL)	0.56*	0.011
WBC (x109/L)	-0.13	0.590
Platelet Count (109/L)	0.28	0.220
Total Cholesterol (mg/dL)	-0.47*	0.031
Triglycerides (mg/dL)	-0.45*	0.041
HDL-C (mg/dL)	0.49*	0.023
LDL-C (mg/dL)	-0.43*	0.044

*Correlation is significant at the 0.05 level (2-tailed).

Table 3 reveals that the Yo-Yo test distance, reflecting aerobic capacity and endurance, showed significant positive correlations with haemoglobin and HDL-C, suggesting that better aerobic performance is linked to elevated levels of these markers. Conversely, significant negative correlations were observed with CRP, total cholesterol, triglycerides, and LDL-C, suggesting that lower levels of inflammation and improved lipid profiles are linked to greater endurance and aerobic capacity. WBC and platelet count did not show significant associations, implying a limited direct impact on aerobic performance in this context.

TABLE 2
CORRELATIONS BETWEEN BIOCHEMICAL VARIABLES AND RAST TEST TIME (N =20)

Biochemical Variable	Pearson r	Sig. (2-tailed)
CRP (mg/L)	0.48*	0.028
Haemoglobin (g/dL)	-0.44*	0.042
WBC (x109/L)	0.10	0.670
Platelet Count (109/L)	-0.25	0.270
Total Cholesterol (mg/dL)	0.41*	0.049
Triglycerides (mg/dL)	0.38	0.072
HDL-C (mg/dL)	-0.42*	0.047
LDL-C (mg/dL)	0.39	0.065

*Correlation is significant at the 0.05 level (2-tailed).

Table 4 reveals that, for the RAST test, which measures anaerobic capacity and sprint performance, significant negative correlations were found with haemoglobin and HDL-C, suggesting that faster (more effectively) sprint times are linked with elevated levels of these markers. Significant positive correlations with CRP and total cholesterol suggest that higher inflammation and less favourable lipid profiles are linked to slower (worse) sprint performance. As with the Yo-Yo test, WBC and platelet count did not show significant relationships with RAST performance, suggesting their limited role in short-duration, high-intensity efforts.

Discussion

Key biochemical factors and performance markers in female top hockey players are clearly and meaningfully related, according to the study's findings. Systemic inflammation was reduced after the training intervention, as evidenced by a considerable drop in C-reactive protein, or CRP, levels. This supports other studies that have demonstrated the anti-inflammatory effects of regular exercise and organise training, which may help athletes recover more quickly and lower their risk of sickness or injury.(Kasapis & Thompson, 2005)
The observed rise in haemoglobin, or Hb, levels implies increased oxygen-carrying capacity, and this is directly linked to increases in aerobic performance, as indicated by a significant rise in Yo-Yo test distances following training. Hockey players need to have a consistent aerobic output throughout games; therefore, this adaptation is essential.
Better metabolic health and cardiovascular risk profiles are reflected in the lipid profile alterations, consisting of the increase in HDL-C and the reductions in LDL-C, triglycerides, and total cholesterol. These adaptations enhance effective energy consumption during high-intensity tasks and help in recovery, which is advantageous for performance as well and long-term health. Although the insignificant change in white blood cell (WBC) count indicates that the training load was suitable and did not impair immune function, the marginal increase in platelet count seen after training may be explained by physiological adaptation to daily exercise, supporting tissue repair and haemostasis.(Lee et al., 2017)(Anon, 2017)
The improvement of performance markers coincided with these metabolic changes. Both the Rast test sprint timings and the Yo-Yo test distance significantly increased, demonstrating how well the training program works to improve anaerobic power and aerobic endurance. These findings highlight how important it is to combine routine biochemical monitoring and performance evaluations in elite athletes since doing so provides a comprehensive picture of training readiness and adaptation.(Pedlar et al., 2020).

Conclusion

This research demonstrates a substantial correlation between specific metabolic markers and performance metrics in top female hockey athletes. The findings indicate that elevated haemoglobin and HDL-C levels correlate favourably with enhanced aerobic and anaerobic performance, as assessed by the Yo-Yo and RAST tests, respectively. Conversely, increased levels of C-reactive protein (CRP), total cholesterol, triglycerides, and LDL-C are associated with diminished performance, underscoring the adverse effects of systemic inflammation and unfavourable lipid profiles on athletic ability. The lack of substantial correlations with white blood cell and platelet counts indicates that these indicators exert a restricted direct influence on short-term performance in this setting. The noted enhancements in biochemical markers and performance indicators after systematic training highlight the need of consistent biochemical assessment for optimising training programs, facilitating recuperation, and minimising injury risk. In summary, the integration of biochemical evaluations with performance assessments offers a holistic strategy for athlete management, allowing coaches as well as sports scientists to customise treatments that improve both well-being and athletic performance. Future studies should use bigger, more varied cohorts and longitudinal methods to fully clarify the dynamic interaction between physiology and performance over the competitive season.

References

Anon, M. (2017). Role of Biomarkers in Sports: Review. Journal of Exercise Science and Physiotherapy, 13(2). https://doi.org/10.18376/jesp/2017/v13/i2/111287

Cai, T., Abel, L., Langford, O., Monaghan, G., Aronson, J. K., Stevens, R. J., Lay-Flurrie, S., Koshiaris, C., McManus, R. J., Hobbs, F. D. R., & Sheppard, J. P. (2021). Associations between statins and adverse events in primary prevention of cardiovascular disease: Systematic review with pairwise, network, and dose-response meta-analyses. BMJ, 374, n1537. https://doi.org/10.1136/bmj.n1537

Immune changes in humans during cold exposure: Effects of prior heating and exercise. (n.d.). https://doi.org/10.1152/jappl.1999.87.2.699

Jeukendrup, A. E., & Gleeson, M. (2004). Sport nutrition: An introduction to energy production and performance. Human Kinetics.

Karakoç, B., Akalan, C., Alemdaroğlu, U., & Arslan, E. (2012). The Relationship Between the Yo-Yo Tests, Anaerobic Performance and Aerobic Performance in Young Soccer Players. Journal of Human Kinetics, 35, 81–88. https://doi.org/10.2478/v10078-012-0081-x

Kasapis, C., & Thompson, P. D. (2005). The Effects of Physical Activity on Serum C-Reactive Protein and Inflammatory Markers. JACC, 45(10), 1563–1569. https://doi.org/10.1016/j.jacc.2004.12.077

Kumar, D. P. (n.d.). Relationship between Selected Physiological Variables and the Performance of Hockey Players. Retrieved September 28, 2024, from https://www.academia.edu/34300520/Relationship_between_Selected_Physiological_Variables_and_the_Performance_of_Hockey_Players

Lee, E. C., Fragala, M. S., Kavouras, S. A., Queen, R. M., Pryor, J. L., & Casa, D. J. (2017). Biomarkers in Sports and Exercise: Tracking Health, Performance, and Recovery in Athletes. Journal of Strength and Conditioning Research, 31(10), 2920–2937. https://doi.org/10.1519/JSC.0000000000002122

Lombard, W. P., Cai, X., Lambert, M. I., Chen, X., & Mao, L. (2021). Relationships between physiological characteristics and match demands in elite-level male field hockey players. International Journal of Sports Science & Coaching, 16(4), 985–993. https://doi.org/10.1177/1747954121998065

Malm, C., & Yu, J.-G. (2012). Exercise-induced muscle damage and inflammation: Re-evaluation by proteomics. Histochemistry and Cell Biology, 138(1), 89–99. https://doi.org/10.1007/s00418-012-0946-z

McArdle, W. D. (with Internet Archive). (2010). Exercise physiology: Nutrition, energy, and human performance. Baltimore, MD : Lippincott Williams & Wilkins. http://archive.org/details/exercisephysiolo0007mcar

Pedlar, C. R., Newell, P. J., & Nathan, A. L. (2020). BLOOD BIOMARKER ANALYSIS FOR THE HIGH-PERFORMANCE ATHLETE. Gatorade Sports Science Institute. http://www.gssiweb.org:80/sports-scienceexchange/article/blood-biomarker-analysis-for-the-high-performance-athlete

Sadleir, R. (2018). Relationships of Physical Fitness Test Results and Player Performance Indicators in National-Level Ice Hockey Players. SOCIETY. INTEGRATION. EDUCATION. Proceedings of the International Scientific Conference. https://www.academia.edu/77926322/Relationships_of_Physical_Fitness_Test_Results_and_Player_Performance_Indicators_in_National_Level_Ice_Hockey_Players

Wehrlin, J., Zuest, P., Hallén, J., & Marti, B. (2006). Live high-train low for 24 days increases hemoglobin mass and red cell volume in elite endurance athletes. Journal of Applied Physiology (Bethesda, Md. : 1985), 100, 1938–1945. https://doi.org/10.1152/japplphysiol.01284.2005

Steinfeldt, J. A., Carter, H., Benton, E., & Steinfeldt, M. C. (2013). Muscularity beliefs of female college student-athletes. Sex Roles, 69(3–4), 158–172.