

## Health Evaluation Index of Basketball in modern sports

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*The Health Evaluation Index of Basketball in Modern Sport is a comprehensive tool designed to assess the physical fitness of basketball players. The index takes into account various health indicators, such as body mass index, resting heart rate, and maximal oxygen uptake, to provide a holistic evaluation of an athlete's health status. The index is particularly useful in modern sport, where basketball players face increasing physical demands and performance expectations. By using the Health Evaluation Index, coaches and trainers can monitor the health and fitness of their players, design individualized training programs, and reduce the risk of injuries. The index can also be used to compare the health status of different players or teams, and to identify areas for improvement. Overall, the Health Evaluation Index of Basketball in Modern Sport is a valuable tool for promoting the health and well-being of basketball players in the contemporary sports landscape.*

KEY WORDS: Health; Basketball; Sports.

### 1. Introduction

The improvement of the economy has led to an increased awareness of health and healthcare among people, resulting in more individuals adopting the fitness concept, which in turn has led to the growth of the fitness industry (Yao et al., 2018). Furthermore, as basketball continues to develop and expand, it has become a crucial skill for many fitness enthusiasts. Despite basketball's popularity, the proportion of people who participate in it in countries with large populations remains relatively low (Mu, 2017). To assess the health of basketball players, a Health Evaluation Index (HEI) is used. The HEI is a comprehensive tool that takes into account multiple pa-

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rameters such as physical fitness, nutrition, mental health, and injury history to provide a holistic evaluation of a player's health status. This article reviews the importance of the HEI in modern sports and provides a case study to illustrate its practical applications (Dawson, 2023). The majority of people adore basketball and consider it to be one of the national fitness initiatives. It not only has a lot of substance and is very beneficial for exercising, but it also strengthens the body and enhances a variety of bodily processes. It is an excellent way for individuals to enjoy a restful night's sleep as well as a type of health care endeavor. The development of people's physical quality and human function is also particularly impacted by it (Chen, 2022). We should encourage more people to play basketball since it is a complete physical activity with minimal entry requirements and few limits. Playing basketball will help all joints and muscles in the human body receive efficient exercise, which will enhance physical function (Castillo et al., 2021). Currently, teenagers have a limited understanding of sports and struggle to learn basketball techniques properly. Local governments are encouraging teenagers to engage in basketball training and study as a means of improving public health. However, teenagers have difficulty understanding how different basketball movements relate to one another, and they struggle to combine basketball training with their own abilities. As a result, finding an effective method of basketball training guidance is essential to promote the healthy development of the public. National fitness and healthy China's two national plans serve as a guarantee to meet the people's needs for a healthier life in the new era and are crucial components of the growth strategy of a modern power.

Sports are now a significant part of thousands of families' everyday lives thanks to the emergence of national fitness, which has a clear positive impact on productivity, physical and mental health, and spiritual culture (Huang and Huang, 2017).

Basketball has a diverse range of sporting activities, and people of all ages can engage due to the sport's load and intensity. Consequently, basketball plays a beneficial and efficient role in implementing the national fitness programme, raising the overall standard of Chinese basketball, and enhancing the public's physical and mental health. National fitness has emerged as a crucial precondition for national health, and the two can be integrated because proper and acceptable exercise is the foundation for guaranteeing physical health (Chu et al., 2022). The HIE of basketball of individuals of all ages was examined in this research, along with the importance of integrating national fitness and public healthcare as a starting point, and the relevant guidance plan was presented.

The Health Evaluation Index serves a critical role in modern sport,

when basketball players confront increasing physical demands and performance expectations, by offering a comprehensive assessment of an athlete's health state. With the use of this index, basketball players' general health and fitness levels may be more precisely evaluated by coaches, trainers, and medical experts.

It's critical to comprehend the relevance of this study since it raises the possibility of using the Health Evaluation Index in basketball training regimens. Coaches and trainers can create specialized training programs and interventions to improve the health and performance of their players by identifying areas for development and monitoring progress over time.

The importance of this work also rests in its potential to advance the discipline of sports science as a whole. The Health Evaluation Index acts as a foundation for other sports or athletic undertakings that may be modified and implemented, enabling thorough health examinations across other disciplines.

The importance of this study will help people better understand how the Health Evaluation Index may have a beneficial influence on basketball practice and performance. It will also show the index's usefulness outside of basketball and identify possible uses for it in the larger field of sports science.

## **2. The importance of national fitness and national health integration**

### **2.1 ADAPTION TO CURRENT NEEDS FOR DEVELOPMENT**

The basis for people's growth and function is their physical and mental health. With national fitness, it is possible to encourage the healthy growth of the country's population and direct them towards adopting a fit lifestyle. Hence, it is essential to encourage the achievement of the objective of a prosperous society for all people based on national health (Gao & Liu, 2021). Basketball is a type of irregular movement in which the bones, joints, and muscles throughout the entire body are interconnected. Exercise can promote bone density, stop the loss of calcium ions from human bones, making them stronger and more resistant to fracture, and treat other ailments such as bone fracture. Basketball played in everywhere. Indoor gymnasiums and outdoor courts both include basketball courts, and their shadows may be seen everywhere. The continual movement of the human body's joints during a game of basketball causes them to become more flexible. To increase their joint surface area, and increase their range of motion and flexibility (Nokoff et al., 2023).

Frequent basketball play can enhance body shape, decrease body fat build up, develop muscle tolerance, and train the activity and strength of all the muscles in the body. One of the key elements influencing the growth of mass sports is leisure time. In China right now, farmers, retirees, and independent workers have more free time. Due to basketball's robust game, entertainment value, and interest, exercise intensity can be adjusted based on the participants' actual circumstances, and the necessary facilities can generally be found. As a result, basketball can cultivate people's sentiment and improve their leisure time. The system will be established closer to the grass-roots and the residents the stronger the economy is and the higher the level of social development. China likewise clearly exhibits the traits of strong units (Jiang and Zhang, 2023).

**Health Index Evaluation:** Athletes' skills, strategies, physical fitness, and psychology serve as a showcase for their abilities and dedication (Yin et al., 2014). Basketball is a sport that requires physical fitness, coordination, and agility. A high-intensity game involves many running, jumping, and sudden changes in direction. To evaluate the health index of basketball, several factors need to be considered, including:

### 2.1.1. *Physical Fitness*

#### *The necessary physical readiness for a basketball game*

There has been a substantial accumulation of detailed data regarding modern basketball coaching techniques during the past two decades (Schelling & Torres, 2016). Basketball's recent quick rise may partially attributed to the body type and exceptional athleticism of players (Delextrat and Cohen, 2008). As previously said, the game has been more faster since the 24-second shot clock was implemented, and the idea of quick play has become essential in basketball. The players now face intense physical demands on both the offensive and defensive ends, making their explosive strength even more crucial (Stojanovic et al., 2012). Strength and conditioning coaches and other industry experts are looking for more efficient ways to foster and improve players' physical skills as well as better ways to monitor and evaluate the fitness requirements for the game of basketball (Meckel et al., 2009).

For overall game performance, aerobic capacity is a crucial element needed for repeated sprints. Yet, the majority of the game's motions, like as leaping, changing directions, and footwork, are considered anaerobic (Abdul-kareem & Awadh, 2023) (Abdelkrim et al., 2007). Basketball games are

said to be anaerobic-dominated, requiring players to sprint quickly and intensely repeatedly. Physical fitness is a performance characteristic that can be evaluated via closed tests, which distinguishes it from other performance factors. There is currently no information on which tests are the best for the sport to which they are used (Mancha-Triguero D, 2019)

### 2.1.2. *Aerobic fitness*

Basketball requires a high level of cardiovascular fitness. Players need to be able to run up and down the court repeatedly for an extended period. A player's aerobic fitness level can be measured using tests such as the beep test or the VO<sub>2</sub> max test (Castillo et al., 2021).

**Muscular strength and endurance:** Basketball players need to have a strong upper and lower body to perform the various movements required in the game, such as jumping, shooting, and defending. Tests such as the bench press, squat, and vertical jump can be used to evaluate a player's strength and endurance (Dawson, 2023).

**Flexibility:** Flexibility is an essential aspect of basketball as it helps players move more easily and reduce the risk of injury. Tests such as the sit-and-reach test or the shoulder flexibility test can be used to evaluate a player's flexibility.

**Agility and speed:** Basketball requires players to be able to move quickly and change direction rapidly. Tests such as the 5-10-5 drill or the agility T-test can be used to evaluate a player's agility and speed.

Overall, a comprehensive health index evaluation of basketball would consider all of these factors and more to assess a player's overall fitness level and identify areas for improvement.

### 2.1.3. *Aerobic test*

The Yo-Yo endurance test involves jogging back and forth for 20 meters while exerting increasing amounts of effort until the participant is fatigued. It measures your maximal aerobic capacity. The test and VO<sub>2</sub> max have a strong connection ( $r = 0.92$ ). This test is accurate and trustworthy for estimating aerobic capacity in various population (Clair G, 1998). Due to its adaptability to the regular activity patterns engaged in by athletes, the test was chosen to assess aerobic fitness every few months. Starting at 8 km/h, the speed rises by 0.5 km/h every minute. An audio disc sets the tempo and provides the audio. The number of times the athlete can complete the sprints

without becoming exhausted determines the test results (Castagna et al., 2005).

**Neuromuscular test:** 5/10-meter sprints starting from a standing position. Test of speed: In this test, sprints from a standing start are used to measure horizontal power. The success of the examinee depends on the initial step. Often, photoelectric cells or opt jump are used to measure times. After 3-5 minutes of recovery in between each sprint, each participant completes two high-start sprints. The fastest time is noted (Gottlieb et al., 2014).

**Absolute Speed test:** 20/30-meter sprint test from a standing start; this test also assesses horizontal power while a cyclical movement is being performed, such as sprints. The capacity for acceleration is essential for successful outcomes. Usually, opto-electric cells or photo-electric cells are used to measure time. Two sprints are performed by each participant starting from a standing position, followed by 3-5 minutes of rest. The fastest time is noted.

**Squat leap test** - In a similar vein, a squat jump can be carried out as a test. The athletes take a squatting stance. The athlete stops moving and jumps as high as they can while holding their hands behind their back or on their hips.

**2 × 5-m agility test:** this test gauges how quickly you can turn and change directions while sprinting. It takes 10 meters to complete the test by running 5 meters in one way, turning rapidly, and sprinting back 5 meters. The test can evaluate performance using photoelectric cells or an Optojump system (Delextrat & Cohen, 2008; Doijad et al., 2013).

**Physical Fitness test:** For each CMJ and DJ trial, a photocell device (Optojump, Microgate TM, Bolzano, Italy) was utilized to assess jump height (cm), with the greatest jump in each test being chosen for further research. To measure linear speed, players ran two trials of 20-m sprints at their maximum effort. There was a passive, standing rest period of 120 seconds between each sprint trial. Sprint split timings of 5, 10, and 20 m were measured using four pairs of photoelectric cells (Microgate TM Polifemo, Bolzano, Italy). Players' COD speed was evaluated using the 505 COD test and the Lane Agility Drill. A single trial of the RCOD sprint test was conducted, consisting of five 30-meter shuttle sprints (15 + 15 m) separated by 30-second periods of passive standing recovery (Table I).

**Nutrition:** The series of processes by which food is broken down, absorbed, and used by living things to support their survival as well as the development and proper operation of their organs is known as nutrition. Nutrition is a key component of "invisible" training since it promotes healthy growth and development, as well as optimal recovery, performance, and injury risk in young athletes (Jeukendrup and Cronin, 2011). Also, young ath-

TABLE I  
*Physical Fitness Test*

Variable	Entire Sample (n=23)
<i>Jump tests</i>	
Countermovement jump height(cm)	24.7±5.6
Drop jump height(cm)	26.1±6.4
<i>Linear Sprint test</i>	
5-m sprint time(s)	1.12±0.08
10-m sprint time(s)	2.00±0.14
20-m sprint time(s)	3.46±0.40
<i>Change of direction (COD) speed tests</i>	
Lane Agility Drill time(s)	15.31±1.00
505 COD test time(s)	2.68 ±0.20
<i>Repeated change of direction (RCOD) spring test</i>	
RCOD sprint test time(s)	34.13±2.06

letes’ psychological characteristics like self-concept and self-efficacy might benefit from good eating practices. Basketball in particular, and the world of sport in general, focuses heavily on food supervision. The role of diet in daily China basketball practice is not made clear enough. Yet, the research of the various factors influencing sports performance demonstrates the crucial role that this plays in the quest for the ideal level of physical aptitude. In China, 23 number of basketball players are randomly selected to discuss their nutritional habit. Table II and Table III display the nutritional knowledge and practices of the full group.

**Injury:** Injury may change a professional athlete’s life and career, and regrettably, studies have indicated increased trends in injury rates ranging from 12.4% (Starkey, 2000) to 15% (Podlog et al., 2015). First, recovering from injuries and getting back into shape present athletes with difficult hurdles that may get in the way of their professional aspirations(Amin et al., 2013). In China, with as much as 39% of people unable to play in the basketball match following Achilles tendon reconstruction to as little as 14% after anterior cruciate ligament (ACL) restoration, injuries needing surgical intervention can be career-ending at one extreme. Injury consequences also impact the corporations that the athletes have contracts with. No matter how many injured players are on a team, the healthy players still on the roster must compete, and data suggests that team performance is also impacted.

TABLE II  
Nutritional Habits

Question	Entire sample (n=23)				
	Never	Sometimes	Often	Always	NR
C1					
Breakfast	4.3	0	0	95.7	0
C2	Tea	Juice	Chocolate	Milk	NR
Beverage					
Breakfast	0	0	0	95.7	4.3
C3	Cheese	Pizza	Bread	Fruit	NR
Eat					
Breakfast	0	0	95.7	0	4.3
	Never	Sometimes	Often	Always	NR
C4 Fruit	13	17.4	30.4	34.8	4.3
C5 Vegetable	8.7	47.8	26.1	13	4.3
C6 Cake	21.7	52.2	13	8.7	4.3
C7 Wine, beer	60.9	30.4	0	8.7	0
C8 Three meals	0	0	21.7	78.3	0
C9	Monotony	Different on weekend	Different sometimes	Different all days	NR
Diet	4.3	0	8.7	87	0
C10	Different all days	Carbohydrate	Lipids	Protein	NR
Diet based on	56.5	0	4.3	34.8	4.3
C11 Snacks	Sweets	Fried	Bread	Fruit	NR
	8.7	21.7	26.1	30.4	13
C12	Juice	Wine, beer	Refresh	Water	NR
Beverages	0	0	8.7	91.3	0
	Never	Sometimes	Often	Always	NR
C13 Milk	0	0	4.3	95.7	0
C14 Water	0	13	26.1	56.5	4.3
C Total	44.78 ± 3.70				



TABLE III.  
*Nutritional knowledge*

Question	Entire sample(n=23)	
	Correct (%)	Incorrect (%)
H1 Carbohydrates	56.5	43.5
H2 Fiber	17.4	82.6
H3 Fat	8.7	91.3
H4 Protein	56.5	43.5
H5 Calories	56.5	43.5
H6 Energy	47.83	52.17
H7 Vitamins and minerals	4.3	95.7
H8 Balanced diet	21.74	78.26
H9 Daily energy expenditure	65.2	34.8
H10 Biological foods	56.5	43.5
H11 Transgenic foods	21.7	78.3
H Total	4.57 $\pm$ 1.88	

There have been few attempts to find possible links between visible basketball game performance metrics and injury risk.

While little is known that could help to lower injury rates, researchers have learned a great deal about specific injury prevalence, with consistent findings regarding which injuries are most common, which injuries cause the most missed time, and the percentage of injuries occurring during competition. The majority of people who had serious injuries returned to sport after their recovery, according to Starkey (Starkey, 2000). Investigators however, their findings on whether postoperative performance fell short of pre-injury performance were conflicting (Amin et al., 2013). The potential significance of fatigue (Fuller et al., 2016) and workload (Nassis and Gabbett, 2017) as injury risk factors has been demonstrated by other writers.

According to the available evidence and limited knowledge on injury risks, several observations can be made, (1) there are likely to be variations in the likelihood of suffering one or more injuries, (2) greater levels of exhaustion would raise the chances of getting hurt, (3) a rise in the amount of physical exertion would be linked with an increased risk of injury, (4) having more years of competitive basketball experience would lead to a higher likelihood of injury, and (5) variances in physical characteristics would not impact the

differences in injury risk (Jiang and Zhang, 2023). The descriptive statistics for the independent variables are shown in Table IV.

In addition to being able to discriminate between players who had no injuries and those who had at least one injury, the average projected likelihood had a positive correlation ( $r = 0.672$ ) with the total number of injury occurrences (Figure 1).

Players who bear a larger load for an extended period of time are more likely to sustain an injury. Performance load can either raise or decrease injury risk. The likelihood of high compliance with advice like rebounding more or shooting the ball less is unlikely. Moreover, increases in load may be brought on by outside

TABLE IV  
Statistics

Label	Group		
	Full Sample (N=1401)	No Injury (n=605)	Injury (n=796)
Accumulated min (scaled per 96)	8.27 ± 6.77	8.23 ± 6.76	9.72 ± 7.11
Rest	1.25 ± 1.20	1.25 ± 1.20	1.19 ± 1.06
Rebounds (scaled per 3)	- 0.50 ± 4.74	- 0.52 ± 4.75	0.43 ± 4.16
Field goal attempts (scaled per 3)	- 1.31 ± 7.72	- 1.35 ± 7.73	0.35 ± 6.64

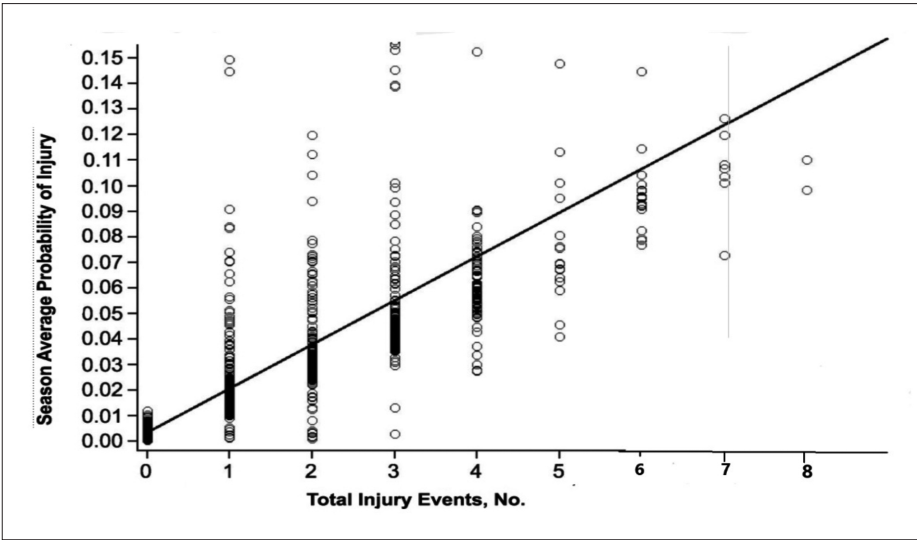


Fig. 1. - The correlation between a player's overall injury incidents and average estimated chance of injury.

variables, such an injury to a teammate. Although monitoring performance load can be useful for determining injury risk, its use to injury prevention may be restricted. The amount of cumulative minutes played exhibited the weakest correlation with injury risk, indicating that limiting cumulative minutes may not be an effective way to avoid injuries for the typical athlete. Yet, among all the factors examined, rest had the greatest impact. For the typical athlete, avoiding back-to-back games can cut their risk of injury by about 16%.

### **3. Discussion**

To improve and assess basketball players' health, it is crucial to comprehend their physical fitness characteristics, physical activity behaviors, dietary habits, nutritional knowledge, and injury risk. Basketball players' motions consist of a mix of horizontal movements (sprints and direction changes), vertical movements (jump shoots and rebounds), and movements that combine the two movement planes, mostly while advancing to the basket and blocking shots. These are fast-paced, high-intensity moves that are frequently made by players in all positions on the court over the course of a game at various intervals. Fitness coaches, physiologists, and other industry experts are searching for the best training techniques to promote and enhance physical talents in basketball players as a result of this combined form of movement. Without a doubt, basketball players' ability to quickly recover from sprints and repeated hops depends on their aerobic capacity (Ramos et al., 2021). Hence, before the start of the season in particular, coaches and fitness coaches must accurately test the aerobic capacity of their players. Currently, a variety of field and laboratory tests for aerobic capacity are available. Although several field tests, including the Cooper test (sequence 12-min running tests), have been created because to the Cooper test's expensive cost, the laboratory  $\text{VO}_2$  max test is accurate (Castillo et al., 2021). Adolescent basketball players must achieve optimal growth and performance, which requires both good physical fitness and a balanced, suitable nutrition. Specifically, 23% of men and 40% of women in the overall sample never or seldom eat fruit, whereas 46% of men and 70% of women in the entire sample never or rarely eat vegetables. In order to prevent chronic diseases like overweight, obesity, diabetes, or cardiovascular diseases, it is advised to consume 5 fruits and vegetables every day. According to research, eating fruits and vegetables can either postpone or prevent the onset of chronic non-communicable diseases, or illnesses linked to bad lifestyle choices (such as type II diabetes and obesity) (Nokoff et al., 2023) (Lampe, 1999). The nutritional makeup of meals, which includes vitamins, minerals (essential nutrients), and dietary fiber, is primarily responsible for these advantages. Adolescents can avoid weight gain and lower

their chance of becoming overweight or obese later in life by increasing their intake of fruits and vegetables and decreasing their intake of fats, sweets, and salt. The vitality of player health cannot be overstated. My study's objective was to empirically contribute to the maintenance of athletes' health by identifying the significant risk factors for injuries. Researchers have looked at post-injury consequences extensively, but prevention has received less attention. In general, increased injury risk was positively correlated with increases in performance load. Similarly, one may read the findings as indicating that a decreased risk of injury is related with reductions in performance load. Yet, noticed that this effect's power varied amongst participants.

According to research on U-14 Spanish national basketball players, male players ( $n = 33$ ) showed greater lower-body power (abalakov jump and multi-jump test) and repeated-sprint capacity (repeat sprint ability test) than female players ( $n = 12$ ) (Manzano-Carrasco et al., 2023; Mancha-Triguero et al., 2021). This is consistent with the body of research suggesting that sex differences in athletic performance arise about the time that men (12–13 years old) start to go through puberty (Handelsman, 2017). The larger absolute and relative fat-free mass of U-14 male players compared to early adolescent females may explain their better physical performance as seen in numerous fitness tests. Females often undergo a reduction in relative fat-free mass before to puberty (McCarthy et al., 2014).

Additionally, the research discovered strong relationships ( $p < 0.05$ ;  $r = 0.60$  to  $0.63$ ) between physical fitness traits (linear sprint time and RCOD ability) and external load variables (total distance, high-speed running distance, and number of jumps performed) during simulated games in elite U-14 male basketball players. The performance index ratings of elite U-14 male players (CMJ height, 20-m linear sprint time, and Agility T-test time,  $r = 0.25$  to  $0.23$ ,  $p < 0.01$ ) and female players (CMJ power,  $r = 0.16$ ,  $p < 0.05$ ) during matches were also correlated with these physical fitness characteristics (Ramos et al., 2021).

### 3.1 ENCOURAGING THE IMPROVEMENT OF THE HEALTH SECTOR

The modernization and transformation of the health sector are essential for social progress in the new era and a key strategy for raising Chinese citizens' standards of living in line with the growth of China's social realities. The traditional healthcare sector is primarily concerned with curing illnesses. It is now starting to change to focus on illness prevention. Hence, it is also necessary to integrate health products with peoples' realities. Participating in basketball regularly can help to increase reflex action speed and the human central nervous system's ability to react quickly, which will help the body become more

adept at quick action and sharp observation. The national fitness system we have built is a service and security system that can continuously supply and improve the sports fitness environment and conditions for all the people, essentially meeting the varied sports fitness needs of all the people, and significantly improving the health quality of all the people. This is done in order to achieve the fundamental goal of improving the health quality of the entire nation.

#### 4. Conclusion

In conclusion, the evaluation of an individual's health index using a combination of physical fitness tests, nutrition, and injury risk factors has been extensively studied and is considered an effective approach to evaluating overall health and wellbeing. This review article highlights the importance of considering multiple aspects of physical fitness, including aerobic capacity, agility, and speed, in addition to nutrition and injury risk, to create a comprehensive picture of an individual's health status. By assessing these different factors, we can identify areas for improvement and create targeted interventions to promote a healthier lifestyle. It is evident that a comprehensive approach to health evaluation can help individuals achieve optimal health and reduce their risk of chronic disease and injury. Future research should continue to explore the relationship between different aspects of physical fitness, nutrition, and injury risk to develop more effective strategies for improving health outcomes.

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