



## Game-Based Physical Fitness Development For FIKK UNM Students

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### ABSTRACT

Physical fitness plays an essential role in maintaining students' health, productivity, and overall quality of life. However, one of the major challenges in physical education is motivating students to actively participate in regular fitness activities. Conventional training methods are often perceived as monotonous and less engaging, which can reduce students' motivation and participation. Therefore, innovative learning approaches are needed to create enjoyable and meaningful physical activity experiences. This study aims to examine the effectiveness of a game-based physical fitness development program in improving the physical fitness levels of students at the Faculty of Sport Science (FIKK), Universitas Negeri Makassar. This study employed an experimental research method using a pretest-posttest control group design. The research participants consisted of FIKK UNM students who were divided into two groups: an experimental group that participated in a game-based physical fitness program and a control group that followed conventional fitness learning activities. The intervention was conducted over eight training sessions involving traditional game activities designed to stimulate various components of physical fitness. Physical fitness was measured before and after the intervention using standardized tests assessing cardiovascular endurance, muscular strength, agility, and flexibility. Data were analyzed using descriptive statistics and t-test analysis. The results of the study indicated that traditional game-based activities had a positive and significant effect on improving students' physical fitness. The experimental group demonstrated a greater improvement compared to the control group, with an average difference increase of 1.240 and a significance level of  $0.001 < \alpha < 0.025$ . These findings indicate that integrating game-based activities into physical education programs can effectively increase students' motivation, participation, and physical fitness development.

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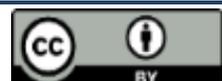
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- Conception and design of the study;
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## INTRODUCTION

Physical education plays a fundamental role in developing students' physical fitness, motor competence, and overall well-being. In educational settings, physical education often referred to as Physical Education, Sports, and Health (PJOK) serves as an essential component of the curriculum that aims to promote active lifestyles, improve



physical performance, and foster positive health behaviors among students (Bailey et al., 2018; Kirk, 2019). Beyond the development of physical health, physical education also contributes to psychological well-being, social interaction, and character formation through structured physical activities and sports participation (Lubans et al., 2016; Fairclough & Stratton, 2020).

One of the primary goals of physical education is to improve students' physical fitness. Physical fitness is defined as the body's ability to perform daily physical activities efficiently without excessive fatigue while still having sufficient energy for leisure activities and unexpected physical demands (Caspersen et al., 2015; Ortega et al., 2018). Physical fitness components generally include muscular strength, muscular endurance, flexibility, cardiorespiratory endurance, speed, agility, balance, and body composition (Kenney et al., 2020). These components are essential indicators of an individual's health status and functional capacity. In the context of university students, physical fitness is particularly important because it influences academic performance, productivity, and overall quality of life. Studies indicate that students with higher levels of physical fitness demonstrate better cognitive function, improved concentration, and stronger academic outcomes compared to those with lower fitness levels (Hillman et al., 2019; Donnelly et al., 2016). Moreover, regular physical activity during early adulthood contributes significantly to long-term health outcomes, reducing the risk of chronic diseases such as obesity, cardiovascular disease, and metabolic disorders (World Health Organization, 2020). However, several studies have reported a decline in physical activity levels among university students worldwide. Modern lifestyles characterized by prolonged sedentary behavior, increased screen time, and academic workload have significantly reduced students' participation in physical activity (Guthold et al., 2018; Keating et al., 2019). As a result, many students demonstrate suboptimal levels of physical fitness, which may negatively affect their health and learning capacity.

This issue is also observed among students in sports-related faculties, including the Faculty of Sport Science (FIKK) at Universitas Negeri Makassar (UNM). Despite their academic focus on sports and physical education, not all students consistently maintain optimal levels of physical fitness. Conventional training approaches often emphasize repetitive drills or structured exercises that may reduce students' motivation and engagement during physical activity sessions. Consequently, innovative and engaging learning strategies are needed to improve students' participation and physical fitness development. One promising approach is the integration of game-based learning into physical education programs. Games provide enjoyable and interactive environments that encourage active participation, collaboration, and continuous movement. When physical activities are presented in the form of games, students tend to participate more enthusiastically, which can ultimately improve their physical fitness and learning outcomes (Casey & Goodyear, 2017; Hastie et al., 2019).

Traditional and modern games have long been used as educational tools to develop motor skills, teamwork, and physical conditioning. Traditional games, in particular, represent culturally inherited activities that involve voluntary participation, enjoyment,

and social interaction (Suherman et al., 2019). These games often require minimal equipment and can be easily implemented in physical education programs. Their cultural and social elements also contribute to students' motivation and engagement in physical activity. Therefore, integrating game-based approaches into physical fitness training may provide an effective strategy for improving physical fitness levels among university students. By combining enjoyable gameplay with structured physical activity, this approach may increase participation, motivation, and overall physical development among FIKK UNM students.

Recent developments in physical education research emphasize the importance of student-centered learning approaches that promote active engagement and enjoyment during physical activity. Game-based learning has emerged as one of the most effective pedagogical strategies for achieving these objectives (Bunker & Thorpe, 2018; Casey et al., 2021). This approach involves designing physical activities in the form of structured games that stimulate students' motivation while simultaneously improving physical and motor skills. Game-based learning is closely related to several pedagogical models widely used in physical education, such as Teaching Games for Understanding (TGfU), Sport Education Model, and Cooperative Learning (Harvey & Jarrett, 2019; Metzler, 2017). These models emphasize learning through play, problem-solving, and tactical understanding rather than solely focusing on technical drills. Through these approaches, students develop physical fitness while simultaneously improving cognitive and social skills.

Studies have demonstrated that game-based learning can significantly improve students' physical activity levels and fitness outcomes. For instance, research conducted by Mandigo et al. (2019) found that students participating in game-based physical education programs demonstrated higher levels of moderate-to-vigorous physical activity compared to those involved in traditional exercise-based programs. Similarly, research by Liu et al. (2020) indicated that integrating games into physical training programs increased students' motivation, enjoyment, and participation in physical activities. Game-based learning has also been widely used in sports training and motor skill development. Research in various sports disciplines such as soccer, basketball, volleyball, and badminton has shown that game-based training methods improve agility, coordination, endurance, and tactical awareness (Memmert, 2018; O'Connor et al., 2020). These findings highlight the effectiveness of games as a medium for enhancing both physical fitness and motor skill development.

In addition to improving physical outcomes, game-based learning also contributes to psychological and social development. Studies show that students participating in game-based activities experience higher levels of enjoyment, intrinsic motivation, and social interaction (Ryan & Deci, 2017; Standage & Ryan, 2020). These psychological factors play a crucial role in sustaining long-term participation in physical activity. Furthermore, game-based physical activity aligns with modern educational philosophies that emphasize experiential learning and active participation. According to constructivist learning theory, students learn more effectively when they are actively involved in the learning process and can construct knowledge through direct

experiences (Kolb, 2015). Games provide such experiences by allowing students to explore movement patterns, develop strategies, and solve movement-related problems in dynamic environments. In the context of higher education, the integration of game-based physical fitness training remains relatively underexplored. While numerous studies have focused on school-level physical education, fewer investigations have examined how game-based approaches can be applied to university students, particularly those studying sports science. Therefore, further research is necessary to explore the effectiveness of game-based physical fitness development programs in university settings.

Although previous studies have demonstrated the effectiveness of game-based learning in improving physical activity and motor skills, several research gaps remain. First, most existing studies focus primarily on school-aged students in primary or secondary education settings. Limited research has examined the application of game-based physical fitness development programs among university students, particularly those enrolled in sports science programs. Second, many previous studies have concentrated on improving specific motor skills or sports techniques rather than focusing on comprehensive physical fitness development. While game-based activities are known to enhance agility, coordination, and tactical understanding, fewer studies have investigated their impact on multiple physical fitness components simultaneously. Third, the cultural context of physical activity also plays an important role in determining the effectiveness of game-based learning. Traditional games, which are often deeply rooted in local cultural values, may provide unique opportunities to increase student engagement and participation. However, research exploring the integration of traditional games into physical fitness programs in Indonesian university contexts remains limited. Fourth, previous studies often examine short-term training interventions without evaluating their broader impact on students' motivation, participation, and long-term physical activity habits. Understanding these aspects is crucial for developing sustainable physical fitness programs in higher education institutions. Therefore, there is a need for empirical research that investigates the effectiveness of game-based physical fitness development programs among university students, particularly within the context of sports science faculties. Such research can contribute to the development of innovative learning strategies that enhance physical fitness, motivation, and participation in physical education programs.

Based on the problems and research gaps described above, this study aims to examine the development of physical fitness through a game-based learning approach among students of the Faculty of Sport Science (FIKK) at Universitas Negeri Makassar. Specifically, this study seeks to evaluate the effectiveness of game-based physical activity programs in improving students' physical fitness levels and participation in physical education activities. The novelty of this research lies in several aspects. First, this study focuses on the implementation of game-based physical fitness development within a university-level sports science program, which has received limited attention in previous research. Second, the study integrates elements of traditional and modern

games as part of the physical fitness training program, providing a culturally relevant and engaging learning approach. Third, this research examines the impact of game-based learning on multiple components of physical fitness, including endurance, strength, agility, and coordination. By integrating game-based learning into physical fitness development programs, this research is expected to provide new insights into innovative strategies for improving students' physical fitness and participation in physical education. The findings of this study may also contribute to the development of more engaging and effective physical education curricula in higher education institutions.

In summary, physical fitness is a fundamental component of students' health, academic performance, and overall well-being. However, declining levels of physical activity among university students highlight the need for innovative approaches to physical education. Game-based learning offers a promising strategy for increasing student engagement and improving physical fitness outcomes. Despite its potential, limited research has explored the application of game-based physical fitness development programs in university settings, particularly in sports science faculties. Therefore, this study seeks to investigate the effectiveness of game-based physical fitness development for FIKK UNM students, contributing to the advancement of physical education practices and promoting active lifestyles among university students.

## **METHODS**

This study employed a quantitative experimental approach to examine the effectiveness of a game-based physical fitness development program for students of the Faculty of Sport Science (FIKK) at Universitas Negeri Makassar (UNM). Experimental methods are widely used in sports science research because they allow researchers to evaluate the causal effects of training interventions on physical performance variables (Thomas et al., 2015; Bishop et al., 2019). The research design applied in this study was a pretest–posttest control group design, which is considered one of the most rigorous designs for assessing the effectiveness of physical training programs (McMillan, 2018; Cohen et al., 2020).

### **Participants**

The participants of this study consisted of undergraduate students enrolled in the Faculty of Sport Science at Universitas Negeri Makassar. Participants were selected using purposive sampling, ensuring that all participants were physically healthy and actively participating in physical education courses. A total of 40 students participated in the study and were randomly divided into two groups: an experimental group (n = 20) and a control group (n = 20). The experimental group received the game-based physical fitness program, while the control group followed conventional physical fitness training activities typically conducted in physical education sessions.

### **Game-Based Physical Fitness Program**

The intervention program was designed based on the principles of game-based learning and physical conditioning, which emphasize active participation, enjoyment, and the integration of multiple physical fitness components within structured play

activities (Casey & Goodyear, 2017; Harvey & Jarrett, 2019). Game-based training has been shown to increase student motivation, engagement, and physical activity levels compared to traditional exercise methods (Liu et al., 2020; Mandigo et al., 2019).

Several traditional and modified games were developed as part of the intervention to target different components of physical fitness, including muscular strength, agility, endurance, and flexibility. Each game was carefully designed to ensure that it stimulated continuous movement and active participation among students. The games were categorized according to students' physical abilities and activity intensity levels to ensure safety and effectiveness (Metzler, 2017; Kirk, 2019).

Guidelines for implementing the games were developed to regulate the frequency, duration, intensity, and objectives of each activity. The program was conducted for eight training sessions, with each session lasting approximately 60 minutes. Each session consisted of a structured sequence including warm-up activities, core game-based training activities, and cool-down exercises. The game activities were designed to encourage cooperative interaction and sustained physical engagement among students, which are key elements for improving physical fitness outcomes (Standage & Ryan, 2020).

### **Physical Fitness Testing**

To evaluate the effectiveness of the intervention program, students' physical fitness levels were measured using standardized physical fitness tests both before (pretest) and after (posttest) the intervention. Standardized physical fitness tests are widely recommended for evaluating training outcomes because they provide reliable and objective measurements of physical performance (Kenney et al., 2020; Ortega et al., 2018). The fitness tests included: 12-Minute Run Test to measure cardiorespiratory endurance; Push-Up Test to assess upper body muscular strength; Sit-Up Test to evaluate abdominal muscular endurance; Sit-and-Reach Test to measure flexibility. These tests are commonly used in physical education and sports science research to evaluate overall physical fitness levels (ACSM, 2021).

### **Data Analysis**

Data collected from the pretest and posttest measurements were analyzed using quantitative statistical techniques. Descriptive statistics were first used to determine the mean and standard deviation of the physical fitness scores for both groups. Subsequently, inferential statistical analysis was conducted using the paired sample t-test to examine differences between pretest and posttest scores within each group, and the independent sample t-test to compare the experimental group with the control group. The use of t-tests is widely recommended in experimental sports science research to determine whether training interventions produce statistically significant improvements in physical performance variables (Field, 2018; Hopkins et al., 2017). All statistical analyses were conducted at a significance level of  $p < 0.05$ .

### **Research Procedure**

The research procedure began with administering the pretest to both groups to measure baseline physical fitness levels. After the pretest, the experimental group participated in the game-based physical fitness training program for eight sessions,

while the control group continued conventional physical fitness activities. At the end of the intervention period, both groups completed the posttest using the same standardized fitness tests. The results of the pretest and posttest were then analyzed to determine the effectiveness of the game-based physical fitness program in improving the physical fitness levels of FIKK UNM students.

## RESULTS AND DISCUSSION

### Result

This section presents the findings of the study regarding the effectiveness of a game-based physical fitness development program for students of the Faculty of Sport Science (FIKK) at Universitas Negeri Makassar (UNM). Data were obtained through a series of physical fitness tests conducted before the intervention (pretest) and after the intervention (posttest). The experimental group received treatment in the form of traditional game-based physical fitness activities for eight meetings, while the control group participated in conventional physical fitness learning activities. The results of the study are presented through descriptive analysis, normality testing, paired sample t-tests, and independent sample t-tests.

### Descriptive Analysis of Physical Fitness Test Data

Descriptive statistics were used to describe the overall distribution of physical fitness scores in both the experimental and control groups before and after the intervention. The analysis includes the number of participants (N), score range, mean score, maximum score, minimum score, standard deviation, and total score.

**Table 1**

Descriptive Analysis of Physical Fitness Test Data for FIKK UNM Makassar Students

Group	N	Range	Mean	Max	Min	Std. Dev	Sum
Experimental Pretest	20	5	14.70	17	12	1.302	294
Experimental Posttest	20	5	19.15	21	16	1.268	383
Control Pretest	20	5	14.70	17	12	1.302	294
Control Posttest	20	2	17.90	19	17	0.852	358

Based on Table 1, the experimental group demonstrated a substantial improvement in physical fitness scores after participating in the game-based physical fitness program. The mean score increased from 14.70 in the pretest to 19.15 in the posttest, representing an increase of 4.45 points. Meanwhile, the control group also showed improvement, although to a lesser extent, with the mean score increasing from 14.70 to 17.90, representing an increase of 3.20 points. The higher increase in the experimental group suggests that the traditional game-based training program contributed significantly to the improvement of students' physical fitness levels.

### Normality Test Results

Before conducting hypothesis testing, a normality test was performed using the Kolmogorov-Smirnov (K-S) test to determine whether the data distribution met the assumption of normality. A dataset is considered normally distributed if the significance value (Sig.) is greater than the significance level ( $\alpha = 0.05$ ).

**Table 2**  
 Data Normality Test Analysis for Physical Fitness Tests for FIKK UNM Makassar Students

Research Variables	N	K-Sz	Sig	$\alpha$	Description
Experimental Pretest	20	0.855	0.458	0.05	Normal
Experimental Posttest	20	1.105	0.174	0.05	Normal
Control Pretest	20	0.855	0.458	0.05	Normal
Control Posttest	20	1.138	0.150	0.05	Normal

The results of the normality test show that all significance values are greater than 0.05, indicating that the physical fitness data in both the experimental and control groups are normally distributed. Therefore, the data meet the assumptions required for parametric statistical analysis using the t-test.

### Paired Sample t-Test Results

The paired sample t-test was conducted to determine whether there were significant differences between the pretest and posttest scores within each group.

**Table 3**  
 Paired t-Test Analysis of Physical Fitness Test Data for FIKK UNM Makassar Students

Research Variables	Mean Difference	tcount	ttable	Significance	$\alpha$
Experimental Posttest	4.450	17.367	2.861	0.000	0.05
Control Posttest	3.200	10.514	2.861	0.000	0.05

The results of the paired t-test indicate that both groups experienced significant improvements in physical fitness levels after the training program. In the experimental group, the calculated t-value ( $t = 17.367$ ) is greater than the critical value ( $t = 2.861$ ), with a significance value of  $0.000 < 0.05$ , indicating a statistically significant improvement in physical fitness after participating in the game-based training program.

Similarly, the control group also demonstrated a significant improvement with a calculated t-value ( $t = 10.514$ ) greater than the critical value ( $t = 2.861$ ) and a significance value of  $0.000 < 0.05$ . However, the improvement observed in the experimental group was notably greater than that of the control group.

### Independent Sample t-Test Results

An independent sample t-test was conducted to compare the posttest results between the experimental group and the control group to determine whether the game-based program produced significantly better outcomes than conventional training.

**Table 4**  
 Independent Sample t-Test Analysis of Physical Fitness Test Data for FIKK UNM Makassar Students

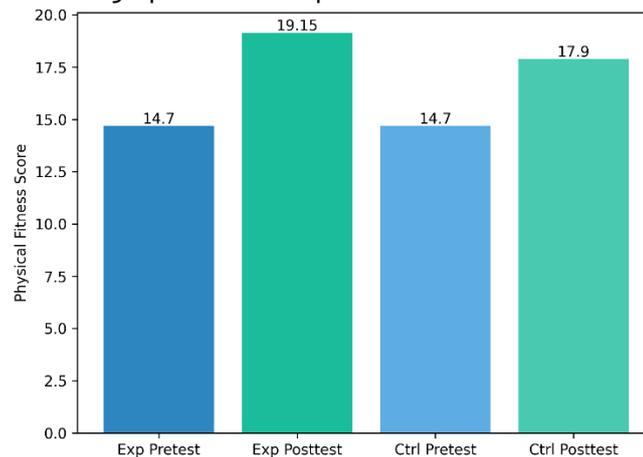
Research Variables	Mean Difference	tcount	ttable	Significance	$\alpha$
Experimental Posttest - Control Posttest	1.250	3.845	2.861	0.001	0.025

The independent sample t-test results indicate that the calculated t-value ( $t = 3.845$ ) is greater than the critical value ( $t = 2.861$ ) with a significance value of  $0.001 < 0.025$ . This result indicates that there is a statistically significant difference between the experimental group and the control group.

The experimental group demonstrated higher physical fitness scores than the control group after the intervention. This finding confirms that the game-based physical fitness development program was more effective in improving students' physical fitness levels compared to conventional training methods.

### Graphical Representation of Physical Fitness Improvement

To further illustrate the improvement in physical fitness scores, the following diagram presents the average pretest and posttest scores for both groups.



**Figure 1.**  
Physical Fitness Score Improvement

The diagram clearly shows that although both groups experienced improvements in physical fitness, the experimental group demonstrated a greater increase in scores, indicating the effectiveness of the game-based physical fitness training program.

## Discussion

### Game-Based Physical Fitness Development for FIKK UNM Students

The results of this study demonstrate that the implementation of game-based physical fitness activities through traditional games significantly improved the physical fitness levels of students at the Faculty of Sport Science (FIKK), Universitas Negeri Makassar. The intervention program conducted over eight training sessions produced meaningful physiological and performance improvements compared with the conventional learning approach applied in the control group. These findings support previous research suggesting that game-based learning environments can effectively enhance physical fitness, motivation, and student participation in physical education settings (Casey & Goodyear, 2017; Harvey & Jarrett, 2019; Liu et al., 2020). Based on the statistical analysis, the t-test results indicated that the calculated t-value was greater than the t-table value, confirming a statistically significant difference between the pretest and posttest scores in both groups. However, the experimental group that participated in the traditional game-based training program demonstrated a greater improvement than the control group. The experimental group showed an increase from a pretest mean of 14.70 to a posttest mean of 19.15, resulting in an average improvement of 4.450 points, whereas the control group improved from 14.70 to 17.90, with an average

increase of 3.200 points. The difference between the two groups was 1.250 points, indicating that the game-based approach provided additional benefits for physical fitness development. These findings align with exercise physiology principles stating that regular moderate-to-high intensity physical activity performed over 6–8 sessions can produce measurable physiological adaptations in the cardiovascular and musculoskeletal systems (Kenney et al., 2020; McArdle et al., 2019). The improvement observed in this study suggests that traditional games such as gobak sodor, bentengan, and hadang provide sufficient training stimulus to stimulate improvements in multiple components of physical fitness simultaneously.

### **Improvement of Cardiovascular Endurance**

One of the key improvements observed in this study was the increase in cardiovascular endurance, measured through running-based fitness tests. Traditional games require continuous movement patterns, including short sprints, directional changes, and repeated acceleration and deceleration, which resemble the physiological demands of high-intensity intermittent exercise. According to Buchheit and Laursen (2018), intermittent physical activity that alternates between high and moderate intensity is highly effective for improving both aerobic and anaerobic capacity. Games such as gobak sodor and bentengan involve dynamic chasing, defending, and attacking movements that stimulate sustained cardiovascular activity. During gameplay, students frequently perform repeated sprint actions and rapid transitions between offensive and defensive roles, which significantly elevate heart rate and oxygen consumption. Similar findings were reported by Mandigo et al. (2019) and O'Connor et al. (2020), who demonstrated that game-based physical activities can increase moderate-to-vigorous physical activity levels among students. Furthermore, the unpredictable and competitive nature of traditional games encourages participants to maintain high levels of physical effort throughout the activity. This continuous engagement contributes to improvements in cardiorespiratory endurance, which is one of the most important components of overall physical fitness (World Health Organization, 2020; Ortega et al., 2018).

### **Improvement of Muscular Strength and Endurance**

In addition to cardiovascular endurance, improvements were also observed in muscular strength and muscular endurance, particularly in the push-up and sit-up tests. Although traditional games are not specifically designed as resistance training exercises, the movement patterns involved naturally engage multiple muscle groups, including the core muscles, upper body muscles, and lower limb muscles. Movements such as sprinting, pulling, blocking opponents, bending, jumping, and rapid directional changes require repeated muscular contractions and stabilization from various muscle groups. These activities stimulate neuromuscular coordination and muscular endurance over time. According to Behm et al. (2017), functional movement activities that involve multiple muscle groups can effectively enhance muscular endurance and strength through repeated activation of stabilizing muscles. Moreover, traditional games often involve bodyweight resistance through dynamic actions such as pushing, holding positions, and maintaining balance during competitive play. These movements resemble

functional training patterns that activate the abdominal, back, arm, and leg muscles simultaneously. Research by Suchomel et al. (2018) indicates that repeated bodyweight movements performed at moderate intensity can produce improvements in muscular strength and endurance when performed consistently over several sessions. Therefore, the improvement in push-up and sit-up performance observed in this study can be attributed to the functional nature of traditional game movements, which indirectly provide resistance-based stimuli for muscle development.

### **Improvement of Agility and Neuromuscular Coordination**

Among the physical fitness components measured in this study, agility showed the most noticeable improvement, particularly in zig-zag running tests. Traditional games inherently require rapid changes in direction, quick reaction times, and strategic movement decisions, making them highly effective for developing agility and neuromuscular coordination. Agility is defined as the ability to change direction rapidly while maintaining balance, speed, and body control (Sheppard & Young, 2016). Traditional games require players to continuously respond to opponents' movements, avoid being captured, or reach strategic positions on the playing field. These dynamic situations stimulate quick reactions and rapid directional movements, which directly contribute to agility development. Research by Young and Farrow (2019) highlights that agility training is most effective when it includes reactive and unpredictable movement patterns, rather than pre-planned directional changes. Traditional games naturally incorporate these elements because players must react spontaneously to the actions of other participants. Consequently, agility improvements occur not only due to physical stimulus but also because of enhanced perceptual and decision-making skills. The results of this study support previous findings indicating that game-based training methods are highly effective for improving agility in sports and physical education contexts (Memmert, 2018; Hammami et al., 2019). The spontaneous nature of movement in traditional games creates a realistic training environment that enhances both motor control and reaction speed.

### **Improvement of Flexibility**

Flexibility, measured using the sit-and-reach test, also showed improvement after eight sessions of game-based training. Although flexibility exercises were not the primary focus of the intervention, the dynamic movements involved in traditional games required participants to frequently bend, stretch, twist, and reach, which naturally promoted joint mobility and muscle flexibility. Dynamic physical activities that involve large ranges of motion are known to contribute to flexibility development by increasing muscle elasticity and joint mobility (Behm & Chaouachi, 2016). Traditional games often involve movements such as lunging, reaching, crouching, and lateral bending, which stretch various muscle groups during gameplay. The improvement in flexibility observed in this study indicates that game-based physical activity can provide indirect flexibility training, particularly when the activities involve diverse and multidirectional movement patterns.

### **Role of Motivation and Active Participation**

Another important factor contributing to the effectiveness of traditional game-based training is the high level of intrinsic motivation generated by game activities.

Unlike conventional exercise programs, which often involve repetitive and monotonous drills, games create a more engaging and enjoyable learning environment. According to Self-Determination Theory, intrinsic motivation plays a critical role in sustaining long-term participation in physical activity (Ryan & Deci, 2017). Traditional games naturally incorporate elements of competition, cooperation, and social interaction, which increase students' enthusiasm and emotional engagement during physical activity sessions. Research by Standage and Ryan (2020) suggests that enjoyable learning environments enhance students' motivation, resulting in higher levels of effort and participation. In this study, students participating in traditional games demonstrated greater enthusiasm and consistent involvement in each training session. The competitive nature of games encouraged students to actively engage in physical movement without feeling forced or pressured. This increased participation likely contributed to the greater improvements in physical fitness observed in the experimental group.

### **Variety of Movement Patterns and Functional Training**

Traditional games are characterized by a wide variety of movement patterns, including running, jumping, dodging, balancing, and rapid changes of direction. This movement diversity stimulates multiple components of physical fitness simultaneously, making traditional games a form of functional training. Functional training refers to exercise activities that replicate natural movement patterns used in everyday life (Behm et al., 2017). Traditional games closely resemble functional training because they involve complex and integrated movements rather than isolated exercises. The combination of various movement patterns improves coordination, balance, neuromuscular efficiency, and motor control, all of which contribute to overall physical fitness (Lloyd et al., 2016). This explains why traditional games can effectively improve multiple fitness components within a relatively short intervention period.

### **Unconscious Training Intensity**

One of the unique advantages of game-based physical activity is the concept of unconscious training intensity. During gameplay, students focus on strategies, teamwork, and winning the game rather than on the physical exertion involved. As a result, they often reach moderate to high exercise intensity without perceiving the activity as physically demanding. This phenomenon has been widely discussed in sport pedagogy literature, which highlights that enjoyable activities reduce perceived exertion while maintaining high physical intensity (Hastie et al., 2019). When students are engaged in competitive gameplay, their heart rate and energy expenditure increase naturally due to the dynamic nature of the activity. Consequently, game-based training provides an effective balance between physical intensity and psychological enjoyment, which is essential for sustainable physical fitness programs.

### **Alignment with Training Principles**

The effectiveness of the traditional game intervention also reflects the application of fundamental training principles, including frequency, intensity, time, and progression (FITT). The program implemented in this study involved eight sessions with consistent

training frequency, allowing sufficient recovery and physiological adaptation between sessions. The dynamic and competitive nature of traditional games also fulfills the overload principle, as students are challenged to perform movements that exceed their usual daily physical activity levels. Additionally, the duration of 60–90 minutes per session meets recommended guidelines for improving aerobic and anaerobic fitness (ACSM, 2021). The progressive nature of gameplay, where students continuously adapt to opponents and improve their strategies, also provides a form of progressive overload, which is essential for long-term physical fitness development.

### **Overall Interpretation of Findings**

Overall, the findings of this study indicate that game-based physical fitness training using traditional games is an effective method for improving students' physical fitness levels. The combination of physiological stimulus, motivational engagement, movement diversity, and adherence to training principles creates an optimal environment for physical development. Compared to conventional physical training methods, traditional games provide a more engaging and comprehensive approach to physical fitness development. These findings support the integration of game-based learning models in physical education programs, particularly in higher education settings such as sports science faculties. The results also highlight the importance of incorporating culturally relevant physical activities, such as traditional games, into modern physical education curricula. Such approaches not only improve physical fitness but also promote cultural appreciation and social interaction among students. Therefore, implementing game-based physical fitness development programs can serve as an innovative and effective strategy for enhancing students' health, physical performance, and engagement in physical activity.

## **CONCLUSION**

Based on the results of the research and statistical analysis conducted over eight intervention sessions, this study concludes that game-based physical fitness development using traditional games has a positive and significant effect on improving the physical fitness of students at the Faculty of Sport Science (FIKK), Universitas Negeri Makassar. The experimental group that participated in traditional game activities demonstrated greater improvement compared to the control group that followed conventional physical education learning. The statistical results indicated a significant difference between the two groups, with an average improvement difference of 1.240 and a significance level of  $0.001 < \alpha < 0.025$ , confirming that the game-based approach effectively enhanced students' physical fitness.

Empirically, the improvement in physical fitness was reflected in several measured fitness components. Cardiovascular endurance increased as a result of continuous and repetitive movement patterns during traditional games, which involved moderate to high intensity activities such as running, chasing, and rapid transitions between offensive and

defensive movements. These dynamic movement patterns stimulated the cardiorespiratory system and improved students' aerobic capacity.

Furthermore, muscular strength and muscular endurance improved through various physical actions involved in the games, including running, jumping, pulling, and maintaining body balance during competitive gameplay. These movements activated major muscle groups such as the abdominal muscles, arms, legs, and lower back, thereby enhancing overall muscular performance.

The study also found improvements in agility, which were evident through activities requiring rapid directional changes, quick reactions to opponents' movements, and coordinated body responses during gameplay. The dynamic and unpredictable nature of traditional games provided an effective stimulus for developing agility and neuromuscular coordination.

In addition, flexibility improved naturally as many movements in the games required participants to bend, stretch, reach, and avoid opponents during the activity. These varied movement patterns contributed to improved joint mobility and muscle elasticity.

Overall, the findings of this study demonstrate that traditional game-based physical activity is an effective, engaging, and practical approach for improving multiple components of physical fitness among university students. Therefore, integrating game-based training methods into physical education programs can serve as an innovative strategy to enhance student participation and physical fitness development in higher education institutions.

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Finally, the authors hope that the results of this research will contribute to the development of innovative game-based learning strategies in physical education, particularly in improving students' physical fitness and encouraging active lifestyles in higher education environments.

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