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**EXTENDED
ABSTRACT**

Analysis of Biomechanical Parameters of Race Walking Between Trained and Untrained Among Pantai Running Club

Ahmad Haikal¹, Muhamad Noor Mohamed¹, Noor Azila Azreen Md Radzi¹, & Muhamad Safiq Saiful Annur^{1*}
¹Faculty of Sports Science and Recreation, Universiti Teknologi MARA, Negeri Sembilan Branch, Seremban Campus, Negeri Sembilan, MALAYSIA

*Corresponding author: msafiq@uitm.edu.my

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I. INTRODUCTION

Race walking is a technical Olympic sport requiring strict rules, like keeping both feet in contact with the ground and the supporting leg straight. Elite athletes excel in balancing speed and efficiency, while untrained walkers often struggle with technique and injury risks [1]. This study analyzes the biomechanical differences in race walking between trained and untrained participants from Pantai Runners Club. Focusing on stride length, stride frequency, and joint kinematics (hip, knee, and ankle), it aims to identify key performance factors contributing to efficiency and injury prevention [2]. By comparing trained and untrained walkers, the research provides insights into optimizing training techniques and improving race walking performance [3].

II. METHODS

This study involved 6 participants (3 trained and 3 untrained race walkers) from the Pantai Runner Club. Joint kinematics (hip, knee, ankle) were recorded using a digital camera during a 15-meter race walking trial from a sagittal plane view. Participants will complete three walking trials at varying speeds: slow, competitive, and maximum pace. Data consistency will be ensured by repeating each trial three times. Joint angles are derived by calculating segment-to-segment vectors (e.g., thigh vs. shank) on each frame, often using Kinovea software [4][1]. Stride frequency was calculated by dividing stride length by time. Kinovea was used to measure joint angles, while Jamovi performed descriptive statistics and independent t-tests to compare biomechanics between the two groups.

III. RESULTS AND DISCUSSION

A. Joint Kinematics

Trained athletes exhibited slightly more extended hip movement, leading to smoother propulsion. The knee joint in trained athletes showed closer-to-full extension, minimizing braking forces [5]. In contrast, untrained athletes displayed less hip extension, less efficient knee control, and excessive ankle flexion, which may increase injury risk [6]. The independent t-test revealed no significant differences for hip (163.90 ± 1.900), ($p = 0.421$) and knee (177.20 ± 2.401), ($p = 0.523$) joint kinematics. However, significant differences were found for ankle kinematics (90.60 ± 4.839), ($p = 0.021$).

B. Stride Length and Frequency

Trained athletes had shorter, consistent strides, contributing to efficiency, while untrained participants overstride [7]. Trained athletes also showed a higher stride frequency, which was linked to improved mechanics. Untrained athletes had slower cadences, with more variability and less efficiency, negatively affecting their performance [8]. The independent t-test reveals the significant level for stride length (102.58 ± 6.175), ($p = 0.002$), and stride frequency (2.65 ± 0.133) ($p < 0.001$), confirming that trained athletes have more efficient biomechanics than untrained athletes.

C. Figure and Table

Table 1 shows a comparison of joint kinematics and biomechanical parameters (hip, knee, ankle, stride length, and stride frequency) between trained and untrained race walkers, showing significant differences in ankle kinematics, stride length, and stride frequency, with trained athletes demonstrating more efficient biomechanics ($p < 0.05$). No significant differences were found in hip and knee joint kinematics.

TABLE I
COMPARISON BETWEEN TRAINED AND UNTRAINED IN JOINT KINEMATIC AND PARAMETER

Parameters	Statistic	Mean	df	SD	p
Joint Kinematic Hip	0.896	163.90	4.00	1.900	0.421
Joint Kinematic Knee	-0.696	177.20	4.00	2.401	0.525
Joint Kinematic Ankle	-3.705	90.60	4.00	4.839	0.021
Stride Length	-7.305	102.57	4.00	6.175	0.002
Stride Frequency	9.733	2.65	4.00	0.133	<0.001

IV. CONCLUSIONS

This study highlights significant biomechanical differences between trained and untrained race walkers. Trained athletes demonstrated more efficient joint kinematics and biomechanical parameters, including stride length and

frequency [9]. These findings emphasize the importance of targeted training to enhance race walking performance and reduce injury risks in untrained athletes [10]. Future research should focus on long-term training effects on novice athletes, using real-time biomechanical monitoring for technique improvement. Studies should explore injury prevention strategies, particularly for knee and ankle strains in beginners. Expanding athlete profiles to include various age groups and experience levels will help identify key progress factors. Collaboration between sports scientists, physiotherapists, and coaches can lead to more effective training programs that enhance performance and ensure long-term athlete health.

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REFERENCES

- [1] Dyer, B. (2023). The controversy and pragmatic resolution of the introduction of foot sensors in competitive race walking. *Technology in Society*, 73, 102226. <https://doi.org/10.1016/j.techsoc.2023.102226>.
- [2] Phillips, S. J. (2008). KINEMATICS OF RACE WALKING. ISBS - Conference Proceedings Archive, 1(1). <https://ojs.ub.uni-konstanz.de/cpa/article/download/1427/1289>.
- [3] Sun, Wei-wei, et al. "Biomechanical Analysis on Hip-Push Skills Applied in Walking Race." *IERI Procedia*, vol. 2, 2012, 264–269. <https://doi.org/10.1016/j.ieri.2012.06.086>. Accessed 20 Jan. 2023.
- [4] Pavei, G., Cazzola, D., La Torre, A., & Minetti, A. E. (2014). The biomechanics of race walking: Literature overview and new insights. *European Journal of Sport Science*, 14(7), 661–670. <https://doi.org/10.1080/17461391.2013.878755>.
- [5] Ahmed, A. Sayed Prof. Dr., & Ahmed, H. Prof. Dr. (2019). Analytical Study for Some Variables of the Stride and Performance Level for the Racewalkers. 1(1), 1–6. <https://doi.org/10.21608/JAT.2019.14104.1000>.
- [6] Ferber, R., Brett, A., Fukuchi, R., Hettinga, B. A., & Osis, S. T. (2024). A Biomechanical Dataset of 1,798 Healthy and Injured Subjects During Treadmill Walking and Running. *Scientific Data*, 11(1). <https://doi.org/10.1038/s41597-024-04011-7>.
- [7] Stenum, J., Rossi, C., & Roemmich, R. T. (2021). Two-dimensional video-based analysis of human gait using pose estimation. *PLOS Computational Biology*, 17(4), e1008935. <https://doi.org/10.1371/journal.pcbi.1008935>.
- [8] Pharswan, A., & Singh, J. (2024). Biomechanical characteristics of race walking: a thematic review. *ShodhKosh Journal of Visual and Performing Arts*, 5(6). <https://doi.org/10.29121/shodhkos.v5.i6.2024.3207>.
- [9] Rodano, R., & Santambrogio, G. C. (2009). Quantitative Comparison of Locomotor Performance in Different Race Walkers. 1(1). <https://ojs.ub.uni-konstanz.de/cpa/article/download/2342/224>.
- [10] Phillips, S. J. (2008). *Kinematics of race walking*. 1(1). <https://ojs.ub.uni-konstanz.de/cpa/article/download/1427/129>.