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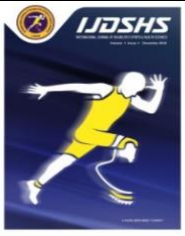

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RESEARCH ARTICLE

Effect of Structured Core Stabilization Exercise Program on Pain and Muscle Performance in Individuals with Scapular Dyskinesia

Sakshi SHAH[1], Sandeep SHINDE[*1] and Pooja JAIN[1]

[1]Krishna College of Physiotherapy, Krishna Vishwa Vidyapeeth, Krishna Institute of Medical Sciences "Deemed to be University", Karad, Maharashtra / India
*Corresponding author: drsandeepshinde24@gmail.com

Abstract

Purpose: The purpose of this research was to determine the effect of structured core stabilization exercise program on pain and muscle performance in individuals with scapular dyskinesis. **Methods:** The study commenced obtaining ethical clearance from an institutional committee, briefing participants about the research and intervention, and obtaining informed consent. In accordance with the inclusion and exclusion criteria, 90 participants were enrolled for the research among which 80 participants enrolled in this study and were allocated into 2 groups at random- Group A (Control group) as well as Group B (Experimental group) by using the envelope method. Treatment was provided for about 6 weeks to both groups.Pre and post test examination was done using Individual Muscle Testing (IMT), core strength testing with Pressure Biofeedback (PB), shoulder joint range of motion (ROM) with Goniometry, in addition with Visual Analogue Scale (VAS) for pain. Statistical methods were utilised to analyse the results. **Findings:** This research found substantial improvements in pain, individual muscle testing and shoulder range of motion for flexion and abduction in two groups (p-value <0.0001), whereas, for internal and external rotation, group A showed p value of 0.0193 and 0.0098, whereas, group B showed p value of <0.0001 and 0.2399.Group B showed more improvement in pressure biofeedback unit (p<0.0001) as compared to Group A (p value 0.0208). **Conclusion:** The present research observed that a structured core stabilization exercise program had shown a significantly enhanced improving muscle performance and reducing pain in individuals with scapular dyskinesis.

Keywords
Frozen Shoulder, Kinetic Chain, Pressure Biofeedback, Quality of life, Scapular Dyskinesia

INTRODUCTION

Scapular dyskinesis is defined as alteration or deviation of resting or active position of scapula during shoulder movement (Roche et. al., 2015; Struyf et. al., 2014). Also shoulder pain secondary to Scapular Dyskinesia causes the highest burden with prevalence of 41.9% (Sağlam & Telli et. al., 2022). For physical functioning, the upper extremity is acrucial component of our body. The upper extremity is used for several daily tasks, including picking up objects, transferring objects, combing,bathing, and many other tasks (Shinde et. al., 2023). In normal upper extremity function, the scapula provides a stable base due to which gleno-humeral mobility occurs. The functioning of the Scapulothoracic joint depends on coordinated motions of the surrounding musculature. Efficient glenohumeral mobility requires the scapula muscles to dynamically place the glenoid. When weakness or dysfunction of the scapular musculature is present, normal scapular positioning and mechanics may get altered (Paine & Voight1993; Kibler, 1998).Scapula muscles work together to stabilise and regulate the scapula's position during active arm movements. This allows the scapula-humeral muscles to maintain a stable length-tension relationship while stabilizing and moving the humerus. The humeral muscles efficacy declines without the scapula's positioning control. The

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moment the upper extremity is raised, the anterior serratus muscles protract the scapula onto the chest, positioning it with flexion actions.The lower and upper trapezius turn scapula upwards in tandem. During the extension of the arm or pulling tasks, the Rhomboids work through the Latissimus Dorsi, the Teres Major, and Rotator Cuff Muscles to turn and retract the scapula downwards. Each of these stabilizing muscles also exerts eccentric control over the acceleration of forward rotation and protraction of the scapula (Kisner et. al., 2017; Micoogullari et. al., 2023).

The scapula serves four biomechanical roles: It is the humerus's centre of rotation, acts as the humerus' anchor to the thoracic wall, prevents the acromion from impeding its movement upon the humerus in both abduction and flexion, resulting in no impingement, and transmits forces from the core to the arm (Paine &Voight,1993; Panagiotopoulos & Crowther, 2008). The scapular stabilising muscles position the scapula for proper glenohumeral functions while offering a firm base of support. Faulty alignment and dyskinesia contribute to variety of syndromes affecting Upper Extremity and Trunk which are caused by fatigue, weakness, neurologic dysfunction or inhibition by intra-articular glenohumeral or subacromial processes (Roche et. al., 2015; Panagiotopoulos & Crowther, 2008). However core stability relates to the musculature's capacity to generate contractile force, core strength implies to an ability to stabilise the spine through muscular activity. In order to control movement and generate force at the extremities, maintaining stability in the core musculature entails regulating the position and motion of the trunk (Huxel & Anderson, 2013; Bliven & Anderson, 2013).

Major core muscles such as Transverse Abdominals anteriorly, Multifidus posteriorly, Pelvic floor muscles inferiorly and Diaphragm superiorly and Minor core muscles such as Lattisimus dorsi, Gluteus Maximus, Trapezius help to stabilize the trunk so that upper extremity can have efficient and strong mobility (Crosbie et. al., 2008; Saini et. al., 2020; Henning, 2016). Neutral spine alignment and regulated movement within that alignment are required for stabilization. The erect spine is frequently, but improperly, correlated with the flat-backed posture. The neutral Spine doesn't have a single fixed position. Instead, it falls in the middle of the joint's range of motion and is usually a comfortable position (Bliss & Teeple, 2005). Besides reducing the strain on the spine, core stabilization increases the stability and endurance of the peripheral joints and permits the transfer of energy to the distal segments. The core serves as the initiator of all voluntary movements, so it's crucial to train it properly (Oliver & Adams, 2010).

The Scapula is a key component in the chain of kinetics, serving as a funnel for the transfer of forces and energy from the lower extremity and core to the upper extremity. Because of their biomechanical dependency, scapular dyskinesia and core stabilization are closely related conditions. The back, pelvis, and abdomen comprise the core muscles, which provide the basis of all body movement. These muscles cause the shoulders and shoulder blades, or scapulae, to adapt in response to weakness or instability. The movement abnormalities associated with scapular dyskinesia can be exacerbated by a weakening or unstable core. Movement flow is disrupted by disruptions in the core, which affect the upper extremities. Scapular dyskinesia can be exacerbated by a weak core, which causes disproportionate shoulder motions when lifting or reaching. Additionally, overstretching the muscles around the shoulder complex due to core weakness can cause abnormal patterns such as excessive upward rotation or protraction, as well as distort scapular movement (Saini et. al., 2020; Brumitt & Dale, 2009; Ellenbecker & Aoki, 2020).

Core muscles' structural organization and proper activation exacerbate intra-abdominal pressure, leading to a stable trunk. Proper functioning stabilizes the trunk before transferring the upper limbs. The hip and pelvis account for over half of kinetic energy in dynamic overhead movements. Trunk flexors, trunk rotationators, and hip extenders help position the spine and accommodate scapular movements, enhancing the stability of the trunk (Henning, 2016).Trunk muscules activates in a feedforward manner during upper or lower limb movements (Ellenbecker & Aoki, 2020; Willard et. al., 2012). This feed-forward process develops as the human body prepares for the possibility of a disruption in spinal stability when its extremities begin to move (Maenhout et. al., 2010). It was recently discovered that after glenohumeral elevation, the Thoracic Spine, in specific, is disturbed (Paine &Voight, 1993). The area of the body that consists of the hips, pelvis, spine, abdomen, and proximal lower limb is

called the core. Two purposes of the core musculature are force generation and transfer and lumbar support stability (Park & Yu, 2013). According to kinetic chain theory, the trunk's position and motion around the lower part of the body facilitate the most effective creation, exchange, and regulation of motion and force to the termination segments (Ellenbecker & Aoki, 2020; Willard et. al., 2012).

The thoracolumbar fascia connects the lower and upper limbs to combine the superior/ inferior and right/left parts of the Kinetics Chain (Willard et. al., 2012). The anterior, the middle, and posterior layers make up the thoracolumbar fascia. To transfer load and energy among the lower and upper limbs, the right and left lobes of the body, and the wall of the abdomen and the lumbar region, for example, these layers play a crucial biomechanical role. Numerous muscle groups are covered by this cover, including the pectoral muscles major and minor, rhomboids major and minor, trapezius, and serratus anterior, which reaches the latissimus dorsi and gluteus maximus towards the distal end (Maenhout et. al., 2010). This situation could indicate a beneficial relationship among core stabilisers in the deep lamina and scapula stabilisers in the superficial lamina (Park & Yu, 2013; Lee, 2021). According to the serape effect, the muscles that form the body have a crisscross design. It takes place with the interaction of Rhomboids Minor, Rhomboids Major, Serratus Anterior, and Oblique Abdominal Muscle (Paine &Voight1993). The concept of transforming accumulated energy towards potential energy is included in the serape phenomenon (Bliss & Teeple, 2005). The musculoskeletal system is fairly adaptable and to maintain function it may create inappropriate movement patterns which causes core weakness in the muscles in people with scapular dyskinesia as it serves a major part within the Kinetic Chain. The proximal segments must function efficiently to provide proximate the stability for distal upper-limb mobility. This requires adequate strength, stability, and mobility of the Trunk, Pelvis, Hips, and Legs (Maenhout et. al., 2010; Lee, 2021; Atta et. al., 2018).

To maintain functional stability during limb movement, muscular strength is required surrounding the Lumbar Spine. This area is known as the core. During the upper limb movement, the Core muscles engage in a Feed-Forward pattern. This process occurs when the body of an individual adapts for the possibility of a disruption in the spinal stability when movement begins. In daily activities requiring different degrees of overhead skill, the core serves as a foundation for upper and lower extremity muscles (Pires & Camargo, 2018; Kaur et. al., 2014). Key stabiliser muscles are activated about 50 milliseconds prior to the primary movement muscles, ensuring inter and intra-segmental stability. This triggering sequence supports both proximal equilibrium and distal movement. The primary source of upper limb movement is the first phase of body stabilisation. When exercising, the effectiveness of motion is more crucial than the quantity, so one should concentrate on motor control (Lee, 2021). An interruption in motor function raises the likelihood of injuries by leading to inappropriate accessory glides in the joints during overhead activities. The A locomotive System is a relatively adaptable framework that produces compensatory motions to preserve function. Nevertheless, this often causes tissue damage. Furthermore, weak core muscles have been linked to injuries from overuse, low performance, and shoulder pain (Lee, 2021; Pires & Camargo, 2018; Kaur et. al., 2014).

The purpose of Core Stabilisation exercise is to establish a firm foundation for precise movement control while guaranteeing proper muscular stability within the Lumbo-Pelvic-Hip complex, forming a rigid cylinder over body perturbations (Kika, 2018; Çelenay & Kaya, 2017). These are known as Neuromuscular Retraining exercises, and they primarily emphasise on increasing the activation of the Local Stabilisers (Transversus Abdominis and Multifidus), Global Stabilizers (External and Internal Obliques), Global Mobilisers (Rectus Abdominus and Iliocostalis), and Load Transferers (i.e., Hip Adductors , Gluteus Medius, Gluteus Maximus, Hip Adductors, Rectus Femoris, Iliopsoas, Latissimus Dorsi, Trapezius, Pectoralis Major ,Deltoid) muscles (Jildeh et. al., 2021). Hence, to enhance neuromuscular control of the local supports, a typical Core Stabilization program begins with exercises such as abdominal drawing-in (also known as abdominal hollowing) or abdominal bracing (also known as co-contraction). Next, it moves on to closed-chain segmented control exercises, which further improve neuromuscular influence and joint stabilization, and finally, it progresses to open kinetic chain activities, that increase distal mobility (Hazar et. al., 2014; Cortell-Tormo et. al., 2017; Biscarini et. al., 2019).

According to current evidences it has been seen that Scapular Stabilization and Rotator Cuff Strengthening are the main choice of treatment for treating Scapular Dyskinesia (Mattson et. al., 2012). There is need of finding the protocol that will focus on integrated activity of both scapular and core stabilization and hence it will help in effective force production during upper extremity movements and allow great range of motion and strength to carry out daily activities. There is paucity of literature on core stabilization program as an equally important part of intervention. As stated Scapular Dyskinesia induced problems are progressive in nature and early and timely rehabilitation will help to reduce long term complications like muscle weakness and loss of mobility. Hence the study has been taken to concentrate upon the Kinetic Chain as it serves as a prime component of treatment and thereby Core Stabilisation exercise program will focus on reducing pain, improving ROM and thereby improving strength of scapular stabilizing muscle and core muscles which will help in effective functioning of the Kinetic Chain. The aim of this research is to determine the effect of structured core stablization exercise program on pain and muscle performance in individuals with scapular dyskinesia.

MATERIALS AND METHODS

Ethical authorization was granted by means of the institutional ethical committee of KVVDU, Karad (Protocol No.: 116/2022-2023). Participant provided informed consent, with the volunteer form covering research details, risks, benefits, confidentiality, and participant rights. The research strictly adhered to the ethical principles of the Declaration of Helsinki, prioritizing participant's rights and well-being in design, procedures, and confidentiality measures.

The present experimental study was carried out at Karad's Krishna College of Physiotherapy. Subjects were admitted based on the inclusion and exclusion standards. Both male and female, aged between 34 to 60 years, scapular dyskinesia diagnosed with lateral scapular slide test, scapular dyskinesia secondary to adhesive capsulitis, other shoulder pathologies were assessed in detail based on clinical assessment and radiographic classification, individuals unable to maintain baseline pressure of 40±5 mmHg for 10 seconds on pressure biofeedback unit, individuals willing to participate were included in this study. İndividuals with any history of recent fractures, surgery, trauma or cancer, with severe morbidity associated with cardio-pulmonary problems and neurological impairments and with any congenital or acquired deformities were excluded.

The subjects received explanations about the aim and methodology of the study. According to ICMR guidelines COVID-19 precautions were taken while assessing the participants. Procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional or regional) and with the Helsinki Declaration of 1975.The subjects completed a well-informed written consent form. Before the assessment, the subjects will be given a brief assessment. Total 90 participants were enrolled for the research, among which 80 participants were recruited in the study and were allocated into 2 groups at random. Group A and Group B by using the envelope method. 2 envelopes containing the group name– A and B were made and participants asked to pick an envelope just before the commencement of the intervention. Pre-test outcome measure assessment included shoulder range of motion, visual analogue scale (VAS), pressure biofeedback unit, individual muscle testing. The intervention allocated to participants in the envelope was given to the participant. Participants in group A received conventional treatment. Participants in group B received conventional physiotherapy treatment with core stabilization exercises (Table 1,2).

Group A (Control Group)

Subjects in Group A (n=40) were given conventional treatment protocol comprising of Hot moist pack, TENS for about 15 minutes and exercises (Table1).

Group B (Experimental Group)

Subjects in Group B (n=40) were given core stabilisation exercise in addition to the conventional treatment protocol (Table2).

Table1. Exercise Program for Group A

Week	Exercise	Repetition
Week 1 (1to 7 days)	Pendular exercisesFlexion-Extension Abduction-Adduction Circumduction	10 Repetitions
	Shoulder isometric exercises	10 repetitions x 5 seconds
	Cross arm stretch	3 repetitions x 15 seconds
	Scapular clock exercises	10 repetitions x 1 set.
Week 2 (Day 8 to 14)	Cross arm stretch	3 repetition x 30 seconds
	Shoulder protraction and retraction	10 repetition x 1 set
	Scapular clock exercises	10 repetition x 2 set
	Wand exercises: • Shoulder flexion • Shoulder extension • Shoulder abduction in scaption • Shoulder external rotation	10 repetition x 1 set
	Cross arm stretch	3 repetition x 30 seconds
	Wand exercises	10 repetition x 2 set
	Wall push up	10 repetition x 1 set
	Resisted shoulder internal rotation (Yellow Thera band)	10 repetition x 1 set
	Resisted shoulder external rotation (Yellow Theraband)	10 repetition x 1 set
Week 4 (22-28 days)	Cross arm stretch	3 reps x 30 seconds hold
	Wall push up	10 repetition x 1 set
	Resisted shoulder internal rotation	10 repetition x 1 set
	Resisted shoulder external rotation	10 repetition x 1 set
	Y,T,W exercises	10 repetition x 1 set
Week 5 -6	Cross arm stretch	3 reps x 30 seconds hold
	Wall push up	10 reps x 2 set
	Resisted shoulder internal rotation (Red Thera band)	10 reps x 1 set
	Resisted shoulder external rotation (Red Thera band)	10 reps x 1 set
	Y,T,W exercises	10 reps x 2 set

(Kisner et.al., 2017).

Table 2. Exercises for Group B

Week	Exercise	Repetition
Week 1 (Day 1 to 7)	Abdominal drawing in manoeuvre	10 reps x 5 seconds hold
	Pelvic bridging	10 reps x 5 seconds hold
	Abdominal drawing-in with alternating lower extremity movement	10 reps x 5 seconds hold
Week 2 (Day 8 to 14)	Abdominal drawing in manoeuvre	10 reps x 10 seconds hold
	Pelvic bridging	10 reps x 10 seconds hold
	Abdominal drawing-in with alternating lower extremity movement	10 reps x 10 seconds hold
Week 3 (Day 15 to 21)	Abdominal drawing in manoeuvre with alternate arm and leg lift	10 reps x 5 seconds hold
	Alternate leg and arm raise in quadruped position	10 reps x 5 seconds hold
	Pelvic bridging with arm lift	10 reps x 5 seconds hold
Week 4 (22-28 days)	Abdominal drawing in manoeuvre with alternate arm and leg lift	10 reps x 10 seconds hold
	Alternate leg and arm raise in quadruped position	10 reps x 10 seconds hold
	Pelvic bridging with arm lift	10 reps x 10 seconds hold
Week 5	Swiss ball alternate arm and leg extension	10 reps x 5 seconds hold
	Swiss ball wall squat	10 reps x 5 seconds hold
	Sitting on ball and carrying out diagonal arm pattern	10 reps x 5 seconds hold
Week 6	Swiss ball alternate arm and leg extension	10 reps x 10 seconds hold
	Swiss ball wall squat	10 reps x 10 seconds hold
	Sitting on ball and carrying out diagonal arm pattern	10 reps x 10 seconds hold

(Hertling & Kessler, 2006).

Outcome Measures

Visual Analog Scale (VAS)

It is a scale which have range from 0 to 10. Zero indicates "no pain" and ten indicates "worst pain imaginable". Participants asked to mark on scale the rate of pain they have from 0 to 10 at rest and on activity. Intra class co-relation score 0.97 (95% CI=0.96 to 0.98) (Boonstra et. al., 2008; Shah & Shinde, 2018; Shinde et. al., 2022).

Goniometry

Goniometry is frequently employed in clinical studies for people experiencing shoulder problems to measure ROM. Goniometry is a reliable and valid method for measuring shoulder ROM, as well as a simple and easily available measure of outcome for clinical studies and therapeutic practice (van et. al., 2015).

Pressure Biofeedback (PBU)

PBU is used to check the strength of back muscles. For the strength assessment, they placed the PBU and inflated the bulb up to 40 mmHg, which is the baseline pressure, and asked the participants to do an abdominal drawing in maneuver. They were supposed to hold it for 10 seconds. The 3 trials are taken, and the best reading is taken into consideration. Measurements are expressed in terms of mmHg (Kumar et. al., 2015; Shinde).

Individual Muscle Testing

It is a procedure used to evaluate the strength of a person's muscle or muscle group, depending on the performance of a movement in regard to the forces of gravity or manual resistance through the available ROM. The examiner in the application of pressure to the participants resistance evaluates the muscle being studied as subjectively "weak" or "strong" on a 5- point scale. Individual muscle testing will be employed to evaluate the scapular stabilisers, including the serratus anterior, upper, and lower trapezius muscles (Vijian et. al., 2023).

Statistical Analysis

Applying SPSS software version 26.0, an analysis of statistics of the recorded data was conducted. For each outcome measure, the mean and the standard deviation were computed. By adding up all of the values and dividing the entire number of values, the mean of the arithmetic was calculated. The software was utilised to calculate different percentages and to draw a variety of graphs with predetermined frequencies using the Excel programme from Microsoft.

RESULTS

The study included 80 individuals who were assigned to two distinct groups of 40 each, group A and B by simple random sampling. Group A acquired conventional exercise program while group B received core stabilisation exercises for 5 times a week for 6 weeks. The study found substantial reduction in pain, improvement in individual muscle testing and shoulder range of motion for flexion and abduction in two groups (p-value <0.0001), whereas, for internal and external rotation, group A showed p value of 0.0193 and 0.0098, whereas, group B showed p value of <0.0001 and 0.2399.Group B showed more improvement in pressure biofeedback unit (p<0.0001) as compared to Group A (p value 0.0208).

Interpretation

Table 3 interpret that among 80 participants with scapular dyskinesis, the age of 47-60 years was found to be commonly affected. Thirty-seven were females and fourty-three were males.

Table 3. Demographic Variables

Variables	Number of subjects
Age (Years)	
34-46	36
47-60	44
Gender	
Female	37
Male	43

Interpretation

Table 4 intertret that the mean VAS values at the rest and during activity were recorded for individuals with scapular dyskinesis in both groups A and group B.Both the groups were found to be statistically extremely significant (p<0.0001).

Table 4. Comparison of the VAS (at rest and during activity) pre- and post-test mean scores within groups A and B

VAS(at rest)	Pre test	Post test	Mean Diff	p–value
Group A	3.66±0.76	1.09±1.03	2.57	<0.0001
Group B	5.17 ± 1.94	0.42±0.58	4.75	<0.0001
VAS (on activity)				
Group A	7.45±0.88	1.28±1.08	6.17	<0.0001
Group B	7.61±0.86	0.74±0.61	6.87	<0.0001

Interpretation

Table 5 interpret that pre-test and post-test ROM values were parameters were acquired for each group A and B, shoulder flexion and abduction is extremely significant (p<0.0001). For internal rotation group A is significant (p=0.0193) while B group is extremely significant (p<0.0001). For external rotation group A is very significant (0.0098) and for group B it isn't significant (p value of 0.2399).

Table 5. Comparison of both pre and post-test mean range of motion scores within groups A and B.

ROM (Shoulder)	Pre test	Post test	Mean Diff	P Value
Flexion				
Group A	95.875±12.064	136.6±17.539	-40.725	<0.0001
Group B	92.775±12.255	145.57±14.903	-47.795	<0.0001
Abduction				
Group A	82.1±11.147	127.97±27.309	-45.87	<0.0001
Group B	80.875±10.37	140.22±12.495	-59.345	<0.0001
Internal rotation				
Group A	55.15±7.020	66.775±5.899	-11.62	<0.0001
Group B	63.225±7.78	81.175±6.710	-17.95	0.0193
External Rotation				
Group A	54.27±7.020	64.975±6.616	-10.70	0.2399
Group B	58.675±9.40	69.475±8.464	-10.86	0.0098

Table 6. Comparison of the individual muscle testing (IMT) pre- and post-test mean scores for groups A and B

IMT	Pre test	Post test	Mean diff	P value
Serratus anterior				
Group A	2.425±0.50	3.20±0.79	0.775	p<0.0001
Group B	2.475±0.50	4.425±0.67	-1.95	p<0.0001
Upper Trapezius				
Group A	2.400±0.49	2.950±0.74	-0.55	P=0.0002
Group B	2.300±0.46	4.375±0.70	-2.075	p<0.0001
Lower Trapezius				
Group A	2.375±0.49	2.975±0.69	-0.6	p<0.0001
Group B	2.425±0.50	4.550±0.63	-2.125	p<0.0001

Interpretation

Table 6 interpret that the pre and post-test IMT score values for patients with scapular dyskinesia which was compared within the groups, it was discovered that both groups' results were very significant (p < 0.0001). For serratus anterior, group A mean pre-test score was 2.425±0.50, and it grew to 3.20±0.79 on the post-test. In contrast, group B pre-test score was 2.475±0.50, and it increased to 4.425±0.67 on the post-test. Group B mean for the upper trapezius was 2.300±0.46 on the pre-test and climbed to 4.375±0.70 on the post-test, whereas

Group A mean was 2.400±0.49 on the pre-test and increased to 2.950±0.74 on the post-test. Group A had a lower trapezius mean of 2.375±0.49 on pre-test and increased to 2.975±0.69 on post-test, while Group B had a mean of 2.425±0.50 on pre-test and 4.550±0.63 on post-test.

Table 7. Comparison of pre test and post test mean scores of pressure biofeedback unit within group A and group B.

Pressure biofeedback	Pre test	Post test	Mean diff	P value
Group A	39.6	39.4	-0.23	p=0.0208
Group B	39.37	36.07	-3.33	p<0.0001

Interpretation

The pre and post-test values of Pressure Biofeedback unit for individuals with scapular dyskinesia was seen for two, the group A and B respectively. For group A it is not significant (p=0.0208) , while group B is considered extremely significant (p<0.0001) (Table 7).

DISCUSSION

The objective of the research was to determine the "Effect of a Structured Core Stabilization Exercise Program on Pain and Muscle Performance in Individuals with Scapular Dyskinesia." The core of the body consists of the pelvis, spine, and proximal lower limb, as well as abdominal structures. The muscles of the pelvis and spine form the core musculature, providing stability to spine and muscles. These core muscles generate energy and transfer it from large body parts to small body parts during various daily activities. In addition to energy generation and stabilizing the hip, pelvis, and spine, the proximal lower limb core muscles are also involved in almost all extremity activities such as running, throwing, and kicking (Roche et. al., 2015). "The capacity to regulate trunk movement and position in order to produce, transfer, and regulate pressures from and to the terminal parts as efficiently as possible during functional tasks is known as 'core stability.' The structure of the scapula is essential for proper shoulder function. The coordinated movements within the scapula and core together provide efficiency for shoulder functioning (Struyf et. al., 2014; Sağlam & Telli et. al., 2022). Core stabilization plays a crucial role in enhancing shoulder joint movement. It achieves this by increasing intra-abdominal pressure**,** which results from the structural organization and activation of core muscles. These core muscles include the multifidi, internal oblique, transverse abdominis, diaphragm, and pelvic floor muscles**.** While performing properly, they form a solid foundation in the trunk. Before initiating movement in the upper limbs, these muscles stabilize the trunk. The study primarily focused on these core components within the kinetic chain, facilitating early rehabilitation and preventing adverse outcomes such as reduced muscle strength and stiffness (Burkhart et. al., 2003; McClure et. al., 2006).

The study's findings revealed that there is very significant effect on pain and extremely significant effect on range of motion of shoulder joint, there is extremely significant effect on the strength of both scapular stabilizing muscle and the core muscles. The study's analysis was conducted using the paired t test. Mean age of the Group A participants was 58.52 ± 3.955 whereas for Group B was 58.767 ± 4.424. The research has suggested a number of core stability training regimens targeted at lowering back discomfort and avoiding injuries. Our goal was to enhance core stability by giving participants more control concerning the core area of the body (Mattson et. al., 2012). The initial exercise was the abdomen drawing in manuever, which was designed to activate the transverse abdominis and oblique muscles, just like in each of the other core stability exercise programmes (Ellenbecker & Aoki, 2020). Other workouts added dynamic movements to the upper and lower extremities to enhance recruitment of muscles as well as distal stability, all while aiming at offering proper lumbo-pelvic control (Kibler, 1998; Oliver & Adams-Blair, 2010; Brumitt & Dale, 2009).

The findings from the current study highlight the effectiveness of a six-week core

stabilization exercise program in correcting scapular positioning within the experimental group, leading to statistically significant improvements in shoulder range of motion**.** Statistical analysis values of ROM score for patients are, in between the group A and B, for flexion it showed quite significant (p=0.0525), for abduction it is considered significant (p=0.0304), for internal rotation is extremely significant (p<0.0001) and for external rotation is considered significant (p=0.0271). Additional research demonstrating a strong correlation between shoulder and stability in the core supports this conclusion. The impact of exercises for the shoulders on the stability of the core has been researched thoroughly which reported that the hip and pelvis provide over half of the energy that is kinetic and force associated with dynamic overhead movements. It was noted that strength of the trunk flexor, trunk rotators, hip extensor help positioning of the spine and thereby accommodate appropriate scapular movements (Henning, 2016; Bliss & Teeple, 2005). In this study, the pressure biofeedback section was employed to assess core muscle strength. Group B (Experimental) showed significant improvement in the PBU values after intervention. Statistical analysis in between two group was was found to be extremely significant (p value <0.0001). Weakness of trunk muscles is directly proportional to the variance in the upper extremity's musculature and vice versa. As the strength improves trunk muscles helps in improving functional abilities and ranges (Maenhout et. al., 2010; Park & Yu, 2013; Lee, 2021).

According to Jason Brumitt and S R. Barry Dale, trunk muscles activates in a feed forward manner during the upper or lower-limb movements (Paine & Voight, 1993; McClure et. al., 2001). The feed-forward process in the human body anticipates potential disruptions in spinal equilibrium as the extremities initiate movement (Mattson et. al., 2012). Additionally, a study by Gamze Cobanoglu and colleagues highlighted a strong relationship between Scapular Strength Test and Core Strength Test**.** The conclusion drawn from this is that muscular strength associated with the scapula and the core is critical for productivity and injury risk assessment. It is clear that in athletes, scapular muscular strength improves along with core muscle strength (Vijian et. al., 2023). Current study included combined core and shoulder exercises. In this study the group B which received core stabilization exercise program showed statistically significant improvement in both core muscle strength and scapular stabilizing muscle strength**.** Statistical analysis of among groups A and group B of IMT score for individuals with scapular dyskinesia revealed an extremely significant difference with p<0.0001. Results showed improved muscle strength of serratus anterior, lower trapezius and upper trapezius in group B. This improvement is seen because the core activation also helped in recruitment of muscle fibres of above-mentioned muscles as they two of them constitute the part of kinetic chain in addition to the thoracolumbar fascia.

Another case study by Kelly Kika examined the the effectiveness of trunk stabilisation as the primary treatment choice for pain in the shoulder provoked by Scapular Dyskinesia and Subacromial Impingement Syndrome. The patient showed reduced rib flare during shoulder flexion and reduced trunk rotation during stability tests were indicators of improvements in trunk stabilisation. By the conclusion of the therapy, improvements in shoulder and scapular strength, improvements in trunk stabilisation and less shoulder pain after ten physical therapy sessions were also observed. This study done for shorter period of time and with limited participant and only focused on abdominals as a part of treatment (Kika, 2018). In this present study, we focused on both flexors and extensors as part of the treatment protocol. This exercise program aimed to stabilize the entire trunk, thereby reducing compensatory movement patterns around the shoulder caused by muscle imbalances. The results also demonstrated significant pain reduction in both groups. Participants in two groups underwent conventional method of treatments, such as hot moist packs and TENS (Transcutaneous Electrical Nerve Stimulation). The combination of these treatments likely contributed to the greater reduction in VAS (Visual Analog Scale) scores**.** The mechanism behind pain reduction by TENS involves stimulating large-diameter nerve fibers in the central nervous system. This stimulation further activates inhibitory pathways**,** leading to pain relief.

In the context of treatment, a study by TuçezekliMsrlolu et al. investigated the immediate impact of core muscle activation postures on maximally voluntarily isometric muscle contraction (MVIC) strength in the area of the

shoulder. They also explored the effectiveness of core stability exercises. Participants underwent a six-week core stabilization exercise program. Following a home-based fitness routine, the MVIC readings showed significant improvement**.** The study concluded that this six-week core stability training program substantially increased shoulder MVIC strength**.** These findings support the use of core-strengthening exercises during the initial stages of shoulder treatment, especially when traditional shoulder exercises for muscle strengthening may cause discomfort (Bliven et. al., 2013; Saini et. al., 2020). In this research, based on statistical analysis, the findings showed improvement in both groups**.** However, when comparing the conventional group (Group A) with the interventional group (Group B)**,** which included a core stabilization exercising program, **s**ubstantial variations were observed in improving range of motion assessed and strength by using pressure biofeedback, individual muscle testing and goniometry. Pain was significantly reduced in both the groups.

The limitations of this research include the inclusion of just those with scapular dyskinesia recognised by lateral scapular slide test and an intermediate assessment. The long-lasting effect of a core stabilisation programme on individuals with scapular dyskinesia was not studied. This research was carried out at just one medical centre that might restrict its applicability to wider populations or geographical regions.

The results might assist medical professionals in creating customized rehabilitation plans for scapular dyskinesia patients, with the goals of reducing pain and improving strength, and endurance of the muscles. Better shoulder mechanics may be mitigated by improved core stability and alignment, which could improve functional results and general quality of life. The results of this study could also influence evidence-based treatment standards, which would facilitate more effective rehabilitation and long-term care plans for this difficult condition.

Suggestions

It is advised to conduct a long-term study with several assessments spaced out over extended follow-up periods. Moreover, more research should be done to see whether core stabilisation exercises are beneficial for patients with various shoulder or spine issues, such as rotator cuff injuries, cervical lordosis, excessive thoracic kyphosis and shoulder impingement.

Conclusion

Based on statistical analysis, the current study observed that both core stabilization and conventional exercises were effective in reducing pain in patients with scapular dyskinesia. The study's findings concluded that when comparing both techniques, the experimental group showed greater significant results in terms of reduction in pain, improvement in range of motion, enhanced core strength, increased scapular stabilizers strength, core stabilization exercises and scapular stabilization are beneficial in treating scapular dyskinesia because they facilitate effective upper extremity movement. Additionally, the transition from early rehabilitation activities to advanced functional rehabilitation exercises can be facilitated by incorporating combined shoulder and core workouts.

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Conflict of İnterest

There are no conflicting relationships or activities.

Ethics Statement

This research followed ethical standards and received approval from the Institutional Ethical Committee of Krishna Vishwa Vidyapeeth, KIMSDU dated 10/08/2022 and numbered 116/2022-2023.

Author Contributions

Design of the Study, SS and SS; Data Gathering, PJ; Statistical Evaluation, SS; Data interpreting PJ and SS; Writing of the Manuscript, PJ and SS; and Search of the Literature, PJ and SS. Each author has reviewed the final draft of the manuscript and given their approval.

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RESEARCH ARTICLE

Discipline Character and Social Interaction on Swimming Athlete Achievement

Monica AGUSTINA[1], Ayi SUHERMAN*[1], Adang Sudrazat[1] and Anggi Setia LENGKANA[1]

[1]Physical Education Program, Universitas Pendidikan Indonesia, Bandung / Indonesia
*Corresponding author: ayisuherman@upi.edu

Abstract
This study aims to determine the character of dicipline and social interaction in the achivements of swimming athletes. This study uses a survey method with a quantitative descriptive reaseacrh design. The sample used was based on the purposive sampling technique, which was advanced from each Artswimschool Purwakarta training center 33 athletes. The tesults if this studi show that the value of sig. Smaller than α (sig. 0.000 < 0.05), which means that H0 is rejected and H1 is accepted. Thus, there is a significant influence between the character of discipline and social interaction on the achievement of swimming and contributing athletes is very large, namely 98%. Based on the results of the research, it can be concluded that: 1) here is a significant relationship between the character of discipline and the achievement of swimmers. It can be concluded that if the character of discipline is higher, then the achievement of swimmers of Artwswimschool Purwakarta will be better; 2) There is a significant relationship between social interaction and swimmers' achievement. It can be concluded that if social interaction is higher, then the achievement of Artswimschool Purwakarta swimmers will be better; 3) a significant relationship exists between discipline, character, social interaction, and swimmers' achievement. Thus, it can be concluded that discipline, character, and social interaction affect swimmers' accomplishments at Artswimschool Purwakarta.

Keywords
Discipline Characters, Social Interaction, Achievement of Swimmer, Young Athletes

INTRODUCTION

Character is defined as the characteristics of a person who depend on the factors of his own life. Character is the mental, moral or ethical disposition of a person or a group of people (Muhtar et al., 2021). Character is a character, psychological trait, morals or habits that distinguish a person from others (Muhtar et al., 2019; Tussubha & Hadiyanto, 2020). Character education is a system that instills character values in students which includes knowledge, individual awareness, determination and willingness as well as actions to instill good values towards God Almighty, oneself, fellow humans, the environment and the surroundings. nation, so that we become human beings (Rudzitis et al., 2014). Character education is a system to instill character values in school students and includes educational components, awareness or desire and action to realize these values (Peters, 2015). Character education is an active effort to form habits so that children's character develops from an early age, so that they can make good and wise decisions and practice them in daily life (Fenney & Lee, 2013).

Character education is education that requires the formation of students' character or students to become good characters. According to (Loland, 2022), character education is important from the perspective of human life, so that the role of education not only shows moral knowledge, but also loves and is ready to take moral actions. Sports contain positive things related to all aspects of human life. In addition to developing motor skills, sports have noble values that can form character. Sports are miniature of society, where

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there are rules, business, cooperation, communication and other things that happen in society. Walgito also learned about the character development of students or athletes (Miller & Dolendo, 2022) said that behavior can be characterized by conditioning or habits, understanding and example. This means that the core values of religiosity, citizenship, independence, mutual cooperation, and honesty are more likely to be part of the character of athletes. If he knows and understands why these basic values must be used to arouse the interest of athletes and of course presented in an interesting way. Current developments have brought many changes. Change is happening in many areas of life. One cannot hide or avoid the impact of changes in one's life. A person must have a strong soul so that the changes experienced do not lead to negative changes.

Character is essential for a community to grow into a nation capable of realizing a secure and prosperous existence. Because morality is one of the most significant factors influencing a country's advancement or regression. A coach's success depends on their ability to help their players develop positive character traits, which can help them achieve their goals (Özcan, 2022). Athletes' unique personalities or characters contribute to their sporting accomplishments in addition to their physical and technical attributes. One of the critical components of an athlete's success is their character or personality. To enhance children's quality, discipline must also be instilled in them from a young age. With this discipline, which stems from self-awareness, athletes or students can excel in their training or academic endeavors. Sports activities closely linked to physical activity are among the many activities for which the success of the training is greatly anticipated. Issues like not getting the desired results from training are frequently linked to problems with physical activity (Cho et al., 2022). This indicates that various circumstances, mainly those about the athlete's training discipline, often impact each exercise and impede the attainment of the desired training outcomes.

Individuals with a disciplined nature are evident in their readiness to comply and behave in conformity with relevant ideals, which include rules, regulations, orders, life orders, or specific guidelines. Athletes who aim to attain optimal performance must possess training discipline, which can be developed through self-discipline (Sun, 2024). Therefore, an athlete with solid self-discipline consistently attains optimal results in every practice, demonstrating their ability to excel in their respective sports. An athlete's ability to attain optimal training outcomes will also be hampered by a lack of self-discipline in finishing his training, ultimately leading to worse performance in his chosen sports. A coach can ascertain the appropriate dosage or training load for each athlete. The coach's ability to mold the athlete's mindset or character is as important as the training load. This essay aims to mold swimmers' social interactions and discipline into their particular forms. Coaches must focus on a few areas to develop an athlete's mental or character and social interaction. These include: 1) Fostering the best possible communication between coaches and athletes; 2) Comprehending the athlete's nature, needs, and interests; 3) Paying attention to the athlete's habits, needs, and interests; 4) Inspiring athletes and assisting them in resolving issues that arise (Shi & Qu, 2022).

With other living things, humans coexist as social organisms. The social setting that serves as a gathering place must be carefully chosen for sound moral principles to emerge. To make life a reality, life values are employed. One set of principles that gives you power in daily life is discipline. As building discipline is essential, it is a crucial illustration of values. The selection of a meeting location's social milieu ought to facilitate the cultivation of discipline (Weziak-Bialowolska et al., 2023). Good life qualities, including discipline, can be developed by selecting the appropriate social setting. Parents are crucial in helping children grow up in the ideal social environment. Parents need to exercise caution when deciding on a social setting for their kids. Cost-effective sports training facilities are among the locations that might be used as gathering spots. The accomplishment sports coaching club uses physical, technical, tactical, and mental training exercises for its sports training program. The components developed to achieve maximum achievement must be carried out based on high discipline. Children starting from an early age will be used to carrying out training programs that have been programmed by the coach. Children must have high discipline to be able to carry out the program that has been prepared by the coach (Wang & Sharma, 2022). High discipline for an athlete is very necessary in order to be able to complete all the training programs that have been prepared by

the coach. Discipline will always be reflected in the implementation of all training components. Habituation that is carried out continuously and continuously from early age to senior level will be able to help the development of discipline. Parents must know how important this is when choosing a place to socialize with their children. Parents should be mentors for children to provide them with the right place to communicate. Sports training at sports clubs is one of the alternatives to improving sports. In the achievement sports development club, the affective and psychomotor fields get a higher frequency of application (Turdalievich, 2022). The effectiveness can be seen from the discipline of children in the implementation of the training program prepared by each coach. Based on the factor of self-discipline in participating in a physical exercise that is carried out is the basis needed to achieve the goal. As when doing an exercise, many problems are found, both incomplete facilities and infrastructure, the role of the coach and the burden of physical training given by the coach can be affect the psyche of athletes, thus athletes can experience stress. Based on the description above, the athlete's discipline factor must be considered so that the training results can be maximized to achieve the desired goal. The goal is to be able to achieve the athlete's body performance according to his sport, so that he can achieve optimal performance.

Based on social theory that humans are social creatures who live in an environment. The social environment as a place of action affects the development of a person's character. Character formation is a process throughout a person's life. In accordance with the above expression, discipline is one of the values that are formed, where discipline is the background of the training process of each exercise, with disciplined training, physical, technical, tactical and mental qualities can be developed optimally during the training (Lee et al., 2016). Discipline is one of the values formed during training. People have a high level of discipline that carries over into their physical activity. Social interaction often occurs in sports activities, especially in sports games and competitions. The relationship in question is the relationship between individuals and individuals, individuals and groups, or groups with other groups. A process of social communication can occur when two people or groups make contact and social interaction. Social contact is the transmission of information and the interpretation of the information transmitted (Olvhøj et al., 2022). This can be done by scolding each other, shaking hands, talking to each other or maybe even fighting. The forms of social interaction that have occurred so far are cooperation, competition, conflict and adaptation. One way to see sports communication is swimming. Good social interaction between athletes will create a harmonious relationship (Ponciano Núñez et al., 2023). A good form of social interaction is seen from cooperation, mutual respect and mutual respect. More and more cooperation is created when a problem is found in training. The athletes love to talk and help each other in the difficulties of training. Good communication between athletes can create mutual respect and create a comfortable atmosphere during training and encourage athletes to succeed in the school environment.

On the other hand, the social interaction of athletes is not good, characterized by a hateful relationship between athletes and a lack of cooperation between athletes. Poor forms of social interaction can occur when athletes hate each other, demean each other, and form peer groups where each group attacks or belittles each other, resulting in less harmonious relationships between athletes (Beldon et al., 2022). Poor social interaction in the school environment gives rise to a practice environment that is not comfortable or conducive. This hinders the progress of athletes in training due to the lack of cooperation, communication, and respect between athletes, so it often creates a training atmosphere that is always boisterous, tense, and usually noisy. It causes quarrels, fights, and others. Athletes are distracted in training.

Swimming has been a sport since humans existed on Earth. Swimming is popular, easy, cheap, and safe for children and adults. Swimming can be used as a way to improve physical fitness. There are four swimming styles and physical education and achievement: 1) Freestyle, 2) Backstroke, 3) Breaststroke, and 4) Butterfly. Sports that can be used to achieve these goals include swimming. Swimming can be used to achieve the goal of exercising because swimming has many benefits. These benefits include body growth and development, communication and interaction with others, and increased self-confidence. They can be used as a recreational

activity because cold stimuli can refresh the body and emotions. Learning to swim can improve an athlete's knowledge of effective and efficient movement, the properties of water, swimming theory, etc. Thanks to these advantages, swimming has entered the world of education from elementary school to high school. The role in talent development is vital because the roles and materials provided affect whether or not the training results are promising. So, researchers are interested in investigating whether coaches can play a good role in improving swimmers' performance. Based on the description above, the researcher is interested in conducting a study titled "Discipline Character and Social Interaction on Swimming Athlete Achievement."

MATERIALS AND METHODS

This study aims to describe and analyze the influence of discipline character and social interaction on the achievement of swimming athletes. Based on the objectives to be achieved and the formulation of the proposed problem, this study includes correlational research using a quantitative survey method approach. This quantitative descriptive research describes the current state of the subject or object of research based on facts that appear or as they are. Descriptive research describes the research situation or event, does not seek or explain relationships, and does not test hypotheses or make predictions. Meanwhile, the survey method was used. The survey method is sampling a population and using questionnaires as a primary data collection tool. The reason for using the survey method is, first, for the completeness of the data. The survey method is quantitative, but usually, the survey that is carried out tends to be more straightforward with simple statistical analysis tools (descriptive statistics) because it only complements data or information.

In the survey study, the researcher asked several people (called respondents) about the character of discipline, including time discipline, discipline in enforcing rules, attitude discipline, and worship discipline, while social interaction includes social contact and communication, identification, accommodation, assimilation, competition and opposition using questionnaires or questionnaires. The questionnaire will be given to advanced class swimmers of the Artswimschool Purwakarta club. Instrument as a research questionnaire is one of the data collection techniques carried out by providing a set of written statements or questions to the respondents and then answered by the respondents.

The survey method used in this study is to collect data on the character of discipline and social interaction on the achievements of swimming athletes. The population in this study is the advanced classes of the Artswimschool Purwakarta club from each training center. A sample of 33 people who have criteria are active members from each Artswimschool Purwakarta center and also have a minimum achievement at the internal level of Artswimschool Purwakarta, which is held every six months to improve the abilities and achievements of all Artswimschool Purwakarta athletes. Ethics of the Research.

Ethics of the Research

This study followed ethical standards and received approval from the Institute for Research and Community Service, Universitas Pendidikan Indonesia, with Letter Number B-0301/UN40.D/PT.01.02/2024. Participant provided informed consent, with the volunteer form covering research details, risks, benefits, confidentiality, and participant rights. The research strictly adhered to the ethical principles of the Declaration of Helsinki, prioritizing participant's rights and well-being in design, procedures, and confidentiality measures.

Research Instruments

The instrument used in this study is a questionnaire that uses the Likert scale assessment criteria. In this study, the researcher used two variables: discipline character (Sal, 2022), and social interaction (Merlin & Prabakar, 2024). Then, the questionnaire was distributed to athletes selected from the 33 samples. The grids in the manufacture of instruments are as follows (Table 1 and Table 2).

The procedures taken in this study can be described into severalstages, namely the preparation stage, the implementation stage, and the data processing and analysis stage, which are as follows:

Preparation Stage

At this stage, the researcher will conduct research in the advanced classes of each Artswimschool Purwakarta center. This preparation stage is the initial stage before the implementation of the research. The steps taken at this preparation

stage are the preparation of proposals containing research designs, applications for permission to conduct research. After being approved, the next step is for the researcher to conduct research in the field according to the method or theory used and get guidance from the supervisor.

Implementation Stage

At this stage, the researcher will use a data collection technique using a questionnaire to 33 samples. This test is used to measure the character of discipline and social interaction in the achievements of swimmers of the Artswimschool Purwakarta club. After conducting research, the next step is to process the data obtained and then process it and the results are used as a basis for drawing conclusions.

Table 1. Grid of disciplinary character research instruments

No	Theory	Indicators	Question Items		Sum
			Positive	Negative	
1	Time Discipline	Adherence to training	5, 6, 7		3
		Obedience in practice	8	9	2
2	Discipline to Enforce the Rules	Obedience to training rules	1, 2, 3, 4		4
		Be organized in training	15, 16, 17, 18, 19	20	6
3	Attitude Discipline	Pray during activities	11		1
		Greeting	10		1
4	Discipline of Worshiph	Obediently carry out prayer services	13	12	2
		Obediently fasting	14		1
		Sum	**17**	**3**	**20**

Table 2. Grıd of social interactıon research instruments

No	Theory	Indicators	Sub Indicators	Question Number		Totaly
				+	-	
1.	Social Interaction Requirements	Social Contact and Communication	Making physical contact	2	1	3
2.	Social Interaction Factors	Identification	1. See the interlocutor as a whole 2. Imitate the interlocutor well	1 1		2
3.	Forms of Interaction	Associative	Accommodation, Assimilation	9		9
		Dissociative	Competition, Opposition	3	3	6
		Totaly		**16**	**4**	**20**

Statistical Analysis

To find out the extent of the significance of the research results, the test uses statistics. This data analysis is used to analyze quantitative data based on the findings in the study using the IBM SPSS type 22 for windows application. The data processing studied is as follows: normality test, homogeneity test, and hypothesis test.

RESULTS

Data Normality Test

Once the data is obtained, the next step is to analyze the data using the help of the IBM SPSS version 22 application. The data processed is as follows: The researcher used Shapiro Wilk's normality test on the variables of discipline character and social interaction. The basis for the decision is as follows:

Based on the SPSS output table "Tests of Normality" above, it is known that the Sig. value in the Shapiro-Wilk normality test is as follows:

Student Discipline with a Sig score of 0.592, and Social Interaction: The Sig value is 0.203. Because the significance value (Sig) for all research variables above > 0.05, it can be concluded that the variables of student discipline and social interaction are normally distributed

Table 3. Test of normality of discipline and social interaction

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	Df	Sig.
Student Discipline	,123	33	,200*	,974	33	,592
Social Interaction	,101	33	,200*	,956	33	,203

Homogeneity Test

The homogeneity test is used to determine whether the data from the research results have the same variant or not. It is said to have the same or no different value (homogeneous) if the significance level is > 0.05 and if the significance level is <0.05, then the data is concluded not to have the same or different variant values (not homogeneous). As a basis for decision making, the homogeneity test is:

Table 4. Homogeneity test

		Sum of Squares	df	Mean Square	F	Sig.
Student Discipline	Between Groups	2224,000	26	85,538	128,308	,000
	Within Groups	4,000	6	,667		
	Total	2228,000	32			
Interaksi Sosial	Between Groups	2700,000	26	103,846	155,769	,000
	Within Groups	4,000	6	,667		
	Total	2704,000	32			

From the calculation of the homogeneity test of two variables (Discipline Character and Social Interaction), it can be seen that the significance value is 0.000. Because the value obtained from the homogeneity test of the sig value. 0.000 < 0.05 then the data has different variant values (**homogeneous**).

Test Hypothesis

To find out whether the hypothesis test on the variables of student discipline and social interaction used in the study is accepted or rejected, the researcher must know the theory of the basis of hypothesis decision-making. It can be seen from the correlation test table regarding the relationship formed between variables before and after being included in the correlation analysis. To interpret the Correlations output table above, there are 3 stages that we must go through, namely: (1) Determining the formulation of the research hypothesis, (2) Seeing the theory of the basis of decision-making in the partial correlation test, and (3) Interpreting the results of the analysis and making conclusions. The basis for decision-making in the Sig. partial correlation test (2-tailed) is as follows:

Table 5. Student discipline

Relationship	r-count	r-table (df 33 - 2)	Sig
Discipline Character	,964	0,344	,000
Social Interaction	,992	0,344	,000
Discipline & Character Social interaction	F = 103,288	0,344	,000

Hypothesis 1

The first hypothesis to be tested reads "There is a significant relationship between discipline character and the achieent of swimmers". The rule of analysis is that if the p-value < 0.05, then Ha is accepted and vice versa. The results of the analysis are described in table 6 as follows: Based on table 5 above, it shows that the correlation coefficient of discipline character in the achievement of swimming athletes is obtained with an r value of 0.964 and a p-value of 0.000 < 0.05, then H0 is rejected, meaning that H1 which read"There is a significant relationship between discipline character and the achievement of swimmers" **is accepted**. The correlation coefficient has a positive value, meaning that if the character of discipline is higher, then the achievements of Artswimschool Purwakarta swimmers will be better.

Hypothesis 2

The second hypothesis to be tested reads "There is a significant relationship between social interaction on the performance of swimmers". The rule of analysis is that if the p-value < 0.05, then Ha is accepted and vice versa. Based on table 5 above, it shows that the correlation coefficient of confidence with freestyle swimming achievement is obtained with an r value of 0.992, and a p-value of 0.000 < 0.05, then H0 is rejected, meaning that H2 which reads "There is a significant relationship between social interaction on swimming athlete achievement" is accepted. The correlation coefficient has a positive value, meaning that if social interaction is higher, then the achievement of Artswimschool Purwakarta swimmers will be better.

Hypothesis 3

The third hypothesis test uses the F test (Simultaneous). The F test is needed to determine the influence of independent variables on dependent variables simultaneously and to determine the accuracy of the regression model used. The accuracy test of the model aims to find out whether the formulation of the model is correct or fit. The third hypothesis test reads "There is a significant relationship between discipline character and social interaction on the performance of swimming athletes". Based on table 5 above, the F value is calculated at 103.288 > F table (df 2; 33) 3.344, while the p-value is 0.000 < 0.05, then H0 is rejected, meaning that H3 which reads "There is a significant relationship between discipline character and social interaction on the achievement of swimmers", is accepted. It can be concluded that the regression model selected is feasible to test the data and the regression model can be used to predict that the character of discipline and social interaction together have an effect on the performance of Artswimschool Purwakarta swimmers.

Coefficient of Determination

The Coefficient of Determination (R2) is essentially used to measure how far a regression model is capable of explaining the variation of dependent variables. The results of the analysis in Table 7 are as follows

Table 6. Results of determination coefficient analysis

Model Summary				
Model	**R**	**R Square**	**Adjusted R Square**	**Std, Error of the Estimate**
1	0,936a	0,877	0,868	0,36222

Coefficient of determination The result of the output in table 6 shows the magnitude of the R Square value of 0.877. This means that 87.70% of the variation in the achievements of swimming athletes can be explained by variations of independent variables, namely discipline character and social interaction. The remaining 12.30% is explained by other causes outside the model, such as technique, physicality, and talent. The effective contribution (SE) and relative contribution (SR) of discipline character and social interaction on the achievement of Artwsimschool Purwakarta swimmers are presented in table 7 as follows:

Table 7. Results of analysis of effective donations and relative donations

Variable	Effective Contribution	Relative Contribution
Discipline Character (X1)	68,40%	65,97%
Social Interaction (X2)	29,60%	34,03%
Totaly	98%	100,00%

Based on the results in table 7 above, it shows that the discipline character variable has a contribution of 68.40% and social interaction of 29.60%. Of the two variables, the discipline character variable has a greater contribution to the achievement of Artswimschool Purwakarta swimmers.

DISCUSSION

The discussion of the research results provides a further interpretation of the results of the data analysis that has been submitted. Based on the results of the study, it can be explained as follows:

Discipline Character in Swimming Athlete Achievement

Based on the results of the study, it was shown that there was a significant relationship between the character of discipline and the achievement of Artswimschool Purwakarta swimmers, which was 68.40%. These results align with research conducted by (Tedesqui & Young, 2017), the results show that the success of an exercise carried out is influenced by one of the factors, namely the self-discipline of the athlete himself. To get good training results, it is recommended that an athlete must have discipline so that the desired training goals will be achieved. This finding aligns with the theory of discipline character. People with a disciplined nature can be seen from their willingness to respond and act according to applicable values, namely in the form of orders, regulations, rules, life orders, or specific rules. Every athlete who strives to achieve maximum achievement must have training discipline, which can be fostered as self-discipline, so an athlete with high self-discipline in every practice. It is carried out to achieve maximum results so that athletes can excel in their sports (Vladova & Hristov, 2017). Likewise, an athlete needs to have self-discipline in completing his training. In that case, he needs to be able to achieve maximum training results so that it impacts decreasing achievements in the sports he participates in.

Human beings as individuals sometimes want to live freely, so they want to break free from the bonds or rules that limit their actions or behavior. But we must understand that humans are social beings who live among interacting individuals, where they need to feel accepted by others. In other words, discipline is essential in an athlete because it is easier to achieve the coach's goals if the athlete has discipline. In sports, to win a match, athletes must always follow the rules according to the training program that has been set, or not follow the training program, follow the rules and be sportsmanlike, or break the rules to win the game immediately (Şimşir & Dilmaç, 2020). All of this is closely related to the issue of athletic discipline and self-control in the face of the desire for satisfaction.

Discipline that is forcibly instilled can create awareness that can increase discipline athletes who behave negatively or reject agreed rules or regulations show symptoms of indiscipline because discipline involves compliance with confirmed rules and values. Often, an athlete's sport is challenged by an internal conflict between prioritizing personal interests or the public interest (Tedesqui & Young, 2018). And regulations, although no one controls sanctions and supervision. Ultimately, he instead follows his plan based on values called self-discipline. Thus, athletes with self-discipline already have the awareness to train themselves, improve their skills, and maintain their physical freshness and fitness, can control themselves not to act against the rules that can be detrimental to their health, and try to live and do their best. Discipline can be developed in such a way that it positively influences the development of athletes' self-esteem. Discipline is indispensable for everyone. Highly disciplined people have higher qualities. Discipline is applied to all levels of society. In this case, athletes who can develop self-discipline will eventually have a "self-image" as a disciplined person (Maratovich & Kolsesyanova, 2023).

Based on the explanation above, it can be concluded that the discipline of an athlete is a moral responsibility that can follow the rules or values that exist in an organization, group, or individual so as to make an athlete by expectations. In this way, athletes achieve the goals or ideals they want to achieve, both in training and achievements in the sports they perform (Yunesa & Khaidir, 2019). This causes discipline in training to be the number one factor that affects an athlete's success in achieving training results. Therefore, the discipline of athletes in conducting training must be considered and should be addressed if they want to obtain optimal training results.

Social Interaction on Swimmers' Achievement

Based on the results of the study, it was shown that there was a significant relationship between social interaction and the achievement of Artswimschool Purwakarta swimmers, which was 29.60%. This aligns with the research conducted by (Lee et al., 2016), the results show that cooperation in sports activities will be better when the intensity of the gathering is greater, and the attitude of openness and mutual respect will strengthen collaboration in each individual or group. Social interaction can occur when there is contact and social interaction between two individuals or groups. Social contact is the first stage in social relationships. Communication is the transmission of information and the provision of interpretation and reaction to the information sent (Bean et al., 2014) identified several things that can be a source of

information to initiate communication or social interaction. Data sources can be divided into two parts, namely physical characteristics and appearances. Physical traits are everything a person has from birth, including gender, age, and race. Appearance can include physical attractiveness, body shape, the appearance of clothing, and conversation. Social interaction often occurs in sports activities, especially sports games and competitions. The relationship is between individuals and individuals, individuals and groups, or groups with other groups. Social communication can occur when two people or groups make contact and social interaction. Social contact is the transmission of information and the interpretation of the information transmitted. This can be done by scolding each other, shaking hands, talking to each other, or maybe even fighting (Ferris et al., 2016). So far, the forms of social interaction are cooperation, competition, conflict, and adaptation. One way to see sports communication is swimming.

Good social interaction between athletes will create a harmonious relationship. A good form of social interaction is cooperation and mutual respect. More and more collaboration is created when a problem is found in training. Social interaction is significant, as a frequent lack of social interaction has serious mental health consequences, perhaps even more severe than physical exercise (Hidayat et al., 2022; Lengkana et al., 2024; Mulya et al., 2021, 2023). The athletes love to talk and help each other in training difficulties. Good communication between athletes can develop mutual respect, create a comfortable atmosphere during training, and encourage athletes to succeed in the school environment. On the other hand, the social interaction of athletes is not good, characterized by a hateful relationship between athletes and a lack of cooperation between athletes (Yukhymenko-Lescroart, 2019). Poor forms of social interaction can occur when athletes hate each other, demean each other, and form peer groups where each group attacks or belittles each other, resulting in less harmonious relationships between athletes. Poor social interaction in the school environment creates a practice environment that could be more comfortable and conducive. This hinders athletes' progress in training due to the lack of cooperation, communication, and respect between athletes. It often creates a boisterous, tense, and rowdy training atmosphere, causing quarrels, fights, and disturbances among other athletes.

Discipline Character and Social Interaction on Swimming Athlete Achievement

Based on the results of the study, it was shown that there was a significant relationship between discipline character and social interaction in the achievement of Artswimschool Purwakarta swimmers, which was 98%. Discipline for the arrival of training time is included in punctuality because this swimming activity is from the child's desire. This child also obeys the instructions from the coach, and in terms of running the program given by the coach, everything is carried out. Even though he is tired and the program is heavy, he still runs it to the maximum. The level of discipline is good, as seen from the results that have been achieved, but over time, the intensity of training time has decreased; discipline in swimming also reduced due to the constraints of certain factors (Vierimaa et al., 2018).

Artswimschool athletes are athletes who are disciplined enough to arrive during training hours. The intensity of the training is also good, but there may be those who are still allowed because there are school activities or because they are sick. Artswimschool athletes, including athletes, obey the coach's orders to run all the programs given; they accept the instructions from the coach even though the program is quite heavy and sometimes tiring (Yukhymenko-Lescroart, 2019). However, the level of discipline has begun to decline because there are also quite a lot of activities from the outside. For the arrival of athletes at a pretty good level of accuracy, because the athlete had already departed half an hour before the training considering that the distance traveled from home to the training ground was quite far, so before the training started, he had already arrived. The intensity of the training is intensive. These athletes obey the athletes' orders and always carry out the programs given. Social interaction can be interpreted as a dynamic social relationship. The social relationship can be between individuals and other individuals, groups with different groups, or groups with individuals. Interaction also includes symbols, where symbols are interpreted as something that the user gives value or meaning.

Good social interaction between athletes will create a harmonious relationship. A good form of social interaction is cooperation and mutual respect. More and more collaboration is created when a problem is found in training. The athletes love to talk and help each other in training difficulties.

Good communication between athletes can develop mutual respect, create a comfortable atmosphere during training, and encourage athletes to succeed in the school environment (Yildiz et al., 2018). A coach must pay attention to the psychological, emotional, and social elements of his athletes because athletes live in a social environment with different wants, needs, and feelings from the people around them. A successful coach is assisted by knowledge of scientific principles closely related to coaching problems in determining athlete achievements. The results of hard work during swimming practice are seen from the time record. However, these results must go through a process that starts with the proper technique, physical exercise, and well-managed emotional aspects.

The psychological factor itself is an essential factor in determining athlete achievement. Psychological disorders that often occur in individual and team sports are anxiety, lack of confidence, difficulty concentrating, and even depression (Hagger et al., 2021). Based on this, mental training must be carried out continuously by athletes so that it has a positive impact on improving performance at the best time (Legg, 2020) said that mental training should continue to be carried out throughout the athlete's sports activities. The mental aspect is one aspect that supports successful sporting achievements, apart from the physical, technical, and tactical elements. Let's look at the contribution of all these aspects to the success of swimming athletes. It can be explained that the contribution of the physical aspect is 38%, the technical element is 20%, the tactical aspect is 12%, and the psychological aspect is 30%.

Conflict of Interest

The authors have declared no conflicts of Interest.

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Ethics Statement

This study followed ethical standards and received approval from the Institute for Research and Community Service, Universitas Pendidikan Indonesia, with Letter Number B-0301/UN40.D/PT.01.02/2024.

Author Contributions

Design of the Study, MA and AS; Data Gathering, MA, AS and AS; Statistical Evaluation, AS and ASL; Data interpreting MA, AS and ASL; Writing of the Manuscript, AS, ASL and MA; and Search of the Literature, MA, AS, AS, ASL. Each author has reviewed the final draft of the manuscript and given their approval.

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RESEARCH ARTICLE

Pre and Post Competition Psychology and its Relationship with Competition Results in Lawn Bowl Disabilities Athletes in Asian Paragames 2022

Islahuzzaman NURYADIN[1], Batista Nila MARBERLIANTINA[1] and Rumi Iqbal DOEWES*[1]

[1]Faculty of Sports, Sebelas Maret University, Indonesia
*Corresponding author: mase.ior2004@staff.uns.ac.id

Abstract
This research purpose was investigated the psychology of disabilities athletes before and after the competition and the relationship with the results of the lawn bowl competition at the Asian Paragames 2022. The research method used is a survey. The 12 blind athletes (6 men and 6 women) participating in this study were aged 37.67±11.07 years, weight 68.58±10.13 kg, height 165.00±7.07 cm, and had 3.19±1.06 years of experience playing lawn bowls. Data analysis was carried out using paired t-test and regression analysis with significance at $p<0.05$. The results of the paired t-test revealed significant differences before and after the competition in athletic identity ($p = 0.000$), anxiety ($p = 0.000$), self-efficacy in sports ($p = 0.000$), expectations of success ($p = 0.000$), and mood profile ($p = 0.000$). The results of the regression analysis revealed that the regression model which included anxiety, athletic identity, expectations of success, self-efficacy in sports, and mood profile was significant for competition outcomes ($F = 101.75$, $p = 0.000$), with 99.92% of competition outcomes explained by variations in psychological variables (R square = 0.992). Based on the relationship, only anxiety shown a negative relationship to the competition results with a regression coefficient of -3.102 for anxiety-state and -0.723 for anxiety-trait. In conclusion, improvements are needed in athletic identity, self-efficacy, expectancy of success, and a positive mood profile to reduce the anxiety level before competition then improve competition performance better in lawn bowl athletes.

Keywords
Psychology, Competition, Lawn Bowl

INTRODUCTION

Competition levels are increasing along with increased sports participation for people with disabilities. Disabilities athletes routinely compete at national and international levels, with participation in the Paralympic Games (Dieffenbach & Statler, 2012). The Paralympic Games are recognized as the world's most important international sporting event for disabilities athletes. Thousands of athletes with disabilities from various sports disciplines are brought together at the Paralympic Games to compete (Blumenstein & Orbach, 2015), one of the sports disciplines is lawn bowl. Silk, Hammond, & Weatherby (2006) explain that lawn bowls are a target sport. Athletes with disabilities can play lawn bowls on a bowling green on a flat grass surface measuring approximately 40 meters x 40 meters. Lawn bowl can be played in singles, pairs, triples, and fours games, where players can form teams in pairs, triples, and fours games. The concept of the game is to deliver the bowl to the jack. The bowl that is closer to the jack, will be awarded 1 point.

In the world of elite disability sport and the Paralympics, psychology is an important factor in achieving sporting success. Psychological factors protect athletes from the potential negative impacts of stress triggers so that athletes will be conducive to achieving optimal sports performance. Several

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studies with various types of research related to the competition psychology of disabilities athletes have been reported. A comparative study of professional athletes with and without disabilities, shows that the psychological component is considered a factor in achieving high performance. People with disabilities show higher global self-esteem scores than those without disabilities. Apart from that, athletes with disabilities show low competitive anxiety before competitions, this happens because they have confidence in what they have such as physical skills and what they have done so far such as their training, they are also supported by coach abilities, they have a strong mentality such as do not have the burden of worrying about other people's assessments, and also have strong motivation that they are capable of achievement, and they are always 100% ready when undergoing training or competitions (Bačanac et al., 2014).

A review reveals that sports athletes have a strong athletic identity (Guerrero & Martin, 2018). A review of athletes with disabilities reported that competitive level was related to competitive anxiety (Pumpuang, Chusakul, & Popa, 2022). Correlation studies show an important relationship between wheelchair athlete performance and self-efficacy (Martin, 2002). A multivariate analysis reported that regarding mood profiles, Paralympians had higher vigor scores and lower depressed mood and confusion (Martin, Malone, & Hilyer, 2011). However, information regarding the psychology of disabilities athletes, especially psychology related to lawn bowl competitions, has not been explained. Therefore, this research was conducted to investigating the psychology of disabilities athletes before and after the competition and its relationship with the results of the lawn bowl competition at the 2022 Asian Paragames competition.

MATERIALS AND METHODS

Design Studies

A survey study was used in this research (Figure 1). The survey was conducted on psychological variables, i.e. anxiety, athletic identity, expectations of success, and self-efficacy in sports which are reported to have a potential impact on the performance of athletes with disabilities (Koper et al., 2020), as well as mood profiles which are reported to differentiate between winning and losing competitors (Terry & Slade, 1995).

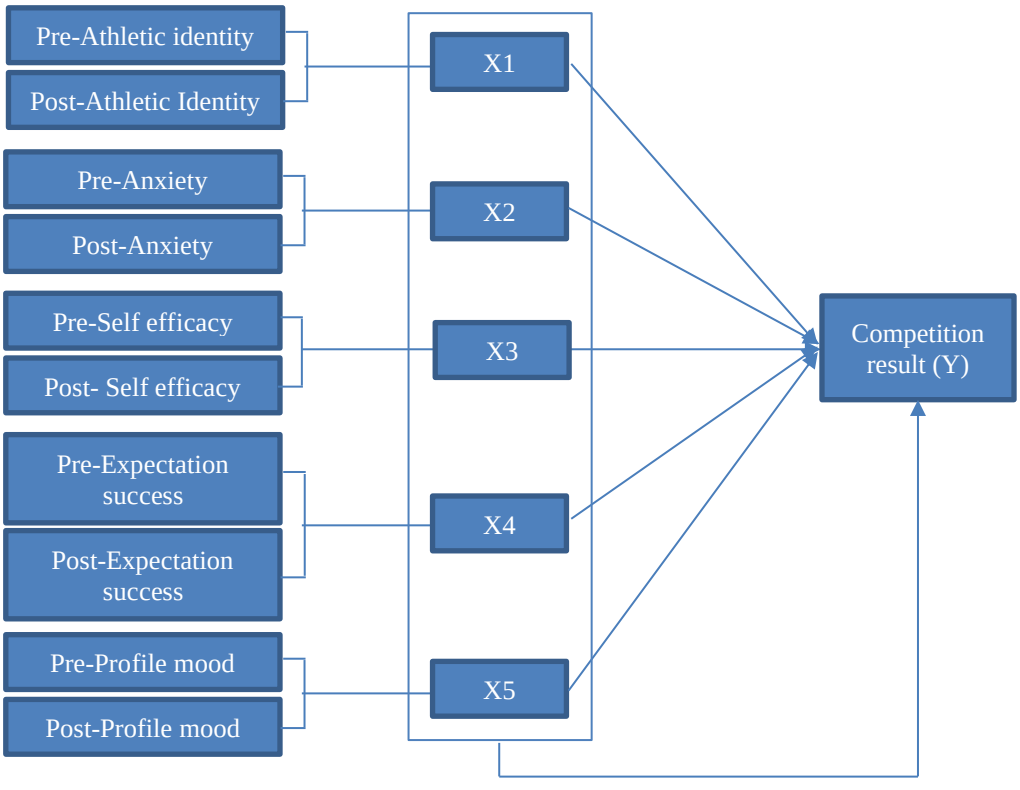

Figure 1. *Flow chart design studies*

Sample

The research sample were all of Indonesian national lawn bowl athletes who competed in the 2022 Asian Para Games competition. A total of 12 lawn bowl athletes, competition classifications B1, B2, B3, B6, and B8 participated in this study (men, n = 6, women, n = 6). They were 37.67±11.07 years old, weight 68.58±10.13 kg, height 165.00±7.07 cm, and had 3.19±1.06 years of playing lawn bowl experience

Demographic data on athletes for each gender is presented in table 1. Informed consent was obtained from all subjects before testing. This resarch was approved by the scientific research ethics committee of Sebelas Maret University, Surakarta at Dr. Moewardi Hospital with protocol code 081/I/HREC/2024, ratification date 11 January 2024. The research strictly adhered to the ethical principles of the Declaration of Helsinki, prioritizing participant's rights and well-being in design, procedures, and confidentiality measures.

Table 1. Athlete demographic data

Gender	Age (years)	Weight (kg)	Height (cm)	Playing experience (years)
Male (n = 6)	40.33±7.84	69.33±12.39	170.17±5.04	3.44±0.84
Female (n = 6)	35.00±13.83	67.83±8.42	159.83±4.54	2.94±1.27
Total (n = 12)	37.67±11.07	68.58±10.13	165.00±7.07	3.19±1.06

Data collection

Data were collected by researchers during the Lawn Bowl competition at the 2022 Asian Paragames. Before the competition, a briefing was held to present the research to the players and coaches. Players are asked to fill out a questionnaire before the competition starts and after the competition ends. The questionnaire consists of athletic identity using the Athletic Identity Measurement Scale (AIMS), anxiety using the State Trait Anxiety Inventory (STAI), self-efficacy in sports using the Self-Efficacy for Physical Activities Scale, expectations of success using the Self- and Task-Perception Questionnaire (STPQ) hope subscale, and mood profile using the Abbreviated Profile of Mood States (Revised Version). Competition results data, namely the medals that participants get in the Lawn Bowl competition, are obtained after the competition is finished. Medal wins were coded as (0 = did not win a medal; 1 = won a bronze medal; 2 = won a silver medal; and 3 = won a gold medal).

Athletic Identity Measurement Scale (AIMS)

AIMS (Athletic Identity Measurement Scale) was used to assess athletic identity (Proios, 2012). There are 10 items in the AIMS that identify the role of athletes related to several aspects such as cognitive, behavioral and affective. The assessment uses a 7 point Likert scale, i.e. 1 for strongly disagree – 7 for strongly agree. To determine the score, the answers to each item are totaled. A high score indicates a strong level of athletic identity. AIMS has test-retest reliability with a value of r = 0.89 and has an internal consistency of α = 0.81 to 0.93 (Proios, 2012).

State Trait Anxiety Inventory (STAI)

The STAI (State Trait Anxiety Inventory) was used to assess anxiety symptoms. STAI evaluates states and traits using different scales. State to show how you feel at the moment, i.e. at this moment; and traits to show how you feel in general. Each scale consists of 20 statements. These two scales classify participants as having low, medium, or high levels of anxiety. Scores can vary from 20 to 80. A score ≤ 30 indicates a low level of anxiety, a score between 31-49 indicates a moderate level of anxiety, and a score equal to or greater than 50 indicates a high level of anxiety. Respondents rated on a four-point scale “Not at all” (1), “Somewhat” (2), “Moderately” (3), to “Very much” (4) for the state scale, “Almost never” (1), “Sometimes” (2), “Often” (3), to “Almost always” (4) for the trait scale. It has internal consistency with an alpha coefficient of 0.92 for the trait subscale and 0.93 for the state subscale, and has excellent test-retest reliability with a Pearson coefficient of 0.96 for the state subscale and 0.98 for the trait subscale (Gorsuch, et al., 2018).

Self-Efficacy for Physical Activities Scale

The Self-Efficacy for Physical Activities Scale was used to assess self-efficacy. There are 18 items in this questionnaire, which cover 6 theoretical sources of self-efficacy ((1) mastery experiences; (2) vicarious experiences; (3) verbal persuasion by others; (4) self-persuasion; (5) positive affective states; (6) negative affective

state). Respondents expressed their opinions on a four-point scale: 1 (strongly disagree) to 4 (strongly agree) (Warner et al., 2014). The assessment is carried out by adding up all the items and a high score indicates high self-efficacy. The Self-Efficacy for Physical Activities Scale has internal consistencies ranging from 0.86 – 0.89 for mastery experiences, 0.83 – 0.86 for vicarious experiences, 0.88 – 0.93 for self-persuasion, 0.82 – 0.88 for verbal persuasion by others, 0.75 – 0.83 for negative affective states, and 0.87 – 0.92 for positive affective states. Test-retest reliability was reported to be satisfactory on all six scales with 0.65 for mastery experiences, 0.66 for vicarious experiences, 0.68 for verbal persuasion by others, 0.65 for self-persuasion, 0.59 for negative affective states, and 0.65 for positive affective states.

Self- and Task-Perception Questionnaire (STPQ)

The STPQ (Self- and Task-Perception Questionnaire) expectancy subscale was used to assess expectancy of success. The expectancy subscale contains 5 question items based on a five-point scale, has internal consistency with an alpha coefficient of 0.92 (Xiang et al., 2003). For example, respondents were asked, "Compared to other athletes, how well do you expect to perform in competition?" (1 = much worse than other athletes; 5 = much better than other athletes) or "How good are you at lawn bowls?" (1 = not at all good; 5 = very good).

Abbreviated Profile of Mood States (Revised Version)

The mood profile was measured using the Abbreviated Profile of Mood States (Revised Version) (Grove & Prapavessis, 1992). This is a questionnaire containing 40 items consisting of seven subscales, namely fatigue, anger, vigor, tension, esteem, confusion, and depression. Participants were asked to rate "How do you feel right now" on each descriptor, for example, "angry", on a 5-point scale marked with 0 = "not at all"; 1 = "a little"; 2 = "moderately"; 3 = "quite a lot"; and 4 = "extremely" (Grove & Prapavessis, 1992). Abbreviated Profile of Mood States (Revised Version) has internal consistency with a very high alpha coefficient for the fatigue, anger, and vigor subscales (between 0.95 to 0.87), moderately for the tension, esteem, and confusion subscales (between 0.76 to 0.70), and depression (0.66).

Data analysis

Data analysis used SPSS17. The Kolmogorov-Smirnov test was used to check normally distributed data. Paired t-test was conducted to determine statistically significant differences in psychological variables before the competition and after the competition. Furthermore, regression analysis was carried out on psychological changes before and after the competition on the results of the competition. The determinant coefficient explains how much psychological influence before and after the competition has on the competition results. The significance level was set at $p<0.05$.

RESULTS

Data on Medals

Of the 12 samples of lawn bowl athletes competing in the 2022 Asian Para Games, 5 athletes did not receive medals (41.67%) and 7 athletes received medals (58.33%) (table 2).

Table 2. Medals won in the 2022 Asian Paragames competition

Sample	Didn't Get a Medal	Get Medals
1	√	
2		√
3	√	
4	√	
5	√	
6		√
7		√
8		√
9		√
10		√
11	√	
12		√
%	**41.57%**	**58.33%**

Data on psychological differences before and after competition

Overall, it was shown that there are differences in psychological variables before and after the lawn bowl competition. Table 3 shown that psychology before competition tends to increase in athletic identity, anxiety-state, anxiety-trait, self-efficacy in sports, and expectancy of success, while only the mood profile that was reported tends to be lower before competition.

Table 3. Psychological differences in lawn bowl athletes before and after competition

Psychological variables	Before Competition (*M ± SD*)	After Competition (*M ± SD*)	*Mean different* (*M ± SD*)	t	*sig*
Athletic identity	62.42 ± 6.69	55.58 ± 7.17	6.83±2.48	9.544	.000*
Anxiety-state	49.83 ± 11.14	45.75 ± 10.04	4.08±1.93	7.334	.000*
Anxiety-trait	48.67 ± 10.68	41.08 ± 9.39	7.58±3.78	6.955	.000*
Self-efficacy	55.00 ± 8.93	49.75 ± 7.83	5.25±2.56	7.096	.000*
Expectancy of success	19.00 ± 2.34	14.50 ± 2.58	4.50±2.32	6.731	.000*
Mood profile	100.25 ± 23.49	108.67 ± 24.97	-8.42±3.50	8.325	.000*

* *Significance at <0.05*

It was further explained regarding the mood profile of lawn bowl athletes, which showed that before the competition, athletes felt fatigue 14.46%, anger 14.55%, vigor 22.28%, tension 14.21%, esteem 13.97%, confusion 10.64%, and depression 9.89%, whereas after competition athletes felt fatigue 13.65%, anger 15.57%, vigor 20.86%, tension 14.03%, esteem 13.57%, confusion 10.81%, and depression 11.50% (figure 2).

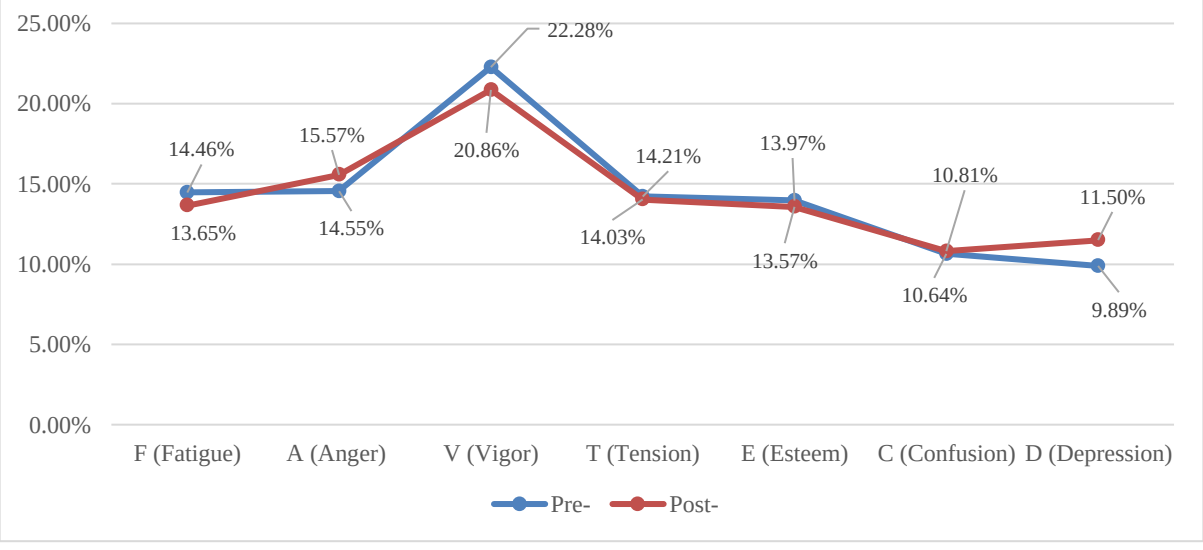

Figure 2. Mood profile of lawn bowl athletes before and after competition

The diagram above is data on the relationship between psychological changes before and after the competition with competition results (medals). The multiple linear regression test shown that changes in psychological variables before and after the competition simultaneously influence the results of the competition (medals obtained are seen in the F_{count} value). The magnitude of the influence can be seen from the R Square value of 0.992, which means that 99.20% of competition results (medal wins) are influenced by psychological variables, including athletic identity, anxiety-state, anxiety-trait, self-efficacy in sports, expectancy of success, and mood profile (table 4).

Table 4. Anova table and determinant coefficients in multiple linear regression tests

Variables	*R*	*R square*	F_{count}	*Sig.*
Athletic identity Anxiety-state Anxiety-trait Self-efficacy Expectancy of success Mood profile	.996	.992	101.705	.000*

* *Significance at <0.05*

From each psychological variable, it can be seen that there is a relationship between each psychological variable and the competition results, where there is a positive and negative relationship seen from the regression coefficient. The negative regression coefficient on anxiety-state and anxiety-trait shown that the relationship is inverse, meaning that the higher the anxiety-state and anxiety-trait, the lower the competitive results. Meanwhile, the positive regression coefficient on athletic identity, self-efficacy, Expectancy of success, and mood profile shown that the relationship is in the same direction, meaning that the higher the athletic identity, self-efficacy, expectancy of success, and mood profile, the higher the competition results. A regression coefficient of 0.329 on athletic identity means that with a 1% increase in athletic identity, competition results increase by 0.329. A coefficient of -3.102 on anxiety-state means that with a 1% increase in anxiety-state, competition results decrease by 3.102. A coefficient of -0.723 on anxiety-trait means that with a 1% increase in anxiety-trait, competition results decrease by 0.723. A regression coefficient of 3,309 on self-efficacy means that with a 1% increase in self-efficacy, competition results increase by 3,309. The regression coefficient of 0.286 on the expectation of success means that with a 1% increase in the expectation of success, the competition results increase by 0.286. A regression coefficient of 0.937 on the mood profile means that with a 1% increase in the mood profile, the competition results increase by 0.937 (table 5).

Table 5. The influence of each psychological variable on competition results

Variables	B	t_{count}	*Sig.*
Athletic identity	.329	4.485	.006*
Anxiety-state	-3.102	-12.224	.000*
Anxiety-trait	-.723	-14.835	.000*
Self-efficacy	3.309	14.028	.000*
Expectancy of success	.286	5.160	.004*
Mood profile	.937	13.905	.000*

* *Significance at <0.05*

DISCUSSION

The main research purposes was analyzed the psychology of disabilities athletes before and after competition and its relationship with the results of lawn bowl competitions. There are two assumptions in this study: first, a higher psychological level in lawn bowl athletes before competition which includes anxiety, athletic identity, expectations of success, self-efficacy in sports, and mood profile; second, anxiety, athletic identity, expectations of success, self-efficacy in sports, and mood profile, have a potential impact on the performance of athletes with disabilities in lawn bowl competitions. Based on the first assumption, researchers conducted a t-test analysis to determine the psychological differences in athletes before and after the competition. The results revealed that there were differences in all psychological variables between before and after the competition, only the mood profile showed an increase after competition, while other psychological variables showed an increase before the competition. Furthermore, based on the second assumption, the researcher carried out a regression analysis on changes in psychological variables before and after the competition, the results being that psychological variables significantly influenced the results of the

competition. Specifically, the regression model with all independent variables explains the variation in the dependent variable by 99.92%.

Regarding the researh results, the first assumption that the mood profile was high before the competition, but the results turned out to be the opposite. In this study, the mood profile score was higher after the competition, while the mood profile score was lower before the competition. However, if explained in more detail regarding the mood profile of lawn bowl athletes, the results shown that before competition the levels of fatigue, vigor, tension and esteem felt by athletes tend to be high, while anger, confusion and depression tend to be low. After competition, athletes tend to feel high levels of anger, confusion and depression as well as a decrease in vigor, tension and esteem. This may be related to some athletes not winning medals. Previous studies also showed the same that levels of anger, confusion, and depression tended to be low and vigor was high in the pre-competition period, while post-competition there was an increase in levels of anger, confusion, and depression as well as a decrease in vigor (Andrade, et al., 2019).

Related to the research results, the second assumption shown that there is a significant correlation between psychological variables and competition results. These results are in line with the researchers' assumptions. However, there is something interesting from the results of regression analysis, that there is a positive and negative correlation. Only the anxiety variable, both in state and trait, shown a negative correlation with competition results. A negative correlation means that increased anxiety can lead to decreased competitive results. This happens because according to Ghorbanzadeh & Bayar (2013), anxiety affects the right decision making skills in negative behavior, where the more the level of anxiety increases, the fewer athletes make the right decisions. Athletes have high pressure with uncertainty about who will win and lose, making it possible to make mistakes in competition. On the other hand, positive correlations were produced on the variables athletic identity, self-efficacy in sports, expectations of success, and mood profile. This is what causes high levels of anxiety before competitions. The same thing was also reported by Ferreira et al., (2007) that athletes with disabilities showed pre-competition anxiety responses.

The findings of this research show a positive correlation with competition results on the athletic identity variable. Regarding athletic identity, Tasiemski et al., (2013), revealed that people who are active for a longer time tend to have a stronger athletic identity. This means that the length of an individual's competitive career needs to be taken into account when interpreting athletic identity results. The research results shown a high score on athletic identity before the competition indicating that the athlete has had a lot of experience in lawn bowls. Meanwhile, according to Guerrero & Martin (2018), athletes with a strong athletic identity are linked to achievement and motivation to achieve goals. Therefore, athletic identity shown a positive correlation with competition results. In line with this, Skučas (2014) said that disabilities athletes in competition groups have a better athletic identity so that they represent stronger self-integrity and less self-blame, their self-confidence grows and they have a better self-image.

The findings of this research show a positive correlation with competition results on the self-efficacy variable in sports. In line with these findings, Martin (2002) also reported the same thing that correlation studies showed an important relationship between wheelchair athlete performance related to self-efficacy. On self-efficacy, there is a study that supports the research results that having a stronger perception of winning is associated with increased self-efficacy (Kwon, Shin, & Shin, 2022). This shown confidence in one's own ability to achieve achievements. Without this belief, the possibility of behavior will decrease, therefore self-efficacy shown a positive correlation, where as confidence in oneself increases in one's abilities, competition results also increase. Athletes convince themselves that they will do it.

The findings of this research show a positive correlation with competition results in the expectations of success variable. Regarding expectations of success, a study shown that the goals of disabilities athletes are higher compared to able-bodied elite athletes, they have a greater desire and enthusiasm to face different challenges (Pensgaard, Roberts, & Ursin, 1999). Therefore, expectations of success have a positive correlation with competition outcomes. This is because according to Cox & Whaley (2004), hope significantly predicts effort and persistence. In addition, Wilson, Marcia, & Dawn (2005) also reported that expectations of success are a determining factor in assessing athlete performance attributions.

The mood profile has a positive correlation with competition results, this is triggered by high vigor and esteem as well as low anger, confusion and depression seen before the competition. In line with this, Rodrigues et al., (2017), reported that high vigor at the pre-competition stage supports better sports performance. Therefore, a mood profile that tends to be positive, such as high vigor before a competition, can also have a positive impact during the competition. As explained by Andrade et al., (2019), vigor, a dimension characterized by physical energy, activity, feelings of excitement, disposition, and animation, is directly related to better sports performance and reaches the highest level before the competition, thus placing athletes in a better position. Meanwhile, low vigor indicates a poor perception of the athlete's physical and emotional capacity.

Based on the data analysis results, this research provides knowledge that can be the basis for further studies related to psychology and its impact on competition results. Regarding the sample in this study, researchers used blind lawn bowl athletes with different levels and types of disabilities according to their respective classifications. So, in preparing lawn bowl athletes to practice and compete, coaches must ensure the athlete's psychological condition in pre- and post-competition. The resarch results indicated that there is a need for interventions to increasing athletic identity, self-efficacy, expectations of success, and a positive mood profile to reduce anxiety levels before competition, because this can improve competition performance in disabilities athletes.

Conclusion

Lawn bowl athletes tend to have athletic identity, anxiety-state, anxiety-trait, self-efficacy in sports, and increased expectations of success before competition, with levels of fatigue, vigor, tension, and esteem felt by athletes tending to be high, as well as anger, confusion, and depression tends to be low before competition. The research results also shown that athletic identity, self-efficacy, expectations of success, and mood profile have the potential to have a positive impact on the competitive performance of lawn bowl athletes, while increased anxiety has a negative impact. Due to the small sample size it is necessary to interpret the findings with caution, which is a limitation of this study. However, researchers used samples that had competed at the international level, so it can be considered a strength of this study. This study also did not verify gender differences in psychological terms.

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Conflict of interest

The authors declare no conflict of interest.

Ethics Statement

This resarch was approved by the scientific research ethics committee of Sebelas Maret University, Surakarta at Dr. Moewardi Hospital with protocol code 081/I/HREC/2024, ratification date 11 January 2024.

Author Contributions

Study Design, IN; Data Collection, BNM, RID; Statistical Analysis, IN, BNM and RID; Data Interpretation, IN, BNM and RID; Manuscript Preparation, IN, BNM and RID; Literature Search, IN, BNM and RID. All authors have read and agreed to the published version of the manuscript

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RESEARCH ARTICLE

The Effect of 8-Week Soccer Training on Group Dynamics and Group Consciousness of Individuals with Intellectual Disabilities

Gizem AKARSU[*1], Erkan GÜVEN[2], Nasuh Evrim ACAR[3], Derya Selda Sınar ULUTAŞ[4], Yunus Emre ASLAN[5], Barış AĞAMOLLA[6], Açelya SABANCALI[6], Büşra ESER[6] and Eyüp ERİKLİ[6]

[1] Mersin University, Faculty of Sports Sciences, Physical Education and Sports Teaching, Mersin / Türkiye
[2] Mersin University, Faculty of Sports Sciences, Coaching Education, Mersin / Türkiye
[3] Mersin University, Faculty of Sports Sciences, Sports Management, Mersin / Türkiye
[4] Mersin University Faculty of Sports Sciences, Institute of Educational Sciences, Mersin / Türkiye
[5] Iğdır University Faculty of Sports Sciences, Coaching Education, Iğdır / Türkiye
[6] Mersin University Faculty of Sports Sciences, Recreation, Mersin / Türkiye
*Gizem Akarsu: gizemakarsu@mersin.edu.tr

Abstract
This study examines the effect of 8-week soccer training on group dynamics and group consciousness of individuals with educable intellectual disabilities. In this study, a one-group pretest-posttest model was used. The study included 8 male individuals aged 13-17 in a special education institution in Mersin province. Before and after the 8-week soccer training, 3 physical education teachers made independent observations and evaluated them with an observation form. According to the observation form pre-test and post-test mean scores, the % difference was calculated from descriptive statistics. When the pre-test and post-test percentage differences were examined; improvements were made in the areas of correct defense (40%), correct offense (40%), successful pass (40%), correct intervention (50%), goal to the opponent's goal (50%), ball control (60%), ball winning (50%), defensive error (20%), intervention to teammate (50%), goal to the wrong goal (20%), ball loss (40%) and team integrity (70%). As a result of the study, it was seen that long-term soccer training was beneficial in branch-specific skills, physical and mental development in individuals with intellectual disabilities. In addition, group consciousness was observed in individuals and behavioral changes occurred in this direction. Since there is a limited number of studies on group consciousness and group awareness in individuals with intellectual disabilities; it is thought that this study will contribute to the literature and guide future studies.

Keywords
Individuals Intellectual Disabilities, Group Consciousness, Group Dynamics, Football

INTRODUCTION

Disability refers to mental, physical or affective differences in an individual's body that have existed throughout human history. Types of disabilities are divided into four groups: visual, physical, hearing and intellectual disabilities (Bailey & Wning, 1994). 'Intellectual disability' is defined as the inability to benefit from normal education with a disability of one fourth or more compared to peers as a result of ongoing decline in mental and psychomotor functions due to various reasons that may occur before, during and after birth (Baysal 1986; Eripek, 1996). Intellectual disability is defined as an individual's intellectual functioning below the normal level, as well as inadequacy in two or more adaptive behaviors such as communication, health, work life, social skills, home life, academic success, self-care skills, and safety (Ataman, 2005; Bertoti, 1999). People with intellectual disabilities experience various limitations in their daily lives according to the type

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and degree of disability and need support (Özsoy et al., 2006).

The most noticeable issue in individuals with intellectual disabilities is that their learning skills are slower (Lewis & Doorlag, 1999). Especially in physical education and sports activities, showing the movements in practice instead of verbal expression makes learning permanent. For this reason, the development of individuals with intellectual disabilities in the field of physical education and sports is faster than in other fields. Individuals with intellectual disabilities avoid leadership in sportive activities due to lack of self-confidence, prefer to obey group members and learn by imitation (Savucu et al., 2006). Educable intellectual disabilities constitute 85% of individuals with intellectual disabilities. Sportive activities provide mental, social and physical development of individuals with educable intellectual disabilities and emphasize their sportive abilities and skills. It also enables them to develop socially and individually, to be productive to society and to lead a healthy life (Bayazıt et al., 2007). Individuals with intellectual disabilities have difficulty adapting to their environment because they cannot meet the expectations of society. Sportive activities develop a sense of belonging to a group or society, provide mental and physical skills, support psychological health, and positively affect all developmental dimensions (physical, mental and social). In this context, active participation of individuals with educable mental disabilities in sportive activities should be supported (İlhan & Esentürk, 2015).

Physical education and sports activities in education programs constitute an important place in terms of physical and physiological development of children. Activities to improve parameters such as strength, coordination, flexibility and speed contribute to the development of children's gross and fine motor skills (Özer, 2005). Football, which is an important team sport that enables the development of these skills, is very important for the physical development of children with disabilities and learning to act in a group. It is thought that participation of disabled individuals in football tournaments will enable them to have an active life, be healthier, gain values such as trust in the team, cooperation and friendship, and improve their communication skills (Yetim, 2014).

Individuals with intellectual disabilities make difficult and time-consuming friendships due to their inability to move independently. Therefore, their friendships do not last long term. Their impatient and stubborn nature shakes the group dynamics in socialization. They prefer to model others instead of being a leader in group work (Özer, 2005). Group education contributes to creating group consciousness in children. Group consciousness is the ability of an individual with disabilities to converse with other peers in a common area, to work in cooperation and to share success. When group consciousness is formed through sportive activities with children, communication skills improve, efforts are made to overcome problems together, and they contribute to working in harmony with each other at the same time (Hill & Gutwin, 2004).

When the literature is examined, it is seen that physical education and sports are beneficial for mentally disabled individuals; socialization (Babkes 1999; Çevik & Kabasakal, 2019; İlhan, 2008), motoric features (Akın & Yüksel, 2016; A.Şahin & F.Şahin, 2020; Keller, 1983; Konar & Şanal, 2019; Şehmus, 2015), attitudes towards sports (Dursun et al., 2019; İlhan, 2009) studies have been found that evaluate the effects of fenugreek on self-care skills (İlhan et al., 2015; Kurtoğlu & Cavkaytar, 2022). In many of the studies in the literature, the physiological or psychological effects of physical education and sports activities on mentally disabled individuals were examined, the phenomenon of socialization was studied, and their attitudes towards sports were evaluated. Group awareness and group consciousness in mentally disabled individuals; students need to cooperate with their peers, socialize, chat and be successful in harmony with each other. However, when the literature was examined, it was seen that there was a limited number of scientific studies on this subject (Yaman, 2015). In this direction, the aim of our study is; To examine the effect of 8-week football training applied to trainable mentally disabled individuals on group dynamics and group consciousness. It is thought that our study will contribute to the literature, fill this gap in the literature, and guide future studies.

MATERIALS AND METHODS

Research Model

In this study, a one-group pretest-posttest model was used. In this model, an independent

variable is applied to a selected group. Measurements are made both before the experiment (pre-test) and after the experiment (post-test) (Karasar, 1999).

Participants

Eight male individuals with educable intellectual disabilities between the ages of 13-17 were included in the study. The informed Parental Consent Form was signed by the parents before starting the study. While the population of the study consisted of students with educable intellectual disabilities, the sample group consisted of 8 male students between the ages of 12-18 in a special education institution in Mersin province.

Data Collection Techniques

Experimental design

Before starting the study, the group consciousness and group awareness behaviors of the children with mental disabilities were evaluated by the private teachers using a questionnaire. Then, for 8 weeks, the football trainings in the program were applied by the football trainer with the Football UEFA B license certificate and the trainers in the study whose branch is football. Afterwards, three physical education teachers evaluated the group consciousness and awareness behaviors of their students again.

Football Training Program

The soccer trainings were conducted 2 days a week (Monday and Wednesday) for 8 weeks as described below. Researchers with soccer coaching certificates gave the trainings.

Tablo 1. Football training program

Week 1	-Concept Teaching (pass, shot, goal, goal, goal, goalkeeper, color, team colors, lines, field area, corner kick, crown, pole, whistle and referee) (10 min.) -Warm-up (10 min.) -Passing Practice (5 min.) -Introduction of the pitch (5 min.) -Recognizing Red Teammates -Yellow Recognizing teammates -Pretest (double goal match) (10 min.)
Week 2	-Concept teaching will continue (10 min.) - Warm-up (10 min.) -Pass and shooting practice (10 min.) -Determination of goalkeepers -Double goal match (10 min.), making sure that the colors of the goal posts are the same as the colors of the teams (10 min.) There will be verbal clues during the match (Yellow team pass, throw to the player in yellow jersey, etc., red team, throw to red, etc.).
Week 3	-Concept teaching will continue (10 min.) - Warm-up (10 min.) -Passing and shooting practice (10 min.) -Two teams will play a short match and identify the problems in the match as a result of the impression, stop the game and make explanations (10 min.) -Evaluation of the children at the end of the day (question and answer)
Week 4	-4. As of the week, leaving the explanation of the concepts as of the week and making warm-ups and matches by dividing into teams based on what has been explained for 3 weeks (Team warm-ups will be separate) -Warming (10 mins) -Passing and shooting practice in their own half (15 min.) -Double goal match (15 min.)
Week 5	-Warm-up (10 min.) (in their own half field) -Passing and shooting practice (10 min.) -Double goal match (15 min.) -Evaluation of the day with the children
Week 6	-Warm-up (10 min.) (in their own half court area) -Passing and shooting practice (10 min.) -Double goal match (15 min.) -Evaluation of the day with the children
Week 7	-Warm-up (10 min.) (in their own half court area) -Passing and shooting practice (10 min.) -Double goal match (15 min.) -Evaluation of the day with the children

Week 8	-Warm-up (10 min.) (in their own half court area) -Passing and shooting practice (10 min.) -Double goal match (15 min.) -General evaluation.

Observation Form Applied Before and After Football Training Program

The observation form was administered by physical education teachers who made observations independently of each other through the researchers before and after the football training. The teachers observed the group dynamics and group consciousness behaviors of the students and gave scores between 0-10 for each parameter in the observation form. The scores given by 3 special education teachers were averaged and calculated. The effect of soccer training on students' group dynamics and group consciousness was evaluated by summing the scores (Appendix-1).

Research Publication Ethics

Before starting the study, ethical approval dated 01.04.2024 and numbered 016 was obtained from Mersin University Sports Sciences Ethics Committee. In addition, a signed voluntary consent form was obtained from the parents of the participants in accordance with the Declaration of Helsinki.

Data Collection

The study data were collected in a special education institution in Mersin province between 15.04.2024-15.06.2024. Before the participants in the study started their soccer training, an observation form was filled out by 3 independent physical education teachers to evaluate the group dynamics and group consciousness of the students. Teachers' student evaluation scores were calculated by taking the average. The 8-week football trainings were carried out by the researchers as specified in the program. The observation forms applied before the soccer training were made again at the end of the training by the physical education teachers who made observations. According to the results of the observation forms filled out by the teachers, the group dynamics and group consciousness behaviors of the participants were evaluated.

Data Analysis

Excel program was used for data analysis. The % difference was calculated from descriptive statistics according to the observation form pre-test and post-test mean scores.

RESULTS

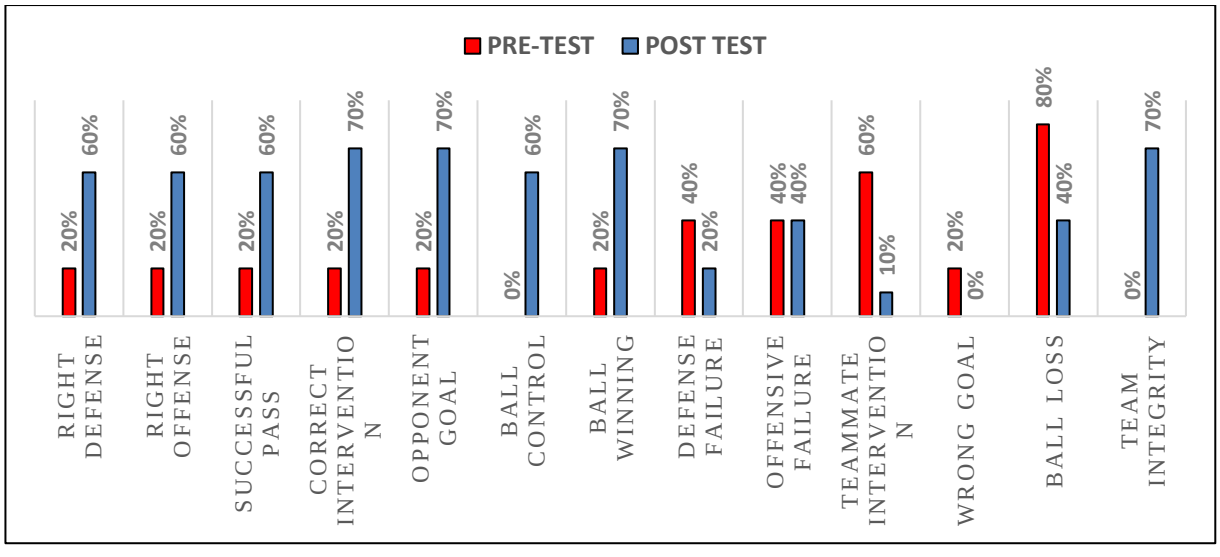

Figure 1. Results of the observation form applied before and after the football training program

According to the results of the observation form applied before and after the 8-week football training in Figure 1; it is stated that individuals showed different levels of development in both physical and mental areas by gaining group awareness. When the pre-test and post-test percentage differences are examined; improvements were made in the areas of correct defense (40%), correct offense (40%), successful pass (40%), correct intervention (50%), goal against

the opponent's goal (50%), ball control (60%), ball winning (50%), defensive error (20%), interference with teammate (50%), goal against the wrong goal (20%), ball loss (40%) and team integrity (70%) (Figure 1).

DISCUSSION

This research aimed to create group dynamics and group awareness by applying 8 weeks of football training to trainable mentally disabled individuals. The study findings show that football training provides group awareness in individuals (team integrity, scoring a goal against the opponent's goal, interfering with a teammate), physical (ball control, successful pass, ball loss, ball winning, correct defense), mental and social (team integrity, interfering with a teammate).) has shown that it provides benefits in developmental dimensions. Group studies can be used in many different ways to provide individuals with skills and awareness in mental, social and behavioral dimensions (Partona & Manbyb, 2009). Group activities for disabled individuals enable individuals to understand themselves and their peers, to concretely grasp the difficulties experienced in adapting to society, and to find out how they can change these behavioral patterns. Group activities enable group participants to express their emotions, confront themselves, and provide opportunities to change. Performing physical education and sports activities through group work is important for social and behavioral change, especially in educable mentally disabled individuals (Yalom, 1992).

The effects of physical education and sports activities on the social development of mentally disabled individuals have been examined by many researchers. İlhan (2008) examined the effect of sports participation on social development in mentally disabled children. As a result of the study, social development was observed in the individuals in the experimental group who participated in sports activities. Through sports activities, mentally disabled children exhibited positive behavior in the sub-headings of participating in group activities, communicating with their peers, and being a sharer. It has been stated that this development is caused by participation in group activities and interaction with peers. Similarly, McMahon (1998) stated that recreational sports activities are effective in integrating mentally disabled individuals into society, social acceptance and making friends with their peers. Again, in the study conducted by Yaman (2015), it was stated that educable mentally disabled children who participated in sports activities for 14 weeks improved in competition, teamwork, group membership, tolerance and self-confidence. In this research, in which 15 trainable mentally disabled individuals participated, it was concluded that as a result of 14 weeks of sports activities, 60% of the individuals (9 people) were able to team up with their friends, and 80% (12 people) were happy with their teammates when they won. The results of this research are parallel to our study findings. It can be said that mentally disabled individuals can exhibit behavior towards belonging to a group/team through sports activities and group work.

Individuals with intellectual disabilities may have problems feeling a sense of belonging to society, a group or a team. Researchers found that physical education and sports activities applied to mentally disabled individuals; He states that it is important for making friends and adapting to the environment (McMahon, 1998), behavioral change and development of learning skills (Stainback, 1983), perception-self-concept development (Rippe et al., 1998) and recovery of behavioral disorders (Koçak, 2016). Babkes (1999) stated in his study results that mentally disabled individuals who participate in physical education and sports activities socialize and develop more than their peers who do not do sports. Pınar and Tekinarslan (2003) stated that peer-mediated teaching provides benefits for mentally disabled individuals in terms of belonging, sharing skills, self-introduction and asking for information. Again, in a study conducted by İlhan (2007), it was stated that physical education and sports activities reduced behavioral problems and improved adaptation to the environment in educable mentally disabled individuals. Similarly, in our study findings, it was observed that through group activities such as team sports, the individual can feel belonging to a group/team, socialize, and communicate closely with his/her peers. Group activities can improve the sense of belonging in mentally disabled individuals and can be used as an important tool in adapting to the environment and their peers.

In our study findings, it was found that football training provides not only social and mental but also physical development (ball control, successful passing, ball loss, ball winning, correct

defense). When the literature was examined, the effect of sports activities, especially football training, which benefits all developmental dimensions, on football skills in mentally disabled individuals was examined. Afacan and Kılıç (2021) gave basic football training to 22 male participants with mental disabilities between the ages of 15-21, 3 days a week for 10 weeks. As a result of the study, it was stated that there was an improvement in football-specific movement skills (ball control, dribbling, passing, and movement with the ball). It was also stated that the participants' coordination, balance and strength parameters increased similarly. Similarly, Barak et al. (2019) stated that there was an increase in the parameters of football skills such as shooting, dribbling and passing of mentally disabled individuals who participated in football training. Again, Çalık et al., (2019) stated in their study that football training applied to individuals with mild and moderate mental disabilities provides motor development (balance, coordination and football skills). When the relevant literature results are evaluated, they are parallel to the findings of this study. No study has been found that gives different results on the subject. This shows the need to conduct more studies in the relevant field and with different branches. It can be said that long-term football training provides benefits in branch-specific skills and motor development in mentally disabled individuals. The reasons for these findings may be that football training is made fun with various equipment (ball, funnel, goal, etc.), demonstrated through practice and group work.

We think that this study will contribute to the literature, as there are limited studies on the subject of sports activities to increase group consciousness and group awareness in mentally disabled individuals. For this reason, the originality of the study subject constitutes the strength of our study. More scientific research is needed on this subject. One of the limitations of our study is that our measurement tool is based only on teachers' observations. In future studies, the effects of sports activities, and especially football-based training, on all developmental dimensions (social, mental and physical) in mentally disabled individuals can be examined. The use of scales and field test applications along with observation tools in monitoring the social, mental and physical development of disabled individuals will contribute to the generalizability of the findings.

As a result of this study, it was observed that 8-week football training provided development in physical, mental and social areas in trainable mentally disabled individuals, and that individuals gained group awareness by feeling belonging to a team/group and made behavioral changes in this direction. Considering the psychological, physical and social benefits that physical education and sports activities create for mentally disabled individuals, it is understood that they are an integral part of education. In private education and rehabilitation centers, more emphasis should be given to sports activities, especially team sports and group activities. Sports activities should not include sports competitions but should include recreational activities that can teach group awareness (Toptaş Demirci, 2019). The program to be implemented for children with educable mental disabilities must be well-planned and sustainable. For this purpose, programs that include different sports branches should be organized according to each individual's proficiency level and disability. For mentally disabled individuals to live an active and healthy life in the school environment and social life, the necessary investments, training programs and equipped personnel deficiencies must be completed.

Ethical Considerations

The study was approved and supervised by the Mersin University Sports Sciences Ethics Committee (Number:016), dated April 01,2024)

Conflict of Interest

The authors declare that they have no conflict of interest.

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Author Contributions

Study concept and design: NEA, BA, AS; Data Collection: GA, EG, DSSU, YEA, BA, AS, BE, EE; Analysis and Interpretation of Results: NEA, GA, EG; Draft manuscript preparation: NEA, GA, EG, DSSU, YEA; All authors reviewed the results and approved the final version of the manuscript.

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RESEARCH ARTICLE

The Effect of Velocity-Based Training on Some Performance Parameters in Football Players

Erkal ARSLANOĞLU*[1], Cansel ARSLANOĞLU[1] Gürkan Selim ÇELGİN[1] Metin BAYRAM[1] and Ahmet MOR[1]

[1]Sinop University, Faculty of Sport Sciences, Sinop / Türkiye
*Corresponding author: erkaloglu@sinop.edu.tr

Abstract
The aim of the study was to investigate the effects of velocity-based (VBT) and traditional strength training (TST) methods on vertical jump, dynamic balance, agility, 10 m acceleration and 20 m sprint performances. Twelve volunteer men randomly divided into two groups participated in the study. After 1 Repetition Maximum (1RM) was determined, the TST group performed 3 sets of 10 repetitions with 40-60% of their maximum weight, while the VBT group performed 3 sets of strength training at a velocity range of 0.75-1.0 m/s for 6 weeks, 2 days a week. In the VBT group, a significant difference was found between 55.16±6.17 cm in the pre-test and 59.16±4.99 cm in the post-test of vertical jump and 4.05±0.27 in the pre-test and 1.72±0.27 in the post-test of balance ($p<0.05$). There was a significant difference between 48.33±3.98 cm in the pre-test and 53.66±4.03 cm in the post-test; between 4.29±0.29 in the pre-test and 3.65±0.48 in the post-test. Optimising the speed while lifting load in VBT enables athletes to react faster to sudden position changes by improving dynamic balance. Although 6 weeks of VBT training increased vertical jump, the difference was not statistically significant, which may be due to sample size, training duration or individual differences. As a result, the increase in vertical jump and balance in both strength training exercises can be explained by the fact that squat exercise activates the quadriceps muscles by activating the knee joint and increases leg strength, endurance and knee stabilisation.

Keywords
Velocity-Based Training, Traditional Strength Training, Football

INTRODUCTION

In an elite football match, players run an average of 10-12 km at moderate intensity (Rampinini et al., 2007). In the aerobic environment in which the game takes place, the most important events are represented by high-intensity training, since most goals are preceded by linear sprints, vertical jumps, or changes of direction by the player who scores or assists (Faude et al., 2012). These movements require lower body muscles to produce high power and strength (Meylan et al., 2009). In this context, it has been reported that jump height, 10 m sprint and 30 m sprint performance are related to maximum muscle strength in professional football players (Wisloff et al., 2004). The positive effects of resistance training on strength, jumping and sprinting abilities in adult football players have been extensively studied (Helgerud et al., 2011; Hoff et al., 2004). Resistance training is necessary to improve athletic performance, including velocity, agility, strength, and even athletic skills (Andersen et al., 2010; Comfort et al., 2012; Ronnestad et al., 2008; Suchomel et al., 2016; Spiteri et al., 2013). Traditional resistance training prescriptions are usually designed based on an individual's 1RM (one repetition maximum) before starting a resistance training session (Zhang et al., 2021; Zhang et al., 2022). However, an athlete's

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training status or performance is constantly changing depending on numerous variables such as daily biological changes, training fatigue, nutrient intake, and sleep. These factors can cause 1RM to fluctuate by up to 36% (Orser et al., 2024). As traditional resistance training programmes rarely account for daily fluctuations (Weakley et al., 2021), pre-designed training loads can be inappropriate, which can reduce the effectiveness of training and even lead to degeneration or injury. Therefore, some regular and flexible resistance training methods called autoregulation methods have been developed to overcome the shortcomings of traditional resistance training.

Velocity-based resistance training (VBT) is a modern resistance training method that uses movement velocity to determine the load and intensity of exercise, allowing for a more personalised and dynamic training programme (Weakley et al., 2019). This method, called velocity-based training (VBT), allows 1RM% to be estimated based on actual velocity for each repetition without the need to perform the most demanding tests to adjust the training load. This method estimates daily readiness (or daily 1RM) and tracks the decrease in velocity per set to manage fatigue accumulation (González & Sanchez, 2010). Repetition rate has been extensively studied as a means of monitoring exercise intensity (Gonzalez et al., 2011). Studies show that resistance training performed at a certain velocity increases muscle strength, so controlling the velocity of movement during training is important (Dalleau et al., 2010). Furthermore, the use of velocity-based training programmes that monitor and prescribe exercises based on velocity outputs has been shown to be effective in increasing strength and power in elite athletes (Włodarczyk et al., 2021). Monitoring barbell velocity during resistance training by methods such as velocity-based training (VBT) can provide valuable feedback on the effectiveness of the training programme and help optimise performance (Achermann et al., 2023).

Due to these advantages, VBT can be applied to athletes who often participate in various training regimes and frequent competitions, especially athletes playing rugby, football, basketball, and baseball (Toby et al., 2015; Hrysomallis et al., 2012; Argus et al., 2009). As controlled studies involving athletes often struggle to find sufficient numbers of participants, more experimental studies are needed to address the controversies and support the efficacy of VBT in athletes.

The unique value of this study is that it investigated the effects of two different strength training methods (traditional strength training and Velocity Based Training) on various athletic performance measures for the lower extremities. The prominent unique aspects of the study are as follows: The research evaluates the effects of both training methods in a holistic manner, examining different components of athletic performance such as maximal strength as well as jumping, sprinting, agility and balance. While traditional strength training gradually increases the load, VBT is speed-oriented and aims to optimise the speed of load lifting. By systematically examining the differences between both methods, this study helps us to understand which performance measure is more effective. The research findings provide practical information for athletes, coaches and sports scientists to determine which training method is more effective in which situations. The study provides important data for developing effective strategies for leg strength and mobility by targeting lower limb muscles.

MATERIALS AND METHODS

Study Model

Experimental method was used in the study. The aim of the study was to investigate the effects of traditional (1RM) strength training and velocity-based strength training on vertical jump, dynamic balance, agility, 10 m acceleration and 20 m sprint performances.

Study Group

In the study, the participants were randomly divided into two groups: Traditional strength training group (n=6) and the velocity-based strength training group (n=6). A total of 12 male volunteers with at least 1 year of football playing history were included After descriptive measurements were taken, 1 Repetition Maximum (1RM) values were measured and then participants were randomly assigned to perform knee dominant trap bar deadlift, squat and hip dominant hip thrust exercises. Descriptive characteristics of the participants are provided in Table 1.

Ethical Implications

This study followed ethical standards and received approval from the Sinop University Human Research Ethics Committee, dated

28/04/2023 and numbered 2023/92. In addition, this study was supported by Sinop University Scientific Research Coordination Unit. Project Number: SBF-1901-23-002, 2023. Participant provided informed consent, with the volunteer form covering research details, risks, benefits, confidentiality, and participant rights. The research strictly adhered to the ethical principles of the Declaration of Helsinki, prioritizing participant's rights and well-being in design, procedures, and confidentiality measures.

Study Design

Before the study, 2 familiarisation exercises were performed. Before these training sessions, the participants were informed about the content of the study, the movements to be performed, the number of repetitions, and the use of trap bars and Olympic bars. Movement techniques were explained and strength training was performed 2 days a week for 6 weeks with the correct technique. After familiarisation, 1 maximal repetition in deadlift, hip thrust and squat were taken 5 days before the study. In the warm-up section before the maximal test, 5 minutes of low-intensity flat running was performed, followed by flexibility exercises and 2 sets of 10 repetitions of warm-up lifts at 40% intensity. Performance test data were collected 3 days before the start of the study. On the day of the performance tests, height and body weight measurements were made before starting the test. For performance tests, 5 minutes general warm-up and 10 minutes special warm-up protocol was applied. After warm-up, dynamic balance, vertical jump, 10 and 20 metres acceleration-sprint run and agility test were performed. At the end of the study, the same protocol applied at the beginning was applied again for the post-tests.

Velocity-Based Strength Training

In velocity-based strength training, movements were performed at a velocity range of 0.75-1.0 m/sec. If the weight lifted was not within this velocity range, the set was terminated.

Figure 1. Enode Pro Velocity-Based Training

Traditional Strength Training

In traditional strength training, participants performed 3 sets of 10 repetitions with weights equivalent to 40-60% of their maximum weight.

Data Collection Tools

Anthropometric Measurements

The height of the football players participating in the study was measured with Seca 213 device and body weight was measured with Inbody 120 Bioimpedance analyser. Body weights were recorded in kilograms and body mass (BMI) were calculated using the formula BMI (kg/m²) = Body Weight (kg) / Height² (m²) (Celgin & Arslanoğlu, 2024).

Vertical Jump

In the study, the vertical jump performances of the athletes were measured using a digital vertical jump device (Takei 5406 Jump-MD Vertical Jumpmeter, Tokyo, Japan). In the vertical jump test, the value of the athlete's jump upwards from the standing position in the squatting position with knees flexed at 90° and hands on the waist was recorded. A 1-minute rest period was given between trials. Each measurement was repeated twice and the best value was recorded (Mor et al., 2022).

Balance Test

Togu Challenge Disc 2.0 (Germany) was used to measure the balance of the footballers. This device has a mechanism that connects an upper platform with a diameter of 44 cm and a lower platform of the same size with 4 rubber rollers of 8 cm in the centre. The platform has a maximum movement of 12° in each direction and has an unstable floor. It detects the balance movements of the person standing on it with three-dimensional sensors and transfers them to the application via Bluetooth. The device has a scoring system from 1-5 (1: very good, 5: very poor), with a lower score indicating better balance. During the test, the athlete stood barefoot on the platform and tried to maintain balance for 20 seconds. The test was repeated twice and the best score was recorded (Mor et al., 2022).

10m Acceleration and 20m Sprint Test

The 10-metre and 20-metre sprint test values of the football players were determined using a photocell on a FIFA approved football field. After the warm-up protocols were applied to prevent any injury during the measurements, they were asked to repeat the 20-metre test track once individually with light jogging. The test start location was determined to be one metre behind the photocell. When the participants felt ready, they started the test with high output. The measurements were made by means of photocells placed at a running distance of 10 and 20 m. The measurement was taken twice, and the best degree in seconds and split seconds for each subject

was evaluated. Complete rest (3 minutes) was given between measurements (Celgin & Arslanoğlu, 2024).

T-Agility Test

After a full rest for the T-agility test, they were allowed to practice the test track at low velocity in order to get used to the track. Four funnels were placed at point B, 9.14 m from the start funnel A and the other two funnels were placed in a T-shape, funnels C and D, 4.57 m to either side of funnel B (Figure 4). As shown in Figure 4, the athletes start running directly from cone 'A' towards cone 'B' which is 9,14 m ahead and touch the cone. They then run sideways to the left side of the 4.57 m cone and touch the cone with their left hand, then run to the rightmost cone and touch it with their right hand. From here they run sideways to cone 'B,' touch it with their left hand, then run back to cone 'A' and complete the test. Trials were cancelled if the footballers did not touch the designated funnels, did not perform the side-slip steps correctly and did not constantly look forward. The duration of the test was recorded by means of a photo-eye system placed in the starting cone. The measurement was performed twice and the best value in seconds and milliseconds for each subject was evaluated. Complete rest (3 minutes) was given between measurements (Celgin & Arslanoğlu, 2024).

1RM Tests

1RM was measured separately in the deadlift with trap bar and hip thrust and squat with Olympic bar. The participants were made to warm up by doing 5-10 repetitions between 40-60% of the estimated 1RM value. The participants were asked to perform 3-5 repetitions with a weight of 80% of the estimated 1RM. Rest was given for 5 minutes until 1RM was found and continued with a 5% increase until 1RM was found. 1RM was found with a maximum of 3 attempts. The weight that can be done with 1 repetition and the 2nd repetition cannot be done is recorded as 1RM.

Velocity-Based Strength Training Method

'Enode Pro' velocity-based training device was used to determine the velocity of the weight lifted in velocity-based strength training. Movements were performed with deadlift, trap bar (hex bar) and hip thrust and squat movements were performed with Olympic bar. In velocity-based level value of the traditional strength training (TST) group was (5.41±0.42) p, the mean height was (174.00±3.16) cm, the mean body weight was strength training, movements were performed at a velocity range of 0.75-1 m/sec. If the weight lifted was not within this velocity range, the set was terminated.

Perceived Difficulty Level (PDL)

The Borg (RPE) scale is a frequently used method for determining subjective training load (intensity) based on participants' feelings (Borg, 1988). A 20-point Borg scale was used to determine the perceived difficulty after each training session.

Data Analysis

In the study, SPSS 26.0 package programme was used for all statistical analyses. Descriptive statistics such as mean and standard deviation were used to evaluate the data. Shapiro-Wilk test was used to determine whether the data showed normal distribution and it was determined that the data showed normal distribution. In this context, the paired sample t test was used for intra-group pre-test-post-test comparisons and the independent samples t test was used for inter-group pre-test-post-test comparisons. Significance level was accepted as $p<0.05$ in statistical analyses.

RESULTS

Table 1. Descriptive characteristics of the participants

Variables	VBT Group n=6 mean±sd	TST Group n=6 mean±sd
Age (year)	21.66±2.16	20.83±0.40
Height (cm)	170.50±6.41	174.00±-3.16
Body Weight (kg)	69.61±7.76	78.00±7.61
Sport Age (years)	9.66±1.03	10.16±1.72
BMI	23.88±1.65	25.75±2.27
RPE	4.93±0.66	5.41±0.42

N= Number of Participants; X= Mean; SD= Standard Deviation; RPE= Perceived Difficulty Level; VBT= Velocity-Based Training; TST= Traditional Strength Training

When Table 1 is examined, the mean perceived difficulty level value of the velocity-based training (VBT) group was (4.93±0.66), the mean height was (170.50±6.41) cm, the mean body weight was (69.61±7.76) kg, the mean BMI value was (23.88±1.65) kg/m², the mean age was (21.66±2.16), and the mean sport age was (9.66±1.03) years. The mean perceived difficulty

(78.00±7.61) kg, the mean BMI value was (25.75±2.27) kg/m², the mean age was

(20.83±0.40) and the mean sport age was (10.16±1.72) years

Table 2. Performance parameters of the participants

Groups				
VBT Group				
Performance Tests	**Pre-Test** (n=6) **mean±sd**	**Post-Test** (n=6) **mean±sd**	**t**	**p**
Vertical Jump (cm)	55.16±6.17	59.16±4.99	-2.449	0.058
20 m sprint (m)	3.05±0.07	3.15±0.11	-2.517	0.053
10 m Acceleration (m)	1.78±0.04	1.86±0.06	-2.519	0.053
Agility (sec)	9.67±0.33	9.55±0.38	0.604	0.572
Balance (p)	4.05±0.27	1.72±0.27	12.57	0.001*
TST Group				
Performance Tests	**Pre-Test** (n=6) **mean±sd**	**Post-Test** (n=6) **mean±sd**	**t**	**p**
Vertical Jump (cm)	48.33±3.98	53.66±4.03	-5.219	0.003*
20 m sprint (m)	3.14±0.09	3.23±0.04	-2.264	0.073
10 m Acceleration (m)	1.83±0.07	1.88±0.04	-1.153	0.301
Agility (sec)	10.12±0.38	9.92±0.36	0.908	0.405
Balance (p)	4.29±0.29	3.65±0.48	3.580	0.016*

N= Number of Participants; X= Mean; SS= Standard Deviation; VBT= Velocity-Based Training; TST= Traditional Strength Training

According to Table 2, the first vertical jump measurement of the velocity-based training (VBT) group was 55.16±6.17 cm and the last measurement was 59.16±4.99 cm. A significant difference was found between the first measurement of balance 4.05±0.27 p and the last measurement 1.72±0.27. The first vertical jump measurement of the traditional strength training (TST) group was 48.33±3.98 cm and the last measurement was 53.66±4.03 cm. A significant difference was found between the first measurement of balance 4.29±0.29 p and the last measurement of 3.65±0.48 p.

Table 3. 1 repetition maximal values of the participants

Groups				
VBT Group				
Movements	**Pre-Test** (n=6) **mean±sd**	**Post-Test** (n=6) **mean±sd**	**t**	**p**
Squat	85.00±10.48	116.66±10.32	-10,304	0.001*
Deadlift	90.83±10.20	126.66±12.11	-8.600	0.001*
Hip Thurst	115.00±23.45	158.33±22.86	-7.769	0.001*
TST Group				
Movements	**Pre-Test** (n=6) **mean±sd**	**Post-Test** (n=6) **mean±sd**	**t**	**p**
Squat	78.33±7.52	96.66±16.32	-3.841	0.012*
Deadlift	78.33±11.69	90.00±18.97	-2.150	0.084
Hip Thurst	100.00±8.94	126.66±10.32	-8.000	0.001*

N= Number of Participants; X= Mean; SS= Standard Deviation; VBT= Velocity-Based Training; TST= Traditional Strength Training

According to Table 3 , a significant difference was found between hip thrust values in both groups. There was no difference in squat and deadlift movements in both groups.

DISCUSSION

Velocity-based training (VBT) is a contemporary resistance training method that allows precise prescription of training intensities and volumes (Weakley et al., 2019). Velocity-based training is a method that allows the percentage of one repetition maximum (1RM%) to be estimated from the actual velocity of each repetition, without the need for demanding maximal tests to adjust training loads (Guerriero et al., 2018). The main aim of this study was to investigate the effect of velocity-based strength training on the development of vertical jump, 20 metres sprint, 10 metres acceleration, agility, and balance by comparing velocity-based strength training with traditional strength training. In our study, the effects of velocity-based strength training and traditional strength training on some motoric characteristics were analysed for six weeks. The results of the velocity loss method and traditional strength training methods were compared with each other. In our study, statistically significant differences between the two groups were found in balance and vertical jump test values.

When the literature is examined, there are findings that VBT has positive effects on sprint performance. In particular, fast movements with load have been shown to increase explosive strength and velocity performance (Liao et al., 2021). VBT has been found to increase the capacity to move at maximum velocity and thus improve the sprint performance of athletes (Jiménez-Reyes et al., 2021). Banyard (2020) applied traditional training method and velocity-based training method to a total of 24 male participants who received resistance training for 6 weeks and 3 times a week. The effects of HTA and GA methods on changes in counter movement jump (CMJ) and sprint performance were compared. As a result, it was reported that the HTA group sustained faster training repetitions with less perceived difficulty and achieved better sprint results compared to the GA method group. In their study with 24 male subjects, Jiménez-Reyes et al., (2021) performed 16 training with squat movement in 8 weeks with the daily adjustment of the load with one group of subjects divided into 2 groups and the other group with the constant load method. As a result of the study, it was observed that both groups improved in 10-metre and 20-metre sprint performances and active jumping performances. However, it was found that the group with constant load adjustment showed more improvement in active jump performance and 20-metre sprint performance than the group with daily load adjustment method. The VBT training type can also lead to significant improvements in sprint performance. Styles, et al., (2016) showed that strength training increases velocity in short-distance sprints. Traditional strength training may not have a direct effect on velocity performance. However, increased muscle mass and strength have been found to improve performance, especially in short-distance sprints (Cormie et al., 2011). Although there was a statistically significant difference in 10 m and 20 m acceleration-sprint tests in our study, the increase in sprint performance is not a desirable situation.

Although there is limited research suggesting that VBT training may be effective on agility, it has been shown that training with explosive movements and load changes generally have positive effects on agility (Brito et al., 2014). It is suggested that VBT can improve agility elements, especially the ability to change direction and acceleration. The effect of speed-based training on agility is directly related to the development of quick movements and the ability to change direction. Asadi et al., (2016) found that velocity-based training significantly improved agility performance. The effect of traditional strength training on agility is mixed. Anderson et al., (2005) stated that this type of training can improve performance by increasing muscle strength and stabilisation in movements that require agility. In our study, no statistically significant difference was observed in the agility test, but a mean decrease was found. Studies examining the effects of VBT directly on balance are limited. Therefore, a comprehensive review of the literature in this area may be useful for practitioners. Speed-based strength training increases the ability of the muscles to contract quickly while improving balance. Strength training seems to improve balance by increasing muscle stabilisation. Muehlbauer et al., (2012) showed that this type of training can improve especially static and dynamic balance. In our study, it was observed that VBT and TST increased body control in movements requiring balance and stability, and thus had a statistically positive effect on balance performance. There is evidence that VBT and TST have significant effects on vertical jump performance. Research has shown that VBT training specifically increases vertical jump height

Banyard et al., (2020). It has been found that VBT improves vertical jump performance by increasing explosive strength and muscle power and this effect contributes to the overall athletic performance of athletes (Dorrell et al., 2020). Liu (2024) conducted a study comparing velocity-based strength training (VBT) with traditional training (CT) to analyse differences in lower extremity explosiveness for butterfly swimming. The study revealed that VBT leads to greater improvements in lower limb explosiveness that can positively affect performance. Similarly, Held et al., (2022) conducted a meta-analysis comparing the effectiveness of traditional and velocity-based strength training on explosive and maximal strength performance. The analysis further supported the benefits of velocity-based training by providing insights into the effect of both training methods on strength and power indices (Held et al., 2022). Speed-based strength training has been particularly effective in vertical jump performance, which requires explosive strength. Gonzalez-Badillo et al., (2010) reported that this training was more effective in increasing jump height compared to traditional methods. The positive effects of traditional strength training on vertical jump performance are associated with an increase in muscle strength and explosive power (Markovic & Mikulic, 2010). In our study, it was determined that there was a statistically significant increase in vertical jump performance for both groups. VBT is considered an effective method to optimise the maximal strength development of load training. VBT has been shown to improve performance by allowing the load to be adjusted according to the velocity of movement during training (Atabaş, 2022). Zhang et al., (2022) conducted a meta-analysis comparing velocity-based resistance training with percentage-based training in terms of maximal strength development. Meta-analysis suggested that velocity-based resistance training may be more effective in terms of maximal strength development, especially for in-season athletes. Velocity-based training (VBT) has gained attention in the field of strength training due to its potential benefits in improving explosive strength and performance. In fact, some studies have suggested the role of VBT in enhancing athletic performance, including power, countermovement jumping (CMJ) and sprinting ability (Banyard et al., 2020; Pareja et al., 2017a; Ramírez et al., 2015). However, some researchers have reported results related to VBT, including non-significant changes in CMJ, sprint and power test sense (Pareja et al., 2017b; Rodríguez et al., 2021; Orange et al., 2019). Research has emphasised the effectiveness of VBT compared to traditional 1RM-based resistance training in improving lower limb explosive strength (Held et al., 2022).

As a result, it was determined that velocity-based training and traditional strength training increased the vertical jump and balance performances of athletes in our study. Considering the reasons for the increase, squat movement, which is one of the lower extremity exercises, is a basic exercise targeting the quadriceps muscle group. This movement actively engages the quadriceps muscles by bending and extending the knee joint, which increases leg strength and endurance. In this context, the quadriceps muscles provide a powerful thrust in the vertical jump by extending the knee joint and are critical for higher jumps. It also helps to maintain balance by providing leg and knee stabilisation during standing and movement. Both strength training methods showed a significant increase in vertical jump and balance tests.

Conflict of interest

The authors declare no conflict of interest. Also, This study was supported by Sinop University Scientific Research Coordination Unit. Project Number: SBF-1901-23-002, 2023.

Ethics Committee

This study followed ethical standards and received approval from the Sinop University Human Research Ethics Committee, dated 28/04/2023 and numbered 2023/92.

Author Contributions

Design of the Study, EA, GSC, AM, CA and MB; Data Gathering, GSC; Statistical Evaluation, EA, GSC and AM; Data interpreting EA, GSC, AM, CA, MB; Writing of the Manuscript, EA, GSC, AM, CA and MB; and Search of the Literature, EA and GSC. Each author has reviewed the final draft of the manuscript and given their approval.

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RESEARCH ARTICLE

Determining the Fitness Level of People with Down Syndrome Living in Kosovo Based on the ALPHA Protocol

Milaim BERISHA[1,3], Taner ATASOY[2], Abedin BAHTIRI[1] and Agron THAQI[*1]

[1]Department of Sport Science and Movement, University for Business and Technology, Pristina / Kosovo
[2]School of Physical Education and Sports, Istanbul Gelisim University, Istanbul / Türkiye
[3]Children's Fitness Center of Canada (CFCC) / Canada
*Corresponding author: agron.thaqi@ubt-uni.net

Abstract

Purpose: This study aimed to establish national norm values for body composition and fitness levels among individuals with Down syndrome. It also aimed to investigate gender differences in body composition features and fitness parameters, analyze the impact of the region where individuals with Down syndrome reside, and compare their fitness levels with international peers. **Methods:** The sample included 81 participants, 40 females (height: 146.6±4.88 cm, weight: 63.6±16.4 kg) and 41 males (height: 157.4±6.21 cm, weight: 66.8±14.8 kg). To assess the physical fitness levels of the participants with Down syndrome, a modified version of the ALPHA testing protocol was used. **Findings:** The results demonstrated significant gender differences ($p<0.05$) in body composition and fitness parameters, with males generally exhibiting better outcomes compared to females. Moreover, significant disparities ($p<0.05$) in body composition and fitness parameters were observed among individuals with Down syndrome residing in different regions of Kosovo. Noteworthy gender disparities exist in terms of body composition and physical fitness metrics, with male participants achieving superior results compared to their female counterparts. Furthermore, noticeable variations were observed among the regional Down syndrome centers, with participants from older centers displaying improved fitness metrics and body composition features compared to those from newly established facilities. **Conclusion:** Gender differences in body composition and fitness were evident, with males outperforming females, except in muscle mass. Future studies should explore fitness and health barriers in Kosovo's DS population, with a focus on improving physical activity through tailored strategies.

Keywords
Body Composition, Disabled People, Motoric Tests, Norm Values

INTRODUCTION

Down Syndrome (DS), is a genetic anomaly instigated by a trisomy of chromosome 21, emerging as the principal genetic determinant of intellectual disability (ID) (Franceschi et al., 2019). DS correlates with numerous health complications, including congenital heart disease, obstructive sleep apnea, celiac disease, and various endocrinopathies. These endocrine irregularities typically manifest as thyroid disorders, diminished bone density, diabetes, stature reduction, and a predisposition to overweight or obesity (Franceschi et al., 2019; Whooten et al., 2018). Indeed, prevalence of overweight and obesity among individuals with DS ranged from 23% to 70%, being significantly higher compared to their counterparts without DS (Brantmüller et al., 2015).

However, participating in regular physical activity (PA) is a cornerstone of a healthy lifestyle, applicable to people of all ages and backgrounds. The benefits of PA for children and adolescents with disabilities, including DS, are well-documented. These benefits encompass maintaining muscle strength, flexibility, and mental well-being (Martin Ginis et al., 2016; Toptaş Demirci & Dolaş, 2023); enhancing overall health and physical fitness (Collins and Staples, 2017);

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boosting self-confidence and self-efficacy (Shields et al., 2012; Must et al., 2015); and fostering social support from peers (Pan et al., 2015).

Yet, compared to their typically developing counterparts, children and adolescents with disabilities often face higher levels of physical inactivity, leading to an elevated risk of secondary or chronic conditions like obesity (Centers for Disease Control and Prevention, 2010). To counteract these health risks, it is recommended that all individuals aged 6-17, irrespective of disability, engage in at least 60 minutes of moderate to vigorous physical activity each day (WHO, 2010).

Given the increased susceptibility of children with intellectual and developmental disabilities to inactivity-related health issues, focusing on enhancing their physical capabilities for daily activities and overall well-being is imperative (Collins & Staples, 2017). In this regard, various international researchers have explored specific aspects of physical activity and fitness level among the individuals with Down Syndrome. More specifically, Tejero-Gonzalez et al., (2013) have tested the validity and the reliability of a protocol for evaluating physical fitness level of DS individuals. They have found the Assessing Levels of Physical Activity (ALPHA) battery of tests to be reliable and suitable for assessing health-related fitness in adolescents with Down Syndrome (Tejero-Gonzalez et al., 2013).

In the last decade, physical fitness level of children and adolescents in Kosovo has been investigated, based on which normative values were determined (Berisha & Çilli, 2018; Berisha & Çilli, 2020). In addition, Tishukaj and colleagues (2017) studied the impact of living environment on physical fitness and anthropometric characteristics of adolescents (Tishukaj et al., 2017). Despite this body of knowledge, regarding the fitness level of healthy population in Kosovo, there is a notable absence of information about the physical fitness, activity levels, and weight status among children and adolescents with Down syndrome in Kosovo. Furthermore, the lack of monitored fitness levels and tailored activities exacerbates the risk of poor physical and motor status. Addressing this gap requires answers to critical questions, which form the core of this study such as the determination of physical fitness level of individuals with DS, the establishment of standards for varying levels of physical fitness within this population, and the comparison of results with other developing and developed countries.

The study's objectives revolve around improving the fitness of individuals with Down syndrome in Kosovo, a cohort currently lacking tailored physical activity initiatives and systematic monitoring. Therefore, this study aimed to: a) create the national norm values of body composition and fitness level of individuals with down syndrome and b) investigate gender differences in body composition features and fitness parameters; c) analyze the effect of the region they DS individuals live in, on body composition characteristics and fitness parameters; d) compare their fitness level with international peers. Furthermore, it has been hypothesized that body composition features and physical fitness parameters are affected by gender and the geographic region.

MATERIALS AND METHODS

Participants

The study sample consisted of 81 volunteers aged 15 and above randomly selected out of the population that is approximately 160 children and adolescents with Down Syndrome in the Republic of Kosovo. The sample group consisted of 40 females (H: 146.6±4.88, W: 63.6±16.4), and 41 males (H: 157.4±6.21, W: 66.8±14.8). While the 34 participants were between 15-18 years (16.3±1.41), old 47 of them were above 18 years old (25.4±6.4). All participants were registered in one of the DS centers in the Republic of Kosovo, located in five biggest regions of the country e.g. Pristine (01), Prizren (04), Mitrovica (02), Ferizaj (05), and Gjilan (06). Whereas there is not DS centers located in Peja (03), and Gjakova (07) regions.

This research has met ethical rules. Research ethical approval was obtained from the Research Ethics Committee of the Institutional Review Board at the University for Business and Technology (UBT) with approval letter code 12334/45. Participants provided informed consent, with the volunteer form covering research details, risks, benefits, confidentiality, and participant rights. The research strictly adhered to the ethical principles of the Declaration of Helsinki, prioritizing participant's rights and well-being in design, procedures, and confidentiality measures.

All study procedures were realized in close collaboration with "Down Syndrome Kosova (DSK)", which organized the participants and

ensured a sustainable environment for testing team to administer fitness tests according to the ALPHA protocol. Prior to the participation in the study, after received detailed information regarding the study procedures, all children and adolescents, and their parents/guardians provided written informed consent.

Figure 1. Locations of DSK centers in kosovo

The following criteria were used as inclusion criteria: to be diagnosed with Down syndrome, to be registered in the Down Syndrome Kosova organization, absence of any acute or chronic illness that may worsen as a result of participating in the activities foreseen in the research, participants in the research must have a doctor's approval. The following exclusion criteria were considered: individuals with severe to profound intellectual disability, individuals with difficulties in gripping objects, individuals who use crutches, individuals dependent on others to perform motor tasks, individuals with amputations and physical disabilities and individuals dependent on wheelchairs.

Procedures

The data were collected between the months of September and November. Initially, all participants completed the anthropometric and body composition assessments. The physical fitness tests were conducted in the same day and consisted of four tests selected to assess the same health-related fitness components assessed by ALPHA fitness testing protocol for people with Down Syndrome Tejero-Gonzalez et al., (2013) evaluating body composition, upper-body strength and cardiorespiratory endurance (Tejero-Gonzalez et al., 2013). The ALPHA protocol includes also the 20-meter shuttle run test (Level) and 4x10 meters shuttle run test (sec). However, the data collected with our sample for these two tests were not valid and reliable due to the fact that more than 50% of participants could not perform properly these tests, and those who performed the tests could not follow the test protocol. Therefore, in order to have more accurate results these tests were excluded. As a result, a modified version of the burpees test, explained below, was used to test the cardiorespiratory capacity and local endurance and force. Before conducting the physical fitness tests, every participant underwent a standardized dynamic warm-up led by the fitness test coordinator.

Physical Fitness Tests

The tests used in order to determine the fitness level of people with "Down Syndrome", assess the same fitness components as the ALPHA protocol developed and used by (Tejero-Gonzalez et al., 2013; Jonatan R Ruiz et al. 2011). The ALPHA test protocol is a reliable and valid tool to assess health-related physical fitness components in children and adolescents with DS.

Anthropometrics

The height of participants was measured employing a portable stadiometer (Seca, Hamburg, Germany) to the nearest 0.5 cm. Body mass was measured to the nearest 0.1 kg using a digital scale (Seca, Hamburg, Germany), with participants wearing light sports clothing and no shoes. In addition, Waist circumference, taken at the narrowest point at umbilicus level, was measured to the nearest 0.1 cm using an elastic circumference tape (Seca 201, Hamburg, Germany). All anthropometric measures were taken in the morning.

Body Composition

The Tanita (BC454) body composition analyzer was utilized to assess body composition features. An experienced professional conducted all measurements. Participants received instructions to abstain from alcohol and caffeine for 24 hours prior to the test, and to refrain from consuming food and fluids for at least four to five hours beforehand. Additionally, they were advised to avoid engaging in physical activity for 12 hours preceding the test. All measurements were taken in the morning. The parameters assessed were the following: body fat

percentage, fat mass, muscle mass, total body water, Body Mass Index (BMI), and basal metabolic rate (kilocalories).

Upper body strength

Dynamometric measurement of handgrip strength serves as a reliable and valid testing procedure for upper body strength (Nhantumbo et al., 2012; Oppewal, & Hilgenkamp, 2020), and the procedures recommended in the Brockport Fitness Test Manual (Winnick, & Short. 2001) were used. Following a brief demonstration and adjustment for hand size, isometric handgrip strength was assessed in both the dominant and non-dominant hands using a portable hydraulic dynamometer (Jamar, Warrenville, IL, USA). Participants were instructed to sit with their shoulders adducted and neutrally rotated, elbows flexed at 90 degrees, and to exert maximal force while squeezing the handle for at least two seconds. Each hand underwent two trials, with a 10-second resting period between attempts, alternating testing sides. The highest scores attained from the two trials were selected for further analysis, presenting absolute values.

Cardiorespiratory fitness

Burpee is a multi-joint exercise that is executed by activating the major muscle groups of the whole body. Recently, Yamashita (2023) conducted a study demonstrating a positive relationship between the 3 Minutes Burpees Test (3MBT) and maximal oxygen uptake estimated using the Yo-Yo IRT (Yamashita, 2023). To assess the cardiorespiratory fitness level of participants, a Modified Burpees Test (MBT) was utilized. Given the specific nature of the sample, the test was modified to enhance its validity and reliability. This was achieved by implementing a 5-second rule, which required participants to stand up from a lying position within 5 seconds and return to a standing position within 5 seconds. The 5-second rule was set based on the pilot testing conducted with 10 DS young individuals. The mechanics of the MBT were adjusted to accommodate the characteristics of the participants and minimize the potential for error (Podstawski et al., 2019). The end of the test was determined by the inability of the participant to comply with the 5-second rule. The result of the test was registered in minutes.

Data analysis

The data analysis was performed using the Statistical Package for Social Sciences (SPSS version 26). The level of significance was set at ($p<0.05$). Initially, the normality of the data was tested with the Kolmogorov-Smirnov, Histogram, and Q-Q Plots methods. The sample was divided into 2 age categories (15 -18 years old and > 18 years old). Since the data proved to be non-parametric and the criteria of the assumptions have not been assumed, the Independent-Samples Mann-Whitney U Test Summary was used to analyze gender differences. The analysis of region differences has been performed by using Kruskal-Wallis 1-way ANOVA (k-samples), all pairwise, while the mean and standard deviation have been performed by using the One-Way ANOVA (Tamhane-s T2) method. Ultimately, the absolute values of body composition features and fitness tests are presented in reference tables in percentiles according to sex and age group, divided in five groups (Very low, Low, High and Very high, and the middle fifty value).

RESULTS

Descriptive statistics for all anthropometric and physical fitness tests for both genders are presented in (Table 1). In particular, results denote that there were statistically significant differences between genders in the majority of body composition features, except BW, VF, and WC ($p>0.05$). Additionally, in terms of physical fitness results, the HG resulted to be significantly different in boys compared to girls ($p<0.05$).

In addition, region based of difference statistics for body composition features and fitness tests are shown in (Table 2). Statistically significant differences ($p < 0.05$) were found between regions of Kosovo, where the DS centers are located, in body composition features and physical fitness tests, except regions 01 and 02 in W, regions 05 and 06 in MM and BM, and region 05 in BM resulted to be statistically not different from other regions ($p>0.05$) (Table 4).

Table 3 and 4 presents the norm values of body composition features separated into four categories (Very low, Low, High and Very high), and the middle fifty value, expressed in percentiles, which is used to compare results instead of the average value. In (Table 5) are presented the norm values for HG and MBT categorized four categories (Very low, Low, High and Very high), and the middle fifty value, expressed in percentiles, which is used to compare results instead of the average value.

Table 1. Gender differences conducted by an Independent-Samples Mann-Whitney U Test

Variables	Gender	X̄ ±SD	Mean Rank	Mann-Whitney U	Wilcoxon W	Test Statistic	Sig.(2-sided test)
Height (cm)	♀	146.6±4.88	23.85	1506.0	2367.0	1506.0	.000
	♂	157.4±6.21	57.73				
Weight (kg)	♀	63.6±16.4	37.75	950.0	1811.0	950.0	.219
	♂	66.8±14.8	44.17				
Body Mass Index (kg/m2)	♀	29.3±7.0	45.15	654.0	1515.0	654.0	.117
	♂	26.8±5.3	36.95				
Fat Percentage (%)	♀	28.2±8.4	54.11	295.5	1156.5	295.5	.000
	♂	17.5±7.9	28.21				
Water Percentage (%)*	♀	52.2±6.0	20.18	738.5	1144.5	738.5	.000
	♂	61.6±8.7	40.88				
Muscle Mass (kg)*	♀	43.2±6.3	20.84	718.0	1124.0	718.0	.000
	♂	52.8±7.5	40.14				
Bone Mass (kg)*	♀	2.3±.3	20.56	726.5	1132.5	726.5	.000
	♂	3.8±5.5	40.45				
Kilocalories (J)*	♀	1425±208.7	22.21	675.5	1081.5	675.5	.000
	♂	1659±239.6	38.63				
Visceral Fat (level)*	♀	4.6±3.6	32.11	368.5	774.5	368.5	.314
	♂	4.1±4.0	27.66				
Waist Circumference (cm)	♀	86.8±16.1	40.41	843.5	1704.5	843.5	.824
	♂	86.4±13.9	41.57				
Handgrip Force (Right) (kg)	♀	13.6±9.5	31.94	1133.5	1994.5	1133.5	.001
	♂	18.7±8.6	48.65				
Handgrip Force (Left) (kg)	♀	12.8±4.8	30.18	1152.0	2013.0	1152.0	.000
	♂	18.8±7.7	49.10				
Modified Burpees (time)	♀	4.24±5.27	35.08	663.0	1293.0	663.0	.704
	♂	3.91±3.56	36.94				

♀: female ♂: male
*Tests are not performed in the population under 18 years old
H: Height (cm), W: Weight (kg), BMI: Body Mass Index (kg/m2), F%: Fat Percentage (%), W%: Water Percentage (%), MM: Muscle Mass (kg), BM: Bone Mass (kg), KCAL: Kilocalories (J), VF: Visceral Fat (level), WC: Waist Circumference (cm), HG: Handgrip Force (R, L) (kg), MB: Modified Burpees (minutes), SBJ: Standing Broad Jump (cm).

Table 2. Regional differences conducted by an Independent-Samples Kruskal-Wallis Test

Variables	Regions	X̄ ±SD	Mean Rank	Test statistics	Asymptotic Sig.(2-sided test)	Pairwise comparisons
W	Prishtine (01)	61.3±12.1	36.24	10.626a	.031	05-04 (sig .022) 05-06 (sig .007) 01-06 (sig .022)
	Mitrovice (02)	64.3±15.6	39.14			
	Prizren (04)	69.7±14.6	49.06			
	Ferizaj (05)	55.5±11.3	26.89			
	Gjilan (06)	78.7±20.6	56.20			
BMI	Prishtine (01)	27.2±5.6	38.43	15.115a	.004	05-04 (sig .010) 05-06 (sig .000) 02-06 (sig .010) 01-06 (sig .009)
	Mitrovice (02)	26.8±5.1	37.28			
	Prizren (04)	29.1±5.6	47.06			
	Ferizaj (05)	23.5±5.2	22.17			
	Gjilan (06)	34.5±7.8	61.30			
MM*	Prishtine (01)	43.4±6.9	21.14	10.053a	.040	01-02 (sig .026) 01-04 (sig .004)
	Mitrovice (02)	50.8±10.2	34.65			
	Prizren (04)	94.3±151.4	38.83			
	Ferizaj (05)	49.2±5.6	35.00			
	Gjilan (06)	48.1±9.3	29.94			
BM*	Prishtine (01)	2.3±.3	21.17	10.028a	.040	01-02 (sig .020) 01-04 (sig .005)
	Mitrovice (02)	4.9±8.1	35.23			
	Prizren (04)	2.7±.3	38.42			
	Ferizaj (05)	2.6±.2	34.88			
	Gjilan (06)	2.5±.5	29.67			

WC	Prishtine (01)	84.0±13.6	37.70	14.414a	.006	05-04 (sig .008) 05-06 (sig .001) 02-06 (sig .014) 01-06 (sig .012)
	Mitrovice (02)	83.4±11.7	36.72			
	Prizren (04)	91.3±13.5	49.24			
	Ferizaj (05)	77.0±13.5	23.39			
	Gjilan (06)	100.0±18.4	59.45			
MB	Prishtine (01)	6.63±6.17	47.63	17.251a	.002	06-01 (sig .002) 02-01 (sig .000) 04-01 (sig .040)
	Mitrovice (02)	2.09±2.00	24.50			
	Prizren (04)	2.94±1.76	33.27			
	Ferizaj (05)	3.97±2.75	40.57			
	Gjilan (06)	1.98±1.64	23.22			

a. The test statistic is adjusted for ties.
b. Multiple comparisons are not performed because the overall test does not show significant differences across samples.
*Test is not performed in the population under 18 years old
H: Height (cm), W: Weight (kg), BMI: Body Mass Index (kg/m2), F%: Fat Percentage (%), *W%: Water Percentage (%), MM: Muscle Mass (kg), BM: Bone Mass (kg), *KCAL: Kilocalories (J), *VF: Visceral Fat (level), WC: Waist Circumference (cm), DG: Handgrip Force (R, L) (kg), MB: Modified Burpees (minutes), SBJ: Standing Broad Jump (cm).

Table 3. Norm values on body composition features based on age and genders valid for DS people of Kosovo

Reference table	H: Height (cm)				W: Weight (kg)				BMI: Body Mass Index (kg/m^2)				F%: Fat Percentage (%)			
	15-18 years old		Over 18 years		15-18 years		Over 18 years		15-18 years		Over 18 years		15-18 years		Over 18 years	
	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂
Very Low	150.3	150.3	141.2	153.0	46.8	56.4	52.3	55.0	21.7	23.3	24.4	21.9	18.1	11.5	21.1	6.8
Low	155.0	155.0	144.0	156.0	57.0	59.7	56.3	61.9	25.1	25.7	27.6	24.7	22.6	17.8	26.3	13.6
Middle Fift	155.5	155.5	145.0	158.0	58.3	65.3	65.3	65.2	25.8	26.2	29.8	25.7	23.9	20.1	29.7	14.5
High	159.0	159.0	147.8	158.5	59.2	71.2	68.5	67.8	27.2	28.7	32.3	26.7	28.2	23.7	33.2	16.4
Very High	162.0	162.0	150.9	164.4	71.0	79.4	80.2	76.2	32.0	31.4	38.7	29.6	31.8	27.4	38.5	19.2

Table 4. Norm values for body composition features based on age and gender valid for DS people of Kosovo

Reference table	W%: Water Percentage (%)		MM: Muscle Mass (kg)		BM: Bone Mass (kg)		KCAL: Kilocalories (J)		VF: Visceral Fat (level)		WC: Waist Circumference (cm)			
	Over 18 years old										15-18 years old		Over 18 years old	
	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂
Very Low	46.0	57.4	37.1	45.6	2.0	2.4	1229	1440	1.5	1.0	69.0	75.0	74.8	73.2
Low	49.7	61.6	40.5	50.7	2.1	2.7	1327	1565	3.0	2.1	78.0	83.0	84.4	82.4
Middle Fifty	51.5	62.5	41.9	52.5	2.2	2.8	1376	1635	4.0	2.7	78.0	91.0	88.0	85.0
High	54.5	64.0	42.4	55.6	2.3	2.9	1426	1734	5.5	3.5	82.8	93.0	93.0	86.0
Very High	58.1	69.5	47.9	60.4	2.5	3.2	1583	1870	9.6	6.5	90.7	99.0	108.4	96.0

Table 5. A norm values on motor abilities based on age and gender valid for DS people of Kosovo

Reference table	HG: Handgrip Force (kg)								MB: Modified Burpees (minutes)			
	15-18 years old				Over 18 years old				15-18 years old		Over 18 years old	
	♀		♂		♀		♂		♀	♂	♀	♂
	R	L	R	L	R	L	R	L				
Very Low	3.4	5.5	8.4	11.2	9.0	8.6	10.4	10.4	1.20	0.70	1.08	1.28
Low	8.4	12.4	13.8	17.0	13.7	11.7	20.2	20.0	2.15	1.38	2.52	2.55
Middle Fifty	11.4	13.5	16.0	17.8	14.4	14.7	20.6	21.7	2.40	2.57	3.30	4.17
High	13.5	14.7	19.4	19.1	15.0	15.9	22.3	23.3	2.50	4.08	3.54	4.43
Very High	18.0	16.3	21.3	24.0	19.3	18.2	28.6	25.5	5.28	5.77	7.53	6.59

DISCUSSION

The current study is the first to present reference values for body composition features and fitness for DS individuals in the Republic of Kosovo. More specifically, this study aimed to: a) create the national norm values of body composition and fitness level of individuals with down syndrome and b) investigate gender differences in body composition features and fitness parameters; c) analyze the effect of the region the DS individuals leave in, on body composition characteristics and fitness parameters; d) compare their fitness level with international peers. The main findings of this study demonstrated that there are significant gender differences in some body composition characteristics and fitness parameters (muscle strength), but no significant gender differences were found on MBT. Additionally, significant differences between regions were found on body composition characteristics and fitness parameters.

Regarding gender differences, this study demonstrated significant gender differences in body composition characteristics and fitness parameters, where male DS participants showed better values in body composition characteristics and fitness parameters (HG). Body composition characteristics such as height, body fat, water percentage, fat percentage, bone mass, showed a tendency of being more positive among male participants compared to female DS participants. The results of the current study are in complete agreement with the results previously reported in a study by Jacinto et al. (2023), where significant differences between sexes were in the total body water, fat mass. On the contrary, no significant differences between genders were found on weight, BMI, visceral fat, and waist circumference. These results are not in agreement with the findings of Jacinto et al. (2023), where significant gender differences were reported in both BMI, and waist circumference, with DS female participants showing higher values (Jacinto et al. 2023). Nevertheless, based on the current findings, it can be speculated that both boys and girls are exposed to the same health-related risk level. Based on the Ungurean et al. (2022) the prevalence of excess weight and obesity among persons with intellectual disabilities was similar among the male and female participants. The results showed an increasing trend by age (Ungurean et al., 2022). In other words, both male and female individuals with Down syndrome have an increased risk of obesity compared to the general population. Factors such as reduced physical activity, dietary habits, and metabolic differences may contribute to this risk (Zemel et al., 2024).

Furthermore, surprisingly, higher muscle mass relative to their body features was found to be present among female DS participants. This result showed a different trend compared to the results of Jacinto et al. (2023), where higher muscle mass was reported among male DS individuals (Jacinto et al., 2023). This difference may be attributed to a myriad of factors such as hormonal influence, nutritional status and the physical activity level of DS participants. In this regard, it was demonstrated that application of physical activity programs in DS population increased bone mass and also lean muscle mass (Ferry et al., 2014; Gonzales et al., 2012).

While not specifically focused on body composition, a study by Giménez et al. (2019) found that males with Down syndrome tended to have greater muscle strength compared to females (Giménez et al., 2019). The results of the current study showed the same pattern, where males with DS demonstrated better results in handgrip strength on both left and right hands compared to female DS participants. These results seem to be in line with the current literature where significant differences have been observed for levels of absolute and relative handgrip strength (Hernández et al., 2023). Furthermore, when the MBT results were compared based on gender, surprisingly, no statistically significant differences were detected. This might be attributed to a poor general physiological capacity of participants with DS to perform a sustained physical work for a long period of time. This aspect is directly related to the inability of individuals with DS to perform daily living tasks (Cowley et al., 2010).

When results were analyzed based on the regional DS centers where the DS participants are registered in, statistically significant differences were found in certain body composition characteristics and physical fitness parameters. DS participants registered in the DS center in Pristina region (01), which is the oldest DS center in Kosovo, demonstrated to have the best condition regarding body composition characteristics and physical fitness. The DS participants from Pristina (01) lead in the general cardiovascular and local endurance (lover body, trunk, and upper body

muscles), and body composition features such as bone mass, add other features etc. On the other hand, DS participants from Prizren (04) region demonstrated worse results compared to the other regions such as Ferizaj (07) in body composition characteristics such as body mass index and waist circumference. Furthermore, DS participants from the DS center in Gjilan (06), being the last established DS center in Kosovo, demonstrated the lowest physical fitness level and the worst body composition characteristics compared to DS participants part of other DS regional centers. Thus, based on these findings, it was demonstrated that the older the DS centers are, the better the physical fitness and body composition characteristics of the DS participants is, and vice versa. These differences could be related to the barriers and facilitators aligned with the various levels of the ecological model of health behavior, such as: (a) intrapersonal, (b) interpersonal, (c) community (availability of programs), (d) organizational (school systems), and (e) policy (education) (Schultz et al., 2023).

Since the current literature lacks the information about the regional differences in physical fitness and body composition characteristics of people with DS, it is difficult to identify the reasons for the regional differences regarding the DS people living in Kosovo. Therefore, the current findings, could be considered as a starting point, and could pave the way for studies studies to identify regional differences and work on eliminating the features caused by the regional differences. Moreover, the results of the current study can be used to develop personalized physical activity programs and interventions customized for different age-groups, genders, and syndrome severity. Additionally, seeing the relevance of these results, the establishment of an ongoing monitoring system using the validated and reliable testing protocols such as ALPHA protocol is of urgent need to ensure the effectiveness of physical activity interventions and early detection of health issues.

Conclusions

It can be concluded that significant gender differences exist in body composition characteristics and physical fitness parameters, with male DS participants showing better results compared to females, excluding muscle mass. Additionally, significant differences were shown to be present also between regional DS centers, with the DS participants of older DS center demonstrating better results in fitness parameters and body composition characteristics compared to the participants of newly established DS centers. Finally, these results highlight the urgent need of establishment of DS centers in the region of Peja (03) and Gjakova (07), where such centers have not been established yet. Furthermore, future studies are encouraged to investigate in more details the physical fitness level and body composition characteristics of DS population in the Republic of Kosovo and try to determine possible regional barriers affecting the general health of DS population, Furthermore, physical activity (PA) should have a crucial role in enhancing health and motor capacity performances among individuals with Down syndrome (DS). Therefore, tailored strategies, implemented by professionals, need to be devised to maintain and enhance physical fitness levels of DS population.

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Conflicts of interest

We affirm that the article we have authored does not involve any conflict of interest.

Ethics Statement

This research followed ethical standards and received approval from the Institutional Review Board at the University for Business and Technology (UBT) dated 13.10.2023 and number (12334/45).

Author Contributions

Design of the Study, MB, TA, AB and AT; Data Gathering, MB and AT; Statistical Evaluation, MB and AB; Data interpreting MB, AB and AT; Writing of the Manuscript, MB, AB and AT; and Search of the Literature, MB, TA and AT. Each author has reviewed the final draft of the manuscript and given their approval.

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RESEARCH ARTICLE

The Effect of Using the Wheatley Educational Model According to Cooperative Groups to Reflective Thinking and Learning the Basic Skills of Freestyle Swimming for Students

Firas Ajeel YAWER*[1]

[1]College of Physical Education and Sports Sciences, Al-Mustansiriya University / Iraq
*Corresponding author: Firascanoe@uomustansiriyah.edu.iq

Abstract
The research aimed to identify the effect of the Wheatley model according to cooperative groups in reflective thinking and learning the basic skills of freestyle swimming for students. As for the research hypothesis, it was represented by the presence of statistically significant differences between the post-tests of the two groups (experimental and control), and the research population was determined by the intentional method of third-stage students in College of Physical Education and Sports Sciences, University of Sulaymaniyah. As for the research sample, it was randomly selected by lottery from Division (A) and consisted of (32) students. It was divided into two groups: the experimental group, which consisted of (14) students, and the control group, which consisted of (14) students. The skill tests for free swimming were relied upon to reach the results after treating them with appropriate statistical means. The researcher concluded that the Wheatley educational model according to the cooperative groups had a positive impact on reflective thinking and learning the basic skills of free swimming for the third stage students of the College of Physical Education and Sports Sciences in University of Sulaymaniyah. The researcher recommended the need to use the Wheatley educational model according to cooperative groups in learning the basic skills of freestyle swimming for different stages and age groups. The researcher also recommended the need to use the Wheatley educational model according to cooperative groups in teaching various other activities and sports.

Keywords
Wheatley Model, Cooperative Groups, Reflective Thinking, Freestyle Swimming Skills

INTRODUCTION

The educational process today, as a result of the tremendous development in various fields of science and the educational field in particular, is characterized by its importance, as the fundamental idea in the educational process depends on the extent of capabilities, ability, readiness, and the necessary amount of time that the learners need, as it is the main focus of the learning process (Abbas, & Malih, 2021), through developing the capabilities of the abilities of the learners, which is the first and last goal in this process, which requires comprehensive and accurate attention in the availability of various educational positions that serve the process of learning and providing opportunities to achieve the optimal performance of different sports skills, through which the ability of the teacher reflects the skill or movement parts and its components, and (Ismail, 2022) highlighted the importance of the teaching process as a key component.

It is one of the cornerstones of the educational process, which is how people's conduct is changed for the better and how information, beliefs, customs, and other behavioral patterns are acquired. By doing this, we can increase the value of physical education and make use of all the procedures and tools at our disposal to help create a generation that is aware and capable of successfully leading the educational process. In achieving the goals of the educational process.

There are many models and educational strategies that were used in learning basic sports

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skills and are still being used, as the success rate in skill and physical performance varied, so experts and researchers sought to find methodsapproaches and models that support learning in a way that is appropriate with students' capacities as well as the educational process and all sporting events (Hatem & Abdul Hussein, 2024). Scientific and skillful and providing the appropriate atmosphere to highlight their abilities and potentials, the educational models, strategies and methods used by the teacher serve as an organization of the educational situation and direct it in order to achieve the educational objectives with the least time and effort. The Wheatley model, which is focused on the cognitive components of learning, is one of the models, teaching tactics, and methods that have evolved. It makes the learner effective, involved, and positive (Yawer & Saadoun, 2023).

The student and his cognitive style. This paradigm makes the student employ a variety of information, knowledge, and thought processes that are all included in one strand, with a focus on mental processes and how to handle them. Through it, the student solves a variety of issues related to his education or attempts to finish a knowledge picture that needs certain details to be finished. This has been confirmed by (Abdel Karim, 2022), which holds that the capacity of the educational process is one of the key components that determines its success. The mental abilities of students, since thinking is the highest mental process, and reflective thinking is considered a comprehensive method that leads the learner to link meanings and ideas, discover ideas, and give meanings so that the learner can discover and think, and teaching the basic skills in freestyle swimming begins with one path, which is learning the basic principles and skills and mastering them (Sarıca, O. & Gencer, 2024).

This is why it has become Like all games and events that must go through many independent variables in their performance, therefore, choosing the appropriate model that achieves the goal with the least time and effort is one of the basic matters that has become obligatory for teachers and tutors to use, organize the teaching steps, and choose the best one that is appropriate to the type of skill, effectiveness, and performance environment, in addition to working to increase the learners' motivation toward learning (Hamoudi& Malih, 2012).

The research's significance stems from its utilization of contemporary models that stay up to date with advancements in the field of education, teaching and education, which gives the learner an effective, positive and active role in the educational process and the learning process, and also helps them develop their mental and thinking processes so that they are able to solve the problems they face and find effective solutions that suit the desired problem. solve it, in addition to helping those in charge of the educational process, including male and female teachers, in transferring some of the learning tasks and duties to the learners, and working in small cooperative groups that gives them motivation and motivation, and conveying the impact of learning among the learners through discussion and topics, and conveying the impact of learning from individuals helps in acquiring the artistic performance of the basic skills in freestyle swimming for the students (Yawer, 2024). Learners of the skills to be learned, which may help them interact positively with the educational environment, take into account individual differences, and respond to the requirements for the skills to be learned, due to the specificity of freestyle swimming, as it is considered one of the difficult sports practiced in an environment that is considered frightening for students who are not good at swimming (Rashid & Neamah, 2024).

The researcher noted that there are many efforts being made by teachers and researchers in order to raise the level of learners, which aims for them to reach positive results in the teaching and learning process. Several developments have emerged in the systems of teaching methods and learning methods to get rid of the traditional style of learning, which has led to a reconsideration of some. Traditional models, strategies, and methods, and choosing modern models and strategies that may be positive and appropriate for teaching the skills to be learned and progressing in, therefore, through the researcher's observation of the educational units, and being one of the specialists in this field, he found that there is a clear weakness in learning some basic swimming skills. This reason is due to the lack of use of modern models, strategies and methods that are compatible with the ages and level of the learners. Because swimming needs more privacy than other sports and games, as it is practiced in a water environment that is different from the environment in which other sports are practiced, in addition to the difficulty of teaching

the basic skills of freestyle swimming, from this standpoint, the researcher sought to use the Wheatley model according to cooperative groups and to identify its effectiveness in learning some Basic freestyle swimming skills for students.

Research objectives

Using the Willy model to prepare instructional units in accordance with cooperative groups.

Identify the effect of Wheatley's model according to cooperative groups on students' reflective thinking.

Identify the effect of the Wheatley model according to cooperative groups in learning some basic freestyle swimming skills for students.

Research Hypothesis

There are no statistically significant differences in the reflective thinking test between the experimental and control groups.

There are no statistically significant differences in the post-tests of basic freestyle swimming skills between the experimental and control groups.

MATERIALS AND METHODS

Research Methodology

In solving a research problem, selecting an appropriate approach is crucial to aligning with the study's objectives. In this case, the researcher chose the experimental method, using two equal groups with pre- and post-tests to assess the effects of an intervention. This approach is well-suited for studies aiming to establish cause-and-effect relationships, as it allows for controlled comparisons between groups and over time. The experimental method ensures the validity and reliability of the findings, making it a robust choice when the research problem involves testing hypotheses and measuring changes due to specific interventions (Abdul Zaid, 2018).

The Research Community and its Sample

The research population consisted of 63 students from the College of Physical Education and Sports Sciences at the University of Sulaymaniyah, enrolled in the third stage for the 2023–2024 academic year. Using a lottery, Section (A), with 32 students, was selected. These students were then divided into two equal groups: 14 in the experimental group and 14 in the control group, while 4 students were assigned to an exploratory experiment. The research sample represented 50.793% of the total population.

This study followed ethical standards and received approval. Participant provided informed consent, with the volunteer form covering research details, risks, benefits, confidentiality, and participant rights. The research strictly adhered to the ethical principles of the Declaration of Helsinki, prioritizing participant's rights and well-being in design, procedures, and confidentiality measures.

Determine Skills

Freestyle swimming skills were determined by relying on books, references, and previous studies that scientifically and clearly defined freestyle swimming skills, which are (body position, leg strikes, arm strikes, breathing, coordination). The researcher adopted a form for evaluating the skill performance of free swimming prepared by (Yawar, 2016). The evaluation form included the five skills related to freestyle swimming, where the evaluation scores were divided according to the importance and difficulty of performance for each skill: body position skill (16), leg strikes score (16), arm strikes (24), breathing (20), compatibility (24), and the total score for the form is from 100 degrees, and the performance was evaluated by a group of experts and specialists in freestyle swimming, to ensure that the evaluation was accurate. The researcher also adopted skill tests for freestyle swimming that were approved through sources, references, and my colleges.

Regular breathing test 10/second (Salary, 1998),

Abdominal buoyancy test (Saeed,2004),

Flow test (front slip) (Al-Samarrai, 1998),

Technical performance test, 25 m freestyle (Salary,1998),

Scale of Reflective Thinking

The researcher reviewed many sources, references, studies and previous research, to choose the scale of reflective thinking, which aims to identify the degree of reflective thinking of students in the College of Physical Education and Sports Sciences for the swimming subject, so the researcher adopted the scale prepared by (Al-Fahdawi, et al., 2024). The scale consists of three domains, namely (perseverance and determination, goal-oriented determined strength, and self-talk support for thinking). The scale consists of 25

items, and the items were distributed among the three domains, with (9) items for the first domain, and (8) items for the second domain. And (8) paragraphs for the third field. A three-scale scoring method (always, sometimes, never) was adopted, and weights were given (1.2.3.) for the positive items and (3.2.1) for the negative items. A panel of professionals with expertise in measurement, assessment, and sports psychology were shown the scale. The study also confirmed the scale's stability to bolster its legitimacy, and the value of the reliability coefficient reached (0.86), which indicates that the scale has a high reliability rate.

Exploratory Experience

A miniature version of the fundamental experiment is the exploratory experiment. On Monday, February 15, 2024, an exploratory experiment was carried out on four pupils to assess reflective thinking prior to the kids entering the swimming pool. After the scale was given out, it was responded. Then the researcher began The work team conducts skill tests in the college swimming pool. The exploratory experiment's goals included determining whether the tests could be used and confirming their validity, as well as learning about the researcher's challenges and roadblocks, the workflow, the process for taking notes and information, and the assistant work team's comprehension of how to administer the tests and distribute them so that everyone knew what to do when the main tests were being conducted.

Equivalence of the two Research Groups

For the experimental and control groups, the researcher ran an equivalency test. In order to ensure that the two groups are homogeneous and equivalent and that all students are at the same level, the researcher administered two educational units and then conducted an equivalency test. This allowed the students to start from the same starting point, as indicated in the table (1).

Table 1. It displays the T value, standard deviation, and arithmetic mean that were determined for the two study groups.

Variables	Experimental group		Control group		t value	sig level	sig type
	Mean	Std. Deviation	Mean	Std. Deviation			
Regular breathing 10/s	6.673	1.888	5.877	2.128	0.727	0.07	Non sig
Floats	10.745	3.812	11.454	3.768	0.987	0.221	Non sig
Flow	5.762	2.373	5.779	3.225	0.685	0.655	Non sig

Preparing Educational Units for the Wheatley Model

The researcher created the instructional modules, and the experimental and control groups' participants underwent the same protocols and learned at the same times. The experimental group's kids were taught using the Wheatley model, while the control group was satisfied with the teacher's approach. The educational program was implemented on February 22, 2023, with two educational units per week, for a total of (14) educational units, and for (7) weeks. The time of the educational unit reached (90 minutes). Under the researcher's guidance, the teacher carried out the instructional units. The application of steps was one of the instructional modules. Wheatley's educational model, which consists of the following steps: (Zayer, et al.,2017)

Task

Small groups

Participation

The Educational Unit was Divided Into Three Sections

Preparatory Section

It includes educational procedures, general warm-up, and physical exercises, with a time limit of (15) minutes.

The main section: It includes (60) minutes, distributed as follows:

The educational aspect: (20) minutes. The teacher works to distribute the students into small cooperative groups consisting of (3-5) students. In this aspect, the lesson and the new concept are prepared by the teacher, then the skill is explained well and in detail, and the model is presented by the teacher. Or a student who masters the skill well. In this aspect, the steps of the Wheatley model are applied through the stages of the model as follows:

The first stage: Tasks: This includes distributing tasks among the students and between the cooperative groups, such as determining the type of exercise and the type of assistance from the colleague within the cooperative groups. As well as

asking some questions by the teacher in the form of a dialogue between him and the students

The applied part: its duration is (45) minutes. It includes the following

The second stage: Small groups: In this stage, educational tasks are accomplished by applying exercises according to cooperative groups, exchanging ideas, correcting errors within one group, repeating skill-specific exercises, and using more than one sense by looking and listening to the teacher's directions, motor performance, and continuous follow-up from Before the teacher.

The third stage: Participation: After all the groups have presented the tasks and duties assigned to them, the groups turn into one group and present ideas, inquiries, and their opinions. Here, the teacher works to crystallize ideas, correct concepts, and establish and deepen the students' correct understanding, by asking questions and presenting ideas. This is done in This stage requires the group students to explain the results based on their previous theories. The teacher intervenes at this stage to move the students to a sound understanding consistent with scientific theories.

The final section: It lasts for ten minutes and consists of relaxing techniques, sauna entry, and a suspenseful water game.

Posttests

After completing the application of the educational units to the members of the two samples (control and experimental), the researcher conducted the final tests on April 4, 2024. The researcher was keen to conduct a reflective thinking test for the students before they entered the swimming pool to conduct the post-tests. The researcher also photographed the students' tests, the 25/m freestyle test, for the purpose of determining the skill tests of this test according to the evaluation form approved by the researcher and presented it to three experts. Each learner's score was calculated using the approved freestyle swimming performance evaluation form by extracting the arithmetic mean.

Statistical Methods

After the researcher conducted the tests and collected the data and for the purpose of analyzing it statistically, the researcher used the ready-made statistical package (SPSS) (v19) to analyze the data and process it statistically.

RESULTS

Table 2. Displays the T value, standard deviation, and arithmetic means for the free swimming technical performance for the experimental and control groups at the post-test.

Variables	Experimental group		Control group		t	Sig	Sig
	Mean	Std. Deviation	Mean	Std. Deviation	valuen	level	type
Body position	12.685	1.742	9.773	2.507	4.6840	0.000	Sig
Leg strikes	13.798	1.663	10.489	1.685	6.751	0.000	Sig
Arm strikes	16.795	2.609	13.368	2.165	4.125	0.000	Sig
Breathing	14.657	2.548	11.110	2.250	3.978	0.000	Sig
Coordination	16.544	1.995	13.593	1.732	5.457	0.000	Sig
Deliberative thinking	67.875	3.542	55.750	3.592	8.956	0.000	Sig

DISCUSSION

When comparing the experimental and control research groups' performance in the free swimming skills (body position, leg strikes, arm strikes, breathing, and compatibility) and looking at the (T) value calculated for each variable under investigation, it is evident that the experimental group performed better than the control group. In particular, the experimental group placed first in the skills (body position, leg strikes, arm strikes, breathing, and coordination). Table (2) makes it evident that there are significant differences in favor of the experimental group. The control group came in second. The researcher attributes the emergence of these results to the application of the Wheatley model according to the cooperative groups, which had a major role in the superiority of the experimental group and the development of the learning process, since learning is this. The model provides the opportunity for all students to learn in small cooperative groups that work to share tasks among everyone, stimulate the learners, give solutions, investigate and explore the learner, and

motivate the learners to stimulate their ideas, each according to their level, reach the correct knowledge, and confirm the correct answers (Yauer & Alfarage, 2021). As well as the emergence of the spirit of participation and positive interaction and the student's appreciation for himself and his colleagues in the cooperative group, as the student's interaction with his colleagues and communication with them gives a clear picture of his awareness, understanding and cooperation (Zaid & Neamah: 2021).

Which increases progress towards achieving one common goal for the learning group together, because the reward is for everyone and not for the student alone, and the positive orientation towards the academic subject, eliminating dependence on the teacher, and relying on themselves with the help of the teacher when needed (Al-Qat, 2000).

This strategy also led to an increase in the competence of the students and increased the students' continuation of performing applied activities, which is represented by the role of the teacher while applying the exercises, correcting errors, giving directions, evaluating the level of performance, moving from one exercise to another (Ali, & Malih, 2022), and linking the skills on a regular basis. In addition to the exercises that improved the students' performance and enabled them to perform the skills stably and smoothly, since the more the exercises and movements given are appropriate and appropriate to the students' level and are characterized by sufficient strength and appropriate speed, the more stable and consistent the performance will be (Rashid & Neamah, 2024).

The educational units prepared by the researcher also contributed to activating reflective thinking by arriving at an integrated picture of the tasks included in the educational units and taking practical steps to transform the picture of the situation into an actual practical application (Abu Dhaheer, 2016).

When preparing the educational units, the researcher intended to direct the students' thinking towards achieving the goals of learning swimming skills according to a clear and accurate scientific methodology that adds a new meaning to the information, knowledge and skills that the students possess (Al-Sahat,2016).

reflective thinking helps the student to acquire many skills in all fields (Al-Khalili, 2015), including the field of mathematical skills. Hashim, (2002) confirms that "learners' ability to perform increases by providing them with individual and collective verbal, visual and motor information directly from the teacher, and that learners learn by looking at other learners, and they perform correctly and correct errors. This provides students with the opportunity to sufficient to express their potential, abilities, and inclinations towards performing skills and exercises through cooperation among themselves (Rashid, 2022)

(Al-Yawar,2021) also confirms that direct education and exercise for learners and verifying information through analysis by learners and investigation helps learners focus on basic and important information and have a good influence through cooperative groups.

From what was shown to us in Table (2), it is clear to us that there are statistically significant differences in the post-tests between the experimental groups and the control group in reflective thinking and learning basic skills in freestyle swimming for students.

Conclusions

The Wheatley model according to cooperative groups has a positive impact on students' reflective thinking. The Wheatley model, according to cooperative groups, has a positive impact on learning the basic skills of freestyle swimming for students. The effectiveness of the educational units prepared by the researcher using the Wheatley model according to the cooperative groups. The steps of the model helped learners correctly understand the information and build a correct cognitive structure through observation and interpretation. The effective role of cooperative groups in learning the basic skills of freestyle swimming.

Recommendations

The researcher recommends the need to use the Wheatley model according to cooperative groups in teaching other age groups free swimming skills.

The researcher recommends the necessity of using the Wheatley model according to cooperative groups in teaching basic skills for different activities and sports such as (basketball - football - volleyball - wrestling – etc). The researcher recommends the need to emphasize students' work in the form of cooperative groups that develop the cognitive and social aspects and correct understanding of information through research and investigation of information through the tasks they

are assigned. The necessity of using the Wheatley model according to small groups to increase the cognitive achievement of learners . The researcher also recommends the necessity of identifying the level of reflective thinking for most groups and ages.

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Conflict of Interest

There is no personal or financial conflict of interest within the scope of the study.

Ethics Committee

This study followed ethical standards and received approval from the Mustansiriyah University Social Sciences Ethics Committee Commission

Author Contributions

Research Design: F.A.Y; Statistical analysis: F.A.Y; Preparation of the article: F.A.Y.; Data Collection- Performed by F.A.Y

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RESEARCH ARTICLE

Enhancing Untrained Football Referees' Strength, Speed, and Endurance through A Mix-training Programme

Erick BURHAEİN*[1], Japhet NDAYİSENGA[2], Carla Cristina Vieira LOURENÇO[3] and, Fidès BANGURAMBONA[2]

[1]Universitas Maarif Nahdlatul Ulama Kebumen, Faculty of Teacher Training and Education, Department of Sports Education, Kebumen / Indonesia
[2]University of Burundi, Department of Physical Education and Sports, Bujurumba / Burundi
[3]Polytechnic University of Viseu, Center for Studies in Education and Innovation, Viseu / Portugal
*Corresponding author: erick.burhaein@umnu.ac.id

Abstract
Given the distance, energy consumption and football referees' physical challenge during matches, it is crucial that their speed, endurance, and strength should be enhanced. It is in this perspective that this One-Group Pretest-Posttest Design quasi-experimental research, aims to (a) validate a mixed-training program to enhance Primus League football referees' speed, endurance, and strength. The research also aims to (b) gather evidence on the program reliability and effectiveness. The sample consisted of 15 Primus League football referees (n=15) who attended a five-week training program with sessions held 3 times per week. During an expert panel, eight Fitness and Vitality Enhancement (FVE) professionals validated the program and later the replicability estimation indicated the training program related tests' high reliability (ICC=0.77). The normality assumption was verified, and the results obtained through paired-sample t test, with related sig.<0.025, indicated that the intervention program effectiveness, except the speed component for which there was not enough evidence of the referees' improvement. With bigger sample sizes, it is recommended that the relation between the referees' age, body mass, and speed be established to shed light on the reason of speed component statistical insignificance.

Keywords
Mix-Training Program, Paired-Sample T Test, Speed, Endurance, Strength, Football Referees

INTRODUCTION

Football referees require specialized training to perform optimally during matches, (Abdula, et al., 2022). There are scientifically evidenced reasons they should train for strength, speed, and endurance as main aspects for which immediate intervention is crucial for untrained Burundian football referees, (Kabadayı, et al., 2021). The existing literature points out that football referees should be trained and best methods to achieve effectiveness in training some of aspects like sprinting and changes of directions, strength, speed, agility, endurance, and cardiovascular fitness, nutrition, and then hydration, (Oybek o'g'li, 2023).

But of those aspects for which football referees should be trained, three have held the world of researchers' attention: the football referees' strength, speed, and endurance, (Kusumah, et al., 2022). Indeed, the existing literature point out that these aspects play a crucial role in ensuring that referees can effectively officiate football match events; but Bouzas-Rico, et al., (2022) focused on the referees' physical fitness. But Castillo, et al., (2016) observed that physical fitness may contribute but cannot be viewed as unique or the most essential factor determining football referees' effectiveness.

To begin, football referees' strength training is very crucial: it is believed that a whole football

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match climax into almost 12 km that a referee covers during a single match, (Aoba, et al., 2011; Barbero-Álvarez, et al., 2012). On the one hand, strength is a fundamental attribute for football referees, (Slack, et al., 2014). Officiating a football match requires a strong physical resilience as sometimes such referees can have recourse to high-speed running, (Brady, et al., 2023). During a match, a referee's physical demands are significant, and strength helps in withstanding match plays. By improving overall strength, referees can better handle the physical challenges they encounter during their duties of officiating football matches, (Weston, et al., 2012; Sarıca, & Gencer, 2024).

On the other hand, research has shown that the referee's strength resilience helps prevent unnecessary Injuries. Strength training enhances stability and reduces the risk of injuries. Referees who engage in exercises targeting strength and stability are less likely to suffer injuries, allowing them to perform better and move more efficiently, (Castillo, et al., 2016).

Although not seemingly directly related, it was scientifically proven that a football referee's strength is statistically significant with control and decision-Making. Recent studies demonstrated how referees' physical fitness significantly influences their decision-making through the match, (Pizzera, et al., 2022; Castillo-Rodríguez, et al., 2023). This brings in an argument that a referee's strength contributes to better control over a match during refereeing. Referees need to exert authority and make split-second decisions.

A strong physical foundation enables them to maintain focus and handle game situations effectively, (Helsen, MacMahon & Spitz, 2019; Samuel, Tenenbaum & Galily, 2021). In their effort to nurture decision-making among football referees, Schweizer, et al., (2011) suggested the use of video as an intervention for those referees; the authors observed that such a method could cultivate referees' intuitive decision-making skills.

As far as football referees' speed training is concerned, there is logical reason for speed training, (Pizzera, et al., 2022). One of the effectiveness of a football refereeing is positioning: for accurate decision that might arise any moment, during a match a football referee needs to be in the right place at the right. So, speed training allows referees to quickly move across the field, which ensures that they have a clear view of player actions and incidents, (Johansen & Erikstad, 2021). That is why speed is crucial for referees to keep up with the game and position themselves optimally. To some level though, positioning and running were found not always to correlated with football referees' accurate decision-making, (Riiser, et al., 2019). There are many other factors affecting accuracy in decision making when refereeing or officiating a match.

Some researchers observed that the football referee's movement pattern resembles that of players "without the ball". They cross the field to stay close to the action, covering approximately the same distance as players. If they would have flows in their speed, this would be a blow on maintaining proximity to the ball possession, thus failing to manage game situations effectively, (Monea, et al., 2019).

Another aspect that is critical for football referees is endurance. Training for football referees on aspects that sustain their endurance is very crucial. It ensures that football referees can consequently maintain their optimal endurance the match as research has shown that a referee runs up to 10,000m through one match, (Reilly and Gregson, 2006). Together with a minimal match duration of 90 minutes, call for their endurance is very recommended. There is test like the Yo-Yo intermittent test level 1 referees' trainers can use to see their performance, (Monea et al., 2019).

As it can be seen, referees have similar workload as players running approximately the same distance as players although in different movement patterns. Understandably then, endurance training prepares football referees to sustain effort through matches, bringing them up to the point of keeping up with play and manage game situations by coordinating speed and endurance, (Blumenstein & Orbach, 2014; Sánchez-García, et al., 2018). Endurance training enable match referees' fatigue management, which ensures that they remain alert and capable of keeping eyes on the game during intense moments.

The main problem is that Burundian football referees officiate matches without any related training either in endurance, speed, and strength. Given how the existing literature linked these aspects with decision-making, one might doubt on the accuracy of decisions made during matches. What is more, an assumption may also nourish an enlightened mind that the cases of repetitive referees' injuries are linked to lack of training on the three aspects mentioned above.

A quick intervention on training football referees in Burundi is very crucial. This research aims at:

Validating a mix-training programme for Burundian football referees;

Testing the developed mix-training programme's effectiveness for Burundian football referees

Based on the research objectives, the guiding question are the following:

How valid and reliable is the mix-training programme for Burundian football referees?

What is the evidence proving the mix-training programme effectiveness for Burundian football referees?

MATERIALS AND METHODS

Participants

The research population is all the academically trained football referees officiating Primus League matches in Burundi football competitions. The non-probabilistic sampling method was used, and the convenience sampling technique allowed us to select only n=15 research sample size of football referees from the Primus League Burundi living in the city of Bujumbura and who take a single bus from their home to the training field, (Dilek, 2022).

This research has met ethical rules. Research ethical approval was obtained Research Ethics Committee with project number 021/REC/2024. Participant provided informed consent, with the volunteer form covering research details, risks, benefits, confidentiality, and participant rights. The research strictly adhered to the ethical principles of the Declaration of Helsinki, prioritizing participant's rights and well-being in design, procedures, and confidentiality measures.

Data collection Instruments

The research instrument consisted of physical test series taken before each Fitness and Vitality Enhancement (FVE) session. So, the data consisted of results from a series of those physical tests carried out at the beginning (pre-test) and at the end of the intervention (post-test). The referees attended the program 3 times a week for 5 weeks.

Research Design and Data Analysis

This is quasi-experimental research with "One-Group Pretest-Posttest Design", (Mertens, 2023). Technically, the design is O X O with:
O: referees' speed, endurance, and strength
X: the mix-training program
O: referees' speed, endurance, and strength after intervention

In this research, referees' speed, endurance, and strength are measured both before and after the mix-training program, the treatment of interest in this study, (Mertens, 2024).

As far as data analysis technique is concerned, the descriptive statistics were used, and the paired-sample t test was computed by the help of RStudio 2024.04.

Physical Test Reliability

The best shot to begin this research result display is about the reliability index. Using the intraclass correlation for the means vectors for the pretest and post-test:

```
> icc_result$value
[1] 0.7749183
```

The item reliability is 0.77, which is higher the conventional cutoff score of 0.7 for reliability index. With the ICC of 0.77, there is an indication of the physical education test replicability .; if the same process of the quasi-experimental research were to be repeated on a sub-sample football match officiating professionals, similar results would be obtained.

Content Validity

The validation process of the mix-training program for the academically trained football referees was done through expert judgement using the Focus Group Discussion (FGD) data collection instrument. Eight (8) experts attended the discussion and the quasi-experimental researchers made presentation about the training content. Based on their expertise in the field, the experts asked questions and suggested improvement of the training content in the very session. The researchers included the expert judgement recommendation and the results of the FGD are tabulated in Table 1 below:

Table 1: Content validity

No	Training Component	Observation after FGD
1	Speed	Valid
2	Endurance	Valid
3	Push -ups	Valid
4	Leg Curl 10KG	Valid
5	Leg Press 45KG	Valid
6	Leg Curl. A/3Min (10KG)	Valid

Table 1 shows that following experts' suggestions for revision during the FGD, all the

mix-training components or content became 'valid'. Since they were validated by experts with renowned experience in physical fitness building intervention for various sports professional categories, the mix-training content were wrapped into this intervention for Primus League match officiating professionals.

Normality Assumption Test

The normality assumption is integrated in the paired t test complete information with lessR RStudio package. It yields out for normality assumption, inference, effect size and two plot, that is, the One-Group and Differences from Equality plots. Given the nature of Physical Test components, mean values are used and not the actual observations. The data used then are the combination of means for the pre-test and post-test on components such SP, END, PUSH LEGCU10K, LEGPRES45K, and LECURLA3M10K.

Below is the normality assumption tested:

H0: The pretest-posttest difference scores is not normally distributed (if p-value < 0.05, accept the H0)

Ha: The pretest-posttest difference scores is normally distributed (if p-value associated with W is ≥ 0.05, there is not enough proof to accept the H0, we assume that the difference scores is normally distributed; we accept the Ha)

The lessR package code line used is:

> ttest(pretest_mean_vector, posttest_mean_vector, data=data, paired=TRUE:

Shapiro-Wilk normality test: W = 0.8054, p-value = 0.066

The p-value is 0.066, which is >0.05; the difference scores between pre-test and post-test follows a univariate normal distribution.

The paired-sample t test

By convention, in paired-sample t tests, the assumption is that H0: μ1 = μ2 (mu or mean of difference =0) and Ha: μ1 ≠ μ2. This means that the alpha is two-tailed (left-tailed, or right-tailed). The cut-off score becomes α/2=0.025. The paired-sample t test for the pairs pre-test and post-test yielded the following output:

RESULTS

Table 2 indicates that the p-values for all the six pairs is >0.025, which results in rejecting the H0 and accepting the Ha: mu ≠0. Except for the speed component that has a mean indicating that mean Speed pre-test > Speed Post-test (the mean difference is positive), other component suggest that the mix-training program was effective. But the speed component should be revisited for further intervention for those football referees. The statistical significance of the endurance and force physical test components are also pictorially highlighted below:

Table 2. Paired-samples t test output

Paired Samples Test									
		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Dev	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	SP_Pre-Post	.45	.17	.045	.35	.54	10.00	14	.000
Pair 2	END_Pre-Post	-4.92	1.19	.30	-5.58	-4.25	-15.97	14	.000
Pair 3	PUSH_Pre-Post	-7.60	4.43	1.14	-10.05	-5.14	-6.63	14	.000
Pair 4	LEGCU10KPre-Post	-32.06	13.23	3.41	-39.39	-24.73	-9.38	14	.000
Pair 5	LEGPRES45K Pre Post	-25.40	7.20	1.86	-29.39	-21.40	-13.64	14	.000
Pair 6	LECURLA3M10K Pre -Post	-90.93	46.00	11.87	-116.41	-65.45	-7.65	14	.000

Given the Figure 1 legend for the pre-test and post-test, all the pairs suggest improvement on the tested component, again except for speed even visually does not indicate much. The most significant is in pair 6, that is, the LEG CURL.A/3MIN (10KG). The post program shows much better improvement. Figure 1 also shows that Pair 4, that is, LEG CURL.C/MIN (10KG), suggests the referees' major improvement on it.

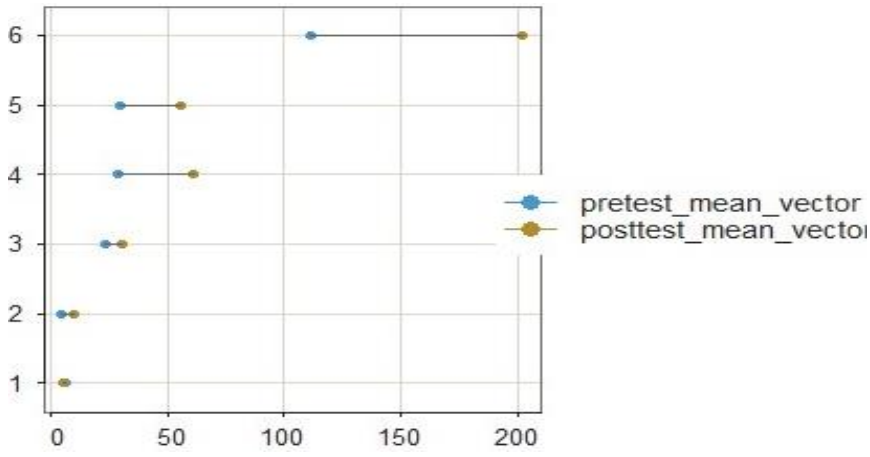

Figure 1. Pre-test and post-test mean vector plot

DISCUSSION

Under this section, the discussion is centered on answering the research questions. The first aspect to cover is the content validity of the program or intervention content and the reliability that physical test administered to foot match officiating professionals. Then there is the overall presentation of the effectiveness of the treatment given the pre-test and post-test scores. To begin, there is evidence of content validity of the mix-training treatment. The eight experts present during expert judgment focus group discussion, after their suggestions were included, they marked the training intervention component as "valid".

Validation of an intervention program in the sports domain is a practice that many researchers find cost effective and reliable. Sum, et al., (2016) got their "physical literacy instrument" validated through expert judgement through experts' panel. During that focus group discussion experts recommended improvements and when all is integrated as they suggested, they validated that instrument for physical education teachers.

Another intervention that got intervention components validated through expert judgement panel is reported in Kholis, et al., (2020), which echoes Van der Veken, et al., (2020). These authors too report community sports programs components that were validated through panels that hosted international experts in the domain required in those programs. Also used expert panel or focus group discussion to validate a tool on sport specialization.

As far reliability is concerned, the intraclass coefficient for the physical sets of tests is ICC= 0.77. This coefficient value is higher than the cutoff score of 0.70 reported in for reliability index. With the ICC of 0.77, there is an indication of the physical education test replicability, (Artero, Espana-Romero, V., Castro-Pinero, Ortega, Suni, Castillo-Garzon, and Ruiz; 2011; Koo & Li, 2016). The reliability of the mix-training program is rather close to Munivrana, et al., (2022) tool's reliability of Alpha=0.76. There is also evidence that the physical test scores satisfy the normality assumption. Given the Shapiro-Wilk normality test, which is accurate for paired-samples with n<30, indicates W = 0.8054, p-value = 0.066. The p-value is 0.066 >0.05 shows that the difference scores between pre-test and post-test follows a univariate normal distribution, (Rejeki, et al., 2023; Basrizal, 2024).

The discussion the aspects of the training validity and reliability brings answer to research question #1 about "How valid and reliable the mix-training program is" given the Burundian football referees' needs. The expert panel used to validate the program or intervention is accurate and the ICC=0.77 is an indicator that repeating the program under similar conditions on a sub-group of football match officiants would yield similar results. Equally, the normality assumption was verified and the p-value 0.066>0.05, indicating that the difference scores between pre-test and post-test follows a univariate normal distribution.

To draw conclusion on the overall effectiveness of the treatment or mix-training program, we analysis results of the paired-sample t test. For this intervention, pairs p-value is compared to the two-tailed (left-tailed, or right-tailed) conventional $\alpha/2=0.025$, (Rulismi, Sahil & Dali, 2024). All the six pairs are sig.<0.025, which allows us to reject the H_0 and accepting the H_a (mu $\neq 0$). Rather, there is improvement on the tested components.

Given the different Pre-test score mean-post-test score mean that is positive, this signifies insignificant threshold on the "Speed" component. Similarly, some components about decision-making training in football umpires were found statistically insignificant in Kittel, Elsworthy & Spittle (2019). In this training program for referees, only the speed component is controversial (Samarein, Samanipour, Asjodi, Shokati, Fallahi, Brownlee & Oliveira, 2023), others were statistically significant. Although referees need to move quickly to keep up with the play, especially during counterattacks or fast breaks, (Castagna, Bizzini, M., Póvoas, Schenk, Büsser & D'Ottavio, 2019), speed was not significantly improved probably due to parameters like age and body mass of the referees, which echoes.

The fact that all the sig. values are less than 0.025 (p-value<0.025) sheds light on the answer to the research question "What is the evidence proving the mix-training program effectiveness for Burundian football referees?" There is enough evidence that the mix-training program was effective give the difference between the pre-test and post-test scores.

Other research, with the intervention was mostly effective on the components LEG CURL.A/3MIN (10KG) and LEG CURL.C/MIN (10KG), which suggests the football referees' major improvement on these two as the post-test means are almost double of the pre-test scores. The overall effectiveness of this training program for football match officiants indicates that football referees need physical training of this kind, (Nathan, 2016; Kabadayı, Yılmaz & Bostancı, 2021).

To conclude, it should be noted that the mix-training program designed to enhance Primus League football referees' speed, endurance, and strength was successful. Validated by experts in the domain of Fitness and Vitality Enhancement (FVE), the intervention was not only found reliable, but its effectiveness was also verified. The football match officiating professionals' endurance and strength improved, which was evidenced by the statistical significance of related paired-samples t test. The speed component, although statistically significant has a mean that shows not difference between speed related pre-test and post test scores, which casts doubt on the effectiveness of this component of the intervention. Given such a conclusive remark, it is recommended that further research be carried out with wider samples and that there be established the relation between the referees' age, body mass, and speed.

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Conflict of Interest

We declare that the article we have written is not involved in any conflict of interest.

Ethics Statement

This research has met ethical rules. Research ethical approval was obtained Research Ethics Committee with project number 021/REC/2024.

Author Contributions

Study design: EB & JN; Data collection: JN & FB; Statistical analysis; EB, JN; Data interpretation; EB, JN & CCVL; Literature search; EB & JN. All authors have read and approved the published version of the manuscript.

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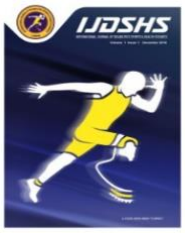

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RESEARCH ARTICLE

Social Interaction Skills Collaboration Model of Autism Spectrum Disorder: Bibliometric Analysis in Publication 2013-2023

Diajeng Tyas Pinru PHYTANZA[*1,2], Edi PURWANTA[2] and Hermanto HERMANTO[3]

[1]Education Science Study Program, Postgraduate Program, Universitas Negeri Yogyakarta / Indonesia
[2]Special Education, Faculty of Education and Psychology, Universitas Negeri Yogyakarta / Indonesia
[3]Guidance and Counseling, Faculty of Education and Psychology, Universitas Negeri Yogyakarta / Indonesia
*Corresponding author: diajengtyas.2021@student.uny.ac.id

Abstract
This study aims to determine the development of scientific publication trends related to collaboration models on social interaction skills of children with autism spectrum disorders in the range of 2013 - 2023 in Crossref, PubMed and Scopus indexed scientific publications. This research focused on the following questions: (1) how is the productivity of publications? (2) what thematic areas are of most interest to academics? (3) future study opportunities that still need further research. This research uses a bibliometric analysis approach. The visualization process is supported using VOSviewer software. There are 1000 scientific publication articles in the range of 2013 - 2023. Scientific publications are dominated in the form of: (1) book; (2) book chapter; (3) journal article; (4) posted content and (5) proceedings. In the keyword density visualization section, it is presented into 6 clusters, namely: (1) asd; (2) child; (3) behavior; (4) autism spectrum disorder; (5) adult and (6) adolescent. Mapping related to the development of publication trends provides information for future study opportunities that are still rarely carried out further research such as: (1) social support, (2) life satisfaction, (3) pcit (parent child interaction therapy), (4) role, (5) differential diagnosis and (6) neurodevelopmental disorder.

Keywords
Autism Spectrum Disorder, Bibliometric, Model, Social Interaction Skill

INTRODUCTION

The ideal timeframe for child growth and development is determined by a multitude of factors, encompassing both internal and external influences. This intricate process renders children susceptible to a variety of health issues that may arise during their growth journey. One of these is the appearance of neurological problems in the brain, which cause the development of interaction, communication, and behaviour to be hampered. This condition is known as autism spectrum disorder (ASD) (Hernawan et al., 2018). Autism is a neurodevelopmental disorder characterized by difficulties in processing information, particularly in the areas of language comprehension, communication, and sensory integration. People with autism often struggle to understand and express themselves using verbal and non-verbal communication. In addition, they may face challenges in organizing and processing auditory and visual stimuli, which can affect their ability to learn and engage with the world around them effectively. Individuals with autism commonly exhibit repetitive motor (Siegel, 1996) The causes of ASD are multifactorial, i.e. the presence of genetic factors and the presence of influential environmental factors (Article Ganaie & Ganaie, 2014). It is an early childhood issue that has a substantial impact on social interaction, communication skills, and behaviour development. The disorder, which creates stereotyped habits, interests, and activities, frequently manifests itself before reaching the age of 3 (American Psychiatric Association, 2013). The disease impairs an individual's ability to engage with others in socially

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acceptable ways. People with autism spectrum disorder (ASD) face both direct and indirect social interaction challenges. Socialisation issues, regardless of cognitive or language abilities, are a key source of impairment for individual (Volkmar et al., 2015). People with ASD struggle with a variety of different social issues, such as relationships with other people, language standards, and communication (Ranjan et al., 2022). Autistic people have an array of signs and symptoms, the degree of severity, cognitive decline, and clinical issues (López & Lópe, 2016). Adolescents with ASD face a variety of social challenges, involving issues with speaking, language standards, and interactions with others (Ranjan et al., 2022). Individuals with ASD have difficulty developing appropriate social skills and may miss out on opportunities for good peer interactions; group training is a viable remedy (Ranjan et al., 2022). Furthermore, considering the growing recognition of ASD in infants with typical cognitive skills (Croen et al., 2002). Children diagnosed with ASD exhibit the ability to read words, although they may encounter challenges in direct verbal communication with their peers. Some common difficulties include a limited capacity to respond when called by their name, a lack of eye contact or gestures, an inability to spontaneously smile at others, and a tendency to not say goodbye unless prompted to do so. These communication hurdles can be observed in children with ASD, highlighting the unique social and linguistic characteristics associated with this disorder.

Scientific publications related to ASDP The publication of scientific articles has historically been the main means of communication for researchers and academics (Cho, 2017). An approach that can be used to measure the quality of scientific publications and also to evaluate them can be done with bibliometric methods (Ibrahim, 2019). Bibliometrics is a quantitative analysis of written documents, these documents are scientific publications. The use of bibliometric analysis can assist in providing an overview of the research field and relationships with other studies. Bibliometrics can represent the quality of a study through the type of research, distribution of research results, statistical analysis of total research results, and others. The statistical examination of books, journals, scientific publications, and authors is known as bibliometrics. The basic and first metrics for such statistical analysis include word frequency analysis, citation analysis, or the number of author publications. Bibliometric indicators are calculated over time (often 3-5 years) and generally employ two approaches: the number of publications, which reflects production, and the number of citations, which measures the effect of the articles generated (Devos, 2011). In some countries, for example the UK, bibliometrics is used as an acceptable and valid measure of research quality (Adams, 2009). This is because bibliometric analysis is comprehensive across science, engineering, technology and mathematics disciplines and all higher education institutions. Furthermore, it is known to be robust and reliable when applied at the level of broad groups of research fields, and is able (at a broad level of aggregation) to identify high quality research. At the global level, this kind of research has been commonly conducted such as the recent trends in global scientific publications (Kim et al., 2018). Kim et al., (2018) in their study reviewed the presentation of recent trends in innovative global scientific journal distribution and publication platforms, with implications for local journals.

Bibliometric analysis can be done with the help of VOSviewer software. VOSviewer is programme that allows you to create maps based on network data and then visualise and explore them. The algorithm system run in this program is similar to Multi Dimentional Scaling (MDS). VOSviewer's clusters are automatically coloured and presented on the map. The clustering algorithm employs a parameter that can be adjusted to produce more or fewer clusters. VOSviewer can display cluster density and colour (Leydesdorff & Rafols, 2012). The programme combines text mining capabilities to discover noun phrase combinations relevant to the mapping and an integrated clustering approach to investigate data co-citation and co-occurrence networks, which gives VOSViewer an advantage over other analysis software (van Eck & Waltman, 2009). Although there are many programs for analyzing text units and similarity matrices, the advantage of VOSviewer is in its visualization.

MATERIALS AND METHODS

To obtain metadata in this study, researchers used phrases in the Crossref, PubMed and Scopus databases in the 2013–2023 time span on August 31, 2023. Based on the thawing, 1000 indexed publications were obtained. The data analysis procedure is shown in Figure 1.

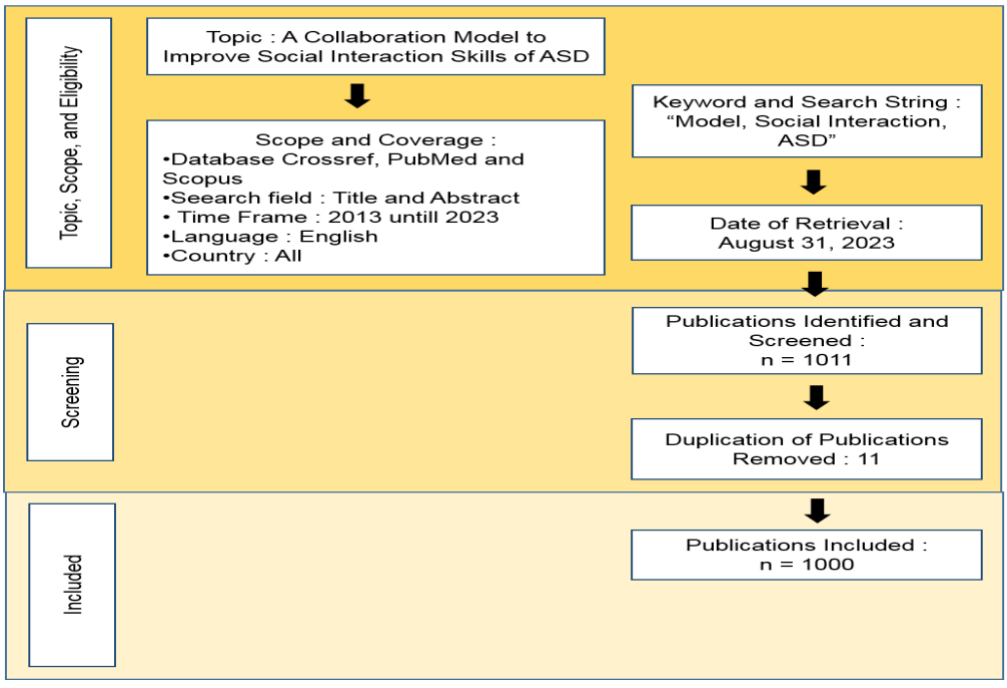

Figure 1. Article metadata search design

In this study, bibliometric analysis is used, bibliometric analysis is used through publication mapping and keyword co-occurrence analysis, a type of shared word analysis (Donthu et al., 2021). The application of keyword co-occurrence analysis is carried out to find publication trends and track themes or topics that appear in a publication using predetermined keywords. This study analyzed the number of documents in terms of document type and language, publication trends in the keywords "model, social interaction, ASD" from 2013 to 2023, and the top 10 citations. In presenting the data visualization, the researcher was assisted by using VOSviewer software previously developed at Leiden University. The parameters in the VOSviewer software used by researchers are presented in Table 1.

Table 1. VOSviewer parameters were employed in the analysis

Item	Characteristic/Value
Type of analysis	Co-occurrence analysis, co-occurrence maps by on text data
Unit of analysis	All Keywords
Counting method	Full counting
Layout:	
Attraction	2 (default setting)
Repulsion	0 (default setting)
Clustering	
Resolution parameter (detail of clustering)	1 (default setting)
Minimum cluster size [N]	1 (default setting)
Visualization:	
Scale	1.00
Weights	Occurrences
Labels size	0.50
Maximum number of lines	1000

Source: Researcher Data

RESULTS

Scientific publications play a crucial role in enhancing research quality and providing guidance to researchers in academia. It is essential to explore the progress and themes of research on collaboration models to enhance social interaction skills in children displaying symptoms of autism spectrum disorder (ASD). To achieve this, bibliometric analysis was employed in this study to examine the development and trends of research in collaboration models aiming to improve social interaction skills in individuals with ASD. According to Siegel, one of the academics who wrote about autism, autism classified as a processing disorder, hinders an individual's ability to comprehend and utilize language effectively, as well as organize information received through hearing and sight, this condition is often accompanied by repetitive physical movements, a strong inclination towards adhering to routines and maintaining uniformity, and exceedingly limited social skills (Siegel, 1996). Primarily observed in childhood, autism significantly impacts the development of crucial aspects such as social interaction, communication proficiency, and behavioral patterns (American Psychiatric Association, 2013). People with autism tend to exhibit fixed and repetitive habits, interests, and activities. Moreover, their capability to engage with others in socially acceptable manners becomes compromised due to the challenges they face in social interaction (Volkmar et al., 2015). It is important to note that such difficulties in social interaction have both direct and indirect repercussions for individuals diagnosed with autism spectrum disorder (ASD). Socialization difficulties pose a significant hindrance for individuals with ASD, irrespective of their cognitive or language abilities. To accurately evaluate the caliber of a study, the implementation of bibliometric analysis proves invaluable. This analytical approach not only gauges the quality of research but also explores facets such as research type, dissemination of findings, statistical scrutiny of collective research outcomes, and more. Bibliometrics, encompassing the statistical assessment of books, journals, scientific articles, and authors, serves as a valuable tool in this process. Metrics such as word frequency analysis, citation analysis, and the quantification of author articles form the foundational bedrock for conducting a comprehensive statistical analysis in this field.

In this study, researchers focus on analyzing the variables of model, social interaction, and autism spectrum disorder. These variables serve as the key factors for conducting a bibliometric analysis. Using VOSviewer visualization, it is evident that the keywords "model," "social interaction," and "autism spectrum disorder" are closely interconnected. This visualization highlights the fact that these specific keywords are significant components that have been extensively explored and discussed in various scientific publications. Therefore, researchers want to analyze scientific publications with the keyword's "model", "social interaction", and "autism spectrum disorder" in the range of 2013 to 2023 indexed by Crossref, PubMed and Scopus. The focus of researchers in this article are: (1) how is the productivity of publications with the keywords "model, social interaction, ASD", (2) what thematic areas are most interested by academics with the keywords "model, social interaction, ASD", and (3) future study opportunities with the keywords "model, social interaction, ASD". In searching for scientific publications, researchers are assisted by using Publish or Perish software. The results of the analysis obtained 1000 scientific publications which were then further analyzed to produce visualizations with the help of VOSviewer software.

The Development of Publication with keywords "model, social interaction, ASD"

The development of scientific publications using the keywords "model, social interaction, ASD" from 2013 to 2023 recorded 1000 scientific publications. The keywords model, social interaction and ASD are interrelated keywords seen from the results of VOSviewer visualization, the results of VOSviewer visualization of the relationship between these keywords can be seen in Figure 2.

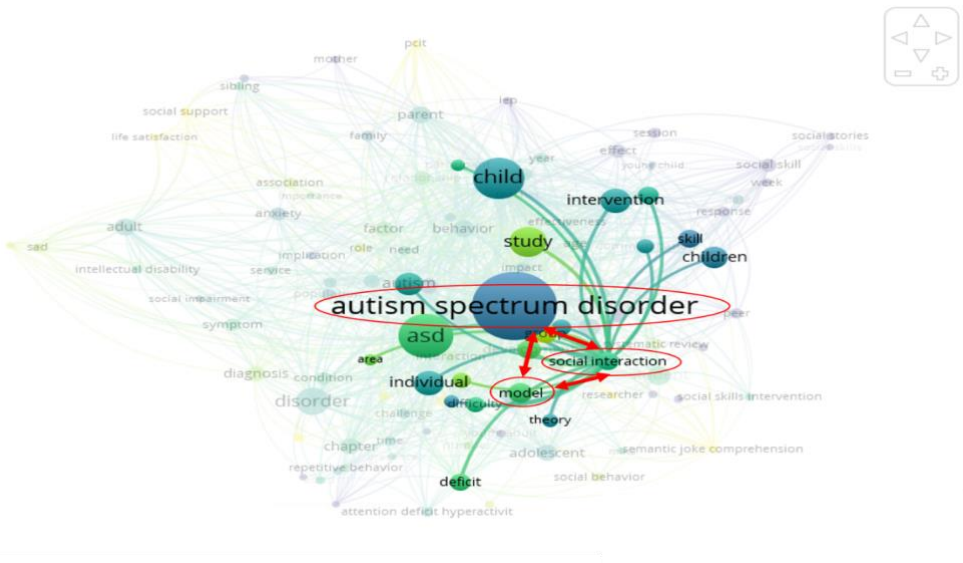

Figure 2. The connection between the keywords model, ASD and social interaction

Based on Figure 2, it can be seen that the keyword with the largest circle, namely "autism spectrum disorder" is the keyword that appears the most of all existing keywords. That has meaning that the model related to social interaction in autism spectrum disorder is a research object in the range of 2013 to 2023 Data on the development of publications with the keywords "model, social interaction, ASD" is shown in Figure.

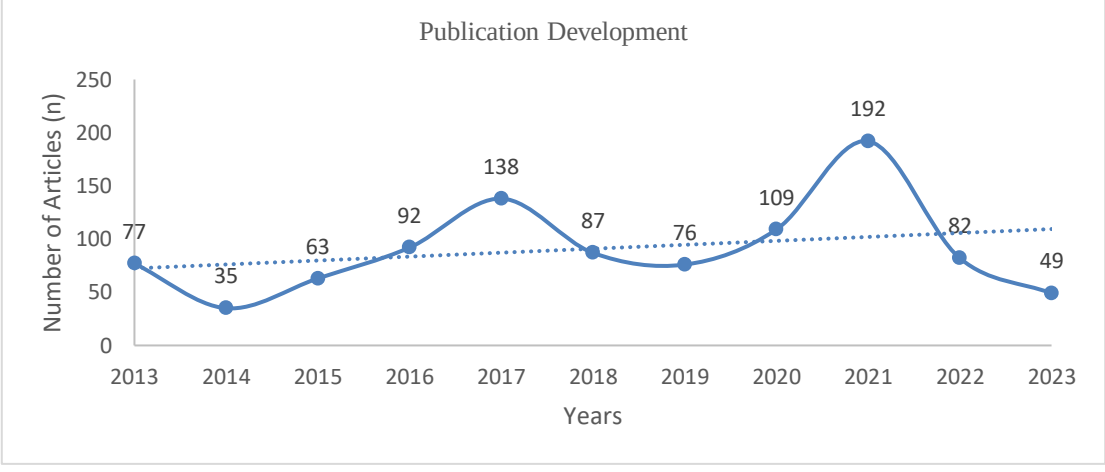

Figure 3. The publication development with keyword “model, social interaction, ASD” from 2013 to 2023

The development of scientific publications with the keywords "model, social interaction, ASD" from 2013 to 2023 experienced changes in the number of publications each year. In 2013 there were 77 scientific article publications, in 2014 there were 35 scientific article publications, then experienced an increase from 2015 to 2017, with 138 scientific article publications in 2017. In 2018 it decreased to 87 publications of scientific articles, in 2019 there were 76 publications. Publications increased again in 2020 and 2021, with the highest number of publications in the last 10 years occurring in 2021 with 192 publications of scientific articles. In 2021, there was a significant increase in the publication of scientific articles with the keywords "model, social interaction, ASD", this condition is possible because 2021 is the Covid-19 pandemic period, where all activities in various fields are affected, including in the field of education. Many academics are trying to analyze the best learning model so that learning continues during social distancing and almost all activities are carried out online. This condition resulted in the publication of many scientific articles related to learning models. The number of publications decreased in 2022 with 82 publications, and finally

in 2023 there were 49 publications of scientific articles. Of the 1000 scientific publications analyzed, there are several types of research designs used. The types of scientific publications with the keywords "model, social interaction, ASD" are shown in Figure 4.

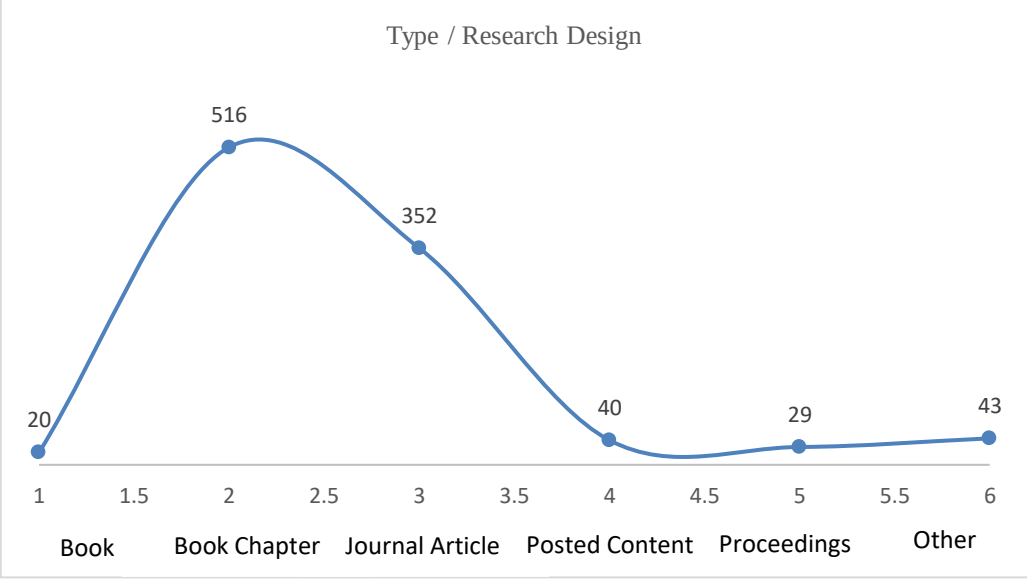

Figure 4. Type/ research design with keyword "model, social interaction, ASD" from 2013 to 2023

There are several types of publications from 1000 scientific publications indexed in the Crossref, PubMed and Scopus databases in the 2013 - 2023 timeframe. There are 20 books, 516 with the type of book chapter and being the most types of publications, 352 journal articles, 40 posted content, 29 in the form of proceedings and 43 others which are divided into 6 data sets, 1 edited book, 1 monograph, 11 peer reviews and 6 reports.

Thematic Trends on Scientific Publications with Keywords "model, social interaction, ASD"

Based on the keyword co-occurrence analysis on 1000 scientific publications, 102 keywords were found and resulted in 6 clusters that appeared from the visualization results of the VOSviewer software. These clusters form a thematic and intersect with other clusters. Cluster 1 (red) related to ASD, cluster 2 (green) related to child, cluster 3 (dark blue) related to behavior, cluster 4 (yellow) related to autism spectrum disorder, cluster 5 (purple) related to adult and finally cluster 6 (light blue) related to adolescent. More detailed occurrences of shared keywords are shown in Table 2.

Table 2. High-Frequency Keyword Group

Cluster	Number of Keywords (items)	Keyword
Cluster 1/ ASD	36	(1) Abstract, (2) adhd, (3) area, (4) asd, (5) attention deficit hyperactivity disorder, (6) autism, (7) autism spectrum, (8) chalenge, (9) time (10) chapter, (11) characteristic, (12) condition, (13) deficit, (14) development, (15) diagnosis, (16) difference, (17) differential diagnosis, (18) difficulty, (19) disorder, (20) dsm, (21) emotion dysregulation, (22) individual, (23) interaction, (24) interest, (25) life, (26) model, (27) mouse model, (28) neurodevelopmental disorder, (29) number, (30) person, (31) presence, (32) prevalence, (33) repetitive behavior, (34) social behavior, (35) social communication, (36) social interaction.
Cluster 2/ child	18	(1) Children, (2) communication, (3) data, (4) effect, (5) effectiveness, (6) iep, (7) intervention, (8) peer, (9) program, (10) response, (11) session, (12) skil, (13) social skill, (15) social stories, (16) teacher, (17) treatment, (18) young child

Cluster behavior	3/	19	(1) Anxiety, (2) association, (3) depressive symptom, (4) evidence, (5) factor, (6) family, (7) implication, (8) importance, (9) life satisfaction, (10) mother, (11) need, (12) parent, (13) pcit, (14) population, (15) quality, (16) relationship, (17) role, (18) sibling, (19) social support
Cluster autism spectrum disorder	4/	15	(1) Assessment, (2) impact, (3) practice, (4) research, (5) researcher (6) review, (7) school, (8) socail, (9) social cognition, (10) social skill intervention, (11) student, (12) study, (13) systematic review, (14) young adult, (15) youth
Cluster 5/ adult		8	(1) Autistic adult, (2) intellectual disabilty, (3) participant, (4) sad, (5) service, (6) social impairment, (7) symptom, (8) use
Cluster adolescent	6/	6	(1) Ability, (2) age, (3) group, (4) mind, (5) semantic joke comprehension, (6) theory

Based on the visualization shown in Figure 5, there are 6 clusters with different colors that become thematic trends in scientific publications, this analysis uses the occurrence of shared keywords. The first cluster (red circle) is more dominant to ASD. ASD refers to autism spectrum disorder, ASD is an autistic spectrum disorder or a group of conditions, some more severe than others, that are also known as autism and influence the growth of interpersonal and communication abilities, as well as an individual's behaviours and passions. The keyword of ASD associated with 36 other keywords similar to what is shown in Table 2. In the 2nd cluster (green color circle) is more dominant to child. A child is a boy or girl during birth until reached the age of adulthood, or a son or daughter of any age. In accordance with theory, autism spectrum disorder symptoms are childhood symptoms that have a substantial influence on interpersonal relationships and communication development and usually appear before the age of three (American Psychiatric Association, 2013).

The visualization of the co-occurrence network of high frequency keywords with the keywords "model, social interaction, ASD" is shown in Figure 5.

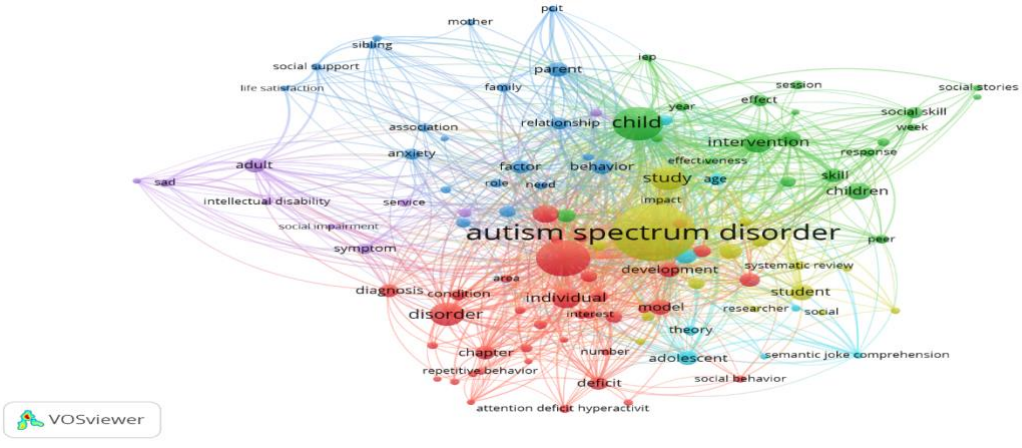

Figure 5. Visualization of high-frequency keyword co-occurrence network with keywords "model, social interaction, ASD"

Based on the visualization shown in Figure 5, there are 6 clusters with different colors that become thematic trends in scientific publications, this analysis uses the occurrence of shared keywords. The first cluster (red circle) is more dominant to ASD. ASD refers to autism spectrum disorder, ASD is an autistic spectrum disorder or a group of conditions, some more severe than others, that are also known as autism and influence the growth of interpersonal and communication abilities, as well as an individual's behaviours and passions. The keyword of ASD associated with 36 other keywords similar to what is shown in Table 2. In the 2nd cluster (green color circle) is more dominant to child. A child is a boy or girl during birth until reached the age of adulthood, or a son or daughter of any age. In accordance with theory, autism spectrum disorder symptoms are childhood symptoms that have a substantial influence on interpersonal relationships and communication development and usually appear before the age of three (American Psychiatric Association, 2013). Based on Tabel 2, the keyword of child associated with 18 other keywords. In cluster 3 (dark blue

circle), behavior is dominant. Behavior is the way that someone behaves. Autism-related symptoms are very closely related to behavior, based on the theory put forward by the American Psychiatric Association (APA) autism symptoms are closely related to the development of social interaction, communication skills, and behavior (American Psychiatric Association, 2013). The behavior of children with autism symptoms is very different from children in general who are the same age. The keyword of behavior associated with 19 other keywords. In the 4th cluster (yellow circle) is dominant to autism spectrum disorder. This keyword appeared twice and became a thematic trend based on the visualization of VOSviewer software. The keyword autism spectrum disorder is the keyword with the largest keyword circle, thus concluding that the keyword autism spectrum disorder is the keyword that appears most used in scientific publications in the range 2013 to 2023 in the discussion of this article. autism is a behavioral symptom in children that is often encountered, and this condition is indeed interesting for academics to conduct further research. Autism spectrum disorder symptoms impair a person's ability to interact socially with others. People with Autism Spectrum Disorder (ASD) face both direct and indirect consequences due to difficulty with social contact. Socialisation issues, regardless of cognitive or language abilities, are a key source of disability for people with ASD (Volkmar et al., 2015). The keyword of autism spectrum disorder associated with 15 other keywords. The last cluster (light blue circle) is dominated by the keyword adolescent. Adolescent is a young person who is developing into an adult. It is undeniable that the symptoms of autism spectrum disorder are closely related to adolescence. although the initial symptoms in autism spectrum disorder mostly begin at the age of under three years, many people only realize when the child grows up. In accordance with the theory expressed by (World Health Organization) WHO that they will be very weak when interacting socially with the community. Adolescence is the age when a child must interact socially with their peers or society in a broad sense someone with autism spectrum disorder symptoms will find it difficult to develop their social skills, joining a group can be the best solution to train their social skills (Ranjan et al., 2022).The keyword of adolescent associated with 6 other keywords. Keywords that are connected to cluster keywords, are keywords that appear together in a scientific publication, which indicates that these interrelated keywords become variables in the study. by looking at the keyword co-occurence can provide valuable information for researchers or academics. researchers can conduct further analysis of the keywords visualized by VOSviewer.

Publication Opportunities with Keywords "model, social interaction, ASD"

To provide an overview of opportunities for future research themes, the researcher conducted an analysis with the help of VOSviewer software to produce a visualization of color differences that indicate old and new research themes. The visualization for future research is shown in Figure 6.

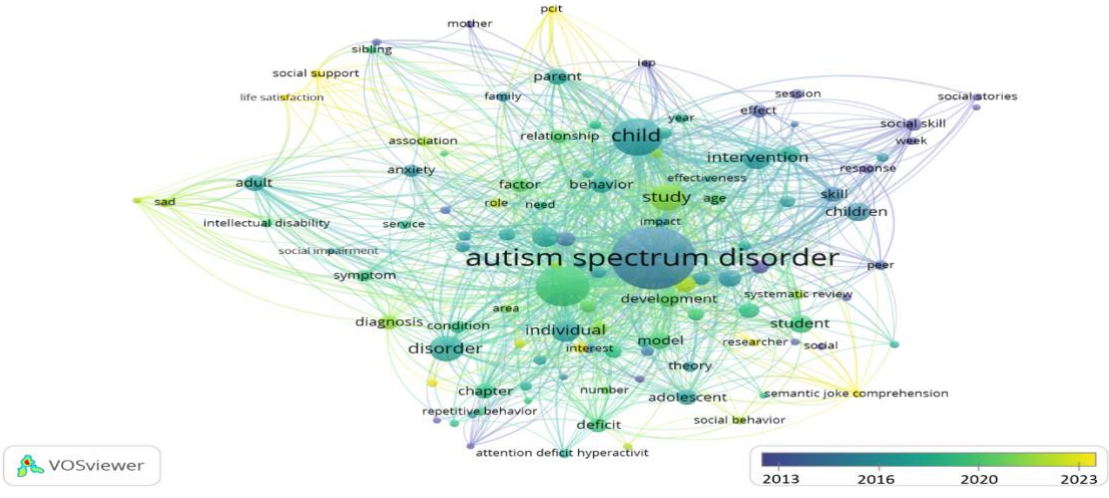

Figure 6. Analysis of Future Research Possibilities Using Overlay Visualisation

Based on the visualization results in Figure 6, there are at least 3 different colors for each keyword. The different colors on the keywords indicate different meanings. The purple color indicates scientific publications with a longer time, the change in the transition of green to yellow indicates newer scientific publications. This color-coding helps highlight the progression and relevance of research trends over time, making it easier to identify emerging areas of interest. Additionally, the visualization provides insight into shifts in focus, indicating how certain keywords have evolved or remained consistent across various publication periods.

DISCUSSION

This analysis aims to gain a deeper understanding of the development of collaborative models in improving social interaction skills in individuals with Autism Spectrum Disorder (ASD) over the past decade. Based on bibliometrics, there has been an increase in publications discussing this topic, with a peak occurring during the COVID-19 pandemic. Research on social intervention models in ASD has been highlighted due to the need to adapt education and therapy centered on social interaction in online environments. This shows the importance of developing effective social intervention methods to support the development of social skills in individuals with ASD, both inside and outside the context of formal education.

Findings from the VOSviewer visualization indicate that the keywords "model", "social interaction", and "ASD" are three main components that are interrelated in the scientific publications analyzed. This relationship indicates a consistent academic interest in intervention models that focus on improving social skills for individuals with ASD. In addition, cluster analysis obtained from bibliometric data highlights various thematic aspects, such as behavior, children, adolescents, and adults, that shape trends in this research. Each cluster reflects a broader understanding of how social interaction models are developed for different age groups, from children to adults with ASD.

Based on the results of this study, there are several research opportunities that can be explored further, including social support, life satisfaction, and parent-child interaction therapy (PCIT). These themes are still rarely discussed in the context of ASD, but have great potential in the development of more inclusive and responsive social interaction models. Thus, future research can enrich collaborative intervention models that holistically support individuals with ASD in various aspects of life, especially in social skills which are their main challenges.

Figure 6 shows that the keyword "autism spectrum disorder" has the largest circle which indicates that research with this keyword has been done a lot, this keyword has a purple circle which indicates that research related to autism spectrum disorder is an older research. Keywords with small circles and yellow color are research that is still rarely done and the latest. Some keywords that are still rarely done by researchers include: (1) social support, social support entails feeling cared for by others and having a trusted network to go to in ordinary or emergencies (Cobo-Rendón et al., 2020). Researchers can conduct further analysis related to the relationship between social support and ASD, for example the Influence of Social Support Network on the Subjective Wellbeing of Children with Autism Spectrum Disorder or can also use experiments or other research methods; (2) life satisfaction, life satisfaction meaning in life and hope are some of the most essential aspects influencing a person's feelings and sentiments in dangerous situations (Karataş et al., 2021). Researchers can conduct further research on the correlation between life satisfaction in adolescents with autism spectrum disorders, or a model that can increase life satisfaction in someone with ASD; (3) pcit (parent child interaction therapy), parent-child interaction therapy (PCIT) is a low-cost, short-term treatment technique that focuses on interactions between parents and children and tries to improve child behaviour (Ulaş et al., 2023). PCIT (Parent Child Interaction Therapy), is a therapy that can be done to improve children with ASD, researchers can experiment with the PCIT model and the impact on ASD or use other appropriate methods; (4) role, role is the position or purpose that someone or something has in a situation, organization, society, or relationship. Researchers can conduct further research related to roles and ASD, as done by (Niken Baghiroh et al., 2020) conducting research related to Role of Government Service for Autism Spectrum Disorder (ASD) Children; (5) differential diagnosis, differential diagnosis is an amount of difference a judgment about what a particular illness or problem is. Researchers can conduct

further research related to differential diagnosis of Autism Spectrum Disorders such as learning disabilities, ADHD and social communication disorders; and (6) neurodevelopmental disorder, neurodeelopmental disorders are disorders that are found in the development of nerves, so that they can affect the performance of activity in the nerves (Lee et al., 2023).

Researchers also tried to conduct further analysis by looking at the relationship between keywords. When the cursor is hovered over one of the keywords, the VOSviewer visualization will associate it with other related keywords. However, some keywords are not related when the cursor is directed at one of the keywords. We think this is a gap and an opportunity for future research themes by combining unrelated keywords. For example, Figure 7 shows one possible future research theme.

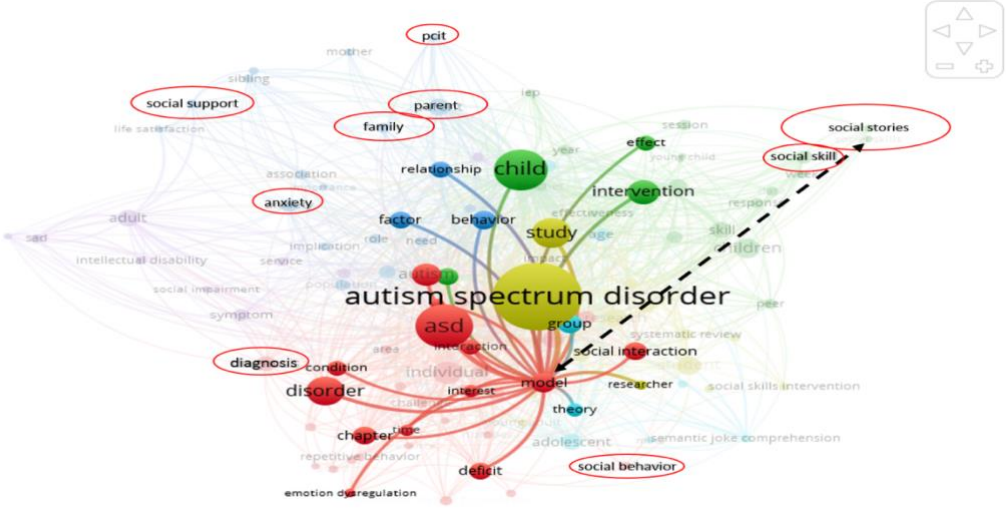

Figure 7. Further Research Opportunities between “model” and “social stories”

Researchers chose the keyword "model" for analysis. In Figure 7, shown in the black dotted line, we can see that the keyword "model" is not related to the keyword "social support". This condition allows for further investigation. In addition to the keyword "social support". There are several keywords that are still not related to the keyword "model", some of these keywords such as: (1) social skill, social skill is an ability to do an activity or job well activities in which you meet and spend time with other people (O’Shea S, 2012); (2) pcit (parent child interaction therapy, (3) parent, parent is a mother or father of a person or someone who looks after a person in the same way that a parent does (O’Shea S, 2012); (4) family, family is a group of people who are related to each other, such as a mother, a father, and their children (O’Shea S, 2012) (5) social support, (6) anxiety, anxiety is an uncomfortable feeling of nervousness or worry about something that is happening or might happen in the future (O’Shea S, 2012); (7) diagnosis, diagnosis is a judgment about what a particular illness or problem is, made after examining it (O’Shea S, 2012) and (8) social behavior, social behavior is the way that someone behaves in which you meet and spend time with other people (O’Shea S, 2012). This condition is an opening for further research. Researchers can develop or conduct other research methods according to keywords that are still rarely carried out by research or collaborate between keywords that are not yet related.

Conclusion

During the period from 2013 to 2023, an extensive analysis of the collaboration model aimed at enhancing the social interaction skills of individuals with Autism Spectrum Disorder (ASD) was conducted. The results of this study reveal that a significant number of scientific publications, precisely 1000, were indexed in renowned databases such as Crossref, PubMed, and Scopus. These findings shed light on the growing interest and extensive research efforts dedicated. The most scientific publications occurred in 2021 with a total of 192 publications, the types of publications were dominated in the form of (1) books; (2) book chapters; (3) journal articles; (4) posted content and (5) procedding. Thematic trends based on VOSviewer output are related to (1) asd; (2) child; (3) behavior; (4) autism spectrum disorder; (5) adult and (6) adolescent. Bibliometric analysis in the

form of mapping provides information related to publication development patterns, with these findings providing information for further research that is still rarely researched such as: (1) social support, (2) life satisfaction, (3) pcit (parent child interaction therapy), (4) role, (5) differential diagnosis, and (6) neurodevelopmental disorder.

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Conflict of Interest

We declare that the article we have written is not involved in any conflict of interest.

Ethics Statement

This research has met ethical rules. Research ethical approval was obtained Ethical Approval with number 1566/EC/KEPK/IX/2024.

Author Contributions

Study design, DTPP, EP, and H; Data collection, DTPP; Statistical analysis, DTPP; Data interpretation, DTPP; Literature search, DTPP. All authors have read and approved the published version of the manuscript.

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RESEARCH ARTICLE

Offensive Performance Indicators: A Comparative Study of Winning, Drawing, and Losing Teams in the 2023 Malaysia Super League

Mohamad Nizam NAZARUDIN[*1], Regi Dwi SEPTIAN[2], Norlaila Azura KOSNI[3] and Ahmad Bisyri Husin Musawi MALIK[4]

[1]Universiti Kebangsaan Malaysia, Faculty of Education, Selangor / Malaysia
[2]Universitas Pendidikan Indonesia, Faculty of Sport and Health Education, Bandung / Indonesia
[3]Universiti Teknologi Mara, Faculty of Sport and Recreation, Pahang / Malaysia
[4]National Defence Universiti of Malaysia, Defence Fitness Academy, Kuala Lumpur / Malaysia
*Corresponding author: mohdnizam@ukm.edu.my

Abstract
This study aimed to identify significant differences in offensive performance metrics among winning, drawing, and losing teams in the 2023 Malaysia Super League (MSL) season. Data were collected from 91 matches during the MSL football league using the InStat® system. The analysed variables included set pieces, corners, free kicks, penalties, and shooting. The results showed that winning teams had discriminative offensive performance indicators such as set pieces with shots (4.48±2.17), % set pieces with shots (17.10±8.58), corners (5.90±3.16), corners with shots (2.05±1.63), % corners with shots (36.56±27.49), free kicks with shots (0.76±0.89), % free kicks with shots (22.02±27.49), penalties (0.30±0.58), penalties converted (0.26±0.52), % penalties converted (21.11±40.35), shots (16.53±6.08), shots on target (6.97±3.35), % shots on target (42.18±13.58), shots from outside the penalty area (7.16±3.41), shots from outside the penalty area on target (2.20±1.65), and % shots from outside the penalty area on target (30.68±21.07). In contrast, drawing teams had higher mean values in set pieces (28.67±5.87) and free kicks (4.34±2.21). In conclusion, these findings have practical implications for coaches in planning and implementing offensive tactics for successful performance. Future research could explore the impact of different tactical approaches and formations on match outcomes and analyse the effectiveness of in-match tactical adjustments.

Keywords
Malaysia, Offensive, Game-Related Statistics, Football, Performance

INTRODUCTION

In recent decades, the field of game analysis has progressively concentrated on the identification and quantification of functional information that optimally enhances both individual athlete and overall team performance (Castellano & Pic, 2019; Glazier, 2010; James, 2006). Performance indicators, which are a set of factors selected and combined to highlight specific aspects of performance, play a crucial role in achieving success in athletics (Lago-Peñas & Lago-Ballesteros, 2011). In contemporary sports, the use of statistical and machine learning models in football game analysis is growing, aiding researchers and practitioners in gaining a deeper understanding of game performance and its key influencing events (e.g., goals, scoring, fouls, etc.), thus altering the pathway to success (Liu et al., 2021).

These indicators provide critical insights into the tactical and technical demands characteristic of contemporary sports (Cullinane et al., 2024). For assessing physical abilities, key indicators include various kinematic data such as total distance traveled, distance covered at different speeds, and accelerations/decelerations (Rohyana & Adawiyah, 2018; Modric et al., 2021; De Albuquerque Freire et

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al., 2022; Phytanza et al., 2023). Evaluating tactical skills often involves measuring the coordination between players, team coordination before crucial events, and the interaction and cohesion between teams, typically using compactness coefficients (Memmert et al., 2017).

Professional soccer coaches prepare their players to execute a distinct style of play, strategically tailored to counter the specific tactics of their opponents in each match. A style of play is defined as the collective behavior of a team, oriented towards accomplishing offensive and defensive objectives within the game (Fernandez-Navarro et al., 2016). This approach encompasses the movement of players and the ball, player interactions, and considerations of speed, time, and spatial dynamics (Hewitt et al., 2016). Notably, match status plays a substantial role in shaping a team's style of play (Paixao et al., 2015; Fernandez-Navarro et al., 2018); This strategic behavior has been highlighted in various studies, including Lago and Martín (2007), who found that trailing teams increase their offensive play, and Bloomfield et al., (2005), who noted that leading teams frequently adopt defensive measures to secure their position

A comprehensive understanding of how contextual variables impact offensive performance in soccer is essential for coaches seeking to refine their teams' tactical strategies and optimize preparations for competitive play. Recent studies have shown that factors such as match location, team ranking, and opposition quality significantly influence a team's attacking style during matches. For instance, González-Rodenas et al., (2021) highlight that these variables impact not only the type of offensive plays employed but also their effectiveness. Teams often adjust between combinative, direct, fast, or counterattacking styles depending on these situational contexts

Furthermore, Lago-Ballesteros and Lago-Peñas (2022) explore how a team's adaptation to these contextual variables can define their tactical behavior throughout a season. By analyzing patterns of attack and defense across various contexts, teams can better identify which strategies are most effective in particular match situations. This approach can provide a foundation for tactical adaptability, allowing teams to respond dynamically to changes in game scenarios.

Despite limited research on the tactical patterns of offensive play in football teams across both individual matches and entire seasons (Gómez et al., 2018; Wang et al., 2015), existing studies have identified diverse attacking strategies employed at various points within and across games. These investigations revealed that certain offensive patterns were more prevalent than others; however, they predominantly focused on passing behaviors without integrating additional variables. Moreover, analyses were limited to single teams per match, overlooking interactions with opponents.

To ascertain the factors contributing to success in football, it is essential to develop performance metrics that distinguish victorious teams from their counterparts (Lepschy et al., 2018). Research consistently highlights that technical attributes significantly differentiate winning from losing teams (Lago-Peñas et al., 2010; Castellano et al., 2012; Zhou et al., 2018). For instance, Das et al., (2022), examining the 2019-2020 and 2020-2021 seasons of the Hero Indian Super League (ISL), identified key indicators such as shots on target, crosses, red cards, and corner kicks as critical success factors. Winning teams demonstrated higher frequencies of shots and shots on target compared to losing teams. Similarly, Kubayi and Toriola (2020) found that variables including goals scored, total shots, shots on target, fouls, offsides, yellow cards, and red cards were significant performance indicators associated with winning teams. In contrast, losing teams exhibited higher averages in total passes, accurate passes, corner kicks, and ball possession.

Further, González-Ródenas et al., (2021) established that winning teams were more likely to utilize counterattacks and direct attacks, rather than combinative play. The study also indicated that during the second half, teams favored counterattacks as a progression method over combinative attacks. Mohamad Zaki et al., (2014), examining goal-related, offense-related, and defense-related variables across eight randomly selected games from the 2012 season, reported a notable distinction in shots on goal between winning and losing teams, reinforcing the critical role of offensive actions in determining match outcomes.

Analyzing attacking indicators like shot locations, counterattacks, and penalty box entries is crucial for understanding football dynamics and improving team performance. Recent studies indicate that counterattacks significantly enhance scoring opportunities by exploiting defensive imbalances, especially compared to slower, positional plays. For example, González-Rodenas et

al., (2021) and Liu et al., (2023) show that successful teams utilize rapid transitions and accurate shot placement, which are key differentiators in high-level matches. Nevertheless, comprehensive studies that integrate these indicators to differentiate between winning, drawing, and losing outcomes in the MSL remain scarce. Existing research often focuses on isolated metrics without considering the interplay between different attacking actions and their contextual importance (Castellano et al., 2012). This gap in the literature underscores the need for a holistic approach to analysing attacking performance. Therefore, this research aims to uncover significant differences in offensive performance metrics among winning, drawing, and losing teams in the 2023 Malaysia Super League season. By examining set pieces, corners, free kicks, penalties, shooting, passing, attacks, penalty area actions, and their correlation with match outcomes, we seek to deepen the understanding of offensive tactics in the MSL. This insight can enable coaches, players, commentators, and fans to appreciate the nuances of offensive play and its impact on success in the league.

MATERIALS AND METHODS

In this study, we examined offensive performance indicators of teams in the 2023 Malaysia Super League (MSL) season to identify differences among winning, drawing, and losing teams.

Research Design

The research followed a structured approach using both descriptive and inferential statistical analyses to assess offensive indicators across different match outcomes. The process began with data collection and proceeded through descriptive statistics and normality tests (Nuggraha et al., 2024). A one-way repeated measures ANOVA was conducted to analyze significant differences among groups, with Tukey's HSD post-hoc tests administered as applicable (Pa et al., 2024).Below Figure 1 is a simplified flowchart of the research design:

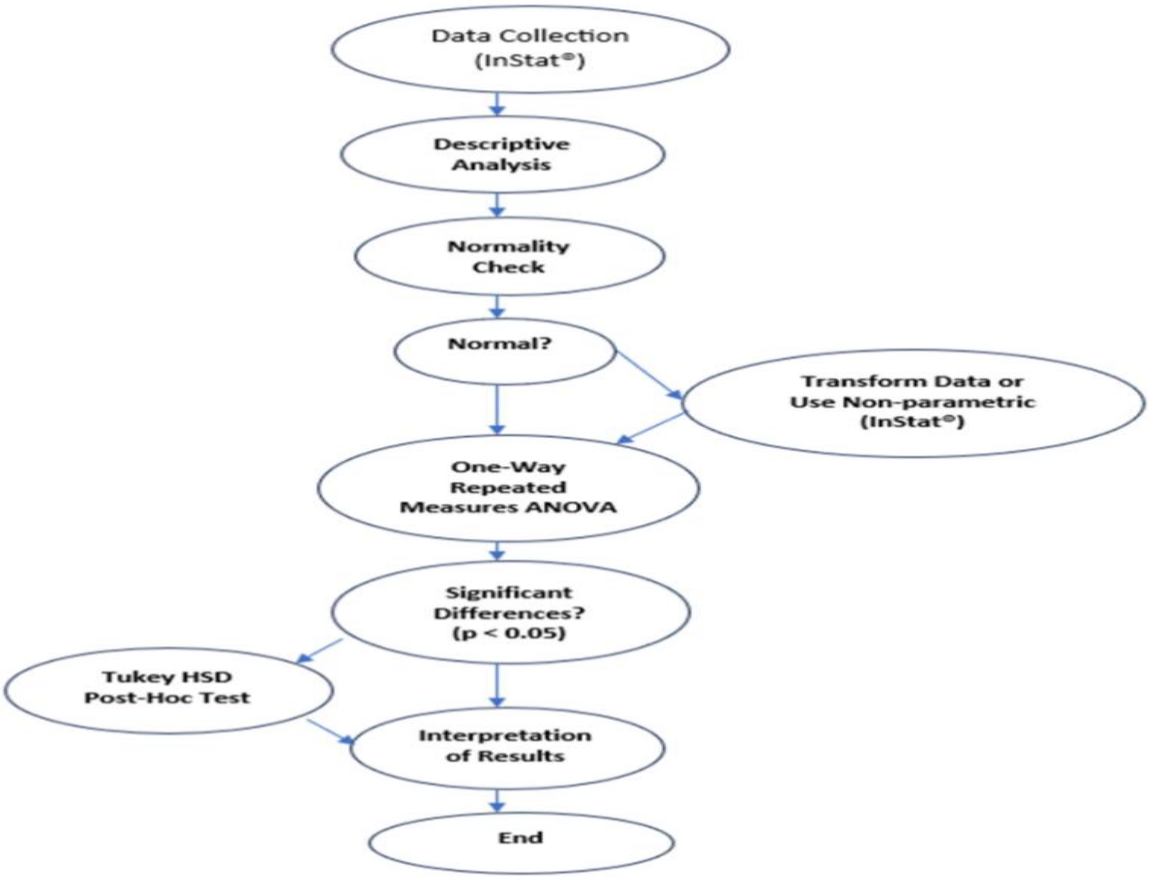

Figure 1. Research flowchart

Participants

The study analyzed data from 14 teams that participated in the 2023 MSL season, encompassing a total of 91 matches. These teams represented diverse competitive levels within the league, offering a broad view of performance metrics across various match outcomes. This sample provides insight into the range of offensive capabilities and strategies employed in the MSL.

Ethical Statement

The research was conducted in strict adherence to ethical standards, prioritizing the safety and welfare of all participants throughout the study's design and implementation phases. Measures were diligently taken to ensure data confidentiality. Authorization to conduct this research was granted by the Ministry of Education, Culture, Research, and Technology, Universitas Pendidikan Indonesia (reference number: 1329/UN40.A6/KP/2024). Informed written consent was obtained from all participants, who were provided with a consent form detailing the study's procedures, potential risks and benefits, data confidentiality protocols, and their rights as participants.

Instruments

Performance data were gathered using InStat®, a globally recognized platform that provides comprehensive analytics on physical, technical, and tactical aspects of team sports (Nazarudin et al., 2024). This platform was selected due to its reliability and extensive use among professional teams in sports such as football, basketball, and handball (Kubayi & Toriola, 2020; Abdul Rahim et al., 2023). In total, 18 technical indicators were analyzed, focusing on set pieces, corners, free kicks, penalties, and shooting. InStat® ensures data consistency and accuracy, which is crucial for performance evaluation at this level.

Procedures

Data collection involved several key steps. Offensive performance metrics for each match were retrieved from the InStat® system. The selected indicators were categorized under set pieces, corners, free kicks, penalties, and shooting to facilitate a focused analysis of offensive actions. Basic descriptive statistics were calculated for all indicators to establish a general overview of offensive performance across the sample matches. The normality of the data was assessed to confirm the appropriateness of conducting parametric tests. This step was essential to ensure the reliability of the subsequent inferential analyses. To assess significant differences among winning, drawing, and losing teams, a one-way repeated measures ANOVA was conducted using SPSS Version 28. For instances where p-values fell below the 0.05 significance threshold, Tukey HSD post-hoc tests were employed to identify and analyze specific inter-group differences.

Data Analysis

The data analysis phase of this study underscores the critical role of offensive performance indicators in differentiating between winning, drawing, and losing teams. Descriptive statistics offered a snapshot of metrics like set pieces and shooting accuracy, revealing how these factors contribute to scoring opportunities. Inferential analysis using one-way ANOVA showed that the percentage of set pieces resulting in shots significantly differed among match outcomes, with winning teams exhibiting greater efficiency (Husain et al., 2022; Tan & Wang, 2024). These findings underscore that successful teams not only create more offensive opportunities but also execute them with precision, which is critical for achieving favorable results (Wright & Hirotsu, 2023).

RESULTS

Set-Piece

Table 1 indicates that the One-Way ANOVA revealed significant differences between match outcomes in several set piece indicators, namely in set pieces ($F_{2,361} = 3.336$, $p < .037$, $\eta^2 = 0.018$), set pieces with shots ($F_{2,361} = 13.75$, $p < .000$, $\eta^2 = 0.071$) and % set pieces with shots ($F_{2,361} = 21.23$, $p < .000$, $\eta^2 = 0.105$). The mean number of set pieces shows a statistically significant variation across the three groups (winning, drawing, and losing teams), evidenced by a p-value of 0.037, which is below the 0.05 threshold for significance. The eta-squared value of 0.018 indicates a small effect size. Among the groups, drawing teams exhibit a slightly higher mean for set pieces compared to both winning and losing teams. Furthermore, the mean number of set pieces leading to shots differs significantly among the three groups, with a p-value of 0.000, well below the 0.05 level, indicating a highly significant difference.

Table 1. Differences between winning, drawing, and losing for a set piece

Indicator	Win		Draw		Lose		F (2,361)	Sig.	Eta-squared (η2)
	Mean	SD	Mean	SD	Mean	SD			
Set pieces	26.780	5.608	28.672	5.874	28.053	5.320	3.336	0.037	0.018
Set pieces with shots	4.480	2.173	3.906	2.060	3.153	2.270	13.750	0.000	0.071
% Set pieces with shots	17.107	8.586	13.622	6.482	11.176	7.735	21.230	0.000	0.105

The eta-squared value of 0.071 suggests a moderate effect size, and winning teams have a significantly higher mean value for set pieces with shots compared to drawing and losing teams. Additionally, the mean percentage of set pieces resulting in shots significantly differs across the three groups, with a p-value of 0.000, underscoring a highly significant variation. The eta-squared value of 0.105 suggests a moderate to large effect size, with winning teams displaying a notably higher mean percentage of set pieces leading to shots compared to drawing and losing teams.

Corners

Table 2 reveals that the One-Way ANOVA showed significant differences between match outcomes in several set-piece indicators: corners ($F_{2,361} = 16.262$, $p < .000$, $\eta 2 = 0.083$), corners with shots ($F_{2,361} = 15.148$, $p < .000$, $\eta 2 = 0.077$), and percentage of corners with shots ($F_{2,361} = 3.744$, $p < .025$, $\eta 2 = 0.02$).

Table 2. Differences between winning, drawing, and losing for corners

Indicator	Win		Draw		Lose		F (2,361)	Sig.	Eta-squared (η2)
	Mean	SD	Mean	SD	Mean	SD			
Corners	5.900	3.164	4.594	2.832	3.953	2.865	16.262	0.000	0.083
Corners with shots	2.053	1.633	1.516	1.309	1.140	1.280	15.148	0.000	0.077
% Corners with shots	36.562	27.499	29.738	24.344	28.161	28.694	3.744	0.025	0.020

The analysis reveals a statistically significant difference in the mean number of corners among winning, drawing, and losing teams, as evidenced by a p-value of 0.000, indicating a highly significant distinction. The eta-squared value of 0.083 denotes a moderate effect size, with winning teams exhibiting a significantly higher mean number of corners compared to drawing and losing teams, suggesting that winning teams tend to secure more corners during matches.

Similarly, the mean number of corners that lead to shots significantly differs among the three groups, with a p-value of 0.000, underscoring a highly significant difference. The eta-squared value of 0.077 indicates a moderate effect size, with winning teams achieving a markedly higher mean in corners resulting in shots, thereby demonstrating greater effectiveness in converting corner kicks into scoring opportunities. Furthermore, a significant difference is observed in the mean percentage of corners resulting in shots across winning, drawing, and losing teams, with a p-value of 0.025, indicating a statistically significant variation.

The eta-squared value of 0.020 suggests a small effect size for this variable. Although the difference here is less pronounced than for previous indicators, winning teams still display a higher mean percentage of corners that result in shots, in comparison to both drawing and losing teams.

Free Kicks

Table 3 shows significant differences among winning, drawing, and losing teams for the number of free kicks, with drawing teams having the highest mean (4.344) compared to winning (3.407) and losing (3.720) teams ($F(2,361) = 4.057$, $p = 0.018$, $\eta^2 = 0.022$). However, there are no significant differences in the mean number of free kicks resulting in shots ($F(2,361) = 0.060$, $p = 0.942$, $\eta^2 = 0.000$) or the percentage of free kicks resulting in shots ($F(2,361) = 1.024$, $p = 0.360$, $\eta^2 = 0.006$), indicating similar efficiency in converting free kicks into shots across all teams.

The mean number of free kicks is significantly different among winning, drawing, and losing teams, with a p-value of 0.018, which is less than 0.05, indicating a significant difference. The eta-squared value of 0.022 suggests a small effect size. Drawing teams have a significantly higher mean value for free kicks compared to winning and losing teams, indicating that drawing teams tend to earn more free kicks during matches. However, there is no significant difference in the mean number of free kicks resulting in shots among the three groups, as the p-value of 0.942 is greater than 0.05, indicating no significant difference. The eta-squared value of 0.000 suggests no effect size, meaning that all teams have a similar mean value for free kicks resulting in shots.

Additionally, there is no significant difference in the mean percentage of free kicks resulting in shots among the three groups, with a p-value of 0.360, which is greater than 0.05, indicating no significant difference. The eta-squared value of 0.006 suggests a very small effect size, indicating that the percentage of free kicks resulting in shots is similar across all teams.

Table 3. Differences between winning, drawing, and losing for free kicks

Indicator	Win		Draw		Lose		F (2,361)	Sig.	Eta-squared (η2)
	Mean	SD	Mean	SD	Mean	SD			
Free kicks	3.407	2.208	4.344	2.213	3.720	2.202	4.057	0.018	0.022
Free kicks with shots	0.767	0.893	0.766	0.886	0.733	0.910	0.060	0.942	0.000
% Free kicks with shots	22.022	27.497	17.892	23.698	18.371	22.823	1.024	0.360	0.006

Penalties

Table 4 shows that the One-Way ANOVA revealed significant differences between match outcomes in several set-piece indicators: penalties ($F_{2,361} = 6.371$, $p < .002$, $\eta 2 = 0.034$), penalties converted ($F_{2,361} = 7.181$, $p < .001$, $\eta 2 = 0.038$), and percentage of penalties converted ($F_{2,361} = 5.839$, $p < .003$, $\eta 2 = 0.031$).

Table 4. Differences between winning, drawing, and losing for penalty

Indicator	Win		Draw		Lose		F (2,361)	Sig.	Eta-squared (η2)
	Mean	SD	Mean	SD	Mean	SD			
Penalties	0.300	0.588	0.172	0.420	0.107	0.350	6.371	0.002	0.034
Penalties converted	0.260	0.524	0.125	0.333	0.087	0.282	7.181	0.001	0.038
% Penalties converted	21.111	40.350	11.719	31.801	8.000	26.597	5.839	0.003	0.031

The mean number of penalties significantly differs among winning, drawing, and losing teams, with a p-value of 0.002, which is less than 0.05, indicating a significant difference. The eta-squared value of 0.034 suggests a small to moderate effect size. Winning teams have a significantly higher mean value for penalties compared to drawing and losing teams, indicating that winning teams tend to earn more penalties during matches. Additionally, the mean number of penalties converted is significantly different among the three groups, with a p-value of 0.001, which is less than 0.05, indicating a significant difference. The eta-squared value of 0.038 suggests a small to moderate effect size, and winning teams have a significantly higher mean value for penalties converted compared to drawing and losing teams, highlighting their efficiency in converting penalties into goals.

Furthermore, the mean percentage of penalties converted significantly differs among winning, drawing, and losing teams, with a p-value of 0.003, which is less than 0.05, indicating a significant difference. The eta-squared value of 0.031 suggests a small to moderate effect size, and winning teams have a significantly higher mean percentage of penalties converted compared to drawing and losing teams.

Shooting

Table 5 shows that a One-way ANOVA revealed significant differences between match outcomes in several shot indicators: shots ($F_{2,361} = 63.333$, $p < .000$, $\eta 2 = 0.26$), shots on target ($F_{2,361} = 98.29$, $p < .000$, $\eta 2 = 0.353$), percentage of shots on target ($F_{2,361} = 24.754$, $p < .000$, $\eta 2 = 0.121$), shots from outside the penalty area ($F_{2,361} = 16.294$, $p < .000$, $\eta 2 = 0.083$), shots from outside the penalty area on target ($F_{2,361} = 19.74$, $p < .000$, $\eta 2 = 0.099$), and percentage of shots from outside the penalty area on target ($F_{2,361} = 3.562$, $p < .029$, $\eta 2 = 0.019$).

Table 5. Differences between winning, drawing, and losing for shooting

Indicator	Win		Draw		Lose		F (2,361)	Sig.	Eta-squared η2
	Mean	SD	Mean	SD	Mean	SD			
Shots	16.533	6.080	12.406	4.471	9.713	4.672	63.333	0.000	0.260
Shots on target	6.973	3.352	3.781	2.051	2.807	1.958	98.290	0.000	0.353
% Shots on target	42.186	13.589	31.506	15.755	29.465	18.775	24.754	0.000	0.121
Shots from outside penalty area	7.160	3.412	6.141	3.299	5.087	2.780	16.294	0.000	0.083
Shots from outside penalty area on target	2.207	1.656	1.531	1.391	1.193	1.121	19.740	0.000	0.099
% Shots from outside penalty area on target	30.681	21.073	26.481	25.774	23.698	22.972	3.562	0.029	0.019

The mean number of shots is significantly different among winning, drawing, and losing teams, with a p-value of 0.000 indicating a highly significant difference. The eta-squared value of 0.260 suggests a large effect size, showing that winning teams have a significantly higher mean value for shots compared to drawing and losing teams. This indicates that winning teams are more aggressive and generate more shooting opportunities. Similarly, the mean number of shots on target also differs significantly among the three groups, with a p-value of 0.000 indicating a very significant difference. The eta-squared value of 0.353 suggests a large effect size, highlighting that winning teams have a significantly higher mean value for shots on target compared to drawing and losing teams, emphasizing their superior accuracy and efficiency.

Additionally, the mean percentage of shots on target is significantly different among winning, drawing, and losing teams. The p-value of 0.000 is highly significant, and the eta-squared value of 0.121 suggests a moderate effect size. This indicates that winning teams have a higher mean percentage of shots on target, reflecting their better shot accuracy and conversion rate. The mean number of shots from outside the penalty area also shows significant differences among the three groups, with a p-value of 0.000 indicating a significant difference and an eta-squared value of 0.083 suggesting a moderate effect size. Winning teams have a higher mean value for shots from outside the penalty area, demonstrating their willingness to take long-range shots.

Furthermore, the mean percentage of shots from outside the penalty area on target is significantly different among the three groups, with a p-value of 0.029 indicating a significant difference. The eta-squared value of 0.019 suggests a small effect size, showing that winning teams have a higher mean percentage of shots from outside the penalty area on target, reflecting their accuracy in long-range shooting.

DISCUSSION

Set Piece

The observed significant difference in the number of set pieces among winning, drawing, and losing teams, with drawing teams demonstrating slightly higher mean values, highlights the strategic importance of set pieces in contemporary football. According to Lago-Peñas et al., (2018), set pieces account for a considerable proportion of goals in professional football, making them crucial for match strategy. However, the higher mean value for drawing teams suggests that merely earning set pieces does not guarantee success. Instead, the

effectiveness of these set pieces in creating scoring opportunities is more critical, as evidenced by the subsequent indicators.

Winning teams exhibit a significantly higher mean number of set pieces resulting in shots compared to drawing and losing teams. This finding aligns with Casal et al., (2019), who observed that successful teams demonstrate greater efficiency in converting set pieces into both shots and goals. The ability to capitalize on set pieces can be attributed to better execution, strategic positioning, and player skills, reflecting the importance of coaching and practice. Winning teams' superior performance in this area underscores the need for precision and effectiveness in set-piece situations, often a decisive factor in closely contested matches.

The percentage of set pieces resulting in shots further highlights the effectiveness of winning teams in utilizing set pieces. Winning teams' significantly higher mean percentage indicates that they are not only earning set pieces but also converting a substantial proportion into scoring opportunities. This efficiency can be linked to contemporary theories on game intelligence and decision-making. Memmert et al., (2019) discuss the role of tactical intelligence and decision-making in football, suggesting that players' ability to make quick, effective decisions during set pieces is crucial for success. The higher percentage for winning teams may reflect better decision-making and execution during these critical moments.

Research by Dios et al., (2017) highlights that set pieces account for a significant proportion of goals scored in professional football, underscoring their importance in determining match outcomes. As Maneiro et al., (2021) point out, successful teams have well-rehearsed set-piece routines that maximize scoring chances. Set pieces, including free kicks, corners, and throw-ins, are essential to football strategy, providing structured scoring opportunities and bypassing the complexities of open play.

Corner

Winning teams' higher mean number of corners suggests a more aggressive and attacking style of play. This finding is consistent with studies by Lago-Peñas et al., (2018), which emphasize the role of set pieces in creating scoring opportunities. Teams that earn more corners are likely to generate more chances to score, increasing their likelihood of winning matches. The higher mean number of corners resulting in shots for winning teams indicates their efficiency in set-piece execution. Casal et al., (2019) found that successful teams are more effective in converting set pieces into shots and goals. This efficiency reflects better preparation, strategic planning, and player skills, suggesting that winning teams have a tactical advantage in set-piece situations.

The higher percentage of corners resulting in shots for winning teams, although with a smaller effect size, underscores their ability to maximize scoring opportunities from set pieces. This efficiency can be linked to game intelligence and decision-making theories, such as those proposed by Memmert et al., (2019). Effective decision-making and execution during set pieces can provide a decisive edge in closely contested matches. These findings are consistent with current theoretical frameworks in sports science and football performance. Specifically, the concept of "match dominance," as discussed by Sarmento et al., (2020), highlights the importance of exerting control over various game elements, including set pieces.

Winning teams' superior performance in corners and their conversion aligns with this theory, reflecting their overall dominance in matches. Additionally, the theory of "situational efficiency" (Ademović et al., 2024) highlights the importance of efficiency in specific game scenarios, such as set pieces. The significant differences observed support this theory, indicating that effective use of corners is a key determinant of match outcomes.

Free Kick

The significant variation in the number of free kicks among winning, drawing, and losing teams, with drawing teams earning the highest mean, suggests that drawing teams may engage in a style of play that induces more fouls from their opponents. This tendency could be attributed to a more aggressive or possession-oriented approach that compels opposing teams to commit defensive errors. However, the absence of significant differences in both the number of free kicks resulting in shots and the percentage of free kicks leading to shots across the three groups implies that teams exhibit comparable levels of efficiency in converting free kicks into scoring opportunities. This finding is consistent with the idea that while earning free kicks can provide tactical advantages, the conversion efficiency of these set pieces into shots or goals does not vary significantly among teams.

The results align with contemporary theories in sports science that emphasize situational efficiency and tactical intelligence. According to Ademović et al., (2024), situational efficiency particularly in set pieces can be a critical determinant of match outcomes. Despite the differences in the number of free kicks, the similar conversion rates across teams suggest that situational efficiency in free kicks is uniformly distributed.

For coaches and practitioners, these results underscore the importance of not only earning free kicks but also focusing on the efficiency of converting these opportunities into shots or goals. Training should therefore include not just strategies to earn free kicks but also drills to improve the effectiveness of free kick executions. This dual focus can provide a competitive edge by maximizing the potential of set pieces.

Penalties

Winning teams have a significantly higher mean number of penalties compared to drawing and losing teams, aligning with recent research emphasizing the tactical advantage provided by earning penalties. Penalties are critical scoring opportunities, and teams that can draw fouls within the penalty area are more likely to score, thus increasing their chances of winning matches. This result suggests that winning teams may adopt more aggressive or skillful play that leads to defenders committing fouls. The higher mean number of penalties converted by winning teams indicates their efficiency in capitalizing on these crucial opportunities. This efficiency can be attributed to better preparation, composure, and skill in penalty situations. Studies such as those by Özdemir, (2019) highlight the psychological aspects of penalty-taking, noting that successful teams often have players with higher confidence and better mental preparation for high-pressure situations.

The substantially higher mean percentage of penalties successfully converted by winning teams highlights their enhanced proficiency in capitalizing on these scoring opportunities. This finding supports theories on situational efficiency in football, as discussed by Ademović et al., (2024). Winning teams' higher conversion rates indicate not only technical proficiency but also effective mental strategies and decision-making under pressure. These findings can be related to contemporary theories in sports science, such as game intelligence and situational efficiency. The ability to earn and convert penalties effectively reflects a combination of tactical acumen, technical skill, and psychological readiness. Memmert et al., (2019) discuss the importance of decision-making and game intelligence, suggesting that players who can anticipate and react appropriately in high-stakes situations, such as penalties, contribute significantly to their team's success.

For coaches and practitioners, these results emphasize the importance of both earning and converting penalties. Training should focus not only on tactics to draw fouls within the penalty area but also on improving players' penalty-taking skills and psychological preparation. Drills that simulate high-pressure penalty situations can help players develop the composure and confidence needed to succeed.

Shooting

Winning teams' significantly higher mean values for shots and shots on target underscore their aggressive attacking style and superior shooting efficiency. This is consistent with the findings of Liu et al., (2020), who emphasized that higher shot volume and accuracy are critical determinants of match success in professional football. Winning teams' ability to generate more shooting opportunities and maintain a high accuracy rate contributes significantly to their success. The higher percentage of shots on target for winning teams highlights their proficiency in converting shooting opportunities into scoring chances. This aligns with the work of Hughes and Franks (2019), who identified shot accuracy as a key performance indicator in football. Teams that can consistently place a higher percentage of their shots on target are more likely to score goals and win matches.

Winning teams' greater number of shots from outside the penalty area indicates their willingness to attempt long-range efforts. This strategic choice can be advantageous, as it diversifies attacking options and puts pressure on the opposing defense. According to Gómez et al., (2018), successful teams often exploit long-range shots to catch goalkeepers off guard and create scoring opportunities from unexpected positions. The significantly higher mean values for shots from outside the penalty area on target for winning teams reflect their accuracy and confidence in taking long-range shots. This finding supports the theory of situational efficiency discussed by Ademović et al., (2024), which emphasizes the importance of executing specific actions effectively under varying game conditions.

Winning teams' ability to accurately target long-range shots enhances their overall attacking threat.

These findings align with contemporary theories in sports performance analysis, such as game intelligence and tactical decision-making. The ability to generate and accurately convert shots, particularly from long-range, reflects advanced game intelligence and decision-making skills. Memmert et al., (2019) highlighted the importance of tactical intelligence in football, suggesting that successful teams possess a higher level of situational awareness and decision-making proficiency. Theories in performance analysis suggest that effective shot-taking is critical for match success. Van Roy et al., (2021) asserts that the quantity and quality of shots are crucial indicators of a team's offensive effectiveness.

For coaches and practitioners, these results emphasize the importance of developing both shot volume and accuracy. Training should focus on enhancing players' shooting skills, particularly in maintaining accuracy under pressure and from various distances. Drills that simulate match conditions and encourage long-range shooting can help players develop the confidence and proficiency needed to capitalize on scoring opportunities.

Conclusion

This study underscores the pivotal role of offensive performance metrics in distinguishing between winning, drawing, and losing teams within the Malaysia Super League. Winning teams consistently demonstrated superior efficiency in converting set pieces, corners, and penalties into shots and goals, underscoring the importance of precision in set-piece execution. These findings align with existing research that emphasizes the tactical advantage of effective set-piece routines (Casal et al., 2015; Memmert et al., 2019) and the role of situational efficiency in match success (Ademović et al., 2024). Additionally, the significantly higher shot volumes and accuracy rates observed among winning teams reflect a more aggressive and accurate shooting approach, supporting the idea that shot quality and frequency are vital to match outcomes (Liu et al., 2021; Hughes & Franks, 2005).

These insights provide practical guidance for coaches and analysts seeking to optimize offensive strategies. Focusing on set-piece conversion, shooting accuracy, and penalty efficiency could offer a competitive edge. Future research might further explore how tactical adjustments during matches impact outcomes, potentially enhancing the understanding of offensive dynamics in football.

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Conflicts of Interest

The authors declare no conflicts of interest regarding this study.

Ethical Statement

This research has met ethical rules. Authorization to conduct this research was granted by the Ministry of Education, Culture, Research, and Technology, Universitas Pendidikan Indonesia (reference number: 1329/UN40.A6/KP/2024).

Author Contributions

Study Design, MNN, RDS, ABHMM; Data Collection, MNN, ABHMM; Statistical Analysis, MNN, RDS, NAK; Data Interpretation, MNN, RDS, NAK; Manuscript Preparation, MNN, RDS, NAK; Literature Search, MNN, RDS, NAK. All the authors agreed on the final draft of the manuscript before submitting it for publication.

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RESEARCH ARTICLE

The Relationship Between Self-Confidence and Anxiety of Petanque Athletes in Facing Matches in Central Java

Mega Widya PUTRI[*1], Gilang Nuari PANGGRAITA[1], Diyah PROBOYEKTI[2], Abdul Aziz Purnomo SHIDIQ[3], Andri Wahyu UTOMO[4], Fatkhur ROZI[5], Ahad Agafian DHUHA[6], Boy Sembaba TARIGAN[7] and Edi SETIAWAN[8]

[1]Physical Education Study Programme, Universitas Muhammadiyah Pekajangan Pekalongan / Indonesia
[2]Physiotherapy Study Programme, Institut Ilmu Kesehatan Bhakti Wiyata Kediri / Indonesia
[3]Faculty of Sports, Sebelas Maret University / Indonesia
[4]Faculty of Sport Science, Universitas PGRI Madiun / Indonesia
[5]Islamic Primary School Teacher Education Study Programme, Universitas Islam Negeri Salatiga / Indonesia
[6]Faculty of Sport Science, Universitas Muhammadiyah Semarang / Indonesia
[7]Sports Engineering, Institut Teknologi Sumatera / Bandar Lampung / Indonesia
[8]School of Education, Universiti Utara Malaysia / Malaysia
*Corresponding author: megawidyaputri@umpp.ac.id

Abstract
Participating in matches is one of the main goals of athletes training. An athlete's Essential components include technique, physical and strategy, and mental conditions that must be prepared to win a match. This study aims to determine the relationship between self-confidence and anxiety of Central Java petanque athletes facing the match. This study employs a quantitative descriptive approach with a product-moment correlation method. It utilized a questionnaire as a testing instrument, which was distributed to the respondents. The sampling method employed was purposive sampling. The population of this study was Central Java petanque athletes aged 12-24 years, with a total of 30 athletes. Data analysis in this study was conducted using SPSS 23 to determine the relationship between self-confidence and anxiety of Central Java petanque athletes facing the match. The results showed a significant relationship between self-confidence and anxiety of Central Java petanque athletes facing the match, with a value of 0.01 <0.05, so Ho was rejected. The r or Pearson correlation value is negative, meaning the relationship between the two variables is negative. In this study, it can be concluded that there is a significant relationship between the level of self-confidence and anxiety of Petanque athletes in Pekalongan Regency. In other words, the higher the self-confidence of an athlete, the lower the level of anxiety in Central Java's Petanque athletes when facing competitions. Therefore, an athlete's mental state is very important to support performance during competitions. An athlete's mental strength can be trained through implementation the coach's training program.

Keywords
Self-confidence, Anxiety, Match, Petanque Athlete

INTRODUCTION

Sport can be defined as structured and planned physical activity to make the body physically and mentally healthier and to achieve achievement (Waluyo, 2022). Petanque is a game sport that originated in France and is currently played in Indonesia (Loser, 2011). This sport can be played by various ages (Nurhasan, 2024). Petanque is a sport that uses an iron ball as a thrower and a wooden ball as a target to bring it closer. When the athlete throws, both feet must be inside a circle with a

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diameter of 50 cm (Fe, 2020). The sport of petanque requires very high accuracy to get points by throwing the bosi ball toward the wooden ball (Hidayah, 2024). To perform petanque techniques, high accuracy is needed so the iron ball is at the right point (Pelana, 2020).

To win a match, every athlete must perform well physically, technically, strategically, and mentally. An athlete must possess a good mentality to overcome opponents in a match. Petanque demands physical, technical, tactical, and mental strength (Widodo & Hafidz, 2018). An athlete must have a mentality formed early to bring athletes to their best achievements (Raievska et al., 2024). Peak performance when competing can be obtained by integrating the physical and mental aspects of sports skills through the right mindset, resulting in maximum achievement (Ben Ohuruogu et al., 2016). Sports psychology examines how mental factors affect athlete performance (Ita, 2022). Mental factors support petanque athletes' performance (Rony et al., 2021). Therefore, coaches, athletes, and sports teams must consider these components. Physical, technical, tactical, and mental aspects are influential in determining an athlete's success. However, the mental aspect must be addressed and is essential in training (Popovych et al. 2022).

Motivation is one of the drivers that requires a clear understanding of the goals and ways that control and regulate human activity (Ita, 2022). Motivational aspects are needed to support athlete confidence, especially in sports (Blynova, 2022). Anxiety is an emotional state experienced by humans in which the body is tense and accompanied by nervous system activity that affects negative feelings and thoughts (Sangervo, 2022). Anxiety can be divided into two, namely cognitive and somatic anxiety (Mercader-Rubio, 2023). Negative anxiety is anxiety that causes worry and fear and causes a decrease in concentration, which will undoubtedly affect performance (Yoon et al., 2022). Somatic anxiety is anxiety that affects emotional states and activities that use the autonomic nervous system (Mercader-Rubio, 2023).

Self-confidence is the most essential part of one's personality that can affect one's life. Self-confidence is a component that affects a person's self-esteem, where the concept of self-esteem can be interpreted as a person's perception of himself (Nader-Grosbois, 2012). In addition, self-confidence can be considered a measure of an individual's ability to cognitively self-regulate under pressure (Tomé-Lourido, 2019). Athletes with a higher level of self-confidence will be more focused on carrying out tasks (Ita, 2022). Self-confidence has an essential impact on athletes (Mitić, 2020). Previous research suggests that athletes with high confidence levels usually have a greater desire to win than other athletes (Yoon et al., 2022). The level of self-confidence not only affects motivation in achieving sporting achievements but also affects emotional conditions during competition (Comeig, 2016). If someone feels less confident, it will unwittingly cause doubts about their abilities. It will tend to think negatively, so tension and thoughts arise that bring failure or defeat when facing a match against athletes who have balanced abilities.

Based on the observations of petanque athletes from Central Java, it was found that 80% of the athletes experienced symptoms of anxiety, both physically and emotionally, during competitions. Additionally, 76% of the athletes lacked confidence in their abilities. Interviews revealed that athletes often felt fear and worry about losing to their opponents. Some symptoms included sweaty palms, a racing heart, weakness, and nausea, which resulted in a lack of focus. This anxiety occurred due to the fear of losing to athletes with either superior or even inferior abilities.

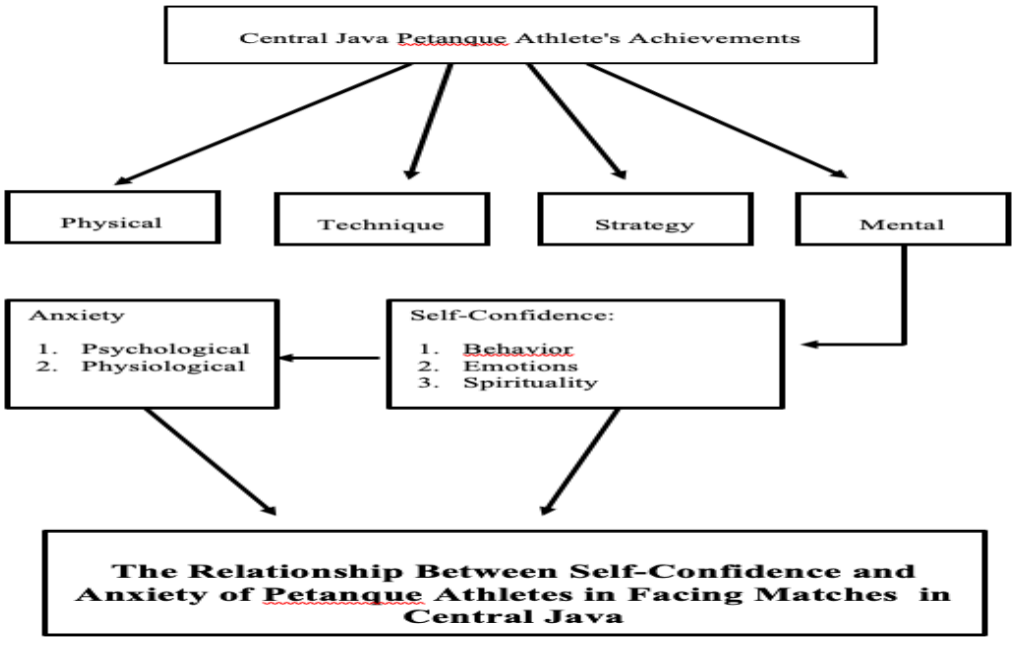
This study aimed to determine the effect of the relationship between self-confidence and anxiety of Central Java petanque athletes in facing the match. The findings of this study are anticipated to offer insights to athletes regarding the presence or absence of a correlation between self-confidence and anxiety among Central Java petanque players during competitions. Thus, sports players, coaches, athletes, officials, and sports organization administrators will have important information for developing athlete achievement, mainly the petanque sport in Central Java.

MATERIALS AND METHODS

Research Design:

This study uses a quantitative descriptive design to find numerical data and analyze the findings (Burhaein, 2020) with product moment correlation to determine whether or not there is a relationship between self-confidence and anxiety of Central Java petanque athletes when participating in

matches using a questionnaire. The data obtained will be processed using statistical analysis.



Picture 1. Flowchart the research design

Population and Sample

A population is a group of subjects who will be subject to the generalization of research results (Azwar, 2018). The population in this study were Central Java petanque athletes with 30 athletes. The sample is the number and characteristics of the population in a study (Sugiyono, 2019). This study uses a purposive sampling technique, where athletes with age criteria of 12-24 years will be sampled, totaling 30 athletes with details of 20 men and 14 women.

Research procedure

The initial preparation includes obtaining research permits from the FOPI Central Java and the research ethics committee at Universitas Muhammadiyah Pekajangan Pekalongan with the number No.095/KEP-UMPP/VII/2024, then preparing the necessary instruments and equipment. Conduct a briefing with research assistants who will help in the data collection process. The next step is to measure the athletes' self-confidence and anxiety by distributing questionnaires that have undergone validity and reliability tests.

Data Collection

The data collection techniques used in this study are as follows: (1) Collecting data on petanque athletes from Central Java. (2) Distributing questionnaires that have been tested for validity to respondents through Google Forms. (3) The researcher then collected the questionnaires and transcribed the responses. (4) After obtaining the research data, the data was processed using statistical analysis, and the researcher drew conclusions and provided recommendations.

Data Collection Steps

Researchers provide athletes with an understanding of the research instruments used in the study. Two research instruments will be taken: self-confidence instruments and anxiety of Central Java petanque athletes in facing matches. The self-confidence instrument has aspects of behavior, emotions, and spirituality, with 36 questions. Meanwhile, in the anxiety instrument, there are psychological and physiological dimensions, which have a total of 31 questions. The questionnaire includes two types of items: favorable (positive statements) and unfavorable (negative statements), arranged randomly. Each question offers four response options: Strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD). Respondents are required to read the statements thoroughly and answer based on their actual experiences to ensure that the data collected can be accurately measured and analyzed. If respondents encounter any confusion, they are permitted to seek clarification from the researcher.

Data Analysis:

Descriptive Statistics

In conducting research data analysis, researchers use percentage descriptive data

analysis. To determine the score criteria using the research norms (Memet Muhamad et al., 2022) as follows:

Table 1: Normality of assessment categories

NO	INTERVAL	CATEGORY
1	Mi + 1,5 SDi ≤ X ≤ STi	Very High
2	Mi ≤ X < Mi + 1,5 SDi	High
3	Mi − 1,5SDi < X ≤ Mi	Low
4	SRi < X ≤ Mi − 1,5 SDi	Very Low

Inferential Statistics

In this study, the normality test was conducted using the Kolmogorov-Smirnov test. This test is employed to determine if the data distribution within the sample follows a normal distribution, utilizing parametric statistical hypothesis testing. The calculations were performed using SPSS 23. Decision-making is based on the following probability criteria:

If the probability is greater than 0.05, the population distribution is considered normal.

If the probability is less than 0.05, the population distribution is considered not normal.

Linearity Test

The linearity test aims to identify whether there is a linear relationship between the independent and dependent variables in the study, indicated by an increase in the dependent variable's score as the independent variable's score goes up. The criteria for making decisions in the linearity test are as follows:

"When the probability value is 0.05 or higher, the relationship between variables X and Y is regarded as linear."

"When the probability value is 0.05 or lower, the relationship between variables X and Y is considered non-linear.

Hypothesis Test

In this study using Pearson Correlation Product Moment, this analysis is used to determine the relationship between variables where other variables are considered to have an effect controlled or made fixed as a control variable.

RESULTS

The purpose of the results of this descriptive analysis is to find out how much the respondents' assessment of Self-confidence and Anxiety of Central Java petanque athletes in facing the match can be explained as follows:

Self-confidence

Descriptive statistics are methods used to describe and provide an overview of research data sets (Memet Muhamad et al., 2022). The descriptive statistics for the confidence data of petanque athletes from Central Java are as follows:

Table 3. Descriptive statistics self confidence

	Statistics
N	30
Mean	670,87
Std Deviation	10,325
Minimum	51
Maxsimum	89

Table 4. Self-confidence assessment norm

NO	Interval	Category	Frequency	Percentage
1	79,12 ≤ X ≤ 89	Sangat Tinggi	8	26,67
2	70 ≤ X < 79,12	Tinggi	8	26,67
3	60,88< X ≤ 70	Low	9	30,00
4	51≤ X < 60,88	Very Low	5	16,67
TOTAL			30	100

Figure 2. Histogram of self confidence

Based on the table and picture above, the level of self-confidence of Central Java petanque athletes is in CATEGORY: Very low by 16.67% or five athletes, Low by 30% or nine athletes, High by 26.67% or eight athletes, and very high by 26.67% or eight athletes.

Anxiety

Descriptive statistics are methods used to describe and provide an overview of research data sets (Memet Muhamad et al., 2022). The following are the results of the descriptive statistics of Anxiety of Central Java petanque athletes in facing the matc.

Table 5. Descriptive statistics of anxiety of petanque athletes of central java

Statistics	
N	30
Mean	82,20
Std Deviation	7,508
Minimum	64
Maxsimum	96

Table 6. Norms for rating anxiety facing the match

NO	Interval	Category	Frequency	Persentage
1	$87{,}68 \leq X \leq 89$	Very high	7	23,33
2	$80 \leq X < 87{,}68$	High	11	36,67
3	$72{,}32 < X \leq 80$	Low	9	30,00
4	$64 \leq X < 72{,}32$	Very low	3	10,00
TOTAL			30	100

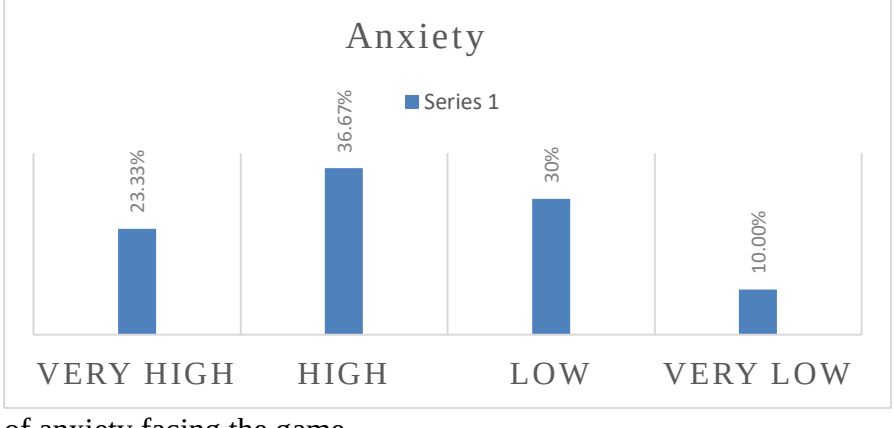


Figure 3. Histogram of anxiety facing the game

The table and picture above show that the level of Anxiety of Central Java petanque athletes when facing the match is in CATEGORY: Very low by 10% or three athletes, Low by 30% or nine athletes, High by 36.67% or 11 athletes, very high by 23.33% or seven athletes.

Prerequisite Test Results

Normality Test

This study employs the Shapiro-Wilk test for assessing normality. The researcher will assess the significance value of the residual variable; if it is greater than 0.05, the data distribution is regarded as normal (Memet Muhamad et al., 2022). On the other hand, if the significance value is below 0.05, the data distribution is considered non-normal. The results of the normality test are presented in the table below:

Table 7. Normality Test Result

Tests of Normality			
	Shapiro-Wilk		
	Statistic	df	Sig.
Self Confidence	.955	30	.230
Anxiety	.971	30	.571

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Based on the statistical analysis of the normality test, the Shapiro-Wilk significance value for the Self-confidence variable is 0.230, and for the Anxiety variable, it is 0.57. Because both significance values exceed 0.05, this suggests that the data follows a normal distribution.

Linearity test

Researchers used the F test in this linearity test, and the X and Y variables were declared linear if the sig value was> 0.05 (Memet Muhamad et al., 2022). The following is the linearity test table:

Table 8. linearity test result

Anova Table							
			Sum of Squares	df	Mean Square	F	Sig.
Anxiety * Self confidence	Between Groups	(Combined)	1134.300	20	56.715	1.020	.515
		Linearity	560.376	1	560.376	10.077	.011
		Deviation from Linearity	573.924	19	30.207	.543	.874
	Within Groups		500.500	9	55.611		
	Total		1634.800	29			

According to the table, the significance value for the relationship between self-confidence and anxiety among athletes in matches is 0.874, which is greater than 0.05. Therefore, these results indicate that the relationship between the independent variable and the dependent variable is considered linear.

Hypothesis Test Results

The calculation in this research hypothesis test uses Pearson Correlation Product Moment, which, if the value of r count> r Table and significance <0.05, then the hypothesis will be accepted and vice versa (Memet Muhamad et al., 2022). The hypothesis in this study reads, 'There is a Significant Relationship Between Self-confidence and Anxiety Levels of Petanque Athletes in Central Java in Facing Matches. The outcomes of the hypothesis test analysis are displayed in the table below:

Table 9. Hypothesis test analysis results

Correlations			
		Self confidence	Anxiety
Self confidence	Pearson Correlation	1	-.585**
	Sig. (2-tailed)		.001
	N	30	30
Anxiety	Pearson Correlation	-.585**	1
	Sig. (2-tailed)	.001	
	N	30	30
**. Correlation is significant at the 0.01 level (2-tailed).			

Based on the table above, it can be seen that the results of the analysis of the calculated r-value are 0.585 and r table 0.361, and the significance value is 0.01 <0.05, so Ho is rejected.

Table 10. Correlation coefficient interpretation

Interval of Coefisıen	**Level of Relatıonshıp**
0,00 – 0,199	Very low
0,20 – 0,399	Low
0,40 – 0,599	Medium
0,60 – 0,799	Strong
0,80 – 1,00	Very Strong

The level of closeness of the correlation coefficient in this study is 0.585, which means it is in the moderate category. The r or Pearson correlation value is negative, meaning the relationship between the two variables is negative. In other words, the higher the level of self-confidence of an athlete, the lower the level of anxiety in Central Java petanque athletes facing the match.

DISCUSSION

Based on the research results, it shows that the significance value of 0.001 < 0.05, thus the hypothesis is accepted. The calculated R is greater than the table R. The R table at a significance level of 0.05 is 0.361. The calculated R obtained is 0.585, which is greater than the R table, so the hypothesis is accepted. The correlation level of 0.585 indicates a moderate relationship. The calculated r value or Pearson correlation is negative, meaning that the relationship between the two variables is negative; in other words, as the level of self-confidence of an athlete increases, the level of anxiety in Central Java petanque athletes decreases when facing competitions. Winners have significantly lower cognitive anxiety and higher self-confidence scores than losing players (Fratta, 2021). The relationship between anxiety and confidence in controlling attention in exercise can be confirmed in competitive circumstances (Tomé-Lourido, 2019). Statistically significant differences in the physical capacity of athletes after undergoing functional training for eight weeks showed a relationship between self-confidence and each subscale in the face of the 1500-meter run (Waluyo, 2022). Athlete characteristics such as confidence and anxiety will affect attentional control during sports competitions (Liu, 2021).

Some may perceive an athlete's level of anxiety and confidence as facilitating and, by others, as debilitating. Still, it shows that the level needed to achieve good performance is subjective (Kim, 2019). Therefore, athletes need to properly manage their effective systems during competition, strengthening their confidence and self-efficacy when facing competition (Lopez, 2018). To reduce anxiety and increase self-confidence in athletes, it is essential to encourage optimism and reduce pessimism and maladaptive perfectionism so that stress will not interfere with sports performance (Paić, 2021). Self-control refers to the process by which individuals monitor and manage behavior, thoughts, and emotions in their interactions with the environment, including task performance but also social interactions (Richard, 2011). Learning self-regulation skills is essential for long-term development, so it will later transition to several stages to support a sporting career from junior to senior to competition level. Athletes must be able to

control their anxiety and confidence; the coach's role is needed to regulate the athlete's mentality in training and competition. Successful athletes have reasonable emotional control and will be effective even when they experience events that make them depressed (Siekanska, 2020).

An athlete with a high level of confidence and a low level of anxiety will feel confident and competent in facing challenges. Good self-confidence is indicated by a positive attitude based on enthusiasm and ability. By being positive, athletes will gain confidence and the ability to control fear and pressure in the match to help achieve maximum performance. A lack of self-confidence will make athletes doubt their skills and become tense and desperate. Self-confidence will positively impact the athlete's concentration, emotions, strategies, effort, momentum, and goals (Robert et al., 2024).

Anxiety can result in a lack of confidence for athletes. In the world of sports, athletes are often faced with situations that are full of pressure and tension. Failing athletes will usually be overwhelmed by hopelessness and the burden of being a winner. Anxiety facing the match is a form of adverse temperamental reaction when there is a sense of worry, loss of control, and a feeling of alertness that makes athletes afraid of failure. Based on this research, it is clear that one of the critical factors for achieving achievement is mental. Good mental conditions allow athletes to be ready to face matches with various problems. Self-confidence and anxiety are psychological factors that can be handled by familiarising themselves during training, one of which is by consulting with a coach.

Conclusion

This research concludes that there is a significant correlation, measured at 0.585, between self-confidence and anxiety among Central Java petanque athletes when facing competitions. To get the title of an athlete, they not only focus on technical, tactical, and strategic factors but also must prepare themselves mentally. With a strong mentality and mature techniques and strategies, athletes will be better prepared for the competition and have a greater chance of becoming champions. An athlete's mental strength can be trained using several mental training methods, and in this regard, the role of the coach is crucial. In future research, it may be beneficial for researchers to continue studying training programs to enhance athletes' mental skills, so that their performance can improve.

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Conflict of Interest

We declare that the articles we write are not involved in any particular conflict of interest and adhere to the Declaration of Helsinki.

Ethics Statement

This study followed the guidelines outlined in the Declaration of Helsinki. Ethical approval was obtained from the Ethics Committee at Universitas Muhammadiyah Pekajangan Pekalongan on July 31, 2025 by number No.095/KEP-UMPP/VII/2024.

Authors Contribution

Research Design, MWP; Research Data Input, GNP, DP; Statistical Data Analysis, AAPS; Data Processing, AWU; Manuscript Preparation, FR; Journal Literacy, AAD, BST, ES. The Authors have Acknowledged and Agreed to the Manuscript.

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RESEARCH ARTICLE

Unveiling the Therapeutic Impact of Virtual Reality Game-Based Exercises on Cervicocephalic Kinesthetic Sensibility in Individuals Battling Cervical Vertigo

G. Vaishnavi GIRIDHARAN[*1], Jibi PAUL[1], Prathap SUGANTHIRABABU[2] and C.V. Senthil NATHAN[1]

[1]Faculty of Physiotherapy, Dr. M.G.R. Educational and Research Institute, Chennai, Tamil Nadu / India
[2]Saveetha College of Physiotherapy, Saveetha University, Chennai, Tamil Nadu / India
*Corresponding author: Vaishnavi.physio@drmgrdu.ac.in

Abstract
This study was aimed to investigate the therapeutic impact of Virtual Reality game-based exercises with Epley maneuver on cervicocephalic kinesthetic sensibility in individuals experiencing cervical vertigo. 8 subjects were selected by simple random sampling method included clinically diagnosed male and female cervical vertigo patients between 40-55 years of age, who had recurring symptom of dizziness over three months, episodic dizziness lasting minutes to hours .Written consent was taken and a detailed outcome assessment was done.Intervention includes Virtual Reality abyss sharks & sea worlds for a duration of 10 minutes with a five-minute rest period and Virtual Reality thrills, for a duration of 10 minutes with a five-minute rest period along with epley maneuver 10 minutes targeting cervicocephalic kinesthetic sensibility.Total duration of the intervention includes 40min/day for 6 days for 12 weeks. Pre test included Cervical Joint Position Error Test for cervicocephalic kinesthetic sensibility and Videonystagmography measures nystagmus, rapid eye movements with a slow and fast phase, to provide objective information about vertigo. Post test done on 6th and 12th week of intervention with the same measures. On comparing pre- and post-intervention outcomes shows higher mean value ($P \leq 0.001$).In conclusion the findings of this study had the potential to contribute valuable insights into the therapeutic utility of Virtual Reality game-based exercises in managing cervical vertigo, offering a novel and engaging approach to rehabilitation. Virtual Reality-based interventions is found effective treatment for individuals battling cervicocephalic kinesthetic sensibility among patients with cervical vertigo.

Keywords
Cervicocephalic Kinesthetic Sensibility, Videonystagmography, JPE,Vırtual Realıty

INTRODUCTION

Cervicogenic dizziness, originally termed "cervical vertigo" by (Ryan and Cope, 1955) has been a topic of controversy in its diagnosis. It is also referred to as proprioceptive vertigo, cervicogenic vertigo, and cervical dizziness (Reiley et al., 2017). Vertigo, characterized by a sensation of spinning, particularly upon changes in position, is a key feature (Brandt et al., 2019). Cervical origins contribute to 7.5% of dizziness causes, impacting quality of life and emerging as a growing concern in community health. Numerous studies highlight dizziness, encompassing both vertigo and non-vestibular forms, as one of the most common medical complaints, affecting about 20-30% of the overall population (Chu et al., 2019).

Cervicogenic dizziness is often associated with flexion-extension injuries and has been observed in individuals with severe cervical arthritis, herniated cervical discs, and head trauma12. However, symptoms may not manifest until months or even years after the initial event. Linked to neurological, vestibular, psychosomatic,

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and cervical spine dysfunction, cervicogenic dizziness is characterized as a disorienting condition leading to impaired postural awareness (Li et al., 2015).

Cervicogenic dizziness, initially termed "cervical vertigo" by Ryan and Cope (1955), has occasionally been a subject of controversy in its diagnosis. It is also referred to as proprioceptive vertigo, cervicogenic vertigo, and cervical dizziness. Vertigo, characterized by a sensation of spinning, particularly upon changes in position, is a key aspect. Cervical factors contribute to 7.5% of dizziness causes, impacting quality of life and emerging as a growing concern in community health (Wrisley et al., 2000). Numerous studies underscore dizziness, covering both vertigo and non-vestibular types, as one of the most common medical complaints, affecting approximately 20-30% of the general population. Cervicogenic dizziness is often associated with flexion-extension injuries and has been identified in individuals with severe cervical arthritis, herniated cervical discs, and head trauma (Revel et al., 2015). However, symptoms may not manifest until months or even years after the initial incident. Associated with neurological, vestibular, psychosomatic, and cervical spine dysfunction, cervicogenic dizziness is described as a disorienting condition leading to compromised postural awareness (Sunget al., 2020).

The cervical muscles have a greater distribution of muscle spindles compared to other muscle groups, particularly the suboccipital muscles which have numerous muscle spindles per unit, indicating a high proprioceptive function requirement (Sung et al., 2008). Proprioception is crucial for proper joint function during movements, aids in motor control, and enhances muscle stiffness, providing dynamic stability to joints. Impairment of functional mobility often results from a lack of proprioceptive feedback. Mechanoreceptor density is higher in deep neck muscles than superficial ones. Proprioceptive input from the neck assists in coordinating eye, head, and body posture, as well as spatial orientation. Based on this, there is a suggestion that a syndrome of cervical vertigo may exist (Rix et al., 2001).

The application of Virtual Reality is a promising approach used for educating cervical kinematics. The benefits of virtual training include diverting attention, thereby reducing pain and kinesiophobia, motivating physical activities, and improving the effectiveness of exercises (Li et al., 2011). Virtual Reality presents the digital environment using computer software, with a head-mounted display utilized to present the imagery to the user. Virtual Reality employs the concept of immersion, allowing Virtual Reality environments to engage and distract the patient. Virtual Reality can assess the integration between the neurocognitive and musculoskeletal systems, which is crucial for motor control and is suggested to play a significant role in the recurrence and chronicity of certain orthopedic disorders. Patients engage in therapeutic activities repeatedly to achieve higher scores without becoming bored. Feedback is a crucial element in motor learning and is a prominent feature in virtual environments (Mahrer et al., 2009).

The Cervical JPE Test measures the ability of a blindfolded patient to accurately relocate their head position back to a predetermined neutral point after cervical joint movement (Takahashi et al., 2018; (Jull et al., 2007).

Videonystagmography (VNG) is a complete diagnostic system for recording, analyzing, and reporting eye movements using video imaging technology, in which hi-tech video goggles with infrared cameras are used. VNG includes a series of tests used to determine whether a vestibular disease may be causing a balance or dizziness problem. Aim of the current study is find the effectiveness of Virtual Reality game based exercise on cervicocephalic kinesthetic sensibility among patients with cervical vertigo.

MATERIALS AND METHODS

Research Model / Design

The methodology employs a randomised experimental design,with pre and post test and was carried out with the approval by the ethics committee of institution's review board, Acs Medıcal College And Hospıtal with the letter numbered 646/2022/IEC/ACSMCH on 14/12/2022. Participants were provided with informed consent, with the volunteer form covering research details, risks, benefits, confidentiality, and participant rights. The research procedures adhered to the guidelines outlined in the updated Helsinki Declaration from 2008, prioritizing participant's rights and well-being in design, procedures, and confidentiality measures.

Research Sample

Study was done at Physiotherapy OPD, ACS Medical College and Hospital. Eight subjects were selected between 40-55 years, clinically diagnosed male and female cervical vertigo patients. All the patients had recurring symptom of dizziness over three months, episodic dizziness lasting minutes to hours were included with their voluntary consent. Other causes of vertigo, including those arising from disturbances of the ear, nose, and throat (ENT); central nervous system (CNS); and cardiovascular system, cervical myelopathy or cervical stenosis, Inflammatory arthritis, neoplastic diseases, infection, trauma, Meniere's disease ,History of previous cervical surgeries or cervical spine surgery, medical conditions that could have a negative effect on balance and patients with significant neurological disorders or spinal cord damage are excluded. All the subjects received Virtual Reality with Epley maneuver 40min/day for 6 days a week for 12 weeks.

Research Instruments and Procedures

Virtual Reality Abyss Sharks & Sea Worlds

The patient is positioned sitting upright with their back supported and head maintained in a neutral position. In this game, the participant wears Virtual Reality goggles and immerses themselves in a virtual underwater environment, collecting various objects such as coins and bottles to achieve a high score by moving their head in all directions. The subjects engage in the game for a duration of 10 minutes with a five-minute rest period interspersed.

Virtual Reality Thrills

The patient is positioned sitting upright with their back supported and head in a neutral position. In this game, the participant wears Virtual Reality goggles and experiences riding a virtual roller coaster, adjusting their head movements accordingly. The subjects engage in the game for a duration of 10 minutes with a five-minute rest period included.

Epley Maneuver

The examiner rotates the patient's head 45 degrees to the right and quickly lays the head back over the end table. The patient's eyes should exhibit torsional nystagmus. Rotate the patient's head 90 degrees to the left, again hold .Instruct the patient to turn their entire head and body in the left lateral position, with the head facing 135 degrees from supine or 225 degrees from the starting position (looking at the floor).Assist the patient in returning back to the sitting supine position while holding their head in place. The head position should be maintained as they are assisted in the sitting position. Total procedure was assisted to do in 10 minutes.

Table 1. Virtual reality training program with the epley maneuver

Research Instrument	Activity	Duration	RestPeriod
Virtual Reality	Abyss Sharks & Sea Worlds	10 Minutes	5 Minutes
Virtual Reality	Thrills	10 Minutes	5 Minutes
Epley maneuver	1. The examiner rotates the patient's head 45 degrees to the right 2. Rotate the patient's head 90 degrees to the left, again hold. 3.Move patient head 90° toward the opposite ear 4. patient should turn their entire head and body in the left lateral position, with the head facing 135 degrees from supine or 225 degrees from the starting position 5.Assist the patient in returning back to the sitting from supine position while holding their head in place	10 Minutes	

Data Collection Tools

Pre test was done before intervention using Cervical Joint Position Error Test for Cervicocephalic Kinesthetic Sensibility (Jull et al., 2007) and Videonystagmography (Gabriele Noreikaite et al., 2024) for cervical vertigo.Post test done on 6th and 12th week of intervention

Cervical Joint Position Error Test

The patient was made to stand. A target was positioned 90 cm in front of the patient, adjustable to their neutral head position (NHP), serving as the zero point. The patient is equipped with a laser pointer mounted on a helmet. They are then instructed to do flexion and return to the starting position, extension and return to the starting position ,left lateral flexion and return to the starting position, right lateral flexion and return to the starting position with the laser pointer indicating the global error relative to the target center. Three trials are conducted for each direction of motion,

with the best score recorded. The difference between the starting and ending positions of the laser beam on the target reflects cervical joint position error (JPE) and proprioception impairment, with greater displacement indicating more significant impairment (Jull et al., 2007).

Videonystagmography (VNG)

It is a sophisticated diagnostic technique utilizing video imaging technology to capture, analyze, and document eye movements. This method employs advanced goggles fitted with infrared cameras.It measures nystagmus, which are rhythmic, rapid eye movements with a slow and fast phase (Gabriele Noreikaite et al., 2024).

Spontaneous Nystagmus

Denotes the occurrence of nystagmus without external stimuli, typically observed in darkness, with the head upright, and at a distance of at least 3 feet from any stimulus.

Gaze-Evoked Nystagmus

Gaze-evoked nystagmus is provoked by directing the patient's gaze in specific directions. The patient is directed to look forward, left, right, upward, and downward, each at angles of 15°, while recording the nystagmus response.

Smooth Pursuit

Smooth pursuit tracking assesses the eyes' ability to accurately follow moving targets, aiding in the detection of potential central pathology affecting eye movement coordination.

Head-Shaking

Head-shaking entails observing the patient's eyes for nystagmus immediately following rapid shaking of the head along a vertical axis.

RESULTS

The collected data were tabulated and analyzed using both descriptive and inferential statistics. All the parameters were assessed using statistical package for (SPSS), with a significance level of p value and a 95% confidence interval set for all analysis.

Table 2 shows significant effect of Virtual Reality training on proprioception among cervical vertigo patients using Joint Position Error Test Flexion comparing the mean values of pre (12) and post-tests (8.27) which has the higher mean value at (***-P≤0.001), Extension comparing the mean values of pre (11.35) and post-tests (8.00) which has the higher mean value at (***-P≤0.001) , Right Lateral Flexion comparing the mean values of pre (9.22) and post-tests (6.37) which has the higher mean value at (***-P≤0.001), Left Lateral Flexion comparing the mean values of pre (13.5) and post-tests (8.75) which has the higher mean value at (***-P≤0.001).

Table 2. Comparison of joint position error test- pre and post

	Pre-Test		Post- Test		Post -Test		F -value	df	P-value
JPET	Mean	SD	Mean	SD	Mean	SD			
Flexion	12	2.0	9.78	1.33	8.27	.96	56.0	2	0.000***
Extension	11.35	2.05	9.08	1.63	8.00	1.70	54.801	2	0.000***
Right Lateral Flexion	9.2250	.46522	7.96	0.89	6.37	0.38	68.611	2	0.000***
Left Lateral Flexion	13.562	2.096	10.32	1.08	8.75	0.73	48.163	2	0.000***

Table 3. Comparison of videonystagmography –pre and post

	Pre-Test		Post- Test		Post -Test		F -value	P-value
JPET	Mean	SD	Mean	SD	Mean	SD		
Spontanous Nystagmus (Right)	16.37	1.40	15.37	1.76	8.625	1.30	351.23	0.000***
Spontanous Nystagmus (Left)	15.87	1.88	15.12	1.24	12.75	1.48	351.235	0.000***
Head Shake (Right)	16.37	15.00	15.00	1.06	9.375	.744	96.791	0.000***
Head Shake (Left)	17.50	17.87	17.87	.834	18.37	.916	426.33	0.000***
Smooth Pursuit	17.87	1.55	17.37	1.18	8.250	1.28	588.940	0.000***
Gaze Nystagmus	27.62	2.13	26.87	1.95	27.25	1.66	781.94	0.000***

Table 3 shows significant effect of VIRTUAL REALITYTraining on cervical vertigo patients using Videonystagmography –Spontaneous Nystagmus (Right) comparing the mean values of

pre (16.37) and post-tests (8.62) which has the higher mean value at (***-P≤0.001) , Spontaneous Nystagmus (Left) comparing the mean values of pre (15.87) and post-tests (12.75) which has the higher mean value at (***-P≤0.001), Head Shake (Right) comparing the mean values of pre (16.37) and post-tests (9.37) which has the higher mean value at (***-P≤0.001) , Head Shake (Left) comparing the mean values of pre (17.5) and post-tests (18.3) which has the higher mean value at (***-P≤0.001) , Smooth Pursuit comparing the mean values of pre (17.8) and post-tests (8.2) which has the higher mean value at (***-P≤0.001) , Gaze Nystagmus comparing the mean values of pre (27.6) and post-tests (27.2) which has the higher mean value at (***-P≤0.001).

DISCUSSION

The present study was aimed to evaluate the effectiveness of virtual reality based exercise on cervicogenic kinesthetic sensation among patient with cervical vertigo improve the functional disability of the patients. Virtual reality , sensory perception is provided through visual analyzer proprioception is organized complexly by bodily sensation and the formation is influenced by receptor apparatus of sensory system activation16. A study by Jozefowicz-Korczynska et al on the effect of VR on vertigo patients undergoing rehabilitation suggested that this is an effective and well tolerated method of therapy (Tomasz Stankiewicz et al., 2021).

According to Vugt et al., (2019), vestibular rehabilitation is a safe and effective management for unilateral peripheral vestibular dysfunction, showed benefits of new technologies involved in vestibular rehabilitation. Use of internet-based vestibular rehabilitation protocols is a safe, effective, and easy accessible form of therapy for adults aged 50 and older with a chronic vestibular syndrome. studies have shown the great potential and efficacy of VR when treating patients suffering from vertigo.

According to Falla et al., (2007) many proprioceptors are distributed over the longus colli and longus capitis muscles. Because these proprioceptors provide postural information as quickly as possible with early contraction during movements of the head or upper limbs, they facilitate suitable movements depending on the stability and posture of the neck region. Pavlou et al demonstrated that virtual reality patients improved 59.2%. Saw Wah Wah et al., (2021) stated that proprioceptive training group targeting the suboccipital muscles was effective than the craniocervical flexion training group and control group in improving static balance. Cervical muscle spindles are the important proprioceptors in maintaining balance control. The enhancement of suboccipital muscle on proprioceptive training is responsible for accurate kinesthesia and proprioception.

This study is aimed to analyze the effect of virtual reality on cervicocephalic kinesthetic sensibility in patients with cervical vertigo. MEDLINE, EMBASE, CENTRAL, CINAHL, PsychInfo, PsychBITE, OTSeeker, Ei Compendex, IEE, Clinical trials.gov and Web of Science databases were searched and reviewed for similar article. A potential mechanism of cervicogenic dizziness would have to be based on altered upper cervical somatosensory input associated with neck problems. If the firing characteristics (the symmetricity) of the cervical somatosensors alter as a consequence of neck pain, a sensory mismatch between vestibular and cervical inputs would be expected to result in cervicogenic dizziness. Physiological studies have shown that small flexion of the upper cervical joints can cause major changes in firing rate of the spindle afferents from perivertebral muscles.

Virtual reality gaming systems construct simulation models that allow players to interact with computer-generated environments, providing them with the sensation of being immersed in a real-world setting (Tomasz Stankiewicz et al., 2021). Virtual Reality (VR) is extensively utilized to create virtual environments, interactive simulations replicating the real world, utilizing diverse display formats such as spherical, flat screens, or head-mounted displays. Users can engage with objects within VR through bodily movements, and additional hardware devices can be incorporated to track motion kinematics or deliver simulated force feedback or haptic feedback to participants (Holden et al., 2005).

In this study Eight participants aged between 40 and 55 years, comprising both male and female individuals clinically diagnosed with cervical vertigo, were selected for the study. VR exercises involving abyss sharks, sea worlds, and thrilling scenarios were used. These VR experiences were designed to challenge and stimulate proprioceptive systems, which are critical in managing cervicocephalic kinesthetic sensibility. In patients with cervical vertigo, abnormal eye movements

detected through VNG can indicate disruptions in the vestibular system, which is closely linked to the proprioceptive input from the cervical spine.The post-intervention VNG results in this study demonstrated a significant reduction in nystagmus, suggesting an improvement . The immersive nature of VR allows patients to engage in dynamic head movements within a controlled and interactive environment, thus facilitating better proprioceptive feedback and motor learning. This improvement in CJPE suggests that VR-based exercises can effectively retrain the cervical proprioceptive system, leading to reduced joint position error and, consequently, a decrease in vertigo symptoms

After analyzing the statistical data, the significant pre- and post-intervention differences ($P \leq 0.001$) highlight the potential of VR exercises to complement traditional therapeutic approaches, offering a more engaging and potentially more effective treatment modality. Hence Virtual Reality was effective in improving cervicocephalic kinesthetic sensibility among patients with cervical vertigo.

Conclusions

The integration of Virtual Reality technology into rehabilitation programs represents a promising avenue for improving cervicocephalic kinesthetic sensibility and overall outcomes in patients with cervical vertigo. Embracing such innovative approaches underscores the commitment to providing holistic and effective care to individuals with cervical vertigo. the positive outcomes observed in this study underscore the importance of adopting innovative technologies in healthcare settings. Virtual Reality offers a novel and engaging platform for rehabilitation, potentially enhancing patient motivation and compliance with exercise programs. Moreover, the ability to customize Virtual Reality experiences to suit individual patient needs and progressions highlights its versatility as a therapeutic tool.

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Conflict of Interest

The authors declare no conflicts of interest.

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Author Contribution

Research Design, GVG; Research Data Input, GVG, JP; Statistical Data Analysis, CVSN; Data Processing, GVG, PS; Manuscript Preparation, PS; Journal Literacy, GVG, JP, PS, CVSN. All authors were contributors and responsible for the manuscript's content and approved the version submitted for publication.

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RESEARCH ARTICLE

Application of Traditional Games to the Fundamental Movement Skills of Children 5-6 Years of Age

Aprilia Wahyuning FITRI[*1], Dimyati DIMYATI[1] and Yulia AYRIZA[1]

[1]Yogyakarta State University,Postgraduate School, Yogyakarta / Indonesia
*Corresponding author: apriliawahyuning.2021@student.uny.ac.id

Abstract
This research is motivated by children's fundamental movement skills, which are less than optimal. Mastery of fundamental movement skills that are less than optimal will affect the achievement of further movement skills. The purpose of the study was to determine the effect of using traditional games on fundamental movement skills. The traditional games applied are engklek, gobag sodor and boi-boinan. Using 3 traditional games is important because the results of previous research on fundamental movement skills have never used more than one type of traditional game and the results of children's fundamental movement skills are maximized. Using a quantitative approach with the type of pre-experimental research design one group pretest posttest Sampling using a random sampling technique with the result being 30 child samples. Using a quantitative approach with the type of pre-experimental research design one group pretest posttest Sampling using random sampling techniques with the results of 30 child samples. Using parametric statistical methods and data collection techniques by observation using the Test of Gross Motor Skill-Second Edition (TGMD-2) instrument, namely running movement, jumping motion, gallop, horizontal jumping movement, catching movement, kicking movement, throwing motion, ball rolling motion, and leap movement. The statistical test results show a p value = 0.00 which means there is a relationship between fundamental movement skills and traditional games. In addition, the results of data analysis have an effect of 5% so it is concluded that there is an effect of traditional games on fundamental movement skills in children.

Keywords
Indonesian Traditional Games, Fundamental Movement Skills, 5-6 Years Old Children

INTRODUCTION

The importance of mastering fundamental movement skills from an early age is one of the important elements to achieving physical competence that will lead children to have good physical literacy (Gallahue & David, 2012). The positive impact of mastering fundamental movement skills is children's involvement in physical activities when they are teenagers (Barnett et al., 2019) as well as their confidence (McGann et al., 2020). In addition, fundamental movement skills also increase the fun of playing so that it can lead children to have good physical activity (Chan et al., 2019). These studies show the importance of children mastering fundamental movement skills from an early age.Mastery of fundamental movement skills also has a positive impact on the realm of children's health such as obesity, which is rarely found in children (Bryant, 2013). Williams (2012) explains that children with fundamental movement skills will be more active which will prevent children from becoming obese. Similarly, research Duncan (2017) also said that children's low fundamental movement skills are related to obesity.

Apart from the health aspect, Bremer (2016) it says that fundamental movement skills have a positive impact on children's social and emotional development. Good movement skills can have a positive impact on children's academic achievement at school such as in aspects of cognitive and language development.

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The importance of mastering fundamental movement skills in children accompanied by the empirical evidence already described, indicates that it should be a consideration for PAUD teachers in school learning. However, the research Kurniawan (2018) said there were 50% of children had not mastered fundamental movement skills, especially in fundamental manipulative movements. From the research results Farepsi & Suryana (2021) dan Firmana et al., (2022) Children's manipulative movements have not increased and have decreased due to learning from the effects of the COVID-19 pandemic. Reinforced there is also no significant increase in manipulative movements in preschools that have used the physical education curriculum for children aged 4-5 years in Finland (Iivonen & Saakslahti, 2014).

In addition, the fundamental movements of children in two big cities in Indonesia such as Cirebon (Widiarti et al., 2021) and Depok (2014 Djuanda & Suryani, 2021) fundamental locomotor movements is not good, for example in the ability of children to jump in various directions using one foot or two feet, and vice versa jumping in the reverse direction. Reinforced by research results (Muslihin, 2020) that children perform fundamental movements such as walking still with the tip of the foot pointing outward, and inward, and when children tread using the ball of the foot and becomes common mistakes exist.

The results of these studies indicate that teachers must further maximize fundamental movement skills in early childhood. Children's fundamental motion learning activities must be by the principles of early childhood learning, namely learning through play. Playing is an activity that is chosen by the child because it is fun and fulfills the primary needs of child development (Andriani, 2012). Traditional games as an activity that is fun for children and uses a lot of movement (Fitri, 2016). Reinforced by research results (Gipit et al., 2017) which concluded that in Malaysia using intervention-based traditional games was efficient in improving preschool children's motor skills.

In general, traditional games in Indonesia have been shifted by modern games (Burhaein, 2017). This results in not too many types of traditional games that still survive or are preserved today. Research results (Nurhayati, 2012) said traditional games in early childhood education institutions are rarely used in learning activities. For this reason, the urgency is to apply traditional games to learning in schools.

Traditional games that are scattered throughout Indonesia are many but are still thought to have the potential to be preserved, namely *gobag sodor, engklek, jamuran, patok lele, kasti, boi-boinan* and *ular naga panjang* (Burhaein, 2017). There are many traditional games in Indonesia, in this study focused on several games such as *engklek, boi-boinan* dan *gobag sodor*. These three traditional games can improve motor development and are fun for young children (Djuanda & Suryani, 2021; Khisma et al., 2023; Susena et al., 2021).

Comparing previous research from Kusumawati (2018) limited to one traditional game, one fundamental motion and less specific to the age range 0-6 years. Thus this encourages researchers to test or prove the effect of traditional games on the fundamental movement skills of children aged 5-6 years and their effectiveness.

MATERIALS AND METHODS

Methods

This study allows researchers to directly evaluate the effect of games on children's skills by comparing skills before (pretest) and after (posttest) the intervention is given. By using only one group, researchers can focus on the changes that occur in that group after being given a particular game. Therefore, the one-group pretest-posttest design provides a practical solution to evaluate an intervention's effect in this complex situation (Creswell, 2014). The research design is presented with a chart in Figure 1.

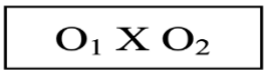

Figure 1. Research design

Participants

The sample determination was carried out using a random sampling technique with the criteria of children aged 5-6 years and not in a condition with special needs so that the total sample was 30 samples with details of 16 boys and 14 girls.

This research has been approved by the Ethics Committee of the University of State Yogyakarta (Reg.No.:T/66/UN34.9/KP.06.07/2024).Participant provided informed consent, with the volunteer form covering research details, risks, benefits, confidentiality, and participant rights. The research strictly adhered to the ethical principles of the

Declaration of Helsinki, prioritizing participant's rights and well-being in design, procedures, and confidentiality measures.

Instruments Study

Data collection techniques were done by observation using instruments Test of Gross Motor Skill-Second Edition (TGMD-2) running movement, jumping motion, gallop, horizontal jumping movement, catching movement, kicking movement, throwing motion, ball rolling motion, and leap movement (Ulrich & Sanford, 2000). This instrument has been validated and reliable on 135 children in Indonesia with validity results 2.27>t table 1.65 and reliability 0.765 (Apriyani et al., 2018).

Procedure

The implementation of the research trial was carried out with 3 stages, namely giving pretests to children to determine initial abilities. Furthermore, the treatment/stimulus is given as an effort to influence children's fundamental movement skills. The treatment is given by using 3 traditional games engklek, boi-boinan and gobag sodor.

The engklek game is a traditional game played by jumping over plots drawn on the ground. The child will jump with one foot over the patches, avoiding the marked patches. In addition, children also throw gaco or other objects into certain plots, and the plots must not be stepped on during the game. This game trains children's balance, agility, and motor coordination.

Gobag sodor is a traditional Indonesian game played by two groups of players. It is played on a rectangular field divided into sections. The main objective is to cross the lines guarded by the opposing team without being touched. Boi-boian is a traditional game popular in Indonesia, especially among children. The game involves two teams, where the goal is to knock over and reassemble a pile of stones while avoiding the opposing team's throwing balls. The game combines speed, agility, and cooperation between players.

The treatment trial was given for 12 meetings, then divided into groups of four to five children. Each group will compete to complete tasks or obstacles contained in traditional games within 10 minutes. The role of the teacher is as a facilitator and supervisor to ensure the implementation of the game as expected. Before each game, the teacher explains and demonstrates to the children how to play the game. After being given treatment, children are given a posttest which aims to determine the final ability of children's fundamental movement skills. Each child's activity was assisted by a research assistant to help observe the assessment of children's fundamental movement skills, which were then analyzed using parametric statistics.

Descriptive analysis will be conducted to describe the data obtained, provide fundamental summary statistics such as mean, median, standard deviation, and frequency distribution, and conduct a Chi-Square Test (Gravetter, 2014) with the TGMD-2 results. In the context of this study, the Chi-Square Test can be used to test the effect of traditional games on fundamental movement skills with the results of the TGMD-2 assessment, and then also statistically describe the fundamental movement skills.

RESULTS

Description of data on fundamental movement skills in the first trial assessment (pretest) before treatment and after treatment (posttest) with running, jumping, leaping (long jump), horizontal jumping, catching, kicking, throwing, and rolling the ball produces the following data:

Running Movement

The results of running movements before the treatment (Pretest) are more dominant in the low category with a total of 28 (93.33%) children in the score range of 4-5 and 2 (6.67%) children in the very low category with a score range of 1-3, while the value after the treatment (posttest) is most dominant in the high category with a total of 26 (86.67%) score range 6-7, 3 (10.0%) low category score range 4-5, and 1 (3.33%) child with a very high category with a score range of 8-12. It can be concluded that there are differences after being given traditional game treatment.

Jumping Motion

The results of running movements before the treatment (pretest) were more dominant in the low category with a total of 23 (76.67%) children in the score range of 4-5, 1 (3.33%) child in the very low category score range 1-3 and 6 (20.0%) children in the high category with a score range of 6-7, while the value after the treatment (posttest) was most dominant in the very high category with a total of 16 (53.33%) score range 8-12, 13 (43.33%) children in the high category score 6-7, 1 (3.33%) low category score range 4-5. It can be concluded that there are differences after being given traditional game treatment.

Leap Movement (Long Jump)

The results of the leap movement (long jump) with a relatively small number of assessments so that the assessment before the treatment (pretest) is the style of treatment (posttest) is most dominant in the very high category with a total of 16 (53.33%) score range 6 and 14 (47.67%) children in the high more dominant in the high category with a total of 22 (73.33%) children in the standard score range of 4-5 and 8 (26.67%) children in the low category of the standard score range of 2-3, while the value after category score range 4-5. It can be concluded that there are differences after being given traditional game treatment.

Table 1. Frequency distribution of pretest and posttest of running motion

Assesment	Standard Score	Frequency			
		Pretest		Posttest	
		Absolut (Fa)	Relative (%)	Absolut (Fa)	Relative (%)
Very High	8 -12	0	0.00%	1	3.33%
High	6-7	0	0.00%	26	86.67%
Low	4-5	28	93.33%	3	10%
Very Low	1-3	2	6.67%	0	0.00%
Total		30	100%		100%

Table 2. Frequency distribution of pretest and posttest of jumping motion

Assesment	Standard Score	Frequency			
		Pretest		Posttest	
		Absolut (Fa)	Relative (%)	Absolut (Fa)	Relative (%)
Very High	8 -12	0	0.00%	1	3.33%
High	6-7	0	0.00%	26	86.67%
Low	4-5	28	93.33%	3	10%
Very Low	1-3	2	6.67%	0	0.00%
Total			100%		100%

Table 3. Frequency distribution of pretest and posttest of long jump movement

Assesment	Standard Score	Frequency			
		Pretest		Posttest	
		Absolut (Fa)	Relative (%)	Absolut (Fa)	Relative (%)
Very High	8 -12	0	0.00%	1	3.33%
High	6-7	0	0.00%	26	86.67%
Low	4-5	28	93.33%	3	10%
Very Low	1-3	2	6.67%	0	0.00%
Total			100%		100%

Horizontal Jumping Movement

The results of horizontal jumping movements before the treatment (pretest) were more dominant in the low category with a total of 24 (80.0%) children in the score range of scores, namely 4-5, and 6 (20.0%) children in the very low category of the standard range of scores 1-3, while the value after the treatment (posttest) was most dominant in the high category with a total of 23 (76.67%) score range 6-7 and 7 (23.33%) children in the low category of score range 4-5. It can be concluded that there are differences after being given traditional game treatment.

Catching Movement

The results of the capture movement with a relatively small number of assessment indicators so

that the assessment before the treatment (pretest) is dominant in the high category with a total of 21 (70.0%) children in the score range of 4-5, 9 (30.0%) children in the low category with a standard score range of 2-3, while the value after the treatment (posttest) is most dominant in the very high category with a total of 16 (53.33%) score range 6 and 14 (46.67%) children in the high category score range 4-5. It can be concluded that there are differences after being given traditional game treatment.

Kicking movement

The results of kicking movements before the pretest were more dominant in the low category with a total of 28 (93.33%) children in the score range of 4-5 and 2 (6.67%) children in the very low category in the standard score range of 1-3, while the value after the treatment (posttest) was most dominant in the high category with a total of 25 (83.33%) score range 6-7, 2 (6.67%) children in the very high category score 8-12 (10.0%) low category score range 4-5. It can be concluded that there are differences after being given traditional game treatment.

Throwing Motion

The results of throwing movements before the treatment (pretest) were more dominant in the low category with a total of 26 (87.67%) children in the standard range of scores 4-5, 3 (10.0%) children in the very low category in the standard range of scores 1-3 and 1 (3.33%) child in the high category with a score range of 6-7, while the value after the treatment (posttest) was most dominant in the high category with a total of 24 (80.0%) score range 6-7, 4 (13.33%) children in the low category score range 4-5 and 2 (6.67%) children in the very high category score range 8-12. It can be concluded that there are differences after being given traditional game treatment.

Ball Rolling Motion

The results of rolling the ball before the pretest were more dominant in the low category with a total of 28 (93.33%) children in the standard score range of 4-5 and 2 (6.67%) children in the very low category in the standard score range of 1-3, while the value after the treatment (posttest) was most dominant in the high category with a total of 23 (76.67%) score range 6-7, 4 (13.33%) children in the very high category score range 8-12 and 3 (10.0%) children in the low category score range 4-5. It can be concluded that there are differences after being given traditional game treatment.

Table 4. Frequency distribution of pretest and posttest of horizontal jumping motion

Assesment	Standard Score	Frequency			
		Pretest		Posttest	
		Absolut (Fa)	Relative (%)	Absolut (Fa)	Relative (%)
Very High	8 -12	0	0.00%	1	3.33%
High	6-7	0	0.00%	26	86.67%
Low	4-5	28	93.33%	3	10%
Very Low	1-3	2	6.67%	0	0.00%
Total			100%	30	100%

Table 5. Frequency distribution of pretest and posttest of catching motion

Assesment	Standard Score	Frequency			
		Pretest		Posttest	
		Absolut (Fa)	Relative (%)	Absolut (Fa)	Relative (%)
Very High	6	0	0.00%	16	53.33%
High	4-5	21	70%	14	46.67%
Low	2-3	9	30%	3	0.00%
Very Low	1	0	0.00%	0	0.00%
Total		30	100%	30	100%

Table 6. Frequency distribution of pretest and posttest of kicking motion

Assesment	Standard Score	Frequency			
		Pretest		Posttest	
		Absolut (Fa)	Relative (%)	Absolut (Fa)	Relative (%)
Very High	8 -12	0	0.00%	2	6.67%
High	6-7	0	0.00%	25	83.33%
Low	4-5	28	93.33%	3	10%
Very Low	1-3	2	6.67%	0	0.00%
Total			100%	30	100%

Table 7. Frequency distribution of pretest and posttest of throwing motion

Assesment	Standard Score	Frequency			
		Pretest		Posttest	
		Absolut (Fa)	Relative (%)	Absolut (Fa)	Relative (%)
Very High	8 -12	0	0.00%	2	6.67%
High	6-7	1	3.33%	24	80%
Low	4-5	26	86.67%	4	13.33%
Very Low	1-3	3	10%	0	0.00%
Total			100%	30	100%

Table 8. Frequency distribution of pretest and posttest of ball rolling motion

Assesment	Standard Score	Frequency			
		Pretest		Posttest	
		Absolut (Fa)	Relative (%)	Absolut (Fa)	Relative (%)
Very High	8 -12	0	0.00%	4	13.33%
High	6-7	0	0.00%	23	76.67%
Low	4-5	28	93.33%	3	10%
Very Low	1-3	2	6.67%	0	0.00%
Total			100%	30	100%

Based on the results of the average value and standard deviation of the overall fundamental movement skills of children. Then the value before the treatment (pretest) consisting of 30 samples was 56.50, the lowest score was 47, and the highest score was 68, with a standard deviation or standard deviation of 5.36. After the treatment (posttest), fundamental movement skills were obtained with an overall average of 82.60. The lowest score is 76, the highest score is 92, with a standard deviation of 4.58.

Table 9. Mean value and standard deviation (SD) of pretest and posttest data

Indicator		Average (x)	Lowest Score	Highest Score	Standard Deviation
Fundamental Movement Test	Pretest	56,50	47	68	5.36
	Posttest	82,60	76	92	4.58

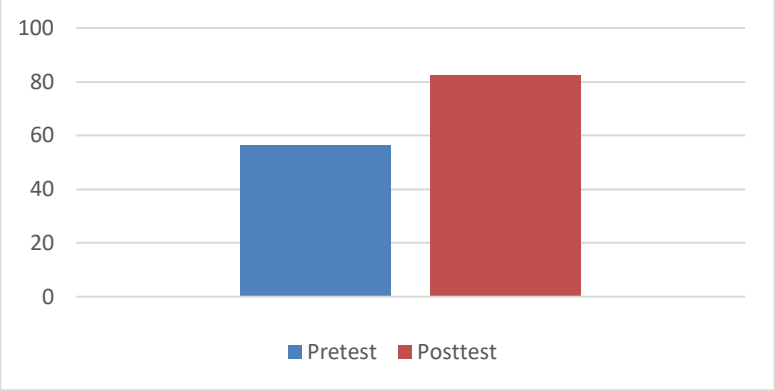

Figure 2. Diagram comparison of pretest and posttest results

Based on the influence test that has been carried out to answer whether the proposed hypothesis is accepted or rejected using the t-test, the results of fundamental movement skills are obtained with a t count of 59.44 which is then compared to the t table. Then obtained d.b = (N-1) with a significance level of 5% of 1.699. The conclusion of the fundamental movement skills test with a t-value of 59.44> t table 1.699 means that the hypothesis is accepted so that there is an effect of traditional games on children's fundamental movement skills with a presentation of an increase of 46.50%. The overall P-value results are less than <0.05, indicating that there is a relationship or there is an effect of the effectiveness of traditional games on children's fundamental movement skills.

Table 10. T-Test values

Treatment	Description	t-test	d.b	t table	Significant Level	Presentation of changes	p-value
Traditional Games	Pretest-Posttest	59.44	29	1.699	5%	46.50%	0.00

DISCUSSION

This study aims to determine the influence and effectiveness of traditional games on the fundamental movement skills of children aged 5-6 years. From the results of static calculations show there is an influence and effectiveness on fundamental movement skills in children aged 5-6 years. These results can be seen before treatment and after treatment using the TGMD-2 assessment instrument.

This is supported by research Akbari et al., (2009) that traditional games can improve children's fundamental movement skills. When compared to previous research Kusumawati (2018) Traditional games are equally effective for fundamental movement skills. This is because traditional games are fun and are done through play. The play approach in children can also improve various other aspects of development including social, emotional, personality, cognitive, and spiritual (Burriss & Burriss, 2011). The application of traditional games has many benefits, the first is very easy to play and use tools or facilities in the surrounding environment, very simple without using costs so imagination and creativity are needed. Second, this game involves many people so that the utilization of learning time becomes more effective and efficient, besides that it also does a lot of movement activities so that the ability to communicate and interact with peers is more active. Third, traditional games contain ancestral values and moral messages such as the values of honesty, togetherness, sportsmanship, responsibility, enthusiasm, and obeying the rules (Burriss & Burriss, 2011).

The results of the analysis also show that children's fundamental movement skills are in the high category (Hardy et al., (2010) said that mastery of fundamental movement skills is influenced by bio-psychosocial and environmental factors. As we know, the development of technology today makes children already love smartphones that provide various interesting features for children. The lack of children's fundamental movement skills may be due

to the reduction in children's physical activities that are consumed by playing smartphones (Zulfikar et al.,2021).

The traditional games used have been modified and have been arranged in a simple way so that children are easy to do and learn the game but do not change the main principles of the game. In addition, aspects that need to be considered in modifying traditional games are motion activities that are tailored to child development, and game steps that are easily understood by teachers and children. The traditional games used in this study are *engklek, gobag sodor* and *boi-boinan*. In contrast to previous research, the traditional game used is only one type (Kusumawati, 2018). Motion activities are contained in traditional games that have been modified in the form of fundamental motion skills. The choice of fundamental movements is an activity that children must do because at that age they begin to experience sensitivity to receive stimuli (Sutini, 2013) and also sensitivity (Hasanah, 2016). Not only that, at this time children also have a very large sense of curiosity, further the development of children aged 5-6 years during motor maturity so that fundamental movement skills are important in supporting physical activity and capital to be healthy and reduce the risk of diseases such as hypertension, diabetes, osteoporosis and cardiovascular disease (Bremer, 2016).

Fundamental movement skills are movements that do not occur naturally but occur when there is physical activity and by more complex areas, so with the mastery of fundamental movement skills, children may participate in doing physical activities (Bustiando & Nurkholis, 2018). Fundamental movement skills can also be said to be one of the stages that will make children actively explore their body movement abilities. Fundamental movement skills develop from the process of learning results by responding to a stimulus with a form of motion control and fundamental movement skills are influenced by maturity and environmental factors (Lemos et al., 2012).

Based on the results of the analysis and research that has been done, it proves that modified traditional games on the ability of children's fundamental movement skills. The existence of these results is expected that traditional games are an important concept to be implemented in the learning process, especially in learning fundamental movement skills in preschool. The advantage of this research is that it is able to influence fundamental movement skills by applying traditional games. As is known, traditional games are starting to be abandoned and are rarely seen in the implementation of fundamental movement learning in preschools. This is because traditional games are considered as folk games that do not keep up with the times, especially the rapid development of technology. The shortcomings in this study are that the assessment indicators used only include 8 movement skills consisting of running, jumping, leaping, horizontal jumping, catching, kicking, throwing, and rolling the ball. Not only that, the shortcomings are also found in the small number of participants and the application time of traditional games is also not long.

Conclusion

From the research that has been carried out, the conclusion shows that there is an influence and effectiveness of traditional games on fundamental movement skills in children aged 5-6 years. The application of traditional games can affect the fundamental movement skills of children aged 5-6 years. These results are in the form of changes in results before treatment (pretest) and after treatment (posttest) with indicators of assessment of movement skills of running movement, jumping motion, gallop, horizontal jumping movement, catching movement, kicking movement, throwing motion, ball rolling motion, and leap movement when showing changes for the better.

The achievement in this study is because traditional games have been modified and adapted to the development of early childhood. In addition, traditional games are conceptualized using a child-centered approach so that it attracts children to do fundamental movement skills activities well. For the future, only further research needs to be carried out to be tested with a larger number of participants, a long time, and cover all aspects of fundamental movement skills.

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Conflict of Interest

We declare that the article we have written is not involved in any conflict of interest.

Ethics Statement

This research has been approved by the Ethics Committee of the University of State Yogyakarta (Reg.No.:T/66/UN34.9/KP.06.07/2024).

Author Contributions

Study design, AF, D and YA; Data collection, AF; Statistical analysis, AF; Data interpretation, AF, D and YA; Literature search, AF, D and YA. All authors have read and approved the published version of the manuscript.

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RESEARCH ARTICLE

Physiological and Technical Analysis of Male Athletes from the Bumi Siliwangi Pencak Silat Club in Indonesia

Kusnaedi KUSNAEDI[*1], Yusuf HIDAYAT[2], Alit RAHMAT[2], Yogi Surya PRATAMA[2], Neslisah Aktas USTUN[3], Agung ROBIANTO[4] and Dywa Ikal MUTAQIN[2]

[1]Magister of Sports Science, School of Pharmacy, Institut Teknologi Bandung / Indonesia
[2]Faculty of Sport and Health Education, Universitas Pendidikan Indonesia, Bandung / Indonesia
[3]Faculty of Sport Science, Recep Tayyip Erdogan University / Turkiye
[4]Faculty of Sport Science, Universitas Negeri Jakarta / Indonesia
*Corresponding author: kusnaedi@fa.itb.ac.id

Abstract
The Indonesian Pencak Silat Team made a brilliant achievement at the 2018 Asian Games by winning 14 gold medals and 1 bronze medal. Seeing the increasing popularity of Pencak Silat, identifying the physiological characteristics of these athletes is very interesting, but currently there are not many studies that examine this. Therefore, this study aims to examine the physiological profile of male Pencak Silat athletes at the Bumi Siliwangi club. This observational study involved two testing sessions, namely a laboratory session to measure anthropometry, VO2max, flexibility, agility, and anaerobic power, and a field session to analyze match performance, including technique, heart rate, and lactic acid levels. The results showed that athletes had an average height of 166.44 cm, a BMI of 20.1 kg/m², a body fat percentage of 11.89%, and a muscle percentage of 37.53%. The average flexibility is 21.08 cm, agility is 5.63 seconds, peak power is 624.64 watts, and average power is 459.37 watts. This study concludes that Pencak Silat is an intermittent sport with moderate to high intensity, then the results of the study stated that pencak silat athletes from the Bumi Siliwangi club have physiological characteristics that are almost similar to athletes from other Asian countries. Thus, this study can be used to strengthen and become a reference for other research.

Keywords
Pencak Silat, Physiological Characteristics, VO2max, Agility, Anaerobic Power, Martial Arts Performance

INTRODUCTION

Pencak Silat is a typical Indonesian martial art (Mulyana & Lutan, 2021). This sport is one of the characteristics of Indonesia. With various situations and developments experienced by the Indonesian people, pencak silat is present as a culture and method of self-defense and has become local wisdom for its practitioners (Rachman et al., 2023). Pencak silat is a branch of sport that emphasizes dexterity, the numbers in this martial art are divided into two groups, namely art numbers and sparring numbers (Harahap & Mahfud, 2023).

Although other countries also have their own martial arts, Pencak Silat is an ancestral heritage of Indonesia that has developed in various regions and has become a symbol of unity in Indonesian culture (Geertz, 1983; Suwaryo et al., 2008). On May 18, 1948, Pencak Silat warriors gathered and formed an organization called the Indonesian Pencak Silat Association (IPSSI) which later changed its name to the Indonesian Pencak Silat Association (IPSI). In 1980, the Inter-State Pencak Silat Association (PERSILAT) was formed, which established regulations in the field of Pencak Silat sports in 1985.

The development of Pencak Silat is very rapid both domestically and internationally. Since 1973, Pencak Silat has been part of the National Sports Week (PON) and continues to be competed until

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now. Pencak Silat has also developed into a competitive sport that is competed in the Asian Games, SEA Games, and European and World Championships. At the 2016 World Championships, it was reported that 37 countries participated (European Pencak Silat Federation, 2016).

The success of the Indonesian Pencak Silat team at the 2018 Asian Games by winning 14 gold medals and 1 bronze medal is an extraordinary achievement. One of the contributing athletes is Hanifan Yudani Kusumah who caught the public's attention with his victory.

Pencak Silat is a sport that requires physical development, especially in the sparring category. Important physical components include speed, agility, flexibility, strength, endurance, reaction, accuracy, and balance (Bompa & Buzzichelli, 2019). All of these components play an important role in improving basic sports technique skills (Saputro & Siswantoyo, 2018). Furthermore, studies also state that the observable indicator is the mastery of the basic techniques of the sport. Mastery of basic techniques with regular, systematic, repeated training and increasing loads will affect organs such as the heart, respiratory system, and blood circulation.

Therefore, to find out the effects caused by this sport, considering the increasing popularity of Pencak Silat martial arts, identifying the physiological characteristics of athletes is very interesting. However, in reality, research on the physiological characteristics of Pencak Silat is still minimal. For example, there is a study that examines the performance characteristics of Pencak Silat athletes, but only highlights the physiological characteristics of relevant elite exponents and identifies the characteristics of Pencak Silat fight results through videos only, both studies do not explain further about the physiological characteristics (Soo et al., 2018). Then there is also research that describes the physiological demands and physical profiles of elite-level athletes and martial artists (Aziz et al., 2002), and research that compares the physiological characteristics of Pencak Silat with other martial arts (Abidin et al., 2018; Apriantono et al., 2020). However, there has been no in-depth research on Pencak Silat in Indonesia or a comparison of the physiological characteristics of Pencak Silat athletes from various countries.

Based on previous references and interest in the challenge of researching the physiological characteristics and performance of Pencak Silat athletes specifically (Aziz et al., 2002; Saputra & Muzaffar, 2022) then comparing the physiological characteristics of Indonesian Pencak Silat athletes with Pencak Silat athletes from several countries in Asia (Irianto & Lumintuarso, 2020). In this study, researchers will try to measure the physiological characteristics of Pencak Silat athletes in the men's category more intensively in the laboratory, as well as analyzing Pencak Silat match statistics in the sparring category.

Thus, this study aims to assess the physiological profile of Pencak Silat athletes in the men's category. This study is expected to provide new or additional findings that strengthen previous references on the physiological characteristics of Pencak Silat athletes in the sparring category.

MATERIALS AND METHODS

This research was conducted in November 2021 and research ethics approval was obtained from the Ministry of Education, Culture, Research and Technology, Indonesian University of Education, project number 1322/UN40.A6/KP/2024.

This research is an Observational Study (Rezigalla, 2020). This study consists of two testing sessions, the first is a laboratory test session which aims to obtain Anthropometry, VO_{2max}, Flexibility, Agility, and Anaerobic Power data. While the second session is a field test which aims to get the results of match analysis seen based on techniques in Pencak Silat movements, heart rate, and blood lactate. There is a minimum interval of 48 hours between sessions. All experiments will be reported in manuscripts and conducted in accordance with the ethical standards of the Declaration of Helsinki (Smith, 1980). Figure 1 shows the Research Plan Framework for this study.

Participants

The population in this study involved accomplished athletes who were members of the Bumi Siliwangi Pencak Silat Club. The sampling technique in this study was purposive sampling (Fraengkel, 2009). This technique includes people who are selected based on certain criteria determined by the researcher based on the research objectives, while people who do not fit the criteria are not sampled. The criteria for sampling are as follows:

Inclusion and Exclusion Criteria

Inclusion criteria are criteria for research subjects who can represent research samples that qualify as samples (Notoatmodjo, 2002). The sample criteria in this study are as follows:

Male, 16-18 years old , Willing to participate in the research thoroughly. Subjects are skilled athletes who regularly participate in competitions in the previous two years and regularly practice at least 10 to 12 hours a week. The research subjects were sparring category Pencak Silat athletes who had participated in national and international tournaments.

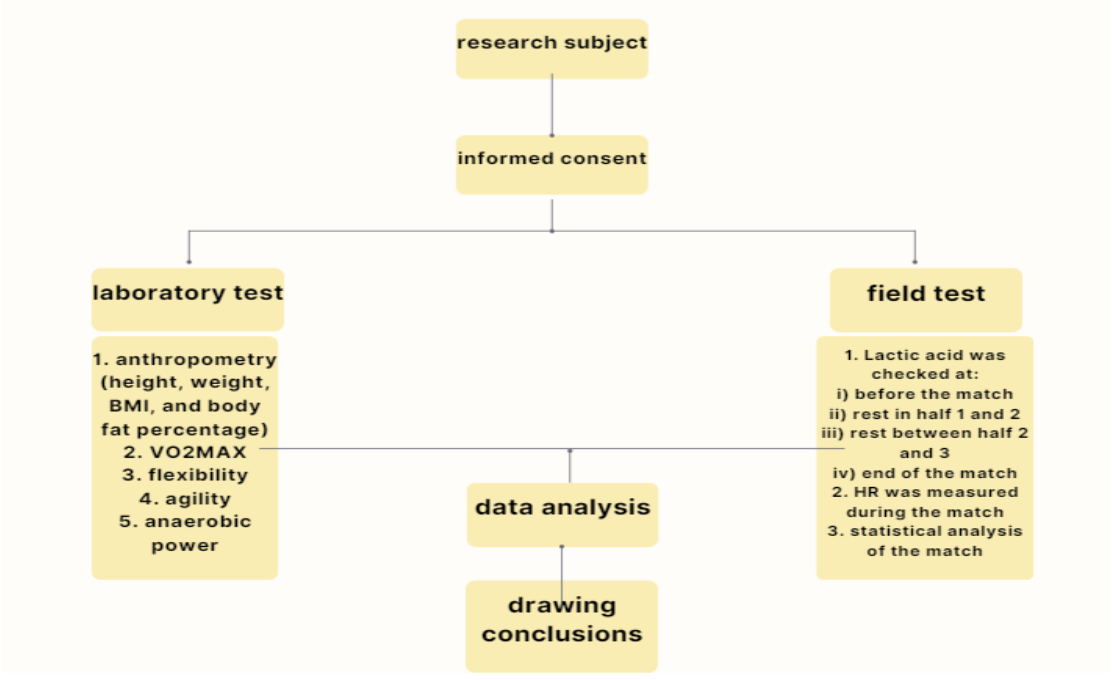

Figure 1. Research plan framework

Exclusion Criteria

Exclusion criteria are criteria for research subjects who cannot represent research samples and do not qualify as samples (Notoatmodjo, 2002). Included in the exclusion criteria in this study are subjects who are experiencing / in the recovery period of an injury so that it has the potential to interfere with performance during the study.

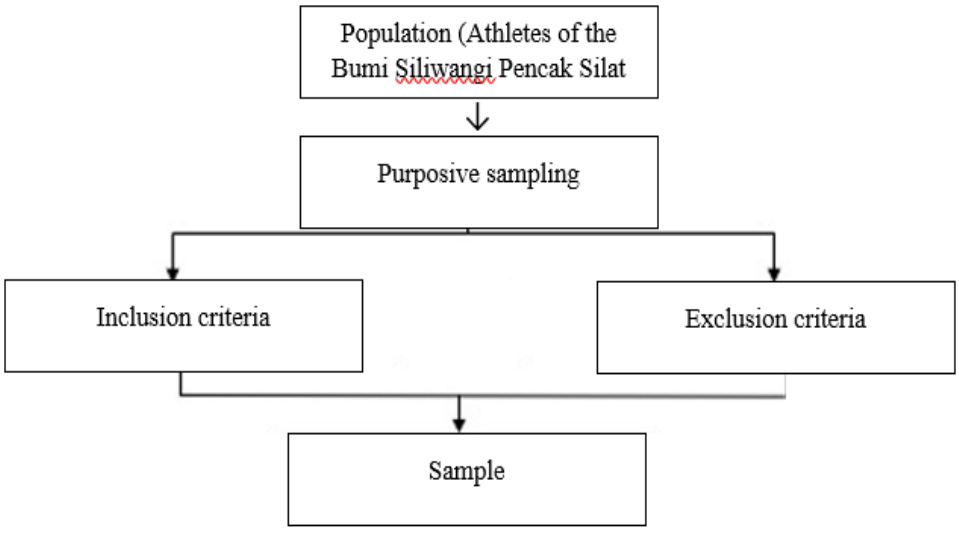

Figure 2. Participants flowchart

Data Collection

The dependent variables in this study are anthropometry, VO_{2max}, flexibility, agility, anaerobic power, heart rate, lactic acid levels.

Flexibility data collection using the takei flexibility measuring instrument, the method used is the Sit and Reach Test.

Agility data collection using the Smart Speed measuring instrument, the method used is 5-10-5.

Anaerobic Power data collection using Smart Speed measuring instruments, the method used is Running Based Anaerobic Test (RAST).

Retrieval of VO_{2max} data for Pencak Silat athletes which will be taken using the Bleep Test method.

Assessment of blood lactic acid, using a portable Accutrend Plus lactate meter (155x62x18.5 mm) battery (3x1.5 V, AAA type) weighing about 100 g. The range of measurement values is 0.8-22 mM. The device is suitable for use in athletes who produce high lactate concentrations mainly due to the contribution of anaerobic metabolism and also produces good accuracy. Blood was taken from all subjects by the blood sampling personnel. The volume of blood taken from the athlete's fingertip was 25-50 µ blood for each analysis.

Subjects were asked to wear a polar Heart Rate H10 from before the match to the end of the match. Heart rate measurements were taken to determine how much the athlete's heart rate was during each round of competition.

The statistical analysis of the match used the mechanism of recording the match using a camera, which was positioned at 5-meters from the north of the field, with a camera height of 3-meters. The techniques assessed for statistical analysis included kicks, punches, catches, and falls.

Data were analyzed by calculating the mean and standard deviation of each individual. Then conduct statistical tests by first knowing whether the data is normally distributed or not. By knowing the data is normally distributed, it can determine the test to be used whether parametric or non-parametric statistical tests using the help of the SPSS application.

Prosedures

Before the data collection process begins, the researcher first conducts sampling based on the inclusion and exclusion criteria that have been determined to the population, namely the Pencak Silat bumi siliwangi club which is under the auspices of the Bumi Siliwangi Pencak Silat Club It has been determined that 12 sparring category Pencak Silat athletes are included in the inclusion criteria, while 2 more athletes are not allowed to be subjects because they fall into the exclusion criteria that have been previously determined.

After the subject is determined, the subject has been given an explanation and introduction to the tools that will be used 2 days before the research begins. Subjects are invited to read the informed consent sheet after getting an explanation related to the research. Subjects who are willing to take part in the study then sign the informed consent. Subjects who are not willing after receiving an explanation have the right to resign without any sanctions.

There are 2 sessions in the study, the first session is laboratory testing, and the second session:

First Session (Laboratory Test)

Anthropometric data collection of subjects by collecting data on age, height, and body weight, muscle mass, fat mass. Figure 3 show Omron Karada Body Composition Monitor HBF-375.

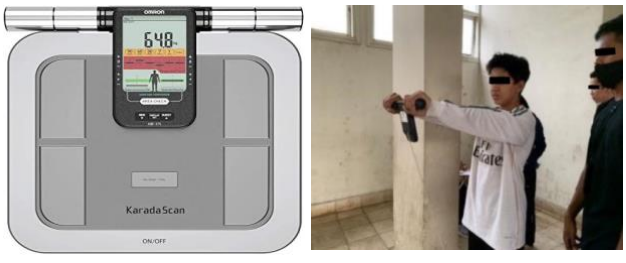

Figure 3. Omron Karada Body Composition Monitor HBF-375

Flexibility data collection using the Digital Anteflexion Meter measuring instrument, and the method used is the Sit and Reach Test. Figure 4 show Digital Anteflexion Meter.

Figure 4. Digital anteflexion meter

Agility data collection using smart speed measuring instruments, the method used is the side step test. Figure 5 show smart speed fussion for agility 5-10-5.

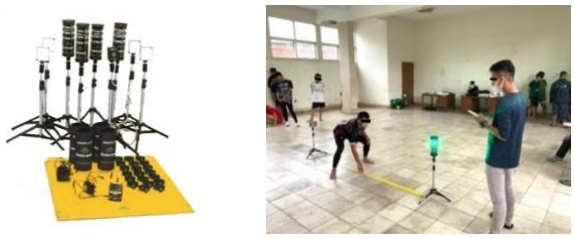

Figure 5. Smart Speed Fussion for Agility 5-10-5

Anaerobic Power retrieval using Smart Speed Fussion measuring instrument, the method used is Running Based Anaerobic Test (RAST). Figure 6 show *Smart Sp.eed Fussion for RAST*

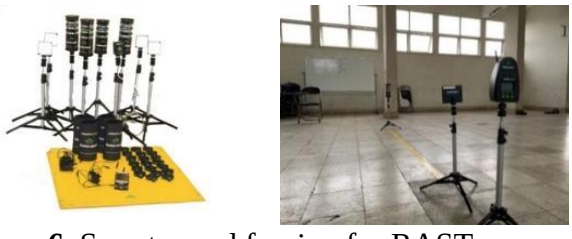

Figure 6. Smart speed fussion for RAST

VO_2max data collection of Pencak Silat athletes who will be taken by the Beep test method.

The next process is the interval / pause before entering the second session, which is for 48 hours.

Second Session (Laboratory Test)

In this field test session, the subject is given an explanation regarding the procedures for the field test and the risks that can occur.

The subject is wearing a heart rate sensor, namely the Polar Hate rate monitor H10 on the chest before wearing a body protector to get his heart rate. Figure 7 show *Heart Rate Monitor Chest Strap Polar H10.*

Figure 7. Heart rate monitor chest strap polar H10

After the sensor is successfully worn, the subject will then be asked to wear a body protector, pubic protective equipment, a plug, and other athlete needs. Figure 8 show *Body Protector Pencak Silat.*

Figure. 8 *Body protector pencak silat*

The subject will be asked to perform Fighting as Fighting during a real match, and the subject is asked to compete in an all-out match. Figure 9 show simulation match

Figure 9. Pencak silat match simulation

Lactic acid levels will be checked by taking blood from the fingertips of the subjects using Accutrend Plus. Figure 10 show Accuratrend Plus ater Kit

Figure 10. Accutrend plus meter kit

Lactic acid levels were checked each round as described below:

Before the Match

Break between innings 1 and 2

Break between innings 2 and 3

End of Match

The entire match is recorded for match analysis purposes

RESULTS

The main objective of this study is to examine the physiological characteristics of the Bumi Siliwangi Pencak Silat Club, especially the men's competition category. This study was conducted in November 2021 - December 2021. Based on the

results of the research that has been carried out, and after the data has been successfully analyzed, the results of anthropometric measurements are obtained which are displayed in table 1 as follows:

Table 1. Statistical analysis anthropometry

Variables	Average $\bar{X}(SD)$
Age (Years)	16,75 (±1,31)
Height (cm)	166,44 (±5,77)
Body Weight (Kg)	55,73 (±7,81)
BMI (kg/m^{-2})	20,1 (±1,68)
Body Fat (%)	11,89 (±4,30)
Muscle Mass (%)	37,53 (±1,91)
Vo_{2max} (ml/kg /min)	49,63 (±4,95)

Table 1 explains that the average age of the current subject is 16.75 (±1.31) years, with a height of 166.44 (±5.77) cm, weight 55.73 (±7.81). Based on age and the results of measuring height and weight using Omron Karada, the average BMI of all participants was 20.1 (±1.68) kg/m-2, the percentage of body fat was 11.89 (±4.30) percent, and the percentage of muscle owned by Pencak Silat athletes was 37.53 (±1.91) percent. In addition to anthropometry, other measurements of Vo_{2max} using the beep test method and obtained an average VO_{2max} of 49.63 (±4.95) ml / kg / min.

Measurement data of Flexibility, Agility, and Annaerobic Power

After anthropometry is obtained, the next assessment is carried out in the same session, namely the laboratory test session where the subject will be examined for flexibility using takei flexibility, agility with the 5-10-5 method with the help of the smart speed fussion tool, and assessment of anaerobic ability using the Running Based Anaerobic Test (RAST) metote which is assisted by the smart speed fussion tool as well, so after the data is successfully obtained, it is immediately processed so that the data can be presented in table 2 as follows:

Table 2. Statistical analysis flexibility, agility, and anaerobic power measurement results

Variables	*Average $\bar{X}(SD)$*
Flexibility (cm)	21,08 (±2,04)
Agility (Sec)	5,63 (±0,28)
Peak Power (Watts)	624,64 (±80,328)
Mean Power (Watts)	459,37 (±74,694)

In table 2, the average flexibility of Pencak Silat athletes is 21.08 (±2.04) cm, and also the agility possessed by Pencak Silat athletes taken using Smart Speed Fussion with the 5-10-5 Agility method, the results obtained are 5.63 (±0.28).

To get Mean Power and peak power done with the Running Based Anaerobic Test (RAST) method with the help of smart speed fussion tools, the average power result is 459.37 (±74.694) and the highest power is 624.64 (±80.328).

Field Test Result Data (Match Simulation)

In the field test results taken based on the results of the simulation of the match category Pencak Silat match with a total of five matches, the following Pencak Silat match statistics can be seen in table 3 below:

Table 3. Statistical Analysis Average techniques used from all athletes

Punch in	Kick In	Successful parry	Successful drop
12	24	14	4

Notes: The average is taken through video recordings of matches and statistical processing of the five matches played.

In Table 3, quantitative data is presented regarding the number of basic techniques performed by all subjects during the competition from the first round to the third round, the results show that on average the subject performs 12 punches that enter points, also on average the subject kicks to get points as many as 24 kicks, in addition, the table also explains that on average the subject makes a successful catch 14 times, and among these catches the average subject can knock down the opponent four times in one match.

Table 4. Statistical analysis comparison of average techniques based on win/loss

Indicator	Win	Lose	*p-value*
Punch In	8 (±1,4)	5 (±2,6)	0.330
Kick In	14,6 (±3,7)	9,4 (±1,7)	0.685
Successful Parry	7,6 (±3,1)	6,4 (±3,4)	0.817
Successful drop	2,8 (±1,2)	1,4 (±1,0)	0.314

In the data table 4, it is known that the average incoming punch in each match is 8 (±1.4) punches by the winner, while the loser can only hit with an average of 5 (±2.6) times in each match. In addition, the average kick that entered the point in each match was 14.6 (±3.7) kicks by the winner, while the loser could only kick an average of 9.4 (±1.7) times in each match. In addition, the average successful catches made in each match were 7.6 (±3.1) catches by the winner, while the losers could only make successful catches with an average of 9.4 (±1.7) times in each match, then legal falls were 2.8 (±1.2) times by the winner and 1.4 (±1.0) times by the subjects who were declared losers. ANOVA has revealed that there were significant differences between the number of punches, kicks, catches and falls made by the winning subjects and the losing subjects (all different within the significant level of $p<0.05$).

Heart Rate and Lactic Acid

Heart rate and lactic acid are tested during laboratory test sessions, before the match simulation starts the athlete is wearing a heart rate sensor on the chest using Polar H10 and later the heart rate will be seen in each round, besides that lactic acid will also be assessed in four tests, the first before the match starts, the break between the first and second rounds, the second and third round breaks, and the end of the match. Therefore, the following data is obtained:

Table 5. Statistical analysis average heart rate of pencak silat athletes during match simulation

Variables	Heart Rate Assessment (bpm)			
	Before the Match	Round 1	Round 2	Round 3
Heart Rate	71.7 (±9.9)	186 (±8,93)	188,7 (±7,67)	190,6 (±9,61)

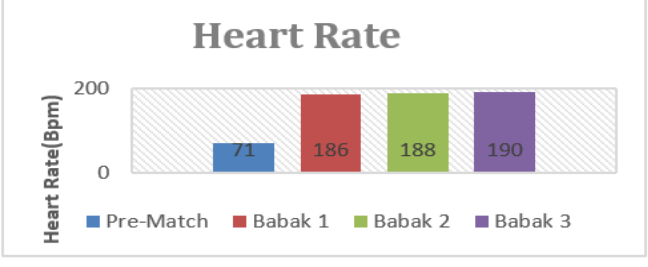

Figure 10. Heart rate diagram

From the data in table 5 above, the results showed that when the first round was completed and an average of 186 bpm was obtained, then the heart rate was taken after the second round ended and an average of 188.7 bpm was obtained, then the pulse was taken after the third round ended and an average of 190.6 bpm was obtained. Apart from the heart rate, researchers also took blood samples to find out the lactic acid levels in the blood of male sparring category Pencak Silat athletes.

Table 6. Statistical Analysis Average lactic acid levels of Pencak Silat athletes during match simulations

Variable	Penilaian asam laktat			
	Rest	Round 1	Round 2	Round 3
Asam laktat	2,08 (±0,32)	5,73 (±1,03)	6,15 (±1,43)	8,12 (±3,21)

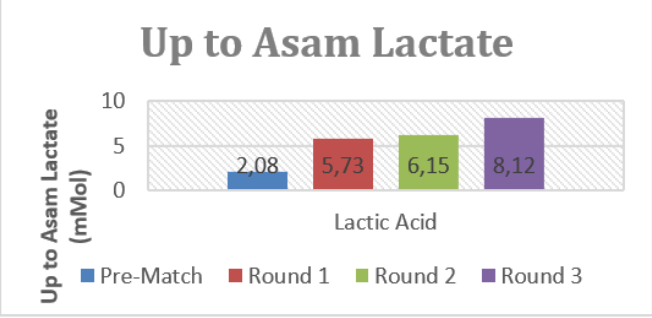

Figure 11. Diagram of lactic acid levels in the blood

From the data in table 6 above, the results show that at rest has an average of 2.08 (±0.32), then blood sampling to know the lactic acid level at the break of the first half to the second half and obtained an average of 5.73 (±1.03), then blood sampling to know the lactic acid level at the break of the second half to the third half and obtained an average of 6.15 (±1.43).

DISCUSSION

The main objective in this study is to assess the physiological characteristics of male sparring category Pencak Silat athletes. Based on the references that researchers have so far followed, that research on the physiological characteristics of Pencak Silat athletes is still not much in demand, as evidenced by the existence of only three studies, namely those conducted by Rashid Aziz et al., (2002) which collected data on the physiological characteristics of elite Singapore Pencak Silat athletes and then compared their characteristics with takwondo and judo. In other research conducted by Abidin et al., (2018) which compares the physiological profiles of Malaysian boxing, muay thai and Pencak Silat athletes, and the latest research is research conducted by Apriantono et al., (2020) which compares the physiological characteristics of junior taekwondo athletes compared to Indonesian junior Pencak Silat athletes. Based on the references that researchers have reviewed more deeply, this research is the first study that does not compare the physiological characteristics of Pencak Silat athletes with other types of martial arts, but the findings of this study will be compared with previous research examining Pencak Silat based on its physiological characteristics. Then this research examines more deeply the physiological characteristics of Pencak Silat athletes strengthened by assessing flexibility, agility, hand grip, and aerobic and anaerobic abilities of Indonesian Pencak Silat athletes (Subekti et al., 2019; Zulfa et al., 2022).

Based on some of our findings, male sparring category Pencak Silat athletes have an average body height of 166.44 (±5.77) cm, then the average BMI of all participants is 20.1 (±1.68) kg/m-2, body fat percentage is 11.89 (±4.30) percent, and muscle percentage is 37.53 (±1.91) percent. In terms of height, Indonesian Pencak Silat athletes are not much different from athletes from Singapore with an average height of 1.72 (± 0.8) and Malaysia with an average height of 1.64 (± 0.08). Researchers assume that the role of nutrition and training characteristics has an important role in order to improve the anthropometric quality of athletes in Indonesia today (Larson-Meyer et al., 2020)

Athletes who have VO_{2max} more than 45.5 ml-kg^{-1}-min^{-1} will have better match performance than athletes who only have VO_{2max} less than 45.5 ml-kg^{-1}-min^{-1}(Winata, 2020). Based on the research results contained in table. 1 where Indonesian Pencak Silat athletes have an average VO_{2max} of 49.63 (± 4.95) and are assumed to have better match performance because they have an average VO_{2max} of more than 45.5 ml-kg^{-1}-min^{-1}. When compared to Pencak Silat athletes from Singapore and Malaysia, the Indonesian Pencak Silat athletes found by researchers tend to have a better VO_{2max} average than Malaysian Pencak Silat athletes. And recent research conducted by (Apriantono et al., 2020) found that Indonesian junior Pencak Silat athletes have an average VO_{2max} of 53.23 (±1.93) ml-kg^{-1}-min^{-1} better than Malaysian (Abidin et al., 2018) and Singaporean Pencak Silat athletes (Aziz et al., 2002).

Men's sparring category Pencak Silat athletes must have good flexibility, agility, and anaerobic power to be able to perform their best techniques (Khotimah et al., 2023; Suwindia & Muliarta, 2023). In table 2, it is found that the average flexibility possessed by Pencak Silat athletes is 21.08 (±2.04) cm, in addition, the average agility of Pencak Silat athletes is 5.63 (±0.28) seconds.

Data collection of average power and peak power of Singaporean and Malaysian Pencak Silat athletes using the Wingate Test method with a bicycle ergometer. The average power of Singaporean athletes is 9.3 (0.7) (Aziz et al., 2002) and Malaysian athletes 450.17 (±66.72) (Abidin et al., 2018). Whereas in the research that researchers do to get Mean Power and peak power is done by the Running Based Anaerobic Test (RAST) method with the help of smart speed fussion testers. RAST testing has been validated as an evaluation protocol option for sports that use locomotion (Aziz & Chuan Teh, 2004), and it was found that post-effort physiological responses (lactate concentration and HR) were very similar (Queiroga et al., 2013). After the test was conducted, the average power result was 459.37 (±74.694) and the highest power obtained was 624.64 (±80.328). Anaerobic Power of Singaporean Pencak Silat athletes looks better than athletes from Indonesia. This is related to in addition to the different levels of athletes between Indonesia and Singapore, the results of anaerobic power testing using the RAST method tend to have smaller values when compared to the Wingate Test method in testing (Ferna, 2009).

Then in the performance of the Pencak Silat match it was found that the dominant technique used by Pencak Silat athletes was kicks with an average of 14.6 (±3.7) kicks entered in each match carried out by the winner, as well as subjects who experienced defeat also used kicking techniques with an average of 9.4 (±1.7) times in each match. Then the results of this study are reinforced by the fact from the results of research conducted by Soo et al., (2018) that for attacking movements, the use of a single front kick is most widely used compared to punching techniques in Pencak Silat matches. Furthermore, Soo et al., (2018) explained specifically that Pencak Silat athletes use better active defense techniques as well, especially by using side kicks and front kicks. So it can be concluded that kicks in Pencak Silat are the dominant technique used. Then the average incoming punch in each match is 8 (±1.4) punches by the winner, while the loser can only hit with an average of 5 (±2.6) times in each match.

In the analysis of the pulse rate during the match, there was an increase in each round, this increase can be described in the form of a diagram in Figure 10. Then, the results of the analysis of lactic acid levels also experienced an average increase in each round, below we present it in the lactic acid level diagram in Figure 11.

We realize that this study still has some limitations. First, the small number of subjects in this study as well as the limited number of subjects who only utilize the men's sparring category, so we suggest for future research, to be able to conduct research in other categories so that it can answer phenomena that have not been revealed in this study. Second, we realize that there are still limitations to the measurement tools we use, namely portable metabolic devices which are very necessary to assess the physiological profile of VO_{2max} in order to obtain more optimal results during laboratory testing and in the field (match simulation). We suggest that future research should pay attention to the portable metabolism device, in order to find out the physiological characteristics of Pencak Silat athletes. However, from some of the results and facts that have been found in this study, it is hoped that it can help coaches, athletes or sports researchers to find and develop better training concepts for athlete development or formulate the right formula for screening potential talent in Pencak Silat athletes.

Conclusion

Based on the results of the study on athletes who participated in the pencak silat match, it can be seen that the sparring category pencak silat is a sport that has alternating characteristics with medium - high intensity. The men's sparring category pencak silat athletes of the Bumi Siliwangi club have an average anthropometry that is almost the same as pencak silat athletes from other Asian countries. Pencak Silat athletes have average flexibility with a very good category, this will be able to help Pencak Silat athletes because the analysis of this study shows that kicks in Pencak Silat are used more often than punches or other techniques. Then during the Pencak Silat match there was an increase in heart rate and lactic acid levels in each round.

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Conflicts of Interest

The authors have no conflicts of interest to declare.

Ethical Statement

Permission to conduct research was obtained from Kementrian Pendidikan, Kebudayaan, Riset dan Teknologi Universitas Pendidikan Indonesia, numbered 1322/UN40.A6/KP/2024.

Author Contributions

Study Design, K, YH, NAU, DIM; Data Collection, K, AR, YSP, NAU, AR, DIM; Statistical Analysis, K, YH, YSP, NAU; Data Interpretation, K, YH, YSP, NAU; Manuscript Preparation, K, AR, AR; Literature Search, K, AR, AR. All the authors agreed on the final draft of the manuscript before submitting it for publication.

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RESEARCH ARTICLE

"Gobak Sodor", Indonesian Traditional Game to Improve Agility of Children with Disabilities

Ibnu Fatkhu ROYANA[*1], Pandu KRESNAPATI[1], Danang Aji SETIYAWAN[1], Muh Isna Nurdin WIBISANA[1] and Mert KURNAZ[2]

[1]Faculty of FPIPSKR, Department of PJKR,Universitas PGRI Semarang, Semarang / Indonesia
[2]Faculty of Sports Sciences, Department of Physical Education and Sport Teaching, Haliç University, Istanbul / Türkiye.
*Corresponding author: ibnufatkhuroyana@upgris.ac.id

Abstract
The traditional game of gobak sodor is a small game whose rules can be simplified according to the conditions of the players. Agility is very important for students with disabilities as it improves their physical abilities and social interactions. The purpose of this study was to determine the effect of traditional gobak sodor games on improving the agility of students with disabilities. This research adopts a quantitative with experimental methods. The experimental design applied in this research is PreExperimental Design with one group pretest-posttest model. The intervention was conducted 16 times within 2 months. The samples of this study were 20 students with intellectual disabilities from grades 4, 5, and 6 of State Special School (SLB). The measuring instrument used to collect data in this study is an agility test, which is measured by a 4 x 10 metre alternating running test (Shuttle run) for students with disabilities. The data obtained were statistically analysed using the t-test formula. Based on the calculation of the t-test that has been carried out, it is obtained that Tscore is worth 2.239173 and Ttable is worth 1.832937. So it can be concluded that there is an effect of "Gobak Sodor", a traditional Indonesian game to improve the agility of children with disabilities State Special School (SLB) of Wiradesa, Pekalongan Regency. Based on the results of the study between the pretest and posttest, there was an increase in the agility test results of students with disabilities at the State Special School (SLB) of Wiradesa.

Keywords
Traditional Game, Gobak Sodor, İndonesian, Student Disabilities, Agility

INTRODUCTION

Play and games are crucial for children's development, serving as a foundation for cognitive, social, and emotional growth. Research indicates that play enhances creativity and problem-solving skills, allowing children to explore their environment and learn through experience (Whitebread et al., 2017). Furthermore, engaging in games fosters social interactions, teaching children essential skills such as cooperation, negotiation, and conflict resolution (De Almeida et al., 2024). Additionally, play is linked to physical development, as it encourages movement and coordination, which are vital for overall health (Shakhobiddinovna, 2024). However, the balance between structured and unstructured play is essential; while structured activities can provide specific learning outcomes, unstructured play allows for greater freedom and creativity (Martins da Silva et al., 2024). Moreover, the emotional benefits of play cannot be overlooked, as it provides a safe space for children to express feelings and cope with stress (Prado & Farias, 2023). Thus, integrating diverse play experiences is fundamental for holistic child development.

Children with intellectual disabilities experience delays in cognitive development that impact their intellectual and social functioning (Indriarti et al., 2022). Their motor development,

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including both gross and fine motor skills, is often slower compared to typically developing children (Ariani et al., 2022; Wouters et al., 2020). These children may struggle with coordination, balance, and muscle strength, which affects their ability to perform physical activities like walking, running, or grasping objects (Özkan & Kale, 2023; Zaragas et al., 2023). Additionally, they might show less motivation or initiative in engaging in physical tasks. With appropriate interventions, such as physical therapy and targeted activities, children with intellectual disabilities can improve their motor skills and gain greater independence (Pinru Phytanza & Burhaein, 2019).

Physical education for children with disabilities must refer to the characteristics of students with various limitations (Hutzler & Choresh, 2024; Majoko, 2019; Tarantino et al., 2022). It is very important to apply the right learning methods to improve their motor skills. The motion learning method applied must be able to attract the interest of students with disabilities in performing movements, so as to improve student movements (Farrell & Leung, 2024; Tarantino & Neville, 2023). By using appropriate learning methods, students will be more interested in doing movement after movement, as well as improving their physical fitness.

Small games are physical activities that involve simple games with easy-to-understand rules that can be played by small or large groups (Asnaldi & Syampurma, 2020; Junianto et al., 2023). Small games are often used in the context of physical education, training, or recreational activities to develop motor, social, and cognitive skills in participants, especially children (Amin et al., 2021; Pratama, 2022). Traditional games are simple games that are part of small games.

Traditional games play a significant role in cultural heritage and social development across various communities. Research indicates that these games not only serve as a means of entertainment but also facilitate the transmission of cultural values and social norms among generations. For instance, Morejón Calixto et al. highlight the educational benefits of traditional games, emphasizing their potential to enhance cognitive skills and promote teamwork among participants (Morejón Calixto et al., 2024). Similarly, Farahani and Mirsafi discuss how traditional games can foster community bonding and cultural identity, particularly in regions where modern influences threaten local customs (Farahani & Mirsafi, 2024). Cheong and Hussain further elaborate on the psychological benefits, noting that engagement in traditional games can reduce stress and improve mental well-being (Cheong & Hussain, 2024). However, Anshory and Sumarjo point out that the decline in participation due to urbanization poses a risk to the preservation of these games (Anshory & Sumarjo, 2024). Luchoro-Parrilla et al. advocate for integrating traditional games into educational curricula to ensure their survival and relevance in contemporary society (Luchoro-Parrilla et al., 2024). Overall, traditional games are vital for cultural continuity and community cohesion, warranting efforts for their preservation and promotion.

Gobak sodor is a traditional Indonesian game played by two teams, with the main objective being to cross lines guarded by the opposing team. The game is played on a rectangular field divided into sections by horizontal and vertical lines. One team is in charge of keeping the opponents from crossing the lines, while the other team tries to cross all the lines from front to back, then back again without being touched by the guards (Manihuruk et al., 2022; Puspitasari et al., 2022). This game not only hones agility and speed, but also cohesiveness and strategy in organising team movements (Ansharudin et al., 2022).

The traditional game of gobak sodor is a small game whose rules can be simplified according to the conditions of the players (Karimah et al., 2021). Based on the results of the study, traditional games are proven to improve children's motor development, both gross motor and fine motor (Phytanza et al., 2023; Sutini, 2018). The results of other studies (Erwanda & Sutapa, 2023) that the development of gobak sodor playmat products has proven effective in improving the gross motor skills of children aged 5-6 years.

Agility is very important for students with disabilities as it improves their physical abilities and social interactions. Research shows that agility training, such as plyometric programmes, significantly improves agility, speed and social engagement among students with disabilities, demonstrating the effectiveness of inclusive physical education strategies (Stefanica et al., 2024). Moreover, agile methodologies in developing digital learning ecosystems for students with disabilities ensure user-centred designs that cater to their unique needs, promoting better rehabilitation outcomes (Aguilar Carlos et al.,

2024). Additionally, research shows a positive relationship between agility and balance in athletes with disabilities, suggesting that improving agility can also improve overall coordination and physical stability (Mustafa et al., 2014). Thus, fostering agility not only supports physical development but also enriches social interactions and overall quality of life for students.

State Special School (SLB) of Wiradesa, Pekalongan Regency has 6 classes with an average of 20 students in each class. Most of the students have down syndrome. Based on the observation, students still have difficulties in performing physical movements, especially agility. It takes time for students to understand the speed of movement and respond to each instruction given. The purpose of this study was to determine the effect of traditional Indonesian games, namely gobak sodor on the agility of students with disabilities at State Special School (SLB) of Wiradesa.

MATERIALS AND METHODS

This research has met ethical rules. Research ethical approval was obtained from the UPGRIS Research Ethics Committee with project number 075/LPPM-UPGRIS/VII/2024.Participant provided informed consent, with the volunteer form covering research details, risks, benefits, confidentiality, and participant rights. The research strictly adhered to the ethical principles of the Declaration of Helsinki, prioritizing participant's rights and well-being in design, procedures, and confidentiality measures.

Type and Design

This research adopts a quantitative method, which is an approach that focuses on collecting and analysing data in numerical form (Little et al., 2024). This study uses a research design with experimental methods. Experimental research is one of the most effective methodologies for researchers. The experimental design applied in this research is PreExperimental Design with one group pretest-posttest model (Norman & Fraenkel, 2009). This research procedure begins with conducting an initial test (pretest), then followed by a final test (posttest) to evaluate changes in the condition of the sample that has received the intervention. Intervention method is a research approach in which researchers apply an action or treatment (intervention) to a specific sample group. The goal is to observe and measure the effects or changes that occur in the sample due to the intervention provided (Cousin & Rui, 2011). The intervention was conducted 16 times within 2 months at State Special School (SLB) of Wiradesa, Pekalongan Regency. The population that became the subject of this study were students of State Special School (SLB) of Wiradesa, Pekalongan Regency. The Stratified Random Sampling method was used to select samples in this study. Stratified Random Sampling is a sampling method in which the population is first divided into homogeneous subgroups or strata based on certain characteristics (Nguyen et al., 2019). The samples of this study were 20 students with intellectual disabilities from grades 4, 5, and 6 of State Special School (SLB) of Wiradesa, Pekalongan Regency.

Research Instruments

Research requires measuring instruments to collect the data needed. In this study, what will be measured is agility using the 4 x 10 metre shuttle run test.

Instruments or measuring instruments in research are devices or tools used to collect the necessary data (Salmia, 2023). The measuring instrument used to collect data in this study is an agility test, which is measured by a 4 x 10 metre alternating running test (Shuttle run) for students with disabilities. The procedure for implementing this shuttle run test involves participants who must run between the prepared stakes for 10 metres 4 times back and forth. After that, the researcher will record the time it takes for participants to complete one series of shuttle runs. The research data was collected twice, namely during the pre-test and post-test. In the final stage, the research data was analysed using a t-test to identify mean differences between samples (Norman & Fraenkel, 2009).

Data Collection Technique

In the data collection process, the information collected includes the results of the initial measurement test and the results of the final measurement test. Shuttle run is a type of fitness test that measures a person's agility, speed and endurance. In this test, participants run back and forth between two points that are a certain distance apart, usually 10 metres, as fast as possible (Dangi, 2019). In the implementation of this shuttle run test, participants must try to achieve the fastest possible time. That is, the less time it takes to complete a series of shuttle runs, the better the level of agility.

Data Analysis Technique

The data obtained were statistically analysed using the t-test formula. Interpretation of the results of the t-test is done by comparing the calculated t

value (t score) with the t value found in the t table (t table) at a significance level of 5% and degrees of freedom (dk) = N - 1. If t score is greater than t table, then H0 is rejected and H1 is accepted, which means there is an effect of small games on the agility of students with intellectual disabilities.

RESULTS

This research was conducted State Special School (SLB) of Wiradesa, Pekalongan Regency. The research was conducted from January 2 to July 30 with 12 meetings. The subjects in this study were students in grades 4, 5 and 6 of State Special School (SLB) of Wiradesa, Pekalongan Regency, totaling 20 students consisting of 14 boys and 6 girls.

The description of research data serves to facilitate reading of research data. The description of the research data includes pretest data and posttest data from the research conducted. In this chapter, the research data will be presented one by one, from pretest data and posttest data of traditional Gobak Sodor games to improve the agility of students with disabilities in grades 4, 5 and 6 State Special School (SLB) of Wiradesa, Pekalongan Regency. The following is a description of the data obtained:

$$\bar{x} = \frac{\sum xi}{n}$$

$$= 37.031$$

$$s = \sqrt{\frac{1}{N-1} \sum_{i-1}^{N} (xi - \bar{x})^2}$$

$$= 4.55$$

From the total data obtained 32 from the pretest and posttest, the minimum value is 31, the maximum value is 46 the mean is 37.03 and the standard deviation is 4.55. After that, calculate the value obtained in the pretest and posttest.

Student Agility Level During Pretest

The pretest data description is based on data obtained from the measurement test results at the time of the pretest or before treatment. The results of descriptive analysis of pretest data of traditional Gobak Sodor games to improve the agility of State Special School (SLB) of Wiradesa students in Pekalongan Regency obtained a maximum Personal best (best time record) of 46, minimum value of 32, mean 37.43, median 36.5, mode 32, and standard deviation value of 4.53. The following is the frequency distribution table.

Table 1. Frequency distribution of pretest

No.	Class Interval	Frequency	Percentage
1.	32 - 34	7	36,50%
2.	35 - 37	2	18, 45%
3.	38 - 40	4	16,25 %
4.	41 - 43	3	14,0%
5.	44 - 16	4	14,5%
Total		20	100%

Based on the table above, it can be seen that most of the students with disabilities at State Special School (SLB) of Wiradesa, Pekalongan Regency during the pretest. In detail, there were 7 students (36.50%) in the 32-34 class interval, 2 students (18.45%) in the 35-37 class interval, 4 students (16.25%) in the 38-40 class interval, 3 students (14.0%) in the 41-43 class interval and 4 students (14.5%) in the 44-46 class interval. If summarized in the form of a histogram, then the following is a histogram of the pretest data frequency distribution data.

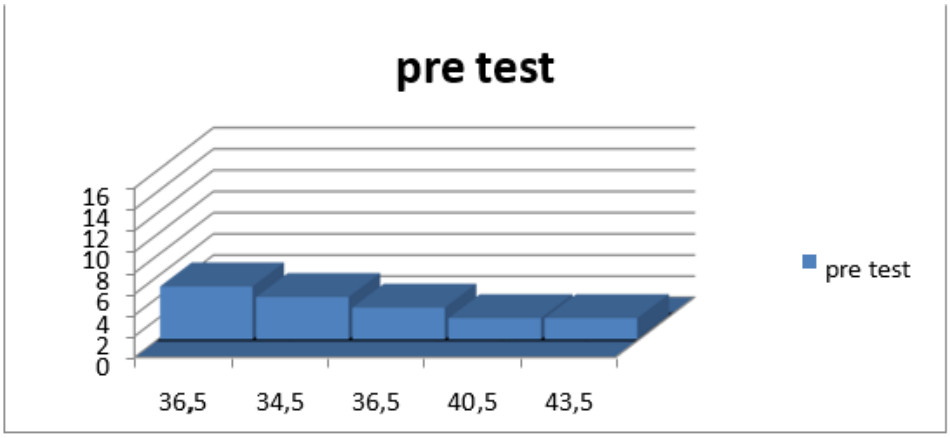

Figure 1. Pretest histogram

Student Agility Level At Posttest

The description of posttest data is based on data obtained from the measurement test results at the time of the posttest. The results of descriptive analysis of posttest data of traditional Gobak Sodor games to improve the agility of students with disabilities at State Special School (SLB) of Wiradesa, Pekalongan Regency obtained a minimum Personal best (best time record) of 31, a maximum value of 49, an average of 38.18, a median of 38.5, a mode of 33, and a standard deviation value of 6.27. The following is the frequency distribution table

Table 2. Frequency Distribution of posttest

No.	Total Value	Frequency	Percentage
1.	31 - 33	4	18%
2.	34 - 36	4	37,75%
3.	37 - 39	2	15,25 %
4.	40 - 42	4	14,50%
5.	43 - 45	6	14,50%
Total		20	100%

Based on the table above, it can be concluded that most of the students with disabilities at State Special School (SLB) of Wiradesa, Pekalongan Regency experienced changes during the posttest. In detail, 4 students (18%) from the 31-33 class interval, 4 students (37.75%) in the 34-36 class interval, 2 students (15.25%) from the 37-39 class interval, 4 students (14.50%) in the 40-42 class interval, and 6 students (14.50%) in the 43-45 interval. If summarized in the form of a histogram, then the following is a histogram of the pretest data frequency distribution data.

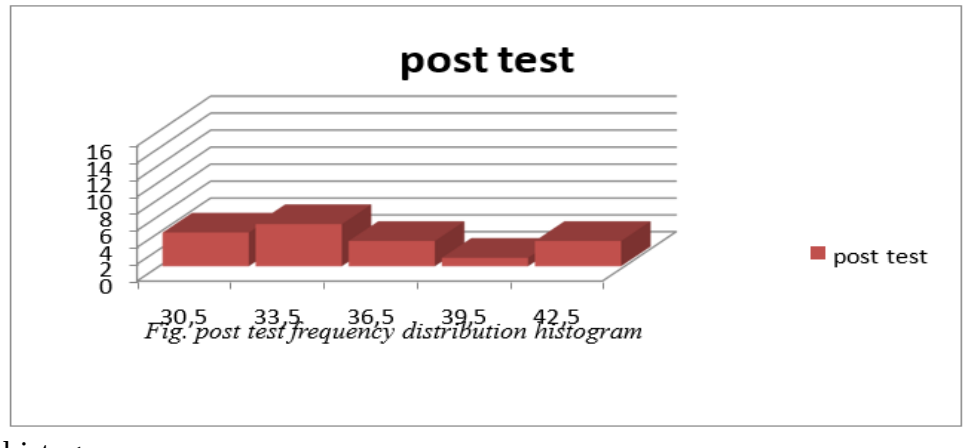

Figure 2. Posttest histogram

Analysis Prerequisite Test

Before conducting the t-test, a prerequisite analysis of data analysis will be carried out which includes normality test and homogeneity test. The results of the prerequisite analysis test are presented below:

Standard Deviation Test

The standard deviation test is used to measure the amount of variation or spread of a number of data values. Here's how to calculate the standard deviation:

Formula:

$$s = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}(x_i - \bar{x})^2}$$

Standard deviation of pre test:

$$s = \sqrt{\frac{1}{N-1}\sum_{i-1}^{N}(xi - \bar{x})^2}$$

= 6.72

Standard deviation of post test:

$$s = \sqrt{\frac{1}{N-1}\sum_{i-1}^{N}(xi - \bar{x})^2}$$

= 5.27

Normality Test

The normality test is used to determine whether there is a change in agility in tunagharita students through a variety of small games using the *Lilliefors* test formula. If $L_{score} < L_{table}$ then the results are not normal if $L_{score} > L_{table}$ then the results are normal. The formulation of the hypothesis to be tested is as follows:

Table 3. Normality test results

Description	Pretest	Post test
Average	39.9362	37.372
Standard deviation	6.836382	6.728392
Scoreer	0.158392	0.157923
Ltable (sig level 0.05)	0.213	0.213
Decision:	**Not Normal**	

Based on the normality test table 4.3 the pretest and posttest results show that $L_{score} < L_{table}$ which means the results are not normal.

Homogeneity Test

The homogeneity test is used to see the similarity of the two variants of the pretest and posttest. The results of the homogeneity test are in the following table:

Table 4. Homogeneity test

Description	Average	Variance S ^{2}	Fscore	Ftable	Decision
Pretest	38.7513	21.53783	0.9589250	0.6838956	Homogeneous
Post test	38.821	22.73723			

The homogeneity test is a test of the equality of data variants, this study is to compare the largest variant and the smallest variant. Based on the homogeneity test table above the pretest with the variant value (S) is 21.53783 while the variant value on the posttest (S^2) is 22.73723 from the calculation results there is F_{score} is 0.9589250 and F_{table} is 0.6838956. The table above uses a significant level $\alpha = 0.05$, it can be seen that the results show that $F_{score} = F_{table}$. So it can be concluded that there is no significant difference, meaning that the data is homogeneous or the same.

T-test Analysis

Hypothesis testing or t-test is conducted to determine whether or not there is a significant effect on the learning model of traditional Gobak Sodor games to improve the agility of State Special School (SLB) of Wiradesa students in Pekalongan Regency.

Table 5. T-test t-Test: two-sample assuming unequal variances

	Variable 1	*Variable 2*
Mean	38.7513	37.821
Variance	21.53783	22.73723
Observations	20	20
Hypothesized Mean Difference	0	
df	30	
t Stat	0.5102939	
P(T<=t) one-tail	0.3301	
t Critical one-tail	1.832937	
P(T<=t) two-tail	0.648293	
t Critical two-tail	2.239173	

Based on the calculation of the t-test that has been carried out, it is obtained that Tscore is worth 2.239173 and Ttable is worth 1.832937 so that the result is $T_{score}>T_{table}$ which means that there is an influence on the speed of children with disabilities. So it can be concluded that there is an effect of "Gobak Sodor", a traditional Indonesian game to improve the agility of children with disabilities State Special School (SLB) of Wiradesa, Pekalongan Regency.

DISCUSSION

An inclusive and pro-disability national curriculum is essential to ensure that every child, regardless of physical or cognitive ability, has equal access to quality education. This means creating a welcoming and supportive learning environment for students with disabilities, where their special needs are recognized and met through adapted teaching methods and adequate resources (Setyaningrum et al., 2021). With an inclusive curriculum, students with disabilities can develop their full potential in academic, social and emotional aspects without feeling isolated or marginalized from their peers (Alnahdi, 2020; Gage, 2021).

Partiality in the national curriculum also has significant long-term impacts on social and economic development. Students with disabilities who receive inclusive education have a greater chance of actively participating in society, working and living independently (Kurnia & Apsari, 2021). This not only benefits the individual but also contributes to diversity and overall social well-being (Pramantik & Burhaein, 2019). By integrating the principles of inclusion in the national curriculum, a country demonstrates its commitment to human rights and social justice, which in turn supports the achievement of the sustainable development goals (SDGs), particularly in terms of quality education for all (Billingsley & Bettini, 2019; Leu, 2022).

Integrating traditional games such as gobak sodor into the national physical education curriculum can make a significant contribution to students' physical and mental development (Usmeldi, 2020). Gobak sodor, which involves fast movements, coordination and strategy, serves as an effective means to improve students' motor skills, such as agility and dexterity (Batsiran & Junaidi, 2022). By making this game part of the physical education routine, students will not only get a balanced physical workout, but also the opportunity to develop social skills such as teamwork and communication (Bertills, 2018). The game also trains students to think strategically and make quick decisions in dynamic situations, skills that are useful in many aspects of life.

Incorporating gobak sodor and other traditional games into the curriculum also plays an important role in the preservation of local culture amidst globalization (Usmeldi, 2020). By teaching these games in schools, students not only learn about the importance of physical activity, but also get to know and appreciate their nation's cultural heritage. This can build a sense of cultural pride and identity among students from an early age.

Moreover, through formal education, traditional games can continue to be preserved and introduced to the younger generation, ensuring that this cultural heritage remains alive and relevant in the future.

Research on the effect of traditional Indonesian games on students' agility shows that the physical activities contained in traditional games significantly improve students' motor agility (Purwasih, 2020). Games such as cricket, gobak sodor, and galah asin involve fast and purposeful movements, which require hand and foot coordination and quick responses to changing situations. This study found that students who regularly participated in these games showed higher improvements in agility than those who were not actively involved (Ansharudin, 2022; Faridah et al., 2024).

Traditional Indonesian games such as engklek, benteng, and galasin have been shown to have a positive influence on student agility. The physical activities contained in these games require students to move quickly, change direction suddenly, and balance the body in various positions. Research conducted by (Nugraha et al., 2023) shows that students who regularly play traditional games have a better level of agility compared to students who are not involved in the game. This is due to the intensive training of muscles and body coordination that occurs during the game.

The game of gobak sodor is one of the traditional Indonesian games that has proven effective in improving students' agility skills. In this game, players are required to move quickly and agilely past guards who try to block them on a narrow path. A study conducted by (Kurniawan & Junaidi, 2024; Purwasih, 2020) found that students who regularly played gobak sodor showed significant improvement in agility ability compared to students who did not participate in the game.

This increase in agility occurs because gobak sodor demands a quick and precise response in dealing with changing situations, such as determining when to move forward or backward and how to avoid guards (Wibisana & Royana, 2023). This exercise indirectly trains the muscles of the body, improves coordination between eyes and feet, and increases students' reaction time. This intensive exercise also requires strategy and quick decision-making, which overall improves students' motor agility.

The results of this study suggest that the integration of gobak sodor game into the physical education curriculum in schools can provide significant benefits in the development of basic motor skills, especially agility. In addition, the game also teaches the values of cooperation and strategy that are useful for students in wider situations. Therefore, gobak sodor is not just a physical activity but also a holistic skill development tool for students (Charunnissa, 2022; Learning et al., 2018).

Traditional games such as gobak sodor can provide significant benefits for students with disabilities, especially in terms of motor and social development. Gobak sodor, which requires players to move quickly and think strategically, can be adapted to meet the needs of students with disabilities, helping them improve agility, coordination and balance. According to research published in the International Journal of Disability, Development and Education (Dahl, 2020), structured physical activities such as traditional games have great potential to improve gross and fine motor skills in children with different types of disabilities. With the right adjustments, gobak sodor can be a means to increase the confidence and social participation of students with disabilities, allowing them to feel a sense of accomplishment and success in inclusive physical activity.

In addition to the physical benefits, gobak sodor also plays an important role in supporting the social and emotional development of students with disabilities. The game requires students to interact and cooperate with peers, which can improve communication skills and strengthen social bonds. Research by (Jung, 2022) in the Journal of Adapted Physical Activity showed that participation in group games can help reduce the sense of social isolation and increase the engagement of students with disabilities in the school environment. Gobak sodor, with its inclusive and participatory approach, can create a supportive environment where students with disabilities feel accepted and valued, which in turn contributes to their emotional well-being.

Traditional games such as gobak sodor have great potential in supporting the physical and cognitive development of students with disabilities. Gobak sodor, which involves repetitive movements and simple rules, can help improve basic motor skills such as agility, coordination and balance in students with intellectual disabilities. According to research published in the *British Journal of Learning Disabilities* (Bonati, 2021), structured physical activities, including traditional games, can

improve gross motor skills and reduce the tendency of stereotyped behaviors in children with intellectual disabilities. Through participation in gobak sodor, these students can experience significant improvements in their motor skills, which also contributes to improved daily functional abilities.

In addition to the physical benefits, gobak sodor can also support the social and cognitive development of students with intellectual disabilities. The game encourages positive social interactions and can improve communication skills and cooperation among students. A study published in the Journal *Disability & Rehabilitation* (Magnusson, 2019) found that participation in group games such as gobak sodor can improve social skills and reduce social isolation in students with intellectual disabilities. With its easy-to-understand rules and inclusive nature, gobak sodor also helps students with visual impairments understand basic concepts such as turns, rules, and simple strategies, all of which are important for their cognitive development.

Based on the results of this study, it is recommended that further studies be conducted with a wider scope and more diverse methods. One of the main recommendations is to conduct a longitudinal study to see the long-term impact of regular participation in gobak sodor on the development of agility and motor skills of students with disabilities. In addition, research involving larger and more diverse samples could provide a more comprehensive understanding of how variations in disability levels affect the outcomes of this intervention. The use of technology such as video analysis to monitor and evaluate students' movements during the game could also be a useful tool to provide more accurate and in-depth data.

The results of this study have important implications for physical education practice in schools serving students with intellectual disabilities. The integration of gobak sodor into the physical education curriculum can be an effective strategy to improve students' agility and motor skills. With support from teachers and school administrators, the game can be adapted to meet students' individual needs, allowing them to participate fully and gain maximum benefit. Further research is also needed to develop practical guidelines for teachers to implement these traditional games inclusively and effectively.

Conclusion

Based on the results of the study between the pretest and posttest, there was an increase in the agility test results of students with disabilities at the State Special School (SLB) of Wiradesa. In addition, based on the results of the normality test and homogeneity test, it can be concluded that gobak sodor (traditional Indonesian game) has an effect on the agility of students with disabilities.

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Conflict of Interest

We declare that the article we have written is not involved in any conflict of interest.

Ethics Statement

This research has met ethical rules. Research ethical approval was obtained from the UPGRIS Research Ethics Committee with project number 075/LPPM-UPGRIS/VII/2024.

Author Contributions

Study design, RIF and KM; Data collection, KP and SDA; Statistical analysis, KP and SDA; Data interpretation, RIF, WMIN and KM; Literature search, RIF, WMIN and KM. All authors have read and approved the published version of the manuscript.

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THANKS TO THE COMMITTEE OF REFEREES

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Dr. Laishram Singh	Department of Physical Education and Sports Science Manipur university, Imphal, Manipur	Dr. Levent Ceylan	Sivas Cumhuriyet University
Dr. M. Abdulbaki Karaca	İnönü University	Dr. Mert Kerem Zelyurt	Marmara University Faculty of Sports Science
Dr. Muhamad Syamsul Taufik	University Of Suryakancana	Dr. Nilgün Vurgun	Manisa Celal Bayar University
Dr. Raif Zileli	Bilecik Şeyhedabili University	Dr. Ramazan Erdoğan	Bitlis University
Dr. Salih Öner	Van Yüzüncü Yıl University	Dr. Sinan Akın	Kütahya Dumlupınar Universitesi Faculty of Sports Science
Dr. Tayfun Kara	Kahraman Maraş Sütçü İmam University	Dr. Yasemin Arı	Tekirdağ Namık Kemal University
Dr. Zekiye Özkan	Van Yüzüncü Yıl University	Dr. İsa Çiftçi	Bingöl University
Dr. Ahmad Nassar	Palestine Technical University-Kadoorie	Dr. Ahmet Kurtoğlu	Bandırma Onyedi Eylül University
Dr. Ahmet Atlı	Iğdır University	Dr. Ali Radhi Abdul Hussein	Ministry of Education, Iraq
Dr. Bereket Köse	Hatay Mustafa Kemal University	Dr. Bojan Doljak	University of Ljubljana, Faculty of Pharmacy
Dr. Erkal Arslanoğlu	Sinop University, Faculty of Sports Science	Dr. Esra Ergun	Üsküdar University
Dr. Gamze Aydin	İstanbul Okan University	Dr. Gizem Karakaş	Sakarya University of Applied Sciences, Faculty of Sports Sciences
Dr. Halil Uzun	Tarsus University	Dr. Hamdi Alper Güngörmüş	Aladdin Keykubat University, Faculty of Sports Sciences
Dr. Hasan Güler	Aydin Adnan Menderes University	Dr. Hilmy Aliriad	Universitas Nahdlatul Ulama Sunan Giri
Dr. Hüseyin Gümüş	Mersin University	Dr. Levent Ceylan	Hitit University
Dr. Mehmet Söyler	Çankırı Karatekin University	Dr. Mehmet Demirel	Necmettin Erbakan University
Dr. Mesut Arslan	Bitlis Eren University	Dr. Metehan Yana	Karabük university
Dr. Mihri Barış Karavelioğlu	Kütahya Dumlupınar University	Dr. Noor Hatem	University of Baghdad

Dr. Osman Kusan	Gümüşhane University	Dr. Raif Zileli	Bilecik Şeyhedabali University
Dr. Rukiye Çiftçi	Gaziantep Islam Science and Technology University	Dr. Sevim Handan Yılmaz	Bartın University
Dr. Sibel Nalbant	Alanya Aladdin Keykubat University	Dr. Tansu Birinci Olgun	İstanbul Medeniyet University
Dr. Vahit Çiriş	Kırşehir Ahievran University	Dr. Ülfet Erbaş	Şırnak University
Dr. İsmail Ceylan	Kırşehir Ahievran University	Dr. Ayten Kaya	Ordu University
Dr. Ayşegül Yapıcı	Pamukkale University	Dr. Azliyana Azizan	Universiti Teknologi MARA
Dr. Burak Buğday	İnönü University	Dr. Fatıma Firdevs Adam	Cumhuriyet University
Dr. Joana Marie Carina M. Gabunilas	Polytechnic University of the Philippines	Dr. Johansyah Lubis	Universitas Negeri Jakarta
Dr. Jusuf Blegur	Universitas Kristen Artha Wacana	Dr. Mehmet Ilkım	İnönü University
Dr. Mustafa Kaya	Erciyes University	Dr. Mustafa Can Koç	İstanbul Gelişim University
Dr. Osman Tayyar Çelik	İnönü University	Dr. Oğuzhan Çolakkadıoğlu	Osmaniye Korkut Ata University
Dr. Pradnya Ghadage	Krishna Institute of medical sciences, Krishna College of Physiotherapy, karad-Satara.	Dr. Richard Bañez	Batangas State University JPLPC-Malvar Campus
Dr. Süleyman Murat Yıldız	Muğla SıtkıKoçman University	Dr. Teejay Panganıban	Batangas State University TNEU JPLPC-Malvar
Dr. Çiğdem Gamze Özkan	Celal Bayar University	Dr. Agus Gumilar	Universitas Pendidikan Indonesiaf
Dr. Asep Sumpena	Universitas Pendidikan Indonesia	Dr. Burcu Akkurt	Fener Bahçe University
Dr. Burhan Hambali	Universitas Pendidikan	Dr. Cihangir Kaçmaz	Kayseri University
Dr. Dian Permana	Universitas Pendidikan	Dr. Elif Esma Safran	Acıbadem Mehmet Ali Aydınlar University,
Dr. Erick Burhaeın	Universitas Ma'arif Nahdlatul Ulama Kebumen	Dr. Firmansyah Dlis	University of Burundi
Dr. Marinel Dayawon	Isabela State University	Dr. Mehmet Akif Kay	Batman University
Dr. Mehmet Haşim Akgül	Burdur Mehmet Akif Ersoy University	Dr. Mohanad Omar	Palestine Technical University-Kadoorie
Dr. Oğuz Özbek	Ankara University	Dr. Reshandi Nugraha	Universitas Pendidikan
Dr. Riyan Jaya Sumantri	Universitas Ma'arif Nahdlatul Ulama Kebumen	Dr. Toni Yudha Pratama	Universitas Sultan Ageng Tirtayasa
Dr. Abdullah Bora Özkara	Karadeniz Teknik University	Dr. Fidès Bangurambona	University of Burundi
Dr. Hamza Küçük	Ondokuz Mayıs University	Dr. Japhet Ndayisenga	University of Burundi
Dr. Mehmet Güllü	İnönü University	Dr. Mert Aydogmus	Karabük University
Dr. Murat Erdoğan	Başkent University	Dr. Muthanna Hafedh	Basra Educational Directorate
Dr. Serdar Şerare	Gazi University	Dr.	