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Article

Risk factors and mechanisms of injuries among college athletes in physical education classes

Guo Chen

Hunan College of Information, Changsha 410148, China; chenguo1122@sina.com

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Abstract: Injuries among college athletes in physical education (PE) classes are a significant concern, impacting both their academic performance and athletic progression. Understanding the risk factors and mechanisms behind these injuries is crucial for developing effective prevention strategies. This research aims to identify and analyze the key risk factors contributing to injuries among college athletes participating in PE classes. Data were collected through questionnaires with PE instructors. The PE instructors were trained with wearable biomechanics sensors, which were used to record joint angles, ground reaction forces, acceleration, and muscle activation during various physical activities such as running, high jumping, and basketball. Risk factors like inadequate warmup, improper techniques, and overuse. Statistical tests were conducted using SPSS to analyze the relationship between biomechanical factors and injury occurrence among college athletes, including Chi-square, Descriptive statistics, Regression, and ANOVA showed that they were strong predictors of future injuries. Descriptive statistics revealed that a significant portion of athletes reported injuries, with sprains being the most common injury type. Chi-square analysis indicated a significant relationship between sport type and injury occurrence. Results indicate that PA lessons can help prevent injuries. Regression analysis offers insights into the relationships between variables and their impact on injury occurrence. The results highlight the need for preventive strategies, such as tailored warm-up routines and monitoring injury history, to minimize injury rates.

Keywords: risk factors; injuries; college athletes; physical education; biomechanics; injury rates; physical activities

1. Introduction

The majority of injuries were sprains and strains that affected the lower extremities. Compared to their peers, men, athletes, and people who engage in high-risk social and independent actions were more likely to suffer from physical activity-related injury (PARI). High-risk rebellious and disruptive actions and engaging in physical activity (PA) improve each person's physical, mental, and emotional health [1].

The American College of Sports Medicine (ACSM) supports the inclusion of sit-and-reach exercises in health-related fitness evaluations due to the relative importance of leg flexibility to everyday activities and athletic performance. Many studies have been conducted to examine the validity and reliability of the sit-and-reach. It is a reliable test that primarily evaluates ankle flexibility [2].

There was no question in the studies about the health advantages associated with regular exercise and physical activity. People who have suffered significant decreases in their physical and mental abilities due to chronic illnesses like diabetes, heart

disease, obesity, depressive disorders, and fractures have been shown to gain the most from their health [3].

Engaging in PA improves their health by reducing the risk of non-communicable diseases and improving bone density, which describes the traits and causes of accidents. According to earlier estimates, the majority of injuries happen outside and comprise injuries, strains, and lower limbs [4].

The psychological and environmental factors that influence a student's awareness, and conduct are among the more challenging issues in the system of physical education (PE) for students. It was impossible to comprehend the psychological mechanism behind a student's active behavior without examining optional expressions. Youngsters must exhibit behaviors to be active. They make it possible to control how each of their minds proceed. Sports offer unique characteristics that have a big impact on student's mental health, emotional experiences, and fitness. They also demand the strongest discipline [5].

Few studies have attempted to determine whether learners and campus mental health care professionals consider PA to be a feasible treatment technique, considering the program's encouraging potential as a preventative measure for psychological counseling. The perspectives and opinions of students and post-secondary mental health care professionals regarding PA for psychological strength help in filling the evidence gap. In particular, the main goal was to learn how people perceive PA validity as a replacement or complementary treatment, as well as how to encourage clinician conversations and student use of PA for psychological disorders [6].

The prevalence and mortality of non-communicable conditions worldwide are greatly influenced by PA. Adults' insufficient PA levels are a worldwide public health concern.

The World Health Organization (WHO) encourages public participation in PA as the outcome of PA PA-related injuries helps create methods to promote supporting physical activity in addition to facilitating the creation of effective actions to lower PA-related injuries [7].

Sports injuries are common complications of contests that lead to a reduction in exercise and activity levels and necessitate expensive, specialist medical care students who ignore injury prevention strategies may have several detrimental effects, including diminished motivation, delayed practical classes, absences, physical and psychological issues, and unfavorable attitudes toward PE [8].

Sports and physical education are no exceptions, as each has unique requirements. A potential physical education and sports specialist should advance their credentials in their chosen sport and become proficient in the fundamentals of other sports. Students researching sports and physical education should devote between 15 and 19 hours a week to sports practice. This makes it possible for the number of injuries to rise [9].

PE demonstrated that routine physical subjective social status may have an impact on physical activity, one of the health-conscious habits. Both mental and physical health can be enhanced by exercising. Subjective social status may have an impact on PE, one of the health-conscious habits [10].

Aim and contribution of the research

The aim of the research is to evaluate the main risk factors and mechanisms causing injuries among collegiate athletes. The primary goal is to develop efficient injury prevention and management techniques and to comprehend how biological, physiological, and training-related factors affect the development of injuries**.**

- Important insights into the reasons behind injuries among collegiate athletes were offered by identifying important risk factors such as physical fitness, clothing, skill level, and warm-up techniques**.**
- Predictive models of injury risk are made possible by the application of sophisticated statistical tests (such as chi-square, regression, and ANOVA), which help to provide a more detailed understanding of the association between multiple variables and injury rates.
- To promote safer physical activity involvement, the conclusion can guide policy regarding athlete training schedules, equipment requirements, and PE educational programs.

The remaining part of this research is divided into 6 parts: part 2: related works, part 3: data collection, questionnaires design, risk and mechanism of injuries, as well as clearly explained statistical approaches. Part 4: the outcome of statistical approaches, finally, part 5: the conclusion.

2. Related works

To provide peace of mind for both teachers and students, PE curriculum management systems in institutions of higher learning also make it easier for teachers to centrally manage their students, guarantee student safety in athletics classes, and lower the possibility of learning injuries in research [11]. The relevant examination focused on the development of a program for Internet of Things (IoT) based system operation for college PE. The impact of the IoT on cognition, along with the use of indoor positioning technology and the Web of Things wireless medium gadgets, was used to design fitness course arrangements, student advertising and sign-in, and system test results. Physical literacy course performance has grown and the positioning and sign-in accuracy were enhanced by this method.

Discussed research on how science and technology might help sports medicine promote athletic development. The benefits of treatment sports for sports-related injuries were being examined in research [12]. The research addressed the impact of sports health sciences on sports injuries and used statistical techniques to comprehend the current state of college learners' sports wounds as well as risk avoidance and control. There was a notable disparity between the student's weekly activity frequency, time, and quantity and their incidents of sports injuries. The severity of injuries caused by sports decreased with elevated involvement in sports.

To investigate prepared sports teachers were to adopt and incorporate wearable technology as a PE innovation in research [13]. In addition to providing case research based on the analytical deduction approach with a builder mindset, the essay features unstructured interviews with 38 PE teachers from public educational institutions. Eight topics on attitudinal shifts, acceptable abilities, efficient usage, preventing injuries, effective workouts, non-sedentary behavior, and system availability were identified

by an investigation based on thematic analysis of the data from interviews. The institutional and technological circumstances that allow PE teachers to be prepared to employ and incorporate connected devices into PE were reflected in these themes.

The female subjects outperformed the male subjects statistically, but infrequent weekly PA was a barrier that prevented the full cycle of tests from showing meaningful gains in research [14]. To maximize flexibility, expanding the number of PE courses offered in university curricula and educating future generations about the importance of expanding and utilizing free time as a means of achieving excellent fitness and a sense of well-being was suggested. Particularly the tests involving positions of work and movements were comparable to those commonly used in joint actions and stretches of the muscle during PA. The results obtained and evaluated through the ANOVA procedure with additional measurements confirmed only slightly significant connections in the groups under investigation.

Examined how virtual reality (VR) based elementary school soccer class affected the flow of the session and the mentality of the pupils about the sport in research [15]. The data was analyzed from 113 elementary school students in Seoul and Gyeonggi-do. Participants were split up into pairs and given either conventional training or a virtual experience. It was suggested that student perceptions and flow were improved by VR innovation. The findings showed that learners who took part in the VR courses felt more flow, focused, and confident.

Relevant risk factors for physical activity-related injuries (PARI) among college students in research [16]. Focusing on restoration and analyzing gender alterations were the primary goals of the article. From more than 90 Chinese institutions that offered rehabilitation, freshmen to seniors between the ages of 15 and 25 were selected using a random whole-group sample technique. Using a standardized autonomy questionnaire, the main risk factors for PARI in each gender were evaluated. These factors included socioeconomic status, levels of exercise, risk-taking and protective behaviors, and PARI. The outcome recommendations for lowering PARI in rehabilitative learners could serve as a foundation for creating future preventative measures for college students generally.

To use the grounded theory approach to present a preventive plan for reducing injuries from sports among kids registered in Iranian universities in research [17]. In the grounded theory approach, a qualitative research methodology was used. In addition to reviewing written materials, 15 renowned academics with backgrounds in sports pathology and PE participated in an interview format to collect data. Changes to current laws and regulations, more hours of PA, increased funding, the creation of an annual system, the use of protective gear, the presentation of protective displays, healthcare evaluations, the formation of expert and technical task forces, and cooperation with additional groups were some of the suggestions that were suggested to avoid sports injuries among students.

To clarify the complexities of school students' injuries from playing basketball at their school by conducting an in-depth investigation and assessment of these injuries were aimed in research [18]. It made an effort to offer a thorough assessment of the traits, sites, and fundamental causes of these injuries. Their goal was to identify observable patterns and trends in basketball-related injuries by utilizing sophisticated techniques for data mining. By bridging the fields of sports and healthcare, the

multidisciplinary promoted a comprehensive strategy for injury prevention and guaranteed the continued well-being of the school football players.

To find the functional movement screen (FMS) ratings would foresee sports injuries in college students with varying levels of sports performance (SP) and PA in research [19]. The FMS test was used to prospectively evaluate 187 college learners between the ages of 18 and 22, who were then categorized based on their PA and SP grades. A year later, data on sports injuries was gathered and tracked. Risk factors for sports injuries were determined using binary logistic regression analysis and Spearman's rank coefficients. The FMS cut-off value was 17.5, and the FMS composite rating could utilize forecast sports injuries in college students. The prediction accuracy of the FMS appears to be impacted by community division based on PA and SP rates.

To explore college PE classes are growing more varied as physical education technology developed but the trend also raises security issues in research [20]. Teachers' and students' safety can be improved by smart sportswear that acts as an immediate human data assessment tool. The modified multi-walled carbon nanotubes (MWCNTs) were used to create a conductive infill for flexible piezoresistive sensors. First, a model of the system for sensing was established and the conductive and piezoresistive effects were analyzed using the tunneling theory and permeability effects. Similar to sophisticated insoles, empirical examination of smart apparel demonstrated the possibility for flexible sensor performance enhancement by bringing sensor data into line with theoretical concepts.

Three facets of sports injury avoidance and treatment, sports injury inquiry, therapy, and prevention in research [21]. Sports injuries would significantly affect students' emotional and physical wellness in addition to having a detrimental effect on PE. The most frequent injuries were from sports, then track and field. Athletics injuries were the most frequent, followed by sports injuries. Their injuries were very minor during the net training game, but they were comparatively more severe due to the constant contact that occurred.

To develop biomechanically based injury prevention and recovery techniques for PE instruction. Research used devices that collect biomechanical data to identify patterns in sports-related injuries [22]. 228 students from various colleges participated in an informational survey. Athletes who have been injured would receive customized rehabilitation plans that take into consideration their particular biomechanical limitations. The result highlighted the need for biomechanical evaluation in enhanced PE programs, which would ultimately improve learning outcomes and general health.

To assess the issues and potential solutions surrounding university PE instructors' management and prevention of sports injuries in research [23]. Teachers of PE were essential to the educational process because they must not only impart proper sports skills but also put in place efficient management and prevention plans to lower the number of sports-related injuries. These upgrades could further shield students from sports injuries and greatly increase the caliber of instruction provided by university instructors.

To examine the sites, types, generates, and prevention methods of ankle wounds among students who participate in basketball as an optional course using a questionnaire survey, and statistical analysis were investigated in research [24]. Ankle

injuries in basketball were primarily caused by poor preparation, inattention, low fitness levels, insufficient technical skill, excessive sports load, and emotional displays under duress, among other factors. To lower the incidence of sports injuries, it was essential to raise students' understanding of sports, teach them self-defense techniques, plan warm-up exercises sensibly, optimize technical movements, modify student's mental state, and optimize venue technology use.

The importance of injury prevention and data mining policy synchronization to raise students' awareness of sports is suggested in research [25]. They could only address the issue of employees' necessities, contribute to insurance good for society, and advance the stability of society with this function. The issue of workers' necessities contributed to insurance's greater good, and advanced democracy with this function.

3. Research design

The purpose of this project is to investigate how biomechanical sensors can help athletes, particularly these three sports basketball, jogging, and high jumping avoid injuries. The research specifically examines how biomechanical sensors can assist reduce the possibility of injury as well as the effects of risk factors like overuse, improper form, and insufficient warm-up. A survey strategy incorporates collecting data in both quantitative and qualitative design.

3.1. Data collection

Table 1. Demographic details of the participants.

Category		No. Of. Participant (N = 300)	Percentage
Gender	Male	150	50
	Female	150	50
Age	25–30	150	50
	30–40	100	33.33
	> 40	50	16.67
Experience	1–5	150	50
	5–10	100	33.33
	> 10	50	16.67
Practice time	2 h	100	33.33
	2–5 h	150	50
	> 5	50	16.67
Type of sports training	Basketball	100	33.33
	Running	100	33.33
	High jumping	100	33.33

Data was gathered from 500 individuals based on age, gender, practice time, experimental level, and type of sports training. Initially, information was collected from a pool of individuals. Among them, only 300 instructors were selected for the effective response in the research. The other 200 instructors partially answered the

survey questions. The 300 participants are engaged in three different types of sports training basketball, running, and high jumping. The investigation comprised 15 questions related to these sports. This process of selection was intended to guarantee equal representation across various knowledge and expertise in these fields. **Table 1** shows the demographic characteristics of the 300 participants.

3.2. Risk factors and mechanisms of injuries

Risk factor: Overuse, improper technique, and inadequate warm-up are important risk factors that lead to injury in players, especially in PE settings. There is a higher chance of fractures, sprains, and injury to ligaments when the bones, and joints, are not adequately warmed up for the active hours of exercise. **Figure 1** shows the risk factors of the involved participants in PE.

- Inadequate warm-up: It refers to inadequate body conditioning before PA. This raises the chance of injury, decreases flexibility of joints, and improves muscle fitness. The right warm-up improved the motion of joints and progressively raised the pulse and blood supply to muscles. Tissues and muscles are more vulnerable to sprains, tears, and strains when this preparation is lacking, especially when doing significant or strenuous exercises. For athletes participating in flexible sports, this risk is particularly substantial.
- Improper technique: Performing wrong movements is referred to as poor technique, and it frequently results from a lack of training, exhaustion, or a lack of knowledge about biomechanics. In sports, improper form increases the risk of acute and chronic injuries by putting excessive strain on bones, muscles, and tissues. Incorrect technique periodically might lead to injury from repetitive stress like injury. Athletes must be trained in suitable motion sequences to lower their risk of damage and enhance their performance.
- Overuse: Overuse injuries happen when athletes do the same exercise repeatedly without getting enough rest, which causes the connective tissue to break down. This is a popular game that involves repetitive activities, like vertical leaping, basketball, and exercising. Common overuse ailments include shin splints, tendonitis, and fractures from stress. To avoid overuse injuries, effective rehabilitation, workouts, and periodicity in routines for exercise are crucial.

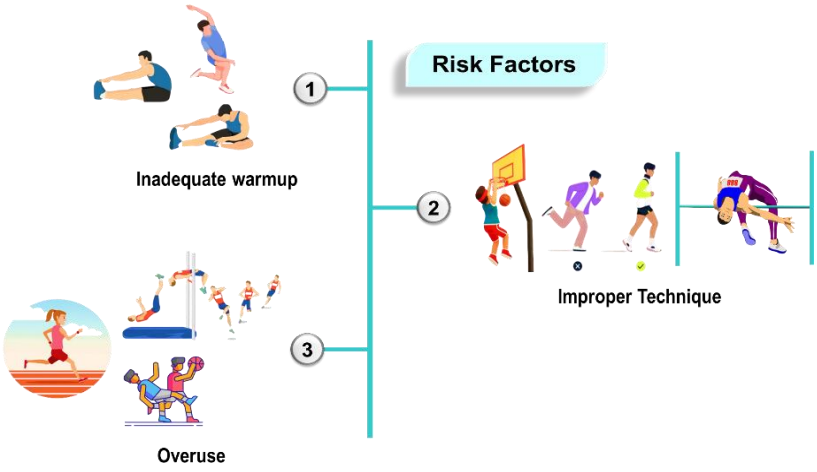

Figure 1. Risk Factor associated with the PE of participants.

3.3. Mechanisms of injuries

The underlying mechanisms that result from physical harm to the body during athletic exercise are known as sports injury mechanisms. Both internal and external factors might contribute to wounds. In basketball, sudden alterations in direction or hops can result in ankle sprains or knee injuries, while inadequate posture during sprinting can cause knee or shin problems. When these factors combine with insufficient warm-up, poor adaptation, or exhaustion, the likelihood of harm increases. **Figure 2** shows the common mechanisms of injury in PE from the questionnaire analysis.

- Ankle sprain: The ligaments supporting the ankle are injured in a sprain, which is frequently brought on by stretching, slipping, or moving the foot outside of its natural range of movement. It usually happens when a foot lands improperly while running, jumping, or making abrupt direction changes, all of which are frequent in sports like basketball. Pain, swelling, bruises, and restricted flexibility in movement are some of the indications.
- Knee injuries: Sports and PA can result in a knee injury. They may entail harm to the bones, ligaments, and tissues. Patellar tendinitis of tissue tears, anterior cruciate ligament (ACL) tears, and ligament sprains are among the most prevalent knee ailments. Jumps, abrupt directional changes, and constant stress are common causes of these injuries, particularly in activities like football, basketball, and jumping.
- Stress fracture: Stress fractures, which are frequently observed in high-impact sports like basketball, sprinting, and leaping, are tiny cracks or significant bruises in a bone brought on by overuse or repetitive force. Lifting weights often impacts bones like the femur, foot, and shinbone are frequently affected. When the bone cannot heal itself after repetitive tension, stress fractures finally form. Regional pain, swelling, and discomfort are among the symptoms; these get greater with movement and are better with rest.

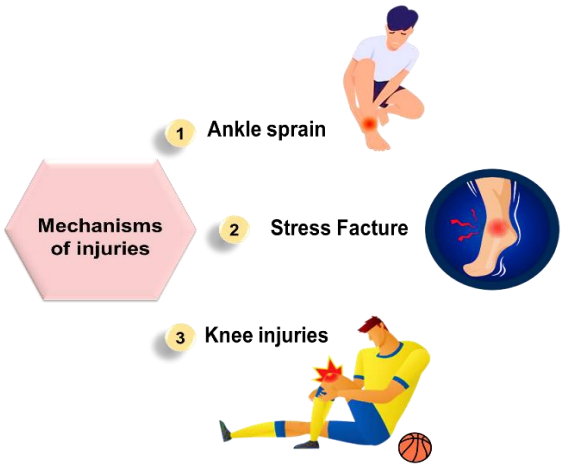

Figure 2. Common injury mechanism from the evaluation of individuals.

3.4. Questionary design

The questionnaire design produces the risk variables based on the sports of running, basketball, and high jumping. Its comprehension of overuse, improper

technique, and inadequate warm-up affects the likelihood of injuries**.** Risk factors and mechanism of injuries based on questions would frame. To prevent the injury, biosensors were used. It observes and acquires current information on physiological characteristics during the movements of individuals and assists in identifying possible injury mechanisms. By monitoring the sensor data, a deeper understanding of different ways to avoid hazards and a greater awareness of risk parameters are obtained. 15 questions were evaluated with 5-point Likert scale. **Table 2** shows the questionnaire design for analyzing the impact on participants.

Table 2. Questionnaire design for evaluation of participants.

S. no	Questions
1	I have faith in my abilities to play sports with appropriate form and method.
2	To avoid injuries from overuse, I consistently take enough time to rest and recuperate during my sessions of exercise.
3	To increase the strength of the muscles, especially in injury-prone areas, I perform workout activities.
4	I usually warm up properly before a workout and calm down properly after.
5	I dress in athletic shoes that are suitable for my athletic endeavors and offer sufficient support.
6	To prevent injury, I keep an eye on the state of whatever surface I train or perform.
7	To avoid ankle injuries during landings and pivots, I employ effective landing methods such as landing with my feet slightly bent.
8	To prevent knee problems, I concentrate on improving my knee tissues, particularly after jumping or turning.
9	I take preventative measures, such as donning protective gear, to prevent hurting my fingers when moving or making touch with the ball.
10	To avoid strains, I include flexibility exercises, especially for the hips and abdomen area.
11	To avoid shin splints, I constantly evaluate my running mechanics and adjust my stance.
12	I progressively up the ante on my running to prevent overuse of broken bones.
13	To avoid Achilles tendinitis during jogging, make sure I get warmed up appropriately and extend my calf muscles.
14	To avoid band disorder, I regularly stretched and improved my leg muscles, hamstrings, and hips.
15	To minimize ankles or knee problems, I concentrate on using appropriate resting methods such as reducing the force with my legs and preventing locked my knees.

3.5. Utilizing biomechanics sensors to prevent injuries

In addition to improving muscle function and contact forces, the biomechanics sensor aids in the biomechanics pattern. The data is essential for determining risk factors that lead to injuries. Three different kinds of biomechanical sensors are being used to measure force and movement. The sensors include an accelerometer, gyroscope, and force plate sensor. **Figure 3** shows the biomechanics sensors to monitor the injuries in physical activities.

- Accelerometer: It can identify forces that alter motion, including acceleration connected to speed. Two or three-dimensional altimeter sensor that measures changes in velocity. The accelerometer measures an athlete’s speed while they run, jump, or cycle. This aids in measuring acceleration or a slowdown, duration

traversed, and the level of physical exertion. It produces the jumping and landing analysis, such as basketball and high jump.

- Gyroscope: The direction of motion is measured using a gyroscope sensor. It offers details about the human body's position and its rotation. Gyroscopes use the concepts of angular velocity to identify movement. A gyroscope is used to measure how the body is oriented during different sports actions. They can evaluate joint rotations and body angles during sprinting, leaping, and rotating, for instance, which is essential for approach enhancement.
- Force plate sensor: A specialized instrument for measuring ground reaction forces (GRF) is the force plate sensor. The structure is capable of detecting acceleration, vertical force, and forces horizontally in all three directions. Numerous strain gauges are inserted within force panels. When a force is applied to the surface, these instruments detect the stress or displacement. The data is frequently recorded in the current time for assessment, and the pressure observations are transformed into force measurements. The athlete's control of posture and equilibrium during active training or following an injury is assessed using force sheets.

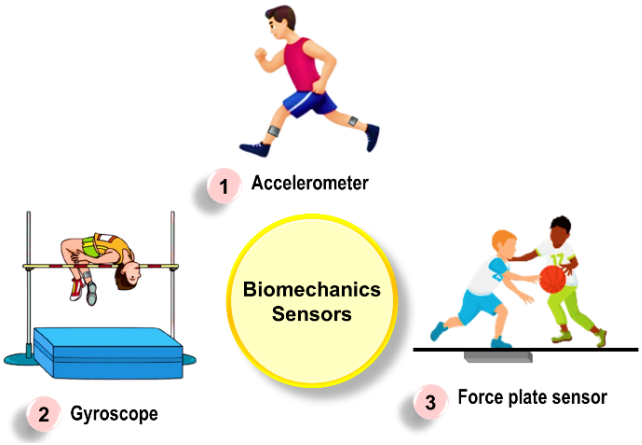

Figure 3. Different biomechanics sensors to monitor the injuries in PE.

3.6. Statistical analysis

The association between risk factors and injury frequency in college athletes in PE was investigated by statistical evaluation of data using SPSS. Risk factors include overuse, improper technique, and inadequate warm-up. Chi-square, descriptive statistics, regression, and ANOVA can be used in the statistical analysis.

- Chi-square: The chi-square test is easy to compute. It is employed to evaluate how well an observation fits into the pattern of an established population or to investigate dependency between two categories of variables. To ascertain whether there is a significant correlation between specific variables like sport type (e.g., basketball, high jump, running) and injury occurrence (e.g., sprains, fractures, strains), the chi-square test is utilized in the investigation of risk factors and ways to prevent harm within students in fitness classes. Equation (1) shows the Chi-square tests suitable for autonomy, and homogeneity is nearly the same.

$$w^2 = \sum_{j=1}^{m} \frac{(P_j - F_j)^2}{F_j} \quad (1)$$

where m represents the table's cell count. A crucial value from the chi-square distributed with $(q-1)(d-1)$. Degrees of freedom are contrasted to the derived test statistic.

- Descriptive statistics: Descriptive statistics involves describing data in some form and presenting it in a way that makes sense so that it is easy to understand. This entails providing demographic data, determining the most prevalent risk variables, and measuring the incidence and types of wounds. A clearer grasp of how variables like intensity of training, warm-up techniques, and sport type affect rates of injuries among athletes will be possible with the aid of descriptive statistics, which will aid in giving an overview of the injury trends.
- Regression analysis: A statistical technique used in making investments in finance, and other fields, regression looks for the nature and degree of a relationship between several independent factors and a factor that is dependent. Finding significant indicators of the probability of injury, such as the effect of training duration, intensity, and experience level on injury severity, will be the goal of regression modeling.
- Analysis of variance (ANOVA): In its most basic version, ANOVA extends the test above two methods by providing a statistical technique to ascertain whether the means of several populations are identical. To put it another way, the ANOVA is used to determine if multiple methods are different from one another. By identifying whether differences in rates of injuries can be attributed to these specific variables, the ANOVA will shed light on how elements such as training frequency range, athletes' knowledge, and sports energy affect injury risk.

4. Result and discussion

Table 3 shows the chi-square test for the different biosensor usage in sports, injury mechanisms, and sports to correlate the variables. Both the injury explanation and sports and the biosensor usage and sports factors have *p*-values (0.279 and 0.262) above the standard cutoff of 0.05. This indicates that there may be no meaningful correlation between the variables that are under investigation, as neither of these correlations is statistically important.

Table 3. Chi-square test to analyze the association between risk factors and injury.

Variable	χ^2 Statistic	Degrees of Freedom (df)	*p*-value
Biosensor usage & sports	6.318	5	0.279
Injury Mechanism & sports	5.321	4	0.262

4.1. Descriptive statistics

Table 4 shows the comparison of minimum and maximum values between the risk factor, injury mechanism, and sports to analyze the fundamental tendency, inconsistency, and distribution characteristics for each sport with the required variables.

Table 4. Descriptive statistics to identify the common injury causes.

Category	Sports	Mean	Median	Min value	Max value	SD	Skewness	kurtosis
Type of injury	Basketball	3.72	4.00	1	5	1.21	0.12	0.85
	Running	3.45	3.50	1	5	1.26	1.09	1.05
	High jumping	3.60	4.00	1	5	1.19	0.15	−0.90
Mechanism of injury	Basketball	4.03	4.00	1	5	1.10	−0.05	−1.00
	Running	3.85	4.00	1	5	1.06	0.18	−1.02
	High jumping	3.92	4.00	1	5	1.14	−0.10	−0.75
Biomechanical sensor (Accelerometer)	Basketball	4.12	4.00	1	5	1.09	0.07	−0.87
	Running	3.98	4.00	1	5	1.10	−0.12	−0.93
	High jumping	4.05	4.00	1	5	1.09	0.2	−0.92
Gyroscope	Basketball	4.08	4.00	1	5	1.05	0.14	−0.78
	Running	3.91	4.00	1	5	1.12	−0.08	−0.90
	High jumping	3.95	4.00	1	5	1.15	0.4	−0.88
Force plate sensor	Basketball	4.15	4.00	1	5	1.11	0.10	−0.83
	Running	4.00	4.00	1	5	1.10	0.5	−0.85
	High jumping	4.10	4.00	1	5	1.07	0.9	−0.80

Descriptive statistics for four categories of injury mechanisms and biomechanical sensors in three sports, basketball, running, and high jumping, are included in the table supplied. To examine the variability in data, let's pay particular attention to standard deviation (SD) and its relationship to the biomechanics sensors used in each sport (accelerometer, gyroscope, and force plate). If the SD level is high, the biosensors could reduce the SD level. This is the main advantage of biosensors.

4.2. Regression analysis

Table 5. Regression analysis to recognize significant predictors of injury occurrence.

Variable	β Unstandardized coefficient	SE (Standard Error)	β (Standardized Coefficient)	*t*-Value	*p*-Value	95% Confidence Interval (Lower)	95% Confidence Interval (Upper)
Sports type basketball	0.25	0.05	0.30	5.00	0.000	0.15	0.35
Running	0.20	0.05	0.25	4.00	0.000	0.09	0.30
High jumping	0.15	0.06	0.20	2.50	0.014	0.6	0.17
Risk factor (overuse)	0.35	0.04	0.45	8.76	0.00	0.27	0.42
Improper technique	0.30	0.05	0.40	6.00	0.000	0.21	0.41
Inadequate warm-up	0.40	0.05	0.50	8.00	0.000	0.32	0.50
Biomechanical sensor (accelerometer)	0.28	0.07	0.33	4.00	0.000	0.15	0.43
gyroscope	0.22	0.06	0.28	3.67	0.000	0.12	0.34
Force plate sensor	0.30	0.06	0.37	5.00	0.000	0.19	0.42
Injury mechanism (ankle sprain)	0.40	0.05	0.50	8.00	0.000	0.30	0.50
Knee injury	0.35	0.06	0.45	5.87	0.000	0.25	0.45
Stress fracture	0.30	0.07	0.38	4.27	0.000	0.16	0.43

Table 5 describes the significant predictors including sports type, risk factors, biomechanical sensors, and injury mechanisms of injury among athletes, concentrated on their coefficients and statistical significance. These findings underline the significance of biomechanical monitoring and injury prevention methods by indicating that the combination of risk behaviors, sports-specific characteristics, and kinematic data are potent indicators of injury risk.

4.3. ANOVA

The findings of an Analysis of Variance (ANOVA) research are shown in **Table 6** to measure significant differences between groups and deliver the strong decline of unproven strategies. Despite being significantly smaller than the Within-group sum of squares (420.48) the between-group Sum of Squares (120.35) remains substantial enough to demonstrate the distinction between the athletics.

Table 6. ANOVA method to estimate the differences in injury risk factors and mechanisms.

Source of Variation	The sum of Squares (SS)	Degrees of Freedom(df)	Mean Square (MS)	*F* value	*P* value
Between-group	120.35	2	60.175	5.45	0.005
Within group	420.48	297	1.417	-	-
Total	540.83	299	-	-	-

4.4. Discussion

According to the test of chi-square, there is no significant correlation between the type of sports and the use of biosensors or injury processes. The regression analysis emphasizes important risk factors like excessive use or incorrect technique as well as biomechanics sensors, in predicting the likelihood of damage. This demonstrates how crucial it is to concentrate on these elements to lower the risk of harm in all activities. The ANOVA findings highlight the fact that harm risk and processes differ among sports, indicating that customized injury prevention plans must be created for every sport according to its particular traits. These results highlight the necessity of focused injury prevention techniques that take into account both biomechanical sensors and an understanding of risk variables specific to a given activity. Athletes and coaches can better control and reduce the risk of injury by concentrating on these factors.

5. Conclusion

The risk factors and injury processes among university students participating in PE sessions highlighted the significance of variables to injuries, including excessive usage, mistaken approach, and inadequate warm-ups. A structured questionnaire was employed for gathering information to conduct the investigation, which involved 500 individuals suffering from various types of injuries. This work demonstrated the vital role of biological sensors biomechanical accelerometers, gyroscopes, and force plate sensors for acquiring continuous information on movements, stress, and recording competitors' movements, and acknowledging possible dangers, which will decrease suffering rates. Along with the usefulness of sensors, statistical techniques such as chi-square ($\chi^2 = 6.318,\ p = 0.279$), regression ($\beta = 0.35, 0.30\ and\ 0.40$), and ANOVA ($F = 5.45,\ p = 0.005$) provided more information on injury processes and

demonstrated an advantageous connection between sensing information and the rate of recovery. The findings recommend embedding biomechanical sensors into injury treatment, optimizing the process of healing, and expanding the effectiveness of treatment, all while developing guidelines that enhance security while lowering the risk of injury.

Limitation and future scope

All things considered, this research highlights the value of biomechanical monitoring in enhancing injury prevention tactics and the necessity of sport-specific therapies to successfully lower injury risks**.** Additionally, the research did not consider outside variables that can affect injury risk, such as ambient circumstances or training intensity.

Ethical approval: Not applicable.

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