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Article

Biomechanical factors affecting sports injuries of college basketball players and training optimization

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Abstract: Basketball is a physically demanding sport that involves high-intensity movement like jumping, cutting, and rapid direction changes. College basketball players are particularly susceptible to sports injuries due to the repetitive stress placed on their musculoskeletal systems. College basketball players frequently suffer from sports-related injuries due to improper movement techniques, excessive usage, and high physical demands. The study analyzes the biomechanical factors affecting sports injuries among college basketball players and develops optimized training programs that focus on injury prevention and performance enhancement. A mixed-methods approach combines biomechanical analysis, injury tracking, and performance assessments. Participants were separated into two groups: the intervention group, which engaged in an 8-week plyometric training program as a warm-up before their regular training, and the control group, which received a regular warm-up exercise program before training. The study outcomes from both groups were assessed in terms of (i) biomechanics during a leg drop-landing task, (ii) biodex balance system, and (iii) athletic performance. Key metrics, such as vertical ground reaction force, knee valgus, ankle dorsiflexion, knee flexion, and hip flexion were evaluated for the interventions before and after 8 weeks. The study identified several biomechanical factors, such as improper joint alignment, muscle imbalances, and incorrect landing techniques, contributing to common injuries like sprains and anterior cruciate ligament (ACL) tears. The intervention group showed important enhancements in athletic performance, biodex balance system, and biomechanics compared to the control group. The study highlights biomechanical analysis is crucial for injury risk identification and optimizing training programs for college basketball players, with plyometric training reducing injury incidence and improving functional performance.

Keywords: biomechanical; plyometric training program; college; basketball; training

1. Introduction

Basketball is an extremely competitive sport that requires athletes to demonstrate abundant power, quickness, perseverance, and capacities because it is an extremely competitive sport [1]. Injuries in basketball are common due to the sport's dynamic nature, including frequent jumping, rapid directional changes, and physical contact. Lower extremity injuries, particularly to the knee and ankle, are among the most reported among college basketball players. These injuries often result from overuse, lack of adequate strength training, and improper biomechanics, affecting performance and long-term health [2]. Individuals who practiced regular physical activity observed that older adults who engaged in running demonstrated better posture control and increased isokinetic strength of core extensor muscles when assessing posture and spinal muscle strength [3]. Among athletes, strong core muscles are critical for maintaining postural stability, reducing the risk of injuries, and enhancing overall performance. Studies suggest incorporating core-strengthening exercises into training regimens to reduce the likelihood of spinal and pelvic instability [4].

The recognition of illness and injury has an important impact on efficiency. Orthopedic abnormalities are the most prevalent conditions that decrease performance [5]. Psychological stress has also been identified as a contributing factor to injury risk, emphasizing the importance of mental well-being in competitive environments [6]. Neuromuscular training programs and dynamic warm-up routines have proven to reduce the incidence of injuries, especially in high-intensity sports like basketball [7]. By focusing on the abdominal area, one can effectively establish the synchronized balance of both limbs, ensure the source of gravitation is balanced, and sustain the steadiness of the spinal and pelvic [8]. Modern sports science emphasizes the role of biomechanical analysis and advanced strength training in minimizing injury risks. Personalized strength and conditioning programs tailored to individual biomechanics have been effective in improving stability and preventing injuries [9]. **Figure 1** depicts the biomechanical factors affecting sports injuries of college basketball players.

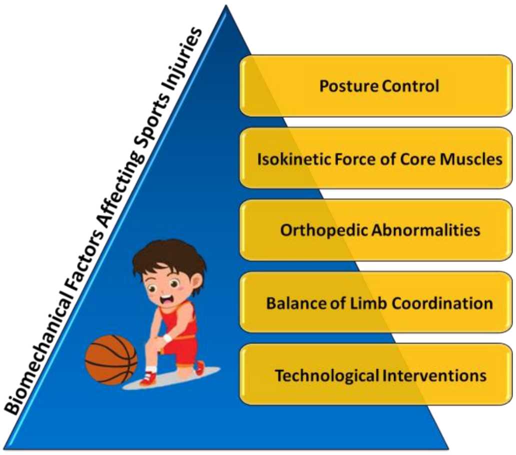

Figure 1. Biomechanical factors affecting sports injuries.

Awareness about basketball has grown more apparent in recent decades due to the quick development of technology. Sports technology aims to employ computer technology to help trainers make selections train, and help athletes compete at a higher level [10]. Wearable sensors and AI-powered analytics tools are now commonly used to monitor player performance and detect early signs of injury. These technologies offer real-time feedback and data-driven insights that support injury prevention and enhance overall athletic performance as a cutting-edge science and technology, artificial intelligence (AI) can track and analyze basketball players' practices and employ practical training techniques that optimize training results [11]. The integration of artificial intelligence devices in basketball has been proving to be very helpful of late. AI could assist the coaches in ideating a better game plan, training basketball players, cutting down sports injuries, and enhancing the enjoyment factor in the games [12]. Furthermore, AI systems can predict injury risks by analyzing biomechanics, enabling coaches and trainers to design customized training programs that minimize injury risks and maximize performance [13].

1.1. Aim of the study

The research examines the biomechanical elements that influence sports injuries in college basketball players and provides training programs that are optimized for performance improvement and avoiding injuries. Performance evaluations injury tracking, and biomechanical analysis were included as components of a mixed-methods approach.

1.2. System in the overview

The research descriptions and relevant publications are provided in phase 2. Phase 3 presented the complete outline of the techniques employed in this suggested approach. Results are explored in phase 4. In phase 5, conclusions and further exploration are determined.

2. Relevant researches

In the research musculoskeletal injuries were extremely prevalent among basketball players [14]. Sprained bones were the most frequent injury type, influence with additional participants was the primary cause of injury, and the ankle and knee were the most damaged physiological parts. The probability of injury increases for the player who trains more frequently each week. Along with the study's data, the ankle and knee were the most common injuries in the stratified sample under analysis. The majority of injuries happened when the player was training. The chance of injury rises with the amounts of times per week.

Study predicted the chances of college athletic injuries by utilizing studies on injuries and an understanding of artificial neural networks (ANN) [15]. A neural network model that works best for college basketball injuries was developed. The ANN technology was applied, in every part of sports in this age of intelligence. It was hypothetically promising to minimize sports injuries by integrating the domains of medicine and sports through the use of neural network technology. The technology significantly identifies injuries, which mostly impact sports.

Research evaluated every anterior cruciate ligament (ACL) injury suffered by national basketball players (NBA) players in-depth using video [16]. Joint kinematics were evaluated visually at three different periods in time. ACL breaks in NBA players were mostly caused by three main processes. The situational patterns that were most frequently seen involved attacking, jumping, and then landing in a basket. The information could be useful in creating injury prevention initiatives tailored to the particular basketball players' play styles and biomechanics.

Basketball players, coaches, and other relevant parties could improve their layup shots by understanding the biomechanics mentioned in the article [17]. Through analysis, the identification of athletes' strengths, and weaknesses, and the recommendation of corrective actions to address weaknesses. It also resulted in improved functionality and appearance for sporting goods. Demonstrated the use of biomechanics in neurological, musculoskeletal, and orthopedic rehabilitation. Sports medicine could employ biomechanics as a technique to determine the mechanical energy and forces that lead to injuries.

The joint-level variables shown in provided a correlation between the two jump types, and jumping speed and dynamics at the joint region were higher throughout the counter movement (CMJ) [18]. From a biomechanical standpoint, the CMJ seems to represent both athlete-specific motion forms that participants would select once exhibiting a deeper play associated highest task jump that involves jumping upward through their desired technique, and it appeared to redirect the majority of the physical function or neurological capability in the joints region. The results could have applications in contexts where basketball players' movement patterns were often evaluated and using the CMJ.

Monitoring a throw's performance and organizing training in to increase the accuracy and quality of sports professionals [19]. It should be pointed out that there were quite many different types of stability training available for sports. The most crucial factor was the proper functioning of the nervous system, which ensured strong neuromuscular control, resulting in stable and controlled movement during a throw. The study indicated that the most trainable and important component during the throw was the torso's stabilization.

Study monitored teenage female basketball players whose knee kinematics were recorded during single-leg jump landings using two-dimensional video cameras [20]. Comparing knees with ACLs revealed differences in knee kinematics and wobbling, which were determined by comparing the relative anterior indication to the flexion movement. Knee wobbling was present in 84% of ACL injuries, and lesser knee flexion due to knee trembling increased the frontal knee motion but not the knee valgus angle. Finally, knee wobble could be a dynamic and biomechanical risk factor for female basketball players' ACL injuries.

The elements of essential dependability connected to risk factors for knee injuries through drop-jump (DJ) landing were evaluated in [21]. Two distinct components of required dependability linked to avoiding knee injuries during DJ landing were core strength motor control, and other components had varying functions. Through the analysis, the athletes significantly avoid knee injury via conditioning and core training. The findings showed a substantial correlation between sit-ups in 20 seconds and deviation from the rehabilitation index, knee examination, and knee assessment.

Study provided a quick monitoring of basketball players' core strength, balance, and coordination [22]. The test group indicated more significant enhancements to muscle group strength after more core exercise, greater balance and coordination capacity after core durability training, and a notably greater shot proportion later conventional training, founded on the outcomes. Finally, the outcomes determined an improvement in the following factors of core strength training, the athletes' static balance. An increased athlete's shooting percentage considerably in both fix-point and dribble jumpers with a perfect range.

Research offered to measure the immediate training process while adjusting the physical activity parameters in specific exercises based on the physiological alterations that basketball players experience [23]. The study employed mathematical statistical techniques, respiratory measurements, cardiac rate during competitions, intake of oxygen gas consumption during physical labor, and increased carbon dioxide. Finally, the physiological action of the exercises used to prepare basketball players suitably varies depending upon the conditions. The work displayed a well-suited training strategy for players that were established based on psychological factors.

The important factors that contribute to basketball players' development of explosiveness were studied [24]. The development of explosive power required intense and physically taxing training. Consequently, athletes possess a suitable degree of preparedness, which was most evident in the physical and technical setup, to begin the instruction. Ultimately, determining the training methods and procedures was essential for effective training arrangements and programming for the growth of smart ways of power.

The consequences of an exercise of mindfulness on the psychosomatic interpersonal abilities and shelling performance of male college basketball players were explored in using an ultimate investigational methodology [25]. A seven-week athlete mindfulness training manual was given to the intervention group. Findings from the offered study: a seven-week mindfulness training program could improve Macau collegiate basketball players' levels of awareness, approval, and concentration, as well as their consistency when shooting free throws and three-pointers. The study offered evidence for the idea that even a short mindfulness training program could lead to advantages in performance and psychology.

Study examined whether playing basketball in groups and engaging in Baduanjin exercise would lower smartphone usage and enhance college students' mental health, as well as whether the benefits would be obtained or not [26]. In a twelve-week experiment, two groups of qualified college students with mobile phones were assigned at random. The findings showed that basketball and Baduanjin exercises could both successfully lower college students' usage of phones and enhance their mental health by lowering stress, anxiety, loneliness, and feelings of inadequacy.

3. Research methodology

This section provides a clear explanation of the participants of the research, biomechanical factors, questionnaire developments, and the result analysis for analyzing injuries and training in sports.

3.1. Participant details

A total of 200 college basketball players were identified and assigned into two groups. They were randomly selected to either one of the two groups (Intervention group and control group), each comprising 100 participants. The able-bodied players were selected based on their participation in the college basketball games. To ensure the respondents were sufficiently broad and representative, measurements were taken of age, sex, and previous playing experience. The intervention group engaged in an 8-week program of plyometric training which was incorporated as a warm-up exercise in their normal training for basketball. This workout was designed in such a way as to enhance strength, quickness, and efficiency of movement while minimizing the risk of injury. The control group, on the other hand, executed a standard warming-up routine consisting of simple stretching and cardio exercises yet, any plyometric exercises. Data was collected at two time points: A baseline and the 8-week post-intervention time. The assessment includes biomechanical assessments of landing motion and skill, balance, and quickness performance measures. This experimental design aimed to assess whether participation in plyometric training would be effective in reducing the risks of injuries and enhancing performance in college basketball players. **Table 1** shows the participant's demographics.

Table 1. Participant's demographics.

Characteristics		***n* = 200**	**Percentage (%)**
Ages	20–45 years	200	100
Gender	Female	80	40
	Male	120	60
Level of Injury	Low	34	17
	Medium	100	50
	High	66	33
Experience in Basketball Playing	<5	42	21
	6–10	90	45
	11–25	68	34

The study inspected 200 basketball players, aged 20 to 45, with a combination of familiarity and wound acquaintance. Among contestants, 60% were male and 40% female. Injury stages differed, with 17% having low injury rates, 50% at a medium level, and 33% at a high level, denoting a variety of injury risks. Experience in basketball also differed, with 21% having under 5 years of experience, 45% between 6 to 10 years, and 34% from 11 to 25 years, signifying diverse proficiency across the group. **Figure 2** displays the level of injury and experience in basketball playing.

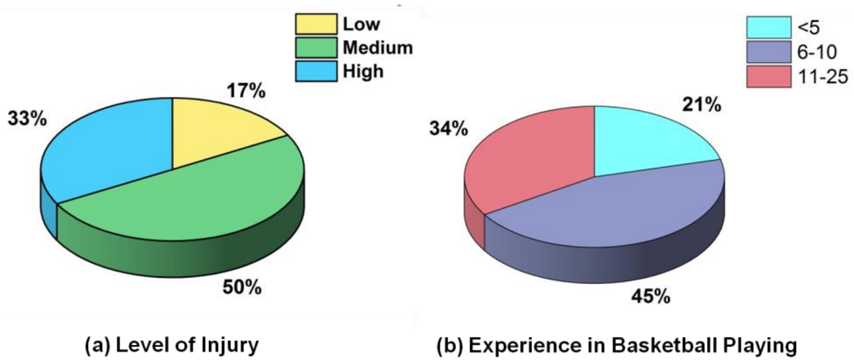

Figure 2. (a) Level of injury; **(b)** experience in basketball playing.

3.2. Biomechanical analysis

Basketball is a high-intensity sport that involves rapid movements like jumping, cutting, and direction changes, making players vulnerable to injuries. College basketball players are particularly susceptible to musculoskeletal injuries due to repetitive stress, improper movement techniques, and high physical demands. Biomechanical analysis is crucial in identifying risk factors for injuries such as ACL tears and ankle sprains. In a study analyzing these factors, a mixed-methods approach was used, combining biomechanical analysis, injury tracking, and performance assessments. Participants were separated into two groups: intervention (plyometric training) and control (the normal range warm-up). Key biomechanical measures, including knee valgus, ankle dorsiflexion, and vertical ground response force, were measured before and after the 8-week intervention. The findings demonstrated that the intervention group significantly improved their athletic performance, balance, and biomechanics.

3.3. Biomechanical evaluation tools

Both the intervention and control categories' study results were evaluated in terms of the leg drop-landing task, the biodex balancing system, and athletic performance. The leg drop-landing tasks are utilized to assess the movement of the basketball player. The biodex balancing system is employed for evaluating the balance during basketball playing. The athletic performance matrices are performed to reduce the injury to the players at the time of playing basketball. The key biomechanical matrices such as hip flexion, ankle dorsiflexion, knee flexion, knee valgus, and vertical ground reaction force are employed before and after 8 weeks of interventions.

3.4. Questionnaire developments

Table 2. Survey questions.

Matrices	Questions
Ankle Dorsiflexion	When you bend your ankle forward, do you feel constrained?
	Do you have stiff ankles after the squats or jumps?
	Does your performance suffer with your ankle flexibility?
Knee Flexion	During sports, are you able to do deep knee bends?
	When you bend your knees, do you experience pain?
	Do you have the confidence to control your knee movements when landing?
Vertical Ground Reaction Force	Do your landings appear inflexible or challenging?
	After engaging in high-impact tasks, do you experience joint pain?
	Could you land with smooth impact incorporation?
Hip Flexion	When you run, is it safe for you to extend your knees?
	Do you have stiff hips, when you warm up?
	Does having increased motion in your hips enhance your sports performance?
Knee Valgus	Do squats cause your knees to give way inward?
	During your sports activities, are you considering your knee consistency?
	Do your legs feel flopping at the time of side movements?

This phase provides the questionnaire development that the questions are based on the biomechanical matrices like ankle dorsiflexion, knee flexion, vertical ground reaction force, hip flexion, and knee valgus. Based on the matrices, there are 15 questions developed and each matrices with three questions are developed. Two rounds were conducted for the participants, such as group discussion and face-to-face interviews within 1 h and 5 points Likert scale was utilized to obtain the responses (0 represents not agree and 5 represents strongly agree). The survey questions are demonstrated in **Table 2**.

3.5. Data analysis

Data evaluation or examination is the technique of collecting and examining large amounts of data to find structures and create useful inferences and this research employed the SPSS software to perform the assessment function. Patterns in basketball injury types, including the most often injured body areas, can be found with the use of statistical analysis. The most frequent injuries in both sexes are strains and sprains. Jumping and landing biomechanics and rapid direction changes are both instances of characteristics that can be identified through statistical analysis in influencing injury risk. This research determines two analysis techniques, such as analysis of variance (ANOVA) and descriptive statistics. The ANOVA is used to analyze variations between the means of several categories (intervention and control categories). It is applied in a selection of occurrences to determine the incomes of numerous classes change in some manner. Descriptive statistics are employed to identify and categorize the characteristics of both categories, including distribution, variability, and primary tendency. These techniques explain the information and assist in identifying connections and patterns.

4. Result

The recommended technique was validated using the 200 participants and the reliability was proved by measuring performance using parameters. This section relates the experimental findings with the suggested model and the approaches that are currently in use.

4.1. Descriptive analysis

Descriptive analysis is a kind of statistical exploration that assists in discussing, offering, or carefully addressing facts and points, so those configurations may progress and fulfill all of the circumstances of the data. It is the performance of classifying lines and relations by employing present and historic records. Descriptive analysis starts with describing participants through demographic information, such as age, gender, experience, and earlier injury history, which helps ensure comparability between intervention and control groups. It pinpoints the regular developments in performance metrics and biomechanics for two types of groups. Extremely, it monitors the injuries by identifying the patterns when the intervention group has less influence than the control group. **Tables 3** and **4** explore the outcomes of descriptive analysis for both control and intervention groups.

Table 3. Descriptive analysis of the control group.

Metrics	Mean	Std. dev	Min	Max
Vertical ground reaction force	2000 N	300 N	1500 N	2500 N
Hip flexion	60°	10°	40°	80°
Knee flexion	70°	8°	50°	90°
Knee valgus	10°	5°	5°	20°
Ankle dorsiflexion	20°	5°	10°	30°

Table 4. Descriptive analysis of the intervention group.

Metrics	Mean	SD	Min	Max
Vertical ground reaction force	1900 N	250 N	1400 N	2400 N
Hip flexion	65°	9°	45°	85°
Knee flexion	72°	7°	58°	88°
Knee valgus	7°	4°	2°	15°
Ankle dorsiflexion	23°	4°	12°	33°

With the intervention and control groups showing slightly different ranges that might specify the effect of the plyometric training program, the mean values, standard deviations (SD), minimum represented as Min, and maximum represented as Max of these metrics offer an in-depth look at the variability in movement patterns as well as potential injury risk factors in both groups.

4.2. ANOVA analysis

The analysis of variance (ANOVA) was performed to determine whether there were differences in the key outcomes between the multiple groups including the intervention and control groups. ANOVA systematically assesses the weighted means of the groups above and seeks to prove the existence or otherwise extremes of variations among the means. This study was carried out to evaluate the differences in vertical ground reaction force, hip flexion, extension of the knee, knee swelling, flexion of the ankle, balance as determined by the Biodex Balance System, and sports effectiveness during the training stage. The results of the ANOVA helped to understand the efficacy of the conducted intervention in particular referring to the changes in biomechanics that would contribute to injury prevention and improving athlete performance. The following **Table 5** and **Figure 3** introduce the results of the ANOVA evaluation:

Table 5. Evaluation outcomes of ANOVA.

Origin of variations	Mean Square	SS	*F*	Df	*p*
Among groups	60.25	120.50	8.34	2	0.002
Within groups	11.12	300.75	-	27	-
Total	-	421.25	-	29	-

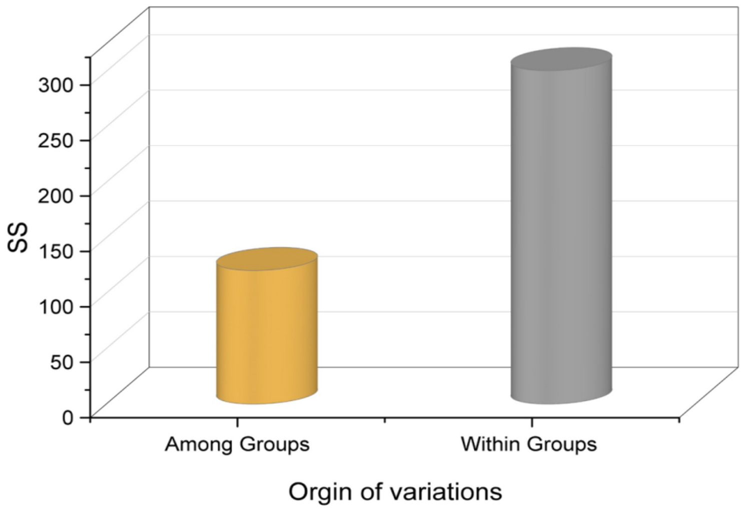

Figure 3. Results of ANOVA analysis.

The findings from the ANOVA analysis suggest not only that there are considerable differences between groups and their variations, however. Representing their between-group variability, the mean square and total squares are 60.25 and 120.50, respectively. These figures demonstrate that there is appreciable diversity among the groups indicating that they do not realize identical performance goals. Another essential point is the computed *F*-statistic of 8.34, which assesses the intergroup variation relative to the intra-group variation. A result of 8.34 indicates that the differences between groups are much more pronounced than the differences within them, indicating that the group means are significantly different. Since the *p*-value of 0.002 is significantly lower than the usual significance threshold of 0.005, it further supports the statistical importance of these changes and indicates that they are unlikely to be the result of chance. On the other hand, the means squares of 11.12, and the sum of squares is 300.75 for within-group differences. As these values indicate, while each group does show some internal variation, this is negligible when compared with the differences between groups. This suggests that the effect of the treatment is strong enough to mask the normal variation that is seen in each group. The overall variability of the data including the sums of squares for within and between groups is expressed by the total sum of squares 421.25. Considering that all sources of variation have been accounted for, this overall figure helps to appreciate the spread of the observations. Taken together, these results suggest that the group differences are meaningful and consistent with the efficacy of the intervention in the variables of biomechanics and sports performance tested. The position that the intervention has been successful is also cogent given the differences among the groups and the low *p*-value.

4.3. Discussion

This study focused on identifying the major biomechanical influences on the risk of injury during strenuous sporting activities, consisting of physical actions such as takeoff and landing, among college athletes who play basketball. The results show that including plyometricic exercises in therapy, practices can prevent injury risks and increase the efficiency of activities that require high energy. The intervention group demonstrated a significantly better change in biomechanical indicators as compared with the control group in the descriptive analysis. For instance, knee flexion improved from 70° ± 8° to 72° ± 7° thus enhancing control and stability. Dorsiflexion before and after the intervention was 20° ± 5° and 23° ± 4° respectively thus facilitating proper landing with minimal chances of sustaining injuries. Adjustment of the Knee Valgus Angle, one of the measurements crucial to the prevention of ACL injuries, underwent significant changes from 10° ± 5° to 7° ± 4° very well aligned without much valgus collapse. Also, the intervention group demonstrated lower vertical ground reaction forces 1900 N ± 250 N when compared to the control group which was 2000 N ± 300 N showing better capacity to absorb shock on the landing. These results were confirmed with ANOVA analysis as there were statistically significant differences in the aforementioned outcomes between the groups. 60.25 was the mean square for any differences between the groups with an F-statistic of 8.34 (p = 0.002). On the other hand, the within-group variation was small and thus the mean square was 11.12 indicating that the intervention was highly effective and uniform across the groups. These contradictions speak to the benefits of adding plyometric exercises in correcting biomechanical deficiencies, promoting greater balance and stability, improving performance, and preventing injuries. Landing strategies for knee flexion and alignment, an important aspect of knee flexion to landing forces, as well as injury prevention from ACL injury, are evident. Improved ankle dorsiflexion and hip flexion also facilitate effective movement patterns and reduce the chances of injuries respectively.

5. Conclusion

The present study confirmed the necessity of biomechanical testing in assessing injury risks and optimizing the training programs of college basketball players. A mixed-method design was employed and several biomechanical factors suspected of being risk factors for classic sports injuries, such as ACL tears or bone fractures, were recognized. These factors include but are not limited to, joint misalignments, muscular imbalances, and poor landing techniques. The intervention group that underwent a plyometric training session lasting 8 weeks outperformed the control group, which simply followed a regular warm-up exercise routine, in balance, biomechanics, and athletic performance. Focused plyometric training is effective in minimizing the risk of injury by increasing the dynamic stability and movement efficiency of an individual. By the descriptive analysis, the intervention group revealed certain advancements, in particular, the enhancement in ankle dorsiflexion angles (from 20° to 23°), enhancement in knee flexion (from 70° to 72°), and reduction in vertical ground reaction force (from 2000 N to 1900 N). Furthermore, knee valgus decreased from 10° to 7°, suggesting a decreased risk of ACL damage. Additionally, the ANOVA Analysis supported the relevance of these results, showing statistically significant differences between the intervention and control groups with a p-value of 0.002 and an F-statistic of 8.34. These findings highlight the value of biomechanical analysis in injury prevention by demonstrating how focused training regimens can improve athlete safety, lower injury risks, and boost performance.

Limitations and future scopes

The short intervention duration is one of its drawbacks since it makes it unable to fully capture the long-term effects on performance and injury prevention. Furthermore, the study may include some new ways that incorporate modern technology, which could increase real-time biomechanical feedback and personalized changes to training programs.

Ethical approval: Not applicable.

Conflict of interest: The author declares no conflict of interest.

References

1. Ferri-Caruana, A., Prades-Insa, B. and Serra-Ano, P., 2020. Effects of pelvic and core strength training on biomechanical risk factors for anterior cruciate ligament injuries. The Journal of Sports Medicine and Physical Fitness, 60(8), pp.1128-1136.
2. Taylor, J.B., Hegedus, E.J. and Ford, K.R., 2020. Biomechanics of Lower Extremity Movements and Injury in Basketball. Basketball Sports Medicine and Science, pp.37-51.
3. Taveira, H.V., De Lira, C.A., Andrade, M.S., Viana, R.B., Tanaka, H., Hill, L., Nikolaidis, P.T., Knechtle, B., Rosemann, T. and Vancini, R.L., 2021. Isokinetic muscle strength and postural sway of recreationally active older adults vs. master road runners. Frontiers in Physiology, 12, p.623150.
4. Zemková, E. and Zapletalová, L., 2022. The role of neuromuscular control of postural and core stability in functional movement and athlete performance. Frontiers in Physiology, 13, p.796097.
5. Sarlis, V., Chatziilias, V., Tjortjis, C. and Mandalidis, D., 2021. A data science approach analyzing the impact of injuries on basketball player and team performance. Information Systems, 99, p.101750.
6. Columbus, A., 2022. A longitudinal investigation into well-being and the influence of injury and perceived exertion on female basketball players.
7. Bank, N., Hecht, C., Karimi, A., El-Abtah, M., Huang, L. and Mistovich, R.J., 2022. Raising the young athlete: training and injury prevention strategies. Journal of the pediatric orthopaedic society of North America, 4(2), p.462.
8. Olsson, A., Kiwanuka, O., Wilhelmsson, S., Sandblom, G. and Stackelberg, O., 2021. Surgical repair of diastasis recti abdominis provides long-term improvement of abdominal core function and quality of life: a 3-year follow-up. BJS open, 5(5), p.zrab085.
9. Wang, J., Li, C. and Zhou, X., 2024. Decoding the court: Insights into basketball training and performance optimization through time-motion analysis. Education and Information Technologies, pp.1-30.
10. Zhong, S., 2022. Application of Artificial Intelligence and Big Data Technology in Basketball Sports Training. Wireless Communications and Mobile Computing, 2022(1), p.8424303.
11. Cheng, Y., Liang, X., Xu, Y. and Kuang, X., 2022. Artificial intelligence technology in basketball training action recognition. Frontiers in Neurorobotics, 16, p.819784.
12. Li, B. and Xu, X., 2021. Application of artificial intelligence in basketball sport. Journal of Education, Health and Sport, 11(7), pp.54-67.
13. McDevitt, S., Hernandez, H., Hicks, J., Lowell, R., Bentahaikt, H., Burch, R., Ball, J., Chander, H., Freeman, C., Taylor, C. and Anderson, B., 2022. Wearables for biomechanical performance optimization and risk assessment in industrial and sports applications. Bioengineering, 9(1), p.33.
14. Minghelli, B., Queiroz, S., Sousa, I., Trajano, J., Graça, S. and Silva, V., 2022. Musculoskeletal injuries in basketball players Southern Portugal: Epidemiology and risk factors. Northern clinics of Istanbul, 9(1).
15. Zhao, D., 2022. [Retracted] Injuries in College Basketball Sports Based on Machine Learning from the Perspective of the Integration of Sports and Medicine. Computational intelligence and neuroscience, 2022(1), p.1429042.
16. Gill, V.S., Tummala, S.V., Boddu, S.P., Brinkman, J.C., McQuivey, K.S. and Chhabra, A., 2023. Biomechanics and situational patterns associated with anterior cruciate ligament injuries in the National Basketball Association (NBA). British Journal of Sports Medicine, 57(21), pp.1395-1399.

17. Chakraborty, S. and Mondal, P., 2020. Importance of biomechanics in Basketball layup shot. International Journal of Physical Education, Sports, and Health, 7(5), pp.237-239.
18. Kipp, K., Krzyszkowski, J., Smith, T., Geiser, C. and Kim, H., 2021. Comparison of countermovement and preferred-style jump biomechanics in male basketball players. Applied Sciences, 11(13), p.6092.
19. Worobel, M., 2020. Stability training and effectiveness of playing basketball. Central European Journal of Sport Sciences and Medicine, 30(2), pp.85-95.
20. Aoki, A., Koresawa, K., No, Y., Sadakiyo, M., Kubota, S. and Gamada, K., 2022. Biomechanical Risk Factors for Anterior Cruciate Ligament Injury in Young Female Basketball Players: A Pilot Study. medRxiv, pp.2022-07.
21. Guo, L., Zhang, J., Wu, Y. and Li, L., 2021. Prediction of the risk factors of knee injury during drop-jump landing with core-related measurements in amature basketball players. Frontiers in Bioengineering and Biotechnology, 9, p.738311.
22. Liu, Y., 2022. A Study on the Importance of Core Strength and Coordination Balance during Basketball Based on Biomechanics. Molecular & Cellular Biomechanics, 19(3).
23. Koryahin, V., Blavt, O., Doroshenko, E.Y., Prystynskyi, V. and Stadnyk, V., 2020. Training effect of special basketball exercises.
24. Aksović, N., Bjelica, B., Milanović, F., Milanovic, L. and Jovanović, N., 2021. Development of explosive power in basketball players. Turkish Journal of Kinesiology, 7(1), pp.44-52.
25. Wang, Y., Lei, S.M. and Wu, C.C., 2023. The effect of mindfulness intervention on the psychological skills and shooting performances in male Collegiate basketball athletes in Macau: a quasi-experimental study. International Journal of Environmental Research and Public Health, 20(3), p.2339.
26. Xiao, T., Jiao, C., Yao, J., Yang, L., Zhang, Y., Liu, S., Grabovac, I., Yu, Q., Kong, Z., Yu, J.J. and Zhang, J., 2021. Effects of basketball and Baduanjin exercise interventions on problematic smartphone use and mental health among college students: a randomized controlled trial. Evidence-Based Complementary and Alternative Medicine, 2021(1), p.8880716.