SPORT TK-EuroAmerican Journal of Sport Sciences

https://revistas.um.es/sportk Online ISSN: 2340-8812

Received: **25/10/2023.** Accepted: **02/04/2024.** Published: **29/04/2024**

The importance of understanding kinesiology for gymnastics: A biomechanist's perspective

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ABSTRACT

Kinesiology has progressed to become one of the most dynamic disciplines for studying and scrutinizing the various aspects of human bodily movement from a scientific perspective. The field has expanded into major areas of sports such as athletics, martial arts, gymnastics, and more. This study aimed to delve deeper into this subject and explore the importance of understanding kinesiology in gymnastics, as it provides a comprehensive context for studying such aspects. The primary goal was to assess the opinions of biomechanists to gain insight into the underlying factors. The study employed a quantitative design, using an original research approach to report findings on the current subject. A total of 36 biomechanists (29 males and 7 females) participated in this study, and data were collected using a questionnaire. The questionnaire included demographic questions and 24 statements. These statements were developed based on extensive evaluations of kinesiology features and their associations or implications for gymnastics. The study outcomes revealed that, over time, gymnasts are becoming increasingly aware of the importance of having a solid understanding of kinesiology for analyzing human body movement patterns. They are optimistically applying this knowledge to optimize their training routines, use their energy and skills more efficiently, and ensure better performance and faster recovery from physical injuries when faced with such challenges.

KEYWORDS

Kinesiology; Gymnastics; Biomechanics; Gymnasts

1. INTRODUCTION

For an extended timespan, it has remained a controversial topic that whether the terms Kinesiology and Biomechanics can be used interchangeably (Atwater, 1980). A number of research

scholars have argued over this topic and reached no collectively agreed-upon opinion. Kinesiology is essentially the study of the principles of mechanics and anatomy in regard to human movement that reconnoitres the underlying phenomena and aspects of human physical activity to offer insightful outcomes regarding their association and impacts on health and overall lifestyle (Anderson, 2002). On the other hand, the study of a living body's movement, including the interplay between bones, muscles, tendons, and ligaments, is known as biomechanics (McGinnis, 2013). Biomechanics is a subfield of kinesiology, which focuses on movement mechanics in particular. It encompasses both research and the practical application of its findings, making it both a basic and applied science (Bartlett, 2014).

People who have observed these trends may be curious about the actual distinctions between kinesiology and biomechanics, as well as whether the term biomechanics will eventually replace kinesiology (Dworak et al., 2010). More than 200 kinesiologists who attended a National Conference on Teaching Kinesiology in 1977 debated a number of topics, including the use of these two terms (Atwater, 1980). They were in agreement that "kinesiology does not equal biomechanics, but there was little agreement as to the proper and appropriate name to call the basic course in "kinesiology biomechanics" (Luttgens & Zernicke, 1977). In order to reach a somewhat usually accepted notion in this regard, it can be asserted that the acquaintance with kinesiology is imperative for anyone who participates in sports (Newel1, 1990).

Gymnastics is a game based on precise performance under the conditions of the player’s complete control over his skills. This performance is evaluated according to the standards of the referees monitoring the performance and the extent of its difficulty. The player and his coach’s awareness of the mechanical method of performing artistic movements must raise the level of the player’s performance and make him more capable of achievement (ALkhawaldeh & ALmaaitah, 2024)

Likewise, gymnasts, whether professional, student or intramural players, require their bodies to move in order to perform their talent (Šalaj et al., 2019), and their bodies must move and function optimally for performance or competition, considering whether there is an injury and whether rehabilitation is required (Ottosson, 2010). A gymnast must be familiar with the ways of managing the healing process in order to recover with the best possible physical movement (Skarstrom, 1915). Gymnasts, athletes, and other athletes rely on professionals with kinesiology knowledge to ensure they are exercising and training in accordance with their needs and goals (Tinning, 2008).

Apart from just the professionals, kinesiology is vital for everyone, not just athletes, gymnasts, and other sports persons (Lawson & Morford, 1979). Anyone who exercises (which is advised for health maintenance) could gain from collaborating with a kinesiology-savvy professional. They can assist in ensuring that people get the most out of their workouts and that their bodies are moving correctly (De Lyon et al., 2017).

Trainers' understanding of mechanical aspects is an important and fundamental matter that determines their ability to develop training programs on correct foundations capable of reaching ideal performance characterized by economy and avoiding the occurrence of injuries (Alkhawaldeh & Alzughılat, 2023).

To recapitulate the idea, a kinesiologist's assistance might come in handy when our bodies hurt or can't do what we need to do. Kinesiology is a part of daily physical movement in everything from health and fitness to physical therapy and rehabilitation. On the other hand, biomechanists study the movement and physical mechanics of the body to understand the underlying facets of how the human body move and in what ways the movement can be made better to ascertain minimal chances of injuries and other physical hazards. However, even after the existence of parallel factors, little has been done to study the two fields altogether under one roof to identify their complementary aspects. Thus, the current study aims to bridge this research gap by investigating the two fields conjointly in a way that will determine the imperativeness of understanding kinesiology for gymnastics. It has been intended to dig deeper into the given topic and explore the opinion and perspectives of bio-mechanists regarding the necessity of understanding and being knowledgeable of the mechanics of kinesiology for gymnasts.

2. METHODS

2.1. Study Design and Participants

The study was based on a quantitative design. An original research approach was employed to report findings on the current subject. A total of 36 biomechanists participated in this study. Each participant was assigned a code ranging from 01BM to 36BM to ensure anonymity in case individual responses needed to be discussed. The questionnaires were sent online, and participants were asked to carefully complete their responses and provide any suggestions at the end if they had any.

2.2. Instrument

For the purpose of data collection, a questionnaire was designed and sent to the targeted population to record their responses. Before proceeding with data collection, the questionnaire was carefully developed. To ensure that the results provided appropriate guidance on the issue under study, several measures were taken. Firstly, an extensive literature review was conducted to identify and extract major themes on the topic. The collected themes were then sorted, with redundant items excluded and similar ones merged, and organized under relevant sections. The first draft was reviewed by two senior professionals—one a kinesiologist and the other a biomechanist—to ensure that the questionnaire included all essential items and did not lack any major themes. The draft was returned with suggestions for modifications in some areas. Accordingly, the questionnaire was amended based on their comments, and the final version was used for the survey. The questionnaire includes demographic questions (gender, age, and educational level) and 24 statements. These statements were developed based on extensive evaluations of kinesiology features and their associations or implications for gymnastics.

2.3. Ethical Considerations

Before initiating the research, all potential ethical considerations were addressed. Participation in the study was voluntary, and written consent was obtained from all respondents. Confidentiality was assured throughout the research, and no personal or identifying information was revealed, except for anonymized primary demographic data included in the questionnaire.

3. RESULTS AND DISCUSSION

To provide an overview of the sample characteristics, the beginning of the questionnaire was designed to collect demographic details from the participants. To maintain confidentiality and anonymity, only generalized details were included. The results of the sample characteristics are presented in Table 1. According to the data, the majority of the participants were male (80.55%), the most common age group was 25 to 50 years (66.66%), and most participants (58.33%) were graduates.

Table 1. Demographic characteristics

Characteristics	N	Average (%)
Total Sample Size	36	100
Gender		
Male	29	80.55
Female	7	19.44
Age		
18 to 25	12	33.33
25 to 50	24	66.66
50 onwards	-	-
Educational Level		
Undergraduate	2	5.55
Graduated	21	58.33
Any other Higher Degree	13	36.11

In the main section, the researcher designed 24 statements in relation to the most cited features of kinesiology and their association or implications for gymnastics. A 3-point Likert rating was assigned to the participants to opt for the appropriate response. The statements were then further portioned into distinct themes on the basis of relevance. The results of the questionnaire and participants' responses are summarized in Table 2.

Table 2. Summary of participant responses by theme

Themes Arising from the Questionnaire	Frequency of Responses (%)		
	Agree	Not Sure	Disagree
Significance	88.88	8.33	2.77
Implications for Better Body Movement	83.33	13.88	2.77
Swift Recovery from Injuries	80.55	11.11	8.33
Maximum Output	88.88	5.55	5.55
Motor Skills	77.77	19.44	12.77
Positive impacts on psychomotor development	94.44	5.55	-
Overall Scores	85.64%	10.64%	3.70%

On the basis of the questionnaire items, six primary themes arose that are listed in Table 2. Overall, it was observed that the majority of the participants (85.64%) agreed with the given statements and were well aware of these features. In regard to the most cited feature, the sections with statements concerning the positive impacts on psychomotor development get the highest percentage (94.44%) of positive responses. At the same time, the section for motor skills had the highest score for negative responses (12.77%) as these were the most disagreed statements. While the majority of the participants (19.44%) were also unsure about the same area.

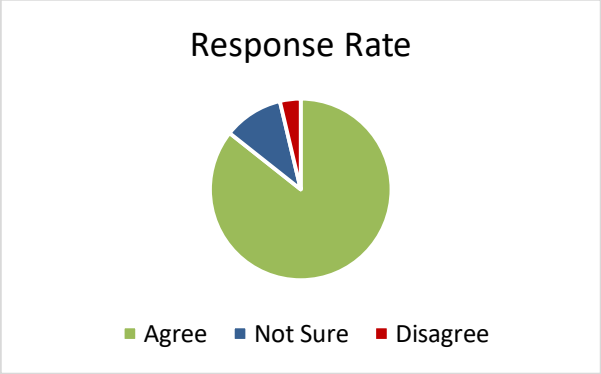

Figure 1. Overall distribution of participants' responses to questionnaire statements

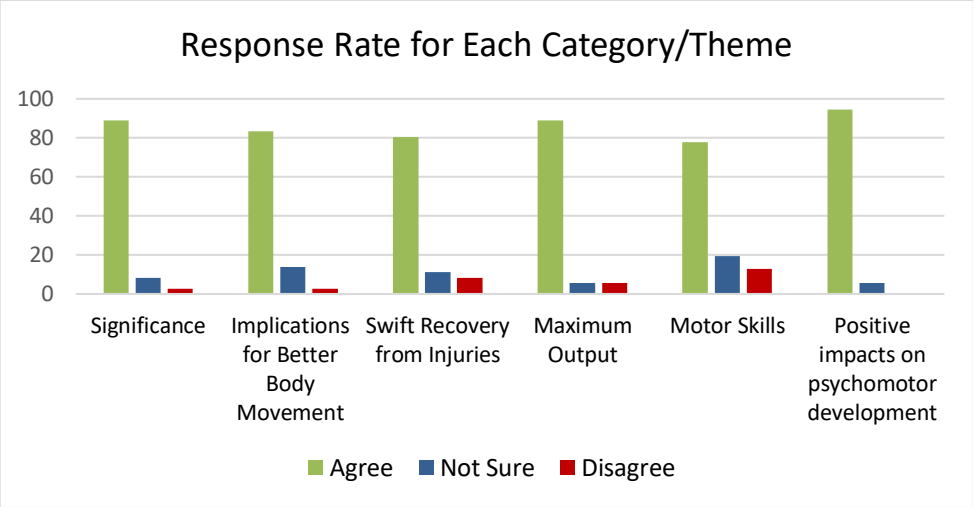

Figure 2. Response rate for each category/theme of statements

Figure 1 depicts the overall distribution of the participants' responses for all statements from the questionnaire, while Figure 2 is the illustrative portrayal of the response rate for each category. After reviewing the figurative representation, it can be seen that the study, to a certain amount of extent, remained successful in capturing the principal implications of acquaintance with kinesiology for gymnasts.

On the basis of the major outcomes of the study that have been gained from the assessment of the overall response rate, it can be established that the majority of the bio-mechanist agreed with the questionnaire's statements. Furthermore, considering the response rate for each category and comparing the outcomes for the most voted category, it can be professed that understanding of kinesiology has a significant positive influence on the psychomotor development of gymnasts. In this area, no participant disagreed with any of the statements and showed the highest level of agreement in contrast to all other sections. Hence, it can be corroborated that the study of human motion can

take advantage of gymnastics' almost limitless possibilities, but skill selection can be daunting, making gymnastics extremely frustrating. To comprehend even one activity or skill, like locomotion, many studies are required due to the nature and complexity of human movement (Skarstrom, 1915).

Gymnastics needs a thorough comprehension of the appropriate ratios of bodily technicalities such as balances to enhance performance aptitude. For instance, Brown et al. (1995) found ground reaction forces exceeding 10 times body weight in two relatively straightforward balance beam dismounts. For more difficult somersault dismounts, the forces were up to 13 times body weight in a follow-up study (Brown et al., 1996). Therefore, they suggested that gymnasts should be permitted to roll out of various dismounts, at least in practice and possibly in competition; The governing bodies of gymnastics are highly unlikely to adopt this idea. There is a trade-off between take-off angular momentum and take-off linear velocities when gymnasts perform acrobatic tumbling exercises on the floor and balance beam, as discovered by Knoll (1996). In summary, the findings validate the notion that know-how concerning bodily functions is indubitably essential for all sports persons, specifically gymnasts owing to the fact that gymnastics is the most challenging of all other sports (Deusen, 2019).

Lastly, at the end of the questionnaire, a suggestion box was attached so that if any participant intends to include any implications from their side, that they believe are essential, they could write it in that box. After filling out the questionnaire, a few respondents proposed some future suggestions. For instance, participant 24BM recommended that:

> *"I would like to suggest that anyone who is interested in pursuing any field of sports as their career, they must focus on first learning in detail about the mechanics and functionalities of our bodies. Sports is not something that you will just learn by practice..., it is an entire science that is needed to be studied before practiced". (24BM)*

The above-mentioned suggestion is vital as the participant has attempted to stress on the inevitability of studying sports as a scientific field of bodily functions that will allow the practitioners to grasp the essential facets that they may not otherwise learn if not studied appropriately. This idea can be validated by the fact that Newell et al. (2010) wrote a book in which they used real-life case studies to underline the significance of science behind exercises and sports. Thus, it can be determined that a lot of researchers (Bishop, 2008; Burwitz et al., 1994; Nevill & Atkinson, 1997; Tulle, 2008) have studied sports as the scientific phenomenon to introduce the cruciality of this concept to the sports community. Another participant comes up with the suggestion that:

> *"Kinesiology and Biomechanics have several overlapping concepts or implications. Hence, instead of arguing about their differences, it would be way better to exploit the best of these fields by focusing on what the fields inform us". (18BM)*

From the above statement, it can be concluded that the participant has attempted to draw attention towards the benefits that kinesiology and biomechanics pose for us while disregarding the controversies over their definitions and functions that are often the topic of discussion among the sports community. Likewise, other respondents also proposed identical recommendations by putting emphasis on the preponderance of the potency of Kinesiology and biomechanics for gymnasts, athletes, and other sports persons who held enormous expectations from these domains in regard to making them familiar with the intrinsic peculiarities and logistics of physical functions and moves of our bodies.

4. CONCLUSIONS

To conclude, the findings of the present study report that kinesiology has multiple implications for gymnasts and is crucial for understanding body functionalities. The results also support the notion that biomechanics is essential for guiding principles and laws of body movement applicable in professional settings. Kinesiology professionals frequently use biomechanical knowledge to improve movement and prevent or treat injuries during qualitative analyses of human motion. The scientific advancement of kinesiology has significantly impacted the field of gymnastics, leading to a substantial and growing body of research. Given the broad interest in the movement of living organisms, biomechanical knowledge is featured in a wide range of academic and professional journals.

5. REFERENCES

1. Alkhawaldeh, I. M., & Almaaitah, M. (2024). Biomechanical Fundamentals of Hand Standing and Somersaults: The Impact of Coaching Interference. *Retos: Nuevas Tendencias en Educación Física, Deporte y Recreación, 51*, 1-5.
2. Alkhawaldeh, I. M., & Alzughialat, M. (2023). Extent of knowledge and application the basics of biomechanics among Paralympic Games coaches. *International Journal of Disabilities Sports & Health Sciences, 6*(3), 482-495.

3. Anderson, D. R. (2002). The Humanity of Movement or "It's Not Just a Gym Class." *Quest, 54*(2), 87–96. https://doi.org/10.1080/00336297.2002.10491768
4. Atwater, A. E. (1980). Kinesiology/Biomechanics: Perspectives and Trends. *Research Quarterly for Exercise and Sport, 51*(1), 193–218. https://doi.org/10.1080/02701367.1980.10609283
5. Bartlett, R. (2014). *Introduction to sports biomechanics: Analysing human movement patterns* (3rd ed.). Routledge. https://doi.org/10.4324/9781315889504
6. Bishop, D. (2008). An applied research model for the sport sciences. *Sports Medicine, 38*(3), 253–263. https://doi.org/10.2165/00007256-200838030-00005
7. Brown, E. W., Witten, W. A., Espinoza, D. M., Witten, C. X., Wilson, D. J., Wisner, D. M., Weise, M., & Learman, J. (1995). Attenuation of Ground Reaction Forces in Dismounts from the Balance Beam. *ISBS-Conference Proceedings Archive.*
8. Brown, E. W., Weise, M. J., Espinoza, D., Wisner, D. M., Learman, J., Wilson, D. J., & Witten, W. A. (1996). Attenuation of ground reaction forces in salto dismounts from the balance beam. *ISBS-Conference Proceedings Archive.*
9. Burwitz, L., Moore, P. M., & Wilkinson, D. M. (1994). Future directions for performance-related sports science research: An interdisciplinary approach. *Journal of Sports Sciences, 12*(1), 93–109. https://doi.org/10.1080/02640419408732159
10. De Lyon, A. T. C., Neville, R. D., & Armour, K. M. (2017). The Role of Fitness Professionals in Public Health: A Review of the Literature. *Quest, 69*(3), 313–330. https://doi.org/10.1080/00336297.2016.1224193
11. Deusen, A. V. (2019). 6 Reasons Gymnastics Is the Toughest Sport There Is. *LiveAbout Dotcom.* https://www.liveabout.com/reasons-gymnastics-is-the-hardest-sport-1714808
12. Dworak, L. B., Rzepnicka, A., Murawa, M., Maczyński, J., & Buszko, P. (2010). Swing-through gait from the perspective of biomechanics and kinesiology. Critical analysis of the current state of knowledge and the idea behind the research. *Chirurgia Narzadow Ruchu i Ortopedia Polska, 75*(6), 392–398.
13. Knoll, K. (1996). Analysis of Acrobkiic Tumbling Exercises on Floor and Balance Beam. *ISBS-Conference Proceedings Archive.*
14. Lawson, H. A., & Morford, W. R. (1979). The crossdisciplinary structure of kinesiology and sports studies: Distinctions, implications, and advantages. *Quest, 31*(2), 222–230. https://doi.org/10.1080/00336297.1979.10519939

15. Luttgens, K., & Zernicke, R. F. (1977). Structure and organization of kinesiology-biomechanics content at undergraduate level. In C. H. Dillman & R. G. Sears (Eds.), *Proceedings. Kinesiology: A national conference on teaching*. University of Illinois, Urbana-Champaign.
16. McGinnis, P. M. (2013). *Biomechanics of sport and exercise.* Human Kinetics.
17. Nevill, A. M., & Atkinson, G. (1997). Assessing agreement between measurements recorded on a ratio scale in sports medicine and sports science. *British Journal of Sports Medicine, 31*(4), 314–318. https://doi.org/10.1136/bjsm.31.4.314
18. Newel1, K. M. (1990). Kinesiology: The Label for the Study of Physical Activity in Higher Education. *Quest, 42*(3), 269–278. https://doi.org/10.1080/00336297.1990.10483999
19. Newell, J., Aitchison, T., & Grant, S. (2010). *Statistics for sports and exercise science: A practical approach* (1st ed.). Routledge. https://doi.org/10.4324/9781315847542
20. Ottosson, A. (2010). The first historical movements of kinesiology: scientification in the borderline between physical culture and medicine around 1850. *The International Journal of the History of Sport, 27*(11), 1892–1919. https://doi.org/10.1080/09523367.2010.491618
21. Šalaj, S., Milčić, L., & Šimunović, I. (2019). Differences in motor skills of selected and nonselected group of children in artistic gymnastics in the context of their motor development. *Kinesiology, 51*(1), 133–140. https://doi.org/10.26582/k.51.1.16
22. Skarstrom, W. (1915). *Gymnastic Kinesiology: A Manual of the Mechanism of Gymnastic Movements.* American Physical Education Association
23. Tinning, R. (2008). Pedagogy, Sport Pedagogy, and the Field of Kinesiology. *Quest, 60*(3), 405–424. https://doi.org/10.1080/00336297.2008.10483589
24. Tulle, E. (2008). Acting your age? Sports science and the ageing body. *Journal of Aging Studies, 22*(4), 340–347. https://doi.org/10.1016/j.jaging.2008.05.005

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

FUNDING

This research received no external funding.

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