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REVIEWER'S REPORT

Manuscript No.: **IJAR-58668**

Title: "Intergenerational Biomechanical Analysis of Joint Adaptations Induced by Regular Playing Beach Football in Coastal Communities of Benin"

Recommendation:
Accept with Minor Revisions……

Rating	Excel.	Good	Fair	Poor
Originality	✓			
Techn. Quality		✔		
Clarity		✔		
Significance		✓		

Reviewer Name: Faheem Abdul Muneeb

Reviewer Report

Overall Assessment

The manuscript entitled "Intergenerational Biomechanical Analysis of Joint Adaptations Induced by Regular Playing Beach Football in Coastal Communities of Benin" investigates the long-term biomechanical adaptations associated with regular barefoot beach football participation across three generations of players in coastal Benin. The study compares seventy-four recreational beach football players representing youth, adult, and veteran age groups with sedentary controls to examine differences in lower-limb joint range of motion, weight-bearing asymmetry, and movement biomechanics. Using two-dimensional motion analysis through Kinovea software, standardized functional tasks, and statistical analyses including ANOVA and Pearson correlation, the authors conclude that regular participation in beach football is associated with greater ankle dorsiflexion, increased hip mobility, improved knee flexion during functional activities, and reduced weight-bearing asymmetry. Furthermore, although these

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biomechanical adaptations decline with age, veteran players continue to demonstrate superior joint function compared with sedentary individuals of similar age.

The topic addressed by the manuscript is both original and relevant. Research examining the long-term biomechanical consequences of beach football remains relatively limited, particularly within sub-Saharan Africa, where environmental conditions, barefoot locomotion, and sporting traditions differ substantially from those reported in existing European and South American literature. By focusing on coastal communities in Benin, the study contributes valuable region-specific biomechanical data while also highlighting the potential public health significance of lifelong participation in physically demanding recreational activities.

The manuscript is logically organized and follows a conventional scientific structure consisting of introduction, methodology, results, discussion, and conclusion. The research objectives are clearly stated, the methodological procedures are generally described in sufficient detail, and the statistical analyses are appropriate for the study design. The discussion effectively relates the findings to existing literature concerning barefoot locomotion, unstable surface biomechanics, neuromuscular adaptation, and healthy ageing. The inclusion of quantitative biomechanical measurements alongside functional interpretation further strengthens the practical relevance of the research.

Nevertheless, several aspects of the manuscript require further refinement before publication. Although the study presents statistically significant findings, greater attention should be given to methodological limitations, participant selection, and interpretation of causality. Certain sections of the discussion occasionally overstate the implications of a cross-sectional design, and several methodological details require clarification to enhance reproducibility. Editorial improvements are also necessary to improve language quality and presentation. These issues, however, concern the refinement of the manuscript rather than its scientific merit. Subject to appropriate revisions, the study represents a worthwhile contribution to sports biomechanics and exercise science.

Strengths of the Paper

One of the principal strengths of the manuscript is its originality. To the best of current knowledge, very few biomechanical investigations have examined the long-term effects of recreational beach football across multiple generations within African populations. By focusing specifically on coastal communities in Benin, the study fills an important geographical and scientific gap in the existing literature and provides valuable reference data for future biomechanical research.

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Another significant strength is the clear research design. The inclusion of three age-based groups of beach football players together with a sedentary control group enables meaningful comparisons regarding the influence of long-term sporting participation and ageing. This intergenerational perspective provides greater insight into the durability of biomechanical adaptations than studies focusing exclusively on young athletes.

The methodological procedures are generally well described. The authors provide detailed information regarding participant selection, inclusion and exclusion criteria, video acquisition protocols, Kinovea configuration, anatomical marker placement, standardized motor tasks, and statistical analysis. Such methodological transparency enhances the reproducibility of the study and demonstrates careful experimental planning.

The quantitative findings constitute another major strength of the manuscript. Significant improvements in ankle dorsiflexion, knee flexion, hip abduction, and internal hip rotation among beach football players compared with sedentary controls are consistently supported by statistical analysis. The observed correlations between years of practice and joint mobility further strengthen the argument that prolonged participation contributes to functional adaptations rather than representing isolated age-related differences.

The discussion appropriately connects the empirical findings with existing biomechanical literature on barefoot locomotion, unstable surface training, anterior cruciate ligament injury prevention, neuromuscular adaptation, and healthy ageing. Rather than merely reporting statistical differences, the authors provide plausible physiological explanations for the observed adaptations, thereby enhancing the scientific value of the study.

The manuscript also possesses important practical implications. The findings suggest that regular participation in beach football may contribute to maintaining joint mobility, improving movement symmetry, and supporting functional capacity across the lifespan. These observations are particularly relevant for physical education programmes, injury prevention strategies, and community-based health promotion initiatives within coastal populations where beach football represents an established recreational activity.

Finally, the use of Kinovea software demonstrates an effective application of accessible biomechanical technology within a resource-limited setting. By illustrating that meaningful kinematic analysis can be performed without expensive three-dimensional motion capture systems, the study provides a practical methodological model that may encourage similar research in developing countries.

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Areas to be Improved

Although the study presents interesting findings, the limitations inherent in the cross-sectional design should be discussed more explicitly. The manuscript frequently suggests that regular beach football directly causes the observed biomechanical adaptations. However, because participants were observed at a single point in time rather than followed longitudinally, causal relationships cannot be established with certainty. Individuals possessing naturally greater joint mobility may also be more likely to participate in beach football over many years. A more cautious interpretation acknowledging this limitation would strengthen the scientific rigor of the manuscript.

The participant selection process could also be described in greater detail. Although inclusion and exclusion criteria are clearly presented, the manuscript provides limited information regarding recruitment procedures, participant representativeness, and whether sampling bias may have influenced the findings. Clarifying how participants were identified and recruited would improve methodological transparency.

The control group requires further discussion. While the manuscript compares beach football players with sedentary individuals, it would be useful to explain whether the control participants were matched for occupational activity, daily physical workload, or other recreational activities that may influence joint mobility. Greater attention to these potential confounding variables would strengthen the validity of the comparisons.

The statistical analysis could be expanded further. While ANOVA and Pearson correlations appropriately address the primary objectives, additional analyses controlling for age, body mass index, or years of practice simultaneously could provide deeper insight into the independent contribution of long-term beach football participation. Multivariable regression analysis, for example, would strengthen the interpretation of the observed associations.

Although Kinovea has been validated for two-dimensional motion analysis, the limitations associated with two-dimensional assessment deserve greater emphasis. The authors appropriately acknowledge this limitation; however, important lower-limb movements involving transverse-plane rotation cannot be accurately captured using the present methodology. Consequently, some conclusions regarding joint biomechanics should be expressed more cautiously. Future studies incorporating three-dimensional motion analysis or wearable inertial measurement units would provide a more comprehensive understanding of movement adaptations.

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The discussion would also benefit from greater comparison with studies involving other sports performed on unstable surfaces, such as beach volleyball or sand running. Since direct beach football literature remains limited, broader comparisons could further contextualize the findings and strengthen the discussion of biomechanical adaptation mechanisms.

Several sections of the discussion occasionally become repetitive, particularly where explanations regarding barefoot locomotion and unstable surface training are reiterated across multiple paragraphs. Consolidating these discussions would improve readability and produce a more concise presentation without reducing analytical depth.

Editorial improvements are also recommended. The manuscript contains numerous grammatical inconsistencies, spacing irregularities, typographical errors, and formatting problems throughout the text. Several figure labels remain partially untranslated or inconsistently formatted, and minor inconsistencies appear in the presentation of tables and references. A careful language revision by a fluent English editor would substantially improve the readability and overall presentation of the manuscript.

Finally, the conclusion could be strengthened by distinguishing more clearly between the direct findings of the present study and broader practical recommendations. While the promotion of beach football as a public health strategy is an interesting suggestion, such recommendations should be presented cautiously given the observational nature of the research and the need for future longitudinal and intervention-based studies.

Recommendation

This manuscript presents an original and methodologically sound investigation into the long-term biomechanical adaptations associated with recreational beach football participation in coastal communities of Benin. The study contributes valuable empirical data from an underrepresented geographical region, demonstrates careful application of biomechanical assessment techniques, and provides findings with potential relevance for sports science, injury prevention, physical education, and healthy ageing. Although the manuscript would benefit from greater methodological clarification, more cautious interpretation of causal relationships, expanded statistical discussion, and editorial refinement, these concerns do not detract from the overall scientific contribution of the work. The suggested revisions are developmental rather than fundamental. Therefore, I recommend that the manuscript be **accepted with minor revisions**.