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*Molecular & Cellular Biomechanics*2025, 22(3), 1037.
https://doi.org/10.62617/mcb1037

Article

Comparison of the effects of different aerobics training modes on sports injury risk of college students

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CITATION

Tian R, Feng X. Comparison of the effects of different aerobics training modes on sports injury risk of college students. Molecular & Cellular Biomechanics.2025; 22(3): 1037. https://doi.org/10.62617/mcb1037

ARTICLE INFO

Received: 7 December 2024
Accepted: 31 December 2024
Available online: 13 February 2025

Abstract: Aerobic exercise is recognized for its multiple health advantages, which include increased cardiovascular endurance, metabolic efficiency, and mental well-being. Aerobic exercise is important for college students because it promotes general physical health and stress management during a pivotal period in their lives. The objective of this research is to analyze and compare the impact of different types of aerobics training on sports injury risk among college students. A total of 235 college students participated in this analysis; they were randomized and separated into four distinct groups: three experimental groups (EG), such as traditional aerobics training, high-intensity interval (HII) aerobics training, and dance-based aerobics training, and a control group (CG) received no aerobics training. The research consumed 8 weeks, with each group completing their allocated training mode two times per week. Self-reports, physical examinations (muscle tiredness, joint strain), and fitness tests were utilized to evaluate the risk of injuries. The data was analyzed using statistical methods and SPPS software. The findings suggest that high-intensity interval aerobics significantly increased fitness; they also increased the risk of injury, especially to the lower limbs. While traditional aerobics training showed modest improvements and a decreased injury rate, dance-based aerobics offered balanced fitness and injury prevention advantages, as well as increased joint mobility and flexibility. The CG demonstrated no significant changes in injury rates or fitness improvements. This analysis emphasizes how crucial it is to customize aerobics programs to each participant's level of fitness reduce the risk of injury and maximize health benefits.

Keywords: aerobics training; sports injury risk; college students; high-intensity interval aerobics training

1. Introduction

Competitive aerobics has grown significantly in the country in recent years, and with it, the risks of sports injuries have steadily increased. Athletes who are not paying attention will get sports injuries because of the demands of aerobics, which include rigorous time limits, more challenging motion requirements, rapid-fire musical support, and coherent coordinated motions [1]. Combining strength and aerobic training is a component of physical training intended to enhance both health and athletic performance. It is crucial to follow the advice to engage in both strength and cardio training since both activities might lead to different responses and health advantages [2]. Combining group exercise, dancing, music, fitness, and entertainment, aerobics is a well-liked sport. Aerobics is a special kind of exercise that combines dance, music, and gymnastics Zhang [3]. These injuries may be mild to severe and involve a simple muscle strain or severe damage to the joints and tendons. They would have a lifelong effect on the athletic performance of a victim and the individual overall well-being [4].

Aerobic exercise is common in colleges where these students go for physical activity purposes. This exercise could be divided into various training modes, with a set of different beneficial/harmful effects. These modes of training include steady-state aerobics, high-intensity interval training, circuit training, and combined aerobic and strength training Birkeland [5]. While these modes are designed to enhance endurance, strength, and overall fitness, they can pose varying degrees of injury risk depending on factors like intensity, duration, and the participant's baseline fitness level [6]. Aerobic activities may cause injuries based on improper technique, not thoroughly warming up, or overtraining, where the body is under more stress than it can handle and needs recovery time [7].

Injury is a real possible risk, since some of the college students engaging in aerobics training may have varying experiences with physical training [8]. Campus academic life tends to expose students to rigorous schedules, stresses, and time pressures that could influence training behaviors [9]. All these factors, in concert with the lack of professional coaching or guidance, make them susceptible to overuse injuries and musculoskeletal strains, especially when high-impact activities like running or vigorous cycling are performed. Certain training modes, such as HIIT, commonly used in group fitness classes, may increase the risk of injury because of the sudden changes in intensity and great demands on the cardiovascular system and muscles [10]. Biomechanics refers to the study of biological structural systems and has witnessed outstanding development in recent years. The challenging behaviors in aerobics can be assessed using biomechanics to ensure that encourages a full understanding of the crucial elements of activities [11]. The analysis predicted that the individuals would improve their abilities of performance by evaluating the biomechanics parameters [12].

It has compared the role of different kinds of aerobic training in sports injuries among college students. It assesses the injury risk and improvement in fitness by self-reporting, clinical examination, and fitness test therefore, it recommends tailored aerobics to minimize injury risks and maximize health effects.

The organization of this research is as follows: the aerobics training impact on sports injuries objective related research shown in part 2, the process details explained in part 3, the performance of result assessment in part 4, then part 5 expresses the overall analysis process concluded.

2. Literature survey

Su Kunxia et al. [13] investigated the preventatives techniques against sports injuries in athletes by determining their causes. The methods used include a literature review, questionnaires, interviews, and statistical analysis. Fingers, ankles, knees, lower back, and thighs were the most prevalent places for injuries, which include sprains, strains, and soft tissue injuries. Scientific training could help to decrease sports injuries and accidents.

Examining the genetic variability of Angiotensin-Converting Enzyme Insertion/Deletion (ACE I/D) in female students and how it affects their reaction to aerobic training was the objective by Kzar Lect Fatimah Hameed et al. [14]. The finding, based on physical and tribal data was that students with ACE ID genes fared better throughout training than those with ACE DD genes. Based on genetic testing, the results allow customized training and sports selection for peak performance.

Enhanced aerobics training, lowering injuries, and promoting growth were the objective by Shen Mingyu et al. [15]. After 1000 aerobics athletes completed a three-month functional strength training program, they were observed for three months. Findings indicated that stability, flexibility, and coordination had improved, while only 9.4% exhibited mild impairments. Athletes' overall performance was improved and injuries were successfully avoided with functional strength training.

54 young soccer players participated by Yan Shuren et al. [16] to assess the effects of short-term low- and high-frequency HII training (HIIT) during their recovery. Both groups saw improvements in knee strength, anaerobic power, and peak oxygen uptake (VO_2 peak), although the high-frequency group (HFG) had a larger increase. It indicated that low-frequency HIIT could be used to improve physical fitness when high-frequency training was not feasible, which made it appropriate for young athletes juggling recovery and other obligations.

Orr Robin et al. [17] examined the connection between initial aerobic efficiency and risk of injury in police applicants. Data from 219 recruits, such as 30-15 Intermittent Fitness Test (IFT) and 20-m Multistage Fitness Test (MSFT) ratings were examined, and the findings showed a significant negative relationship across fitness stage and injury rates, suggesting that decreased fitness increased the risk of injury. MSFT and IFT scores had a high correlation.

Liu Qiannan, and Yiqiao Zhang, [18] compared the effects of continuous aerobic, anaerobic, and control exercise modalities on individuals with chronic illnesses during 12 weeks. It evaluated changes in metabolism, body composition, and form, with an emphasis on the effects of varying exercise durations (0–6 weeks, 6–12 weeks). The findings revealed notable gains in physical flexibility, cardiopulmonary function, and muscular strength, especially in the back, waist, and shoulder regions.

Seong Donghun et al. [19] examined the short-term off-season physical training affected young soccer players' thigh muscle function and core dynamic balance. The players were trained for two weeks in middle and high school. Body composition, physical fitness, core strength, and knee muscle function all significantly improved, indicating that the exercise was successful in preventing injuries.

Assessing the efficacy of aerobic exercise in the treatment of youths with sport-related concussions (SRC) and mild traumatic brain injury (mTBI) were the objective by Shen Xiaotian et al. [20]. A meta-analysis of randomized controlled trials was conducted using STATA software. The findings indicated that, in comparison to standard therapy, aerobic exercise considerably decreased recovery time and post-concussion symptoms, but it did not affect neurocognitive performance.

BallTrain (aerobic training with a ball and plyometrics) and HIIT Train (HIIT plus weight training) were the two 4-week pre-season intervention programs that were compared by Thomakos Pierros et al. [21] while aerobic fitness increased in both groups, HIIT Train had a higher Yo-Yo Intermittent Recovery Test Level 1 (IR1) improvement. The HIIT Train group's Countermovement Jump (CMJ) performance, however, dropped noticeably, which might indicate that concurrent training causes overload and exhaustion.

The sport of Aero Fencing, which combined rhythmic choreography, fencing footwork and handwork, and aerobic dancing to music, was introduced by Esfanjani Mina et al. [22]. In the experiment, fencers in the control group got standard fencing instruction, while those in the experimental group trained in AeroFencing for four weeks. Results indicated that the experimental group significantly outperformed the control group in terms of anaerobic power, hand speed during attack, and leg speed.

Güler Özkan et al. [23] compared the impact of aerobic and anaerobic training on female soccer players' single-leg dynamic balance. Stability tests were conducted after 16 subjects completed the Bruce protocol and maximum cycling efforts. The findings indicated that while both aerobic and non-aerobic activities had comparable recovery durations, aerobic exercise led to a larger acute impairment in balance. 10 min of rest brought balance back to baseline.

Kozina Zhanneta et al. [24] evaluated the injury prevention technology and impact on the prospects for physical education and sports professionals who were rock climbing's understanding of medical-biological subjects, particularly anatomy. With decreases ranging from 2.3 to 8.1 times, depending on the intricacy of the injury, the experimental group demonstrated a notable increased in their understanding of anatomy and a reduced risk of finger injuries.

Zhong Fei et al. [25] investigated the possible impacts of an 8-week exercise regimen on the gut microbiota of elderly women who did not engage in exercise. Alpha diversity remained almost unchanged. Followed intervention, operational taxonomic units (OTU) showed a propensity to create two clusters. These results suggested that in physically sedentary older women, an 8-week exercise training program might somewhat alter the relative abundance and OTU clustering of gut microbiota.

Tingaz Emre Ozan et al. [26] analyzed the university student-athletes impulsivity and awareness while concentrating on their history of sports injuries. The Barratt Impulsiveness Scale, the sociodemographic data form, and the mindfulness assessment for sport were utilized, and 181 athletes were included. The findings indicated that while athletes with severe injuries scored lower on impulsiveness tests, those with a history of injuries scored higher. They discovered an encouraged association between the frequency of injuries and motor impulsiveness.

Fan Hainan et al. [27] examined the effects of intensive aerobic activity at three different levels on executive function in college students who were hooked to their cell phones. The 30 participants were split into two groups, one received the Go/NoGo task to examine response restriction, while the other was given the Flanker task to evaluate interference control. The findings indicated that moderate-intensity exercise significantly improved response inhibition and did not affect interference control.

3. Methodology

A quasi-experimental design has been used in the examiner to explore various modes of aerobics training on the risk of sports injuries and fitness levels among college students. This design will help to compare the outcomes through distinct training interventions, apart from natural differences among participants. **Figure 1** demonstrates the proposed analysis procedure diagram.

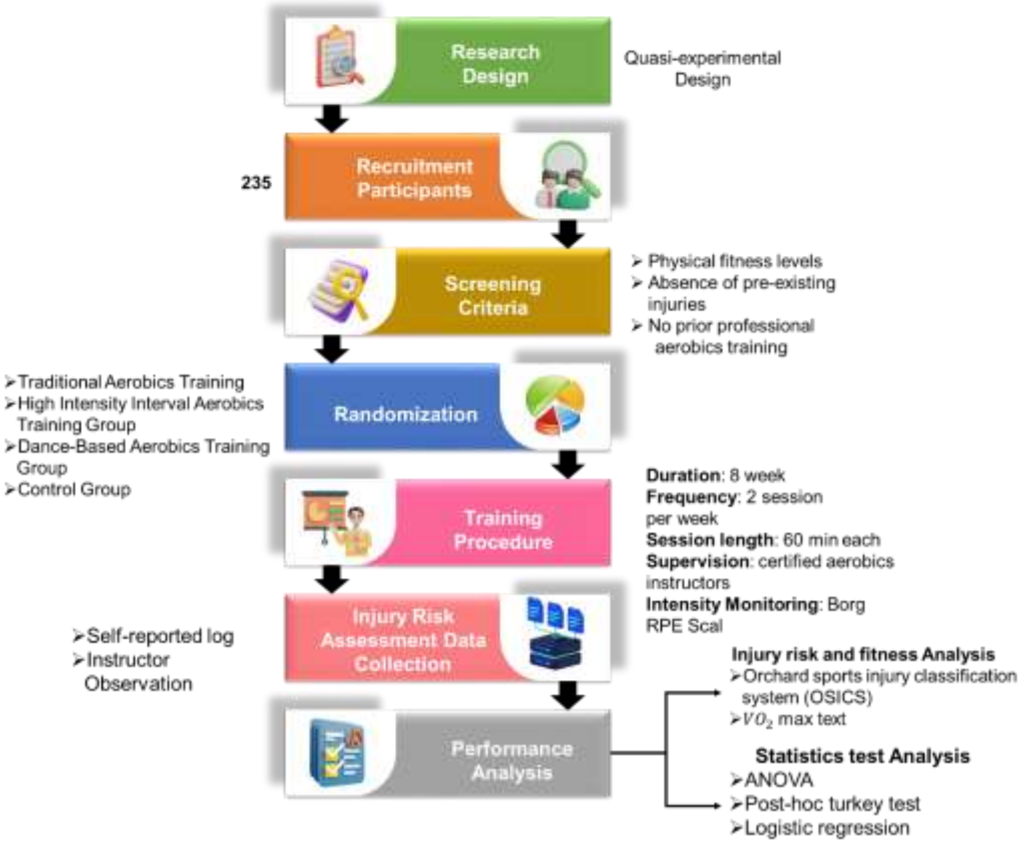

Figure 1. Basic concept of the proposed analysis procedure.

3.1. Participants

The sample size was 235 college students who were selected to participate. This sample was representative and ensured that findings could be generalized to the general population of young adults. The participants were separated into 4 groups: 3 EG and one CG. The respective EG (177) included those going through traditional aerobics training (59), high-intensity interval aerobics training (HII) (59), and dance-based aerobics training (59). The CG (58) did not participate in any aerobic training during the 8-week program and thus served as a point of comparison. The assigned routine was followed by each group twice a week, and it analyzed how different training modes influenced fitness and injury risks. **Table 1** demonstrates the demographic data for aerobics training participants.

Table 1. Demographic data of the participants in aerobics training.

Demographic Characteristic	Experimental group			Control group (*n*=58)	Total (*n*=235)
	Traditional Aerobics training (*n*=59)	HII Aerobics training (*n*=59)	Dance-Based Aerobics training (*n*=59)		
Age					
18–20	30 (50.8%)	32 (54.2%)	31 (52.5%)	29 (50.0%)	122 (51.9%)
21–23	20 (33.9%)	18 (30.5%)	19 (32.2%)	21 (36.2%)	78 (33.2%)
24–25	9 (15.3%)	9 (15.3%)	9 (15.3%)	8 (13.8%)	35 (14.9%)
Gender					
Male	28 (47.5%)	30 (50.8%)	27 (45.8%)	29 (50.0%)	114 (48.5%)
Female	31 (52.5%)	29 (49.2%)	32 (54.2%)	29 (50.0%)	121 (51.5%)
Fitness Level					
Low	12 (20.3%)	10 (16.9%)	14 (23.7%)	13 (22.4%)	49 (20.8%)
Moderate	29 (49.2%)	31 (52.5%)	26 (44.1%)	30 (51.7%)	116 (49.4%)
High	18 (30.5%)	18 (30.5%)	19 (32.2%)	15 (25.9%)	70 (29.8%)
Prior Exercise Experience					
None	5 (8.5%)	7 (11.9%)	4 (6.8%)	6 (10.3%)	22 (9.4%)
Light	20 (33.9%)	22 (37.3%)	18 (30.5%)	19 (32.8%)	79 (33.6%)
Regular	34 (57.6%)	30 (50.8%)	37 (62.7%)	33 (56.9%)	134 (57.0%)
Body Mass Index (BMI)					
Underweight (BMI < 18.5)	6 (10.2%)	7 (11.9%)	8 (13.6%)	5 (8.6%)	26 (11.1%)
Normal Weight (BMI 18.5–24.9)	40 (67.8%)	38 (64.4%)	41 (69.5%)	37 (63.8%)	156 (66.4%)
Overweight (BMI 25–29.9)	10 (16.9%)	11 (18.6%)	9 (15.3%)	12 (20.7%)	42 (17.9%)
Obese (BMI ≥ 30)	3 (5.1%)	3 (5.1%)	1 (1.7%)	4 (6.9%)	11 (4.7%)

3.2. Inclusion and exclusion criteria

The inclusion criteria were aged 18–25 years, with equal numbers from each gender, being physically fit to safely engage in aerobic exercises, and not received any professional training in aerobics, which would ensure that their skill level was uniform. Exclusion criteria included those with pre-existing injuries, medical conditions contraindicating physical activity, or recent participation in structured aerobics or fitness programs, to minimize risks and maintain uniformity in the evaluation of training impact.

3.3. Training procedure

All groups were enrolled in an 8-week training program, conducting two sessions per week; the duration of each was 60 min. All training sessions were conducted under qualified aerobics instructors with concerns for consistency, safety, and specific training schedules concerning each group. The Borg Rating of Perceived Exertion (RPE) scale is used, which is a subjective scale assessing one's perceived effort during exercise to monitor exercise intensity, as shown in **Table 2**. It ranges from 6 (no exertion) to 20 (maximal exertion) with numbers corresponding to different levels of effort based on how hard the participant feels they are working.

Table 2. Comparison of Borg RPE across different groups about sports injury risk.

RPE Rating	Perceived Effort	Traditional Aerobics Training Group	HII Aerobics Training Group	Dance-Based Aerobics Training Group	Control Group
6–7	Very, very light	Light stretching, warm-up	Warm-up or cool-down	Low-intensity warm-up or cool-down	No exercise
8–9	Very light to light	Moderate intensity movement	Easy intervals	Low to moderate-intensity dance	No exercise
10–11	Light to somewhat hard	Moderate, steady aerobics	Warm-up phase or easy intervals	Light to moderate dance intensity	No exercise
12–13	Somewhat hard	Moderate to moderately hard	Moderate to hard intervals	Moderate-intensity dance workout	No exercise
14–15	Hard	Moderately hard aerobics	Hard intervals (majority of workout)	High-intensity dance workout	No exercise
16–17	Very hard	Close to maximal effort	Very hard intervals (brief)	High-intensity dance workout	No exercise
18–19	Very, very hard	Near maximal effort (short bursts)	Maximal effort intervals (short bursts)	Very high-intensity dance workout	No exercise
20	Maximal exertion	Maximal effort (rare)	Maximal effort	Maximal dance effort (brief)	No exercise

The RPE scale helps monitor and adjust the intensity of workouts to keep participants within safe, effective intensity levels of their respective training procedures.

3.4. Injury risk assessment

Data on injuries were obtained by two major methods: self-reported logs from the participants themselves and observations by certified aerobics instructors. This was to ensure that subjective and objective views were considered in the assessment of injury risks. Self-report logs: The participants were required to log any injuries or discomfort they experienced during their training sessions or afterward. These logs helped track minor injuries that might not have been immediately observed. Instructor observations: They observed participants during training sessions and noted any signs of injury or unusual behavior indicative of a predisposition to possible injury. This real-time monitoring helped identify potential issues early. Injuries were classified by type (muscle strain, joint discomfort, etc.), location, and severity. **Table 3** and **Figure 2** show injury risk assessment data.

Table 3. Injury risk assessment data for self-reported log and instructor observations.

Injury Data Source	Injury Type	Frequency (%)	Total Participants (235)
Self-Reported Logs	Muscle Strain	10.2%	24
	Joint Pain	5.1%	12
	Tendonitis	3.8%	9
	Fracture	0.8%	2
Instructor Observations	Muscle Strain	8%	19
	Joint Pain	6%	14
	Tendonitis	2.9%	7
	Contusion	2.1%	5
No Reported Injury	No Injuries	60.8%	143

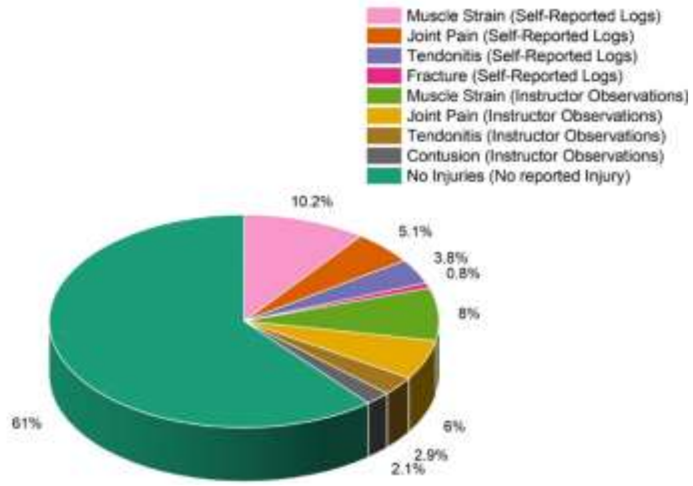

Figure 2. Distribution of injury-type observation.

4. Performance analysis

4.1. Injury risk and fitness analysis

Assessment results revealed better cardiovascular fitness and flexibility. VO_2 max scores increased, showing an increase in aerobic capacity. Flexibility significantly increased, showing improved Sit-and-Reach Test results. The Orchard Sports Injury Classification System (OSICS) was followed for the standardized injury classification.

Initial versions of the OSICS (1-8) used a 3-digit categorization. The OSICS is a system of classifying injuries in sports into the type of injury, severity of injury, and part of the body affected. The system classifies the injury in a consistent manner, which is extremely important in understanding the patterns of injury risk that will prevent them in future training or competition.

Table 4. OSICS outcome based on injury risk assessment data.

Groups	**Injury Type (OSICS)**	**Injury Location (OSICS)**	**Injury Severity (OSICS)**	**Frequency (%)**
Experimental group				
Traditional Aerobics training	Muscle Strain (1.1)	Lower Limbs (7)	Mild (1)	5 (10%)
	Joint Pain (2.1)	Knees (7)	Moderate (2)	2 (4%)
	Tendonitis (4.1)	Ankle (7)	Mild (1)	3 (6%)
	Fracture (5.1)	None (N/A)	Severe (3)	1 (2%)
HII- Aerobics training	Muscle Strain (1.1)	Lower Limbs (7)	Severe (3)	8 (16%)
	Joint Pain (2.1)	Ankles (7), Knees (7)	Moderate (2)	4 (8%)
	Tendonitis (4.1)	Knee (7)	Mild (1)	2 (4%)
	Contusion (6.1)	Upper Limbs (7)	Mild (1)	1 (2%)
Dance-Based Aerobics training	Muscle Strain (1.1)	Lower Limbs (7)	Mild (1)	4 (8%)
	Joint Pain (2.1)	Hips (7), Knees (7)	Moderate (2)	3 (6%)
	Tendonitis (4.1)	Foot (7)	Mild (1)	2 (4%)
Control Group	No Injuries	N/A	N/A	0 (0%)

The OSICS-based injury **Table 4** classifies the specific injuries according to type, location, and severity for the different groups training in aerobics. The most severe injuries were found among the HIIT group because of the high intensity; these were muscle strains and pains in the joints of the lower limbs. Traditional and dance-based aerobics are less frequently injured, with complaints of mild to moderate strains of muscles and pains in the joints. The control group did not sustain any injury, as they did not engage in any aerobics training. On the injury risk, dance-based aerobics was the most balanced program. It achieved the best combination of fitness by trying to stay away from the risk of injuries. It demonstrated fewer major injuries and more enhanced joint mobility and flexibility, making this a safer approach compared with HIIT.

The VO_2 max test is widely accepted as a valid assessment of cardiovascular fitness-the highest use of oxygen in intense exercise. This covers the ability of the lungs, muscles, and heart to utilize oxygen effectively.

Table 5. VO_2 max test for cardiovascular fitness assessment.

Group	$\mathbf{Pre-TrainingVO_2\,Max}$ $(\mathbf{ml/kg/min})$	$\mathbf{Post-TrainingVO_2\,Max}$ $(\mathbf{ml/kg/min})$	**Improvement** (%)
Experimental group			
Traditional Aerobics training	35.4	38.6	9.04
HII-trainingAerobics training	36.1	42.5	17.71
Dance-Based Aerobics training	34.8	39.2	12.64
Control Group	35	35.2	0.57

The VO_2 max **Table 5** and **Figure 3** compare pre- and post-training cardiovascular fitness across four groups. The HII aerobics training group showed the greatest improvement (17.71%), highlighting its effectiveness in significantly boosting aerobic capacity. The dance-based aerobics training group demonstrated balanced results (12.64%), offering fitness benefits alongside flexibility and injury prevention. The traditional aerobics training group achieved moderate improvement (9.04%), providing consistent cardiovascular benefits with lower injury risk. The control group changed the least, 0.57%, reflecting the absence of specific training. The high-intensity interval aerobics group increased the most in VO_2 max and was the most effective for cardiovascular fitness, but it had the highest risk for fatigue or injury.

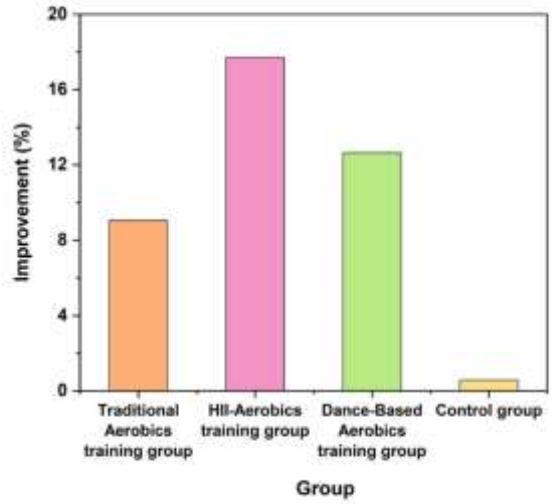

Figure 3. Improvements in VO_2 max across different training groups.

A widely used and easy-to-administer flexibility test is the sit-and-reach test. There is an abundance of publicly available data to depend on when using the traditional testing procedure. The sit-and-reach test **Table 6** shows flexibility in participants of different groups involved in aerobics training before and after the training program that lasted 8 weeks. Pre-test and post-test test results in inches and centimeters are included for both males and females, as shown in **Figure 4**.

Table 6. Outcome of Sit-and-reach test for Pre-and post-test flexibility measurements.

Groups	**Years (18–25)**							
	Male				**Female**			
	pre − training		**post training**		**pre − training**		**post training**	
	inches	**cm**	**inches**	**cm**	**inches**	**cm**	**inches**	**cm**
Experimental group								
Traditional Aerobics training	7.9	20.1	8.3	21.1	7.8	19.8	8.1	20.6
HII- Aerobics training	8	20.3	8.5	21.6	7.9	20	8.3	21.1
Dance-Based Aerobics training	7.7	19.6	8.9	88.6	7.6	19.3	9	22.9
Control Group	7.8	19.9	7.9	20.1	7.7	19.6	7.8	19.8

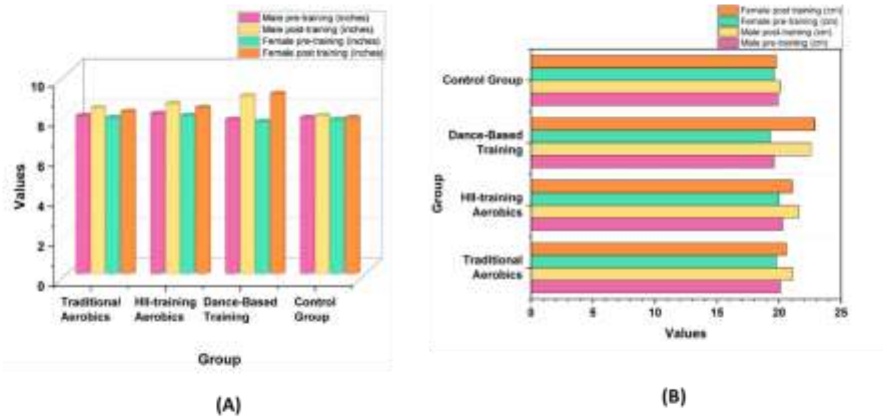

Figure 4. Pre and post-training measurements. **(A)** inches;**(B)** cm.

Among the groups, the dance-based training aerobics group had the highest increase in flexibility: both males and females showed a significant increase in post-test flexibility, 8.9 inches/22.6 cm for males and 9.0 inches/22.9 cm for females. That group improved beyond any other group. The CG had the least increase in flexibility; there was no significant increase either for male or female participants. Therefore, it indicates that dance-based aerobics tends to be more effective in improving flexibility compared to traditional aerobics, HII Training, or no training at all.

4.2. Statistical test analysis

The performance analysis on the impact of various aerobics training types on sport injury risk on college students, SPSS version 15 was used for data analysis. Injury incidence and fitness improvements were compared using ANOVA across groups. Post-hoc Tukey tests were also completed to determine which groups differed in terms of injury incidence for specific group comparisons. Injury outcome was subject to logistic regression analysis, controlling for baseline fitness measures and training compliance scores. This provided a three-level test of interaction between fitness and training factors with the outcome of injury.

ANOVA is a statistical technique used to compare means across many groups at a similar time to identify whether the discovered deviations are the result of opportunity or reflect actual distinctions. ANOVA reveals the links between variables and pinpoints the authentic sources of deviation by splitting the overall modification into fragments. ANOVA is a reliable method for better understanding complex relationships since it can handle several elements and their interactions. Using this statistical technique, the four training groups were compared for differences in injury incidence and fitness improvements. ANOVA is used to assess if the groups' injury rates or levels of fitness differ in any statistically significant manner.

The ANOVA **Table 7** indicates that there is a significant difference among the four groups: Traditional Aerobics, HII training aerobics, dance-based aerobics, and control, with an $F = 5.12$ and a$p = 0.003$, lower than the conventional significance threshold of 0.05. This means that at least one of the groups differs significantly from the others in injury incidence or fitness improvements. Traditional, high-intensity interval and dance-based aerobics contrast significantly with the control group.

Table 7. Outcome of ANOVA for assessing the training modes on injury risk.

Source of Variation	The sum of Squares (SS)	df (Degrees of Freedom)	Mean Square (MS)	$F -$ statistic	$p -$ value
Between Groups	2.5	3	0.83	5.12	0.003
Within Groups (Error)	12.8	231	0.06		
Total	15.3	234			

The post-hoc Tukey test is any test of significance performed between groups after an ANOVA to establish which particular groups or conditions are significantly different from others. These are used only when the results from an ANOVA statistical test show that there is a difference between groups. To ascertain whether the group techniques differ significantly from each other, an ANOVA is performed. If ANOVA results are significant, post-hoc tests are conducted to find out exactly which pairs of groups differ from each other. The widely used test is known as Tukey's honest significant difference (HSD) compares all mean pairings while limiting the total Type I error rate. Results of the post-hoc Tukey Test based on mean differences with 95% CI comparison between aerobics training groups are shown in **Figure 5**.

Table 8. Outcome of Post Hoc Tukey Test Analysis.

Group Comparison	Mean Difference	SE Difference	HSD	95% CI	T-value	p-value
Dance-Based vs. Control	1.2	0.45	2.67	(0.35, 2.05)	2.67	0.012
Dance-Based vs. Traditional Aerobics	0.3	0.45	0.67	(−0.15, 0.75)	0.67	0.51
Dance-Based vs. High-Intensity Interval	−0.8	0.45	−1.78	(−1.75, 0.15)	−1.78	0.08
Traditional Aerobics vs. Control	1.5	0.45	3.33	(0.65, 2.35)	3.33	0.04
High-Intensity Interval vs. Control	2	0.45	4.44	(1.15, 2.85)	4.44	0.03
Traditional Aerobics vs. High-Intensity Interval	−0.5	0.45	−1.11	(−1.35, 0.35)	−1.11	0.27

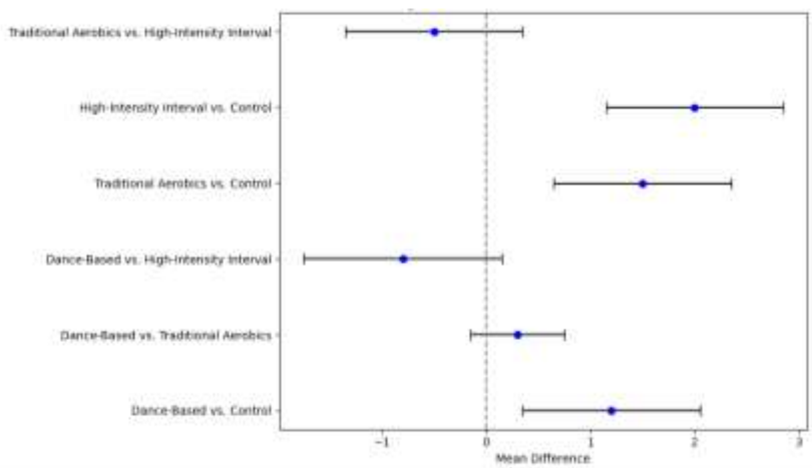

Figure 5. Post-hoc Tukey test results for comparisons between aerobics training group (95% CI).

Table 8 shows the result of the post-hoc comparisons between the different groups in aerobics training and that of the control group. Improvement in fitness and injury prevention was highly significant for the Dance-Based Aerobics training group related to the control group, with a $p = 0.012$. Moreover, significant differences were obtained in comparisons of HII Aerobics training and Traditional Aerobics training against the control group, with respective $p = 0.03$ and 0.04. However, dance-based aerobics training did not significantly differ from Traditional Aerobics, $p = 0.51$ and High-Intensity Interval Aerobics, $p = 0.08$, thus, although superior compared with the control group, it is relatively similar when compared with other experimental groups in the same basis of fitness and injury outcome. The most significant group in improving fitness and reducing injury risk was dance-based aerobics compared to the control group.

Logistic regression is extremely comparable to linear regression; however, it uses binary response variables. Based on particular features, a logistic regression model estimates the chance of a specific outcome. Equation (1) will be used to express the logarithm of probability because the value is a proportion.

$$\log\left(\frac{\pi}{1-\pi}\right) = \beta_0 + \beta_1 w_1 + \beta_2 w_2 \ldots \beta_n w_n \quad (1)$$

where the probabilities of an occurrence are represented by π, and the coefficients of regression for the initial group are denoted by β_i and the w_i variables of explanation. It is necessary to emphasize an essential concept at that point. For every variable $w_1 \ldots n$, the individuals that exhibit the reference level make up the reference group, which is denoted by β_0. Logistic regression has been used to model the odds of injury occurrence from the different categories of training groups, controlling for baseline fitness and compliance with training. It is best suited for assessing the relationship between multiple predictors and a binary outcome.

Table 9. Outcome of Logistic Regression Analysis Test.

Source	***B***	**SE B**	**Wald χ^2**	***p***	**OR**	**95% CI OR**
Intercept	−0.23	0.15	2.4	0.12		
Experimental group						
Traditional Aerobics training	−0.69	0.31	5.03	0.03	0.5	(0.26, 0.96)
HII Aerobics training	0.53	0.25	4.41	0.04	1.7	(1.02, 2.83)
Dance-Based Aerobics training	−1.2	0.42	7.96	0.01	0.3	(0.13, 0.68)
Control (Reference Group)	0	0	0		1	

Note: Coefficients (B), standard error(SE), Wald chi-square test statistic(Waldχ^2), Odds ratio(OR), and confidant interval (CI).

In logistic regression, **Table 9** presents the odds of injury across the aerobics training groups versus the control group. Dance-based aerobics significantly decreased injury risk, $\mathrm{OR} = 0.30$, $p = 0.01$, and it safest form of training. Traditional Aerobics showed reduced injury risk, $\mathrm{OR} = 0.50$, $p = 0.03$. On the other contrary, high-intensity interval aerobics significantly increases the risk of injury, with an $\mathrm{OR} = 1.70$, $p = 0.04$. The control group is the baseline against which the rest are compared. These findings point to dance-based aerobics training as the most effective and injury-safe option.

4.3. Discussion

The outcome of the research demonstrated that varied aerobic training techniques had an important effect on both physical achievements and injury probability. The high-intensity interval aerobics (HII) group exhibited the highest enhancement of cardiovascular wellness, as determined by VO_2 max testing, in contrast to conventional and dance-based aerobics. Furthermore, the Sit-and-Reach test confirmed that adaptability increased more in the dance-based aerobics group, implying that it may have the capacity to improve various kinds of action. Injury risk evaluations discovered that traditional aerobics and HII training were more inclined to trigger injuries than dance-based aerobics. Post-hoc Tukey tests verified these disparities, especially about the harm associated with HII and dance-based aerobics. Logistic regression analysis authorized these findings, confirming that the kind of activity mode had an important effect on both levels of fitness and injury probability, with dance-based aerobics presenting a more secure option. Finally, the findings underscored the importance of establishing an aerobics method of training that suits individual fitness targets and injury tolerance to risk.

5. Conclusion

The research effect of different types of aerobics training on the risk of sports injuries among college students is based on various fitness metrics. To compare the traditional aerobics training, HII aerobics training, dance-based aerobics training, and a control group (no aerobics) influenced injury risk and improvements in fitness over 8 weeks. A 235 academic individuals were randomly allocated to one of four groups, each receiving their respective training regimen twice per week for 8 weeks. Fitness assessments, such as cardiovascular fitness measured by VO_2 max and flexibility measured by the Sit-and-Reach Test, were conducted during pre- and post-training periods. The injured data were recorded using self-reported logs and instructor observation; injury severity was classified with the OSICS. Statistical evaluation consisted of ANOVA, Post-hoc Tukey tests, and logistic regression to evaluate group differences in injury rates and gains in fitness. The findings of the ANOVA demonstrated that the groups' rates of injury and fitness gains varied significantly. With modest gains in cardiovascular fitness and flexibility and a low risk of injury, dance-based aerobics offered the best-rounded advantages. Significant fitness increases were demonstrated by the High-Intensity Interval Aerobics group, but they also had an increased risk of lower-limb injuries. The traditional aerobics group yielded a moderate increase in fitness at a reduced risk for injuries, while the control group showed no significant improvements in either fitness or injury rates. In post-hoc Tukey tests, Dance-Based Aerobics were found to have fewer injuries (p=0.012), than High-Intensity Interval Aerobics and were more effective than the control group in improving the subject's joint mobility and flexibility. Logistic regression analysis verified that Dance-Based Aerobics significantly lowered injury risk compared to the other groups, OR = 0.30, $p = 0.01$, while High-Intensity Interval Aerobics significantly increased injury risk, OR = 1.70, $p = 0.04$. According to the examination's findings, dance-based aerobics has become an effective and safe training method and an aerobics program should be customized to each individual's level of fitness for the greatest health advantages and the lowest chance of injury.

Limitation and future scope

Limitations of assessing injury risk include variability in individual responses to different modes of aerobics training. Further, inconsistent compliance with the training schedule and the heterogeneity of fitness levels among participants could bias the results. Future directions are required to establish personalized training plans that include injury prevention methods and assess long-term effects in various demographic conditions for more generalized conclusions.

Author contributions: Conceptualization, RT and XF; writing—original draft preparation, RT and XF; writing—review and editing, RT and XF. All authors have read and agreed to the published version of the manuscript.

Ethical approval: Not applicable.

Conflict of interest: The authors declare no conflict of interest.

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