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CONTENTS

ORIGINAL ARTICLE

A biomechanical analysis of differences between natural and clinical angle degrees and correlations to performance in road cycling

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

Abstract

Background and Study Aim The study aims to determine differences between natural and clinical angle degrees in hips and shoulders, and determination of the correlations between angle degrees and functional threshold power (FTP) in road cycling athletes.

Material and Methods The study includes 11 male road cycling athletes aged 14-16 years old. The volunteer's body weight average was determined as 68.5±14.58, body height average was 175.4±6.98, and body mass index average 21.8±3.87. Volunteers are active athletes in "Büyükçekmece Road Cycling Team". To measure the performance of the cyclists clinical hip angle, clinical shoulder angle, hip angle degree, shoulder angle, functional threshold power (FTP) tests were used. The Kinovea 0.8.15 program was used in the data analysis of the variables in the study. Analyzes were performed using SPSS 26 analysis program. The analyses of the Shapiro Wilks test resulted in the normal distribution of the variables included in the study. Correlations between FTP test parameters and angle degrees, the correlation of a continued variable were calculated with Pearson correlation.

Results A statistically significant correlation between functional threshold power parameters such as distance, power avarege, total energy, cadance avarege, speed avarege, functional threshold power, and hip angle degree parameter ($p<0.05$). Similarly, correlations between functional threshold power, parameters such as power avarege and back curve resulted to be statistically significant ($p<0.05$). Also, like an functional threshold power parameter, speed avarege resulted to be in a significant correlation with the clinical shoulders angle degree.

Conclusions Based on these results, increases in the FTP parameters may affect positively the cyclist's performance helping to avoid undesirable hip angles, which may lead to back pain. Similarly, power average and back curve degree resulted to be in a correlation. Therefore, the back curve degree may be increased or decreased by the changes in the power average parameter. In addition, during the high intensity of training and fatigue levels increased, the clinical hip and shoulder angles were also increased.

Keywords: back curve, functional threshold power, natural angle, clinical angle, cyclist

Introduction

The harmony of the posture positions of the body on the bicycle according to the joint positions of the human body is important in terms of performance [1]. The literature has shown that hip and shoulder angle degree is a determinant factor in road cycling performance. It is important to analyze the difference between natural and clinical angles measured during cycling, as changes in the kinematic chain may have an effect on performance, technique efficiency, and injury risk [2]. For more, high clinical angle degrees on the back, and lack back curve may cause lower and upper back pain and decreases in performance. However, most common cycling injuries to the lower extremity are preventable [3]. In this context, up to 60% of cyclists suffer from persistent pain especially in the neck and back [4]. This issue usually results from a prolonged extension of the cervical spine and a hyper-flexed lumbar spine that induce potentially high loads and compression at the intervertebral discs during increased forward-leaning [5]. Based on the fact that the body works better in anatomical positions it can be thought that a high clinical angle degree is undesirable in road cycling. Therefore, the similarity of natural angle degrees and clinical angle degrees may avoid injuries and back pains of athletes. There are studies in the literature about riding upright, raising the body height, shortening the body length can solve back discomfort. However, the elasticity of the body tissues may allow a significant clinical angle degree, which is related to the hips, hamstrings, and shoulders muscles [6]. Also, the elasticity of the body tissues may be affected by the active flexibility [7] and mobility [4;8]. Literature has shown that more flexibility and mobility mean better dynamics in road cycling [9]. Also, low back pain may occur in riders who are overstretched on the bike. Most common cycling injuries to the

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lower extremity are preventable [10]. Some studies have reported that posture affects performance in cyclists. Recently, reported that lower torso angles attenuate performance in well-trained male cyclists [11]. For this reason, it has been observed that studies on this subject have increased rapidly in the literature in recent years.

Based on the current literature it can be seen that there is a lack of research that directly addresses the issue of the clinical angle degree effect on performance and back pain. In addition, it seems that current literature failed to determine the difference between clinical angle degrees (increases in the back curve caused by loads and fatigue), and natural angle degrees (back position while athletes are not loaded or fatigue level is low). Therefore, addressing this issue may be beneficial in cyclist training programs creating, setting training sessions, and determining the muscle groups needed to be improved. Similarly, the results of the study may help to clarify the motor abilities needed to be improved to decrease clinical angle degree, respectively back curve caused by the increase of training intensity and fatigue level of the athletes. Thus may be beneficial to decrease the back pain of the cyclist and increase the performance during competition. In the light of the previous information, it needs to determine differences between natural and clinical angle degrees during cycling, and the effects of the angle degrees on performance in road cycling.

The study aims to determine differences between natural and clinical angle degrees in hips and shoulders. Besides this, the study aims to determine the correlations between angle degrees and performance (functional threshold power FTP) in road cycling performance. In addition, by the determination of the differences between natural and clinical angle degrees, it will be determined the role of the flexibility and mobility on hips and shoulders positions during cycling.

Material and Methods

Participants

The study was included 11 male road cycling athletes aged 14-16 years old. The volunteer's body weight average was 68.5±14.58, body height average was 175.4±6.98, and body mass index average 21.8±3.87 volunteers are active athletes in "Büyükçekmece Road Cycling Team".

Research Design

To determine the differences between clinical and natural angle degrees, which occur during cycling, a causal relational research model was used [12]. Athletes were informed about the activities and tests, which were made for the study. Besides this, athletes, parents, and coaches of the team were informed about the benefits and risks (even there was not predicted any risk) of the applied activities and tests. The study was made according to the Helsinki declaration. The ethical approval of the study was taken from the Istanbul Gelisim University.

Testing Procedures

Clinical hip angle

Clinical hip angle tests reference is lumbar spine (L5) when is located me measurement tool. The angle is created by the line, which starts from the lumbar spine and continues to the greater trochanter of the femur. Similarly, the second line of the angle starts from the lumbar spine (L1-L5) and continues to the thoracic spine (T1-T12) imaginary straight line. It means that the curve of the spine is not considered in angle degree determination [13]

Clinical shoulder angle

The clinical shoulder angle test includes an imaginary line across the thoracic spine and the second line across the acromion and lateral epicondyle of the humerus. The angle degree created by the imaginary line across the thoracic spine and line across the acromion and lateral epicondyle of the humerus is named the clinical shoulder angle degree. It means that the curve of the spine is not considered in angle degree determination. It may help to determine the curve degree of the spine during cycling [13].

Hip angle degree

Hip angle degree measurements reference is greater trochanter of the femur, which is the center of the angle. The first line of the angle starts from the greater trochanter to the lateral epicondyle of the femur. The second line of the angle degree starts from the greater trochanter to the acromion [13].

Shoulder angle

Shoulder angle degree measurements reference is acromion, which is the center of the angle. The first line of the angle starts from the acromion and continues to the lateral epicondyle of the humerus. The second line of the angle degree starts from the acromion and continues to the greater trochanter [13].

Note: To determine the differences of the back curve during the FTP test execution in the testing process of the angle degree, the athlete was photographed in 1st, 5th, 10th, 15th, and 20th minutes (every 5 mins). The angle degree that occurred in each position were compared to each other. Measurements were made when the leg was completely straight which means that the pedal was at 5 o'clock.

Functional threshold power (FTP) test

The FTP test is defined as the uppermost power sustainable for 60-min in a quasi-steady state [13]. The intensity setting of the FTP test is created to be third degree and is determined as a standard for all athletes. A 30-minute warm-up protocol was applied before the 20-minute FTP test. The air resistance level in the control group was 1, while in the experimental group, it was 3. For this test, we

suggested 95 rpm as a good benchmark cadence, but it was not limited to this. Because the literature has shown that the preferred cadences should be determined based on the cyclist's requirements (80-100 rev. min^{-1}) [14]. The implementation of the FTP test was done on the Wattbike Pro/Trainer device [15].

Statistical Analysis

For the data analysis of the variables the Kinovea 0.8.15 program, which is a video player for sports analysis and provides a set of tools to capture, slow down, study, compare, annotate and measure technical performances (16), was used. To mark the location, measure distance, and determine the angle degree of the videos, tools of the program such as a line, circle, cross marker, angle, etc. were used. The videos were recorded with a Galaxy S10, which has three cameras on the back: a main 12-megapixel with an aperture that shifts between f/1.5 and f/2.4 depending on light, an ultra-wide 16-megapixel unit, and a telephoto 12-megapixel for zooming.

Analyzes were performed using SPSS 26 analysis program. To determine the normality of the data, the Shapiro Wilks test was used. The analyses of the Shapiro Wilks test resulted in the normal distribution of the variables included in the study. To determine the general values of the variables descriptive statistics were applied. Correlations between FTP test parameters and angle degrees, the correlation of a continued variable were calculated with Pearson correlation. Differences between Hip angle degree (natural and clinical angles), and shoulder angle degree (natural and clinical angles) were calculated by using Independent T-test statistics. The difference percentage between natural and clinical angle degrees was calculated by using the formula "%Δ = (x natural angle – x clinical angle) / clinical angle".

Results

In table 1, where the average values were given, has been determined the normality of the FTP test and its parameters which seem to be normal (mesocortical) expecting the CPrpm which the kurtosis value resulted to be leptokurtic. Besides this, results were divided into three categories (25th, 50th, and 75th) as percentile values to be used as determinants for cyclists' level on the FTP test and its parameters.

In table 2, where the average values were given, has been determined the normality of the angle degree parameters which seem to be normal (mesocortical) expecting the BC° which the kurtosis value resulted to be leptokurtic. Besides this, results were divided into three categories (25th, 50th, and 75th) as percentile values to be used as determinants for cyclists' level on angle degrees and back curve which occur during the cyclist's performance.

Results of table 4 have determined statistically significant differences between hip angle degree ($\bar{X}$=106.6) and clinical hip angle degree ($\bar{X}$=120.3),

Table 1. Descriptive statistics and level of the FTP and its parameters

Parameters		DKm	PAwat	ET	CArpm	PPwat	PMwat	CPrpm	SAkmh	HRa	HRp	FTP
$\bar{X}$		12.17	203.0	305.6	90.64	715.5	3.1664	130.8	36.7	188.60	207.0	192.7
SD		1.04	43.6	49.8	8.016	212.0	.72362	20.4	3.0	6.5	7.9	41.6
	25th	11.31	173.0	271.0	85.0	540.0	2.95	122.0	34.0	183.7	199.2	164.0
%	50th	11.89	187.0	287.0	88.0	726.0	3.15	133.0	36.0	188.5	209.0	177.0
	75th	12.99	223.0	329.0	96.0	938.0	3.79	150.0	38.0	194.5	214.2	212.0

Distance (km): Dkm, PAwat: Power Avg (wat), ET: Total energy, CArpm: Average cadance (rpm), PPwat: Peak Power (wat), PM_wat: Power/Mass (wat), CPrpm: Peak cadance (rpm), SAkmh: Average speed (km/h), HRa: Average heart rate, HRp: Peak heart rate, FTP: Functional threeshold power; Skewness: > 1 - positive skew, ± 0 - normal, < - 1 - negative skew; Kurtosis: > +2 leptokurtic distribution, ± 2 normal (mesokurtic) distribution, < -2 platokurtic distribution.

Table 2. Descriptive statistics and level of the angle degree and back curve during cycling

Parameters		HAo	CHAo	SHAo	CSHAo	BCo
$\bar{X}$		106.6	120.3	86.2	106.2	145.322
SD		3.5	4.2	4.6	6.0	9.5542
	25th	103.3	119.0	84.0	101.1	136.3
%	50th	107.1	120.7	87.5	106.1	143.4
	75th	110.2	122.6	88.6	109.9	151.4

Had: Hip angleo, CHAo: Clinical hip angle degree, SHAo: Shoulders angle degree, CSHAo: Clinical shoulders angle degree, BCo: Back cureve degree; Skewness: > 1 - positive skew, ± 0 - normal, < - 1 - negative skew; Kurtosis: > +2 leptokurtic distribution, ± 2 normal (mesokurtic) distribution, < -2 platokurtic distribution.

where is seen that clinical hip angle is higher than natural angle degree during cycling ($p<0.05$). Similarly, statistically significant differences between shoulders angle degree ($\bar{X}=86.2$) and clinical shoulders angle degree ($\bar{X}=106.2$) were determined, where is seen that clinical shoulders angle is higher than natural shoulders degree during cycling ($p<0.05$). While the differences between hip angle and clinical hip angle degrees were determined as 13%, differences between shoulders angle and clinical shoulders angle degrees result to be 23%.

Discussion

As a result of the study differences between natural and clinical angle degrees in hips and shoulders have been determined. Besides this, the correlations between angle degrees and performance (functional threshold power FTP) have been determined. Determination of the differences between natural and clinical angle degrees determined the role of the flexibility and mobility on hips and shoulders positions during cycling.

To be more specific, a statistically significant

Table 3. Correlations between FTP test parameters and angle degrees that occur during cycling

Parameters		HAo	CHAo	SHAo	CSHAo	BCo
DKm	r	-.703	.436	-.480	.130	-.590
	p	.023	.208	.160	.720	.072
PAwat	r	-.704	.412	-.326	.212	-.624
	p	.016	.208	.327	.532	.040
ET	r	-.707	.410	-.328	.216	-.628
	p	.015	.211	.325	.524	.039
CArpm	r	-.676	.491	-.326	.217	-.658
	p	.023	.125	.327	.521	.028
PPwat	r	-.551	.225	-.356	.587	-.774
	p	.079	.506	.283	.058	.005
PMwat	r	-.385	.132	-.043	-.078	-.035
	p	.243	.698	.899	.819	.918
CPrpm	r	-.554	.533	-.197	.701	-.896
	p	.077	.092	.562	.016	.000
SAkmh	r	-.658	.434	-.305	.165	-.568
	p	.028	.183	.363	.628	.068
HRa	r	-.488	.481	.111	.743	-.617
	p	.152	.159	.761	.014	.058
HRp	r	-.213	.431	.064	.527	-.459
	p	.554	.213	.860	.118	.182
FTP	r	-.707	.411	-.326	.212	-.625
	p	.015	.209	.329	.531	.040

Distance (km): Dkm, PAwat: Power Avg (wat), ET: Total energy, CArpm: Average cadance (rpm), PPwat: Peak Power (wat), PM_wat: Power/Mass (wat), CPrpm: Peak cadance (rpm), SAkmh: Average speed (km/h), HRa: Average heart rate, HRp: Peak heart rate, FTP: Functional threeshold power; HAO: Hip angleo, CHAo: Clinical hip angle degree, SHAo: Shoulders angle degree, CSHAo: Clinical shoulders angle degree, BCo: Back curve degree.

Table 4. Differences between natural angle degrees and clinical angle degrees that occur during cycling

Parameters	$\bar{X}$	SD	%	p
HAo	106.6	3.56	13	0.000*
CHAo	120.3	4.24		
SHAo	86.2	4.67	23	0.000*
CSHAo	106.2	6.09		

HAo: Hip angleo, CHAo: Clinical hip angle degree, SHAo: Shoulders angle degree, CSHAo: Clinical shoulders angle degree.

correlation has been determined between FTP parameters such as distance, power average, total energy, average cadence, average speed, FTP, and back curve tests such as hip angle degree parameter. The degree of hip angle increases as distance, average power, total energy expenditure, average cadence, and average speed increase; It gives the result that the curvature of the back increases with fatigue, which is not a desirable situation for athlete performance. Based on this, studies are showing that increased hip angle is also associated with insufficient back strength. In addition, the insufficiency of lumbar and hamstring flexibility can be seen as the most important reason for the increase in the degree of hip angle [17]. Similarly, it is seen that there is a strong positive relationship between clinical shoulders angle degree and peak cadence. As the cadence increased, the clinical shoulder angle also increased. It can be said that one of the most important consequences of unnatural (clinic) positions is the imbalance in muscle activation of spinal flexors and extensors, which causes may be muscle fatigue [18].

In addition, a statistically significant differences between hip angle degree and clinical hip angle degree, where is seen that clinical hip angle is higher than natural angle degree during cycling. Previous studies have shown that a reduction in the back curve can improve performance and minimize the risk of injury [19]. In this study by Moshe Salai et al. [18] from the fluoroscopic/biomechanical study of cyclists, it appears that low back pain can be attributed, in part, to the anatomical extension between the pelvis and the spine. This results in tensile forces along the anterior longitudinal ligament of the lumbar spine, which increase as the result of sitting on the saddle and reclining on the handlebar, as has been shown in this work. Based on the fluoroscopic/biomechanical studies of cyclists made by Salai et al., [18] low back pain can be partially attributed to the anatomical extension between the pelvis and spine. As seen in Table 4, there is a significant difference between hip angle and unnatural (clinical) angle degree.

Schulz and Gordon's [11] pilot study of recreational cyclists found that in 95% of trials, lumbar spine flexion increased when participants cycled for 10 minutes which as the effect of gravity made an increase in spine extension more likely. They noted that the adoption of greater flexion may be a mechanism for reducing the end gap position of the lumbar facet joints and joint compression in an extended position. Considering that Schulz and Gordon's [4] study reached this conclusion even though the 10-minute cycling maintenance was quite short. Anyway, the 10 minutes' time may not be valid to get a conclusion on the matter. Therefore, using the 20-minute high-intensity FTP test would be more appropriate to get more valid results.

Conclusions

As the conclusion of the study, hip angle degree resulted to be correlated with FTP parameters such as distance, power average, total energy, average cadence, and average speed. Therefore, hip angle degree can be changed positively or negatively by the increases or decreases of the FTP parameters, especially distance, power average, total energy, average cadence, and average speed. Based on these results, increases in the FTP parameters may affect positively the cyclist's performance and help to avoid undesirable hip angles, which may lead to back pain. Similarly, power average and back curve degree resulted to be in a correlation. Therefore, the Back curve degree may be increased or decreased by the changes in the power average parameter.

When angle degrees of hips and shoulders have been compared to the clinical angles has been shown that clinical hip and shoulders degrees are higher than natural angles. This means that during the high intensity of training and fatigue levels increased, the clinical hip and shoulder angles also increased.

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Conflict of interests

The authors reported no potential conflict of interest.

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REVIEW ARTICLE

Physical education teaching in Italian primary school: theoretical lines and operational proposals

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Authors' Contribution: A-Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

Abstract

Background and Study Aim: For the new reform to be applied in the best possible way, it is a priority and useful to promote the development of knowledge on the organization and methods of teaching/learning in physical education in primary school. This study aims to search for a new didactic organizational model for physical education in primary school, starting from the theoretical lines, showing the contrasts of the significant aspects and the uniqueness of heuristic learning, with a consequent theoretical and argumentative elaboration of operational proposals.

Material and Methods: For this purpose, an accurate survey of the scientific literature has been analyzed, highlighting the critical issues that characterized the various proposals and attempt to implement physical activity and sports education courses in primary school over the years, up to the recent legislative innovation.

Results: The path of the definition of physical education in primary school was marked by stages that did not always enhance the educational and training dimension of the motor and sports experience, making the school discipline assume a marginal and optional role in the face of an extracurricular practice characterized by a widespread organization and more capable of intercepting and responding to the physical exercise and sport needs of society. This complex situation has only generated confusion without solving the problem of the absence of physical and sporting activity in the 5-10 age group, as required by the World Health Organization and the European Union, by adequately and uniquely qualified teachers. It is now useful to promote the development of knowledge on the didactic organization of the primary school, on the different teaching/learning methods in physical education, to contextualize the scope of the new legal provision to the current legal framework.

Conclusions: The study highlights the value of a new approach in teacher training that aims to ensure the acquisition of key competence, according to the Recommendation of the European Parliament. This perspective can be easily realized by using a core curriculum uniformly applied at the national level.

Keywords: sport and health, teaching method, didactic organization, physical education training

Introduction

Physical education in primary school in Italy is one of the ten teaching disciplines of the curriculum established by the Ministry of Education. After a resolution of the collegial bodies and decisions of the school manager, it is subject to the actual provision of teaching like the other disciplines in compliance with the legal framework [1]. For some time, there has been discussion on the compulsory teaching of physical education in primary school by specialist teachers, provided with the required qualification to achieve the objectives relating to health, the adoption of correct lifestyles, physical well-being, the achievement of motor skills, to learning transversal to knowledge related to the body and movement and, finally, to social skills through sports practice [2]. The recent legislative innovation, introduced by article 103 of the 2022 Budget Law [3], which provides for specialist teachers to teach physical education in primary school, has rekindled the debate that had timidly taken shape on the occasion of the government bill n. 992/2018, which already provided for the introduction of the specialist teacher of physical education in primary school to guarantee "real and qualified teaching to children through suitable and targeted interventions from the point of view of motor development, but not only, also to produce effects on the plan of learning, prevention and socialization" [4]. The formulation of article 103 has detailed the methods of implementing this innovative measure for primary schools and is therefore imminently applied by the Italian Ministry of Education. To this end, it is, therefore, a priority and useful to promote the development of knowledge on the organization and teaching/learning methods in physical education in primary

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school so that the new reform can be applied in the best possible way. Therefore, the methodological choices in Physical Education must be deepened and analyzed according to the peculiarities that characterize the fundamental theoretical approaches to motor control and learning, according to the specific learning objectives and skills development goals to be achieved at the end of primary school. Specifically, the two main approaches to motor learning (the cognitive and the ecological-dynamic approach) generate teaching methods that materialize in the spectrum of reproductive and productive teaching styles [5], directives and non-directive [6, 7] in teaching mediated by the teacher and mediated by the student [8], in an executive variability that the teacher must wisely and consciously guide.

Hypothesis. Highlighting the educational and training valence and the influence of different didactic approaches on motor learning, we want to open a critical scenario on the current organizational model for physical education in primary school.

Purpose. This in-depth study aims to highlight a new didactic organizational model for physical education starting from the theoretical lines, showing the contrasts of the significant aspects and the uniqueness and unrepeatability of heuristic learning with consequent elaboration theoretical argumentative of operational proposals.

Material and Methods

Data sources and search strategy

For this purpose, archival research was conducted by analyzing regulatory and professional documents to derive the most significant, logical and rational deductions. Archival research intends to highlight the critical issues that characterize the various proposals and attempts to implement physical activity education courses in Italian primary schools over the years, up to the recent legislative innovation. For the purpose of searching the available literature, the following databases were used: Scopus, Scholar and Web of Science. Searching was performed using the following terms (individually or in combination): teaching method, physical education, primary school, and motor learning.

All the papers and abstracts were evaluated to select potential papers to be included in the systematic overview. Relevant studies were considered after a detailed search if they met the criteria.

Type of study and analysis

Inclusion criteria. The analysis included theoretical and practical studies on motor learning approaches and the teaching of physical education in the Italian primary school.

Results

Only 20 articles met the inclusion criteria and were included in two paragraphs: one on the state of the art of physical education teaching in Italian primary school and one on the teaching styles in physical education; then concluding with a description of the desirable educational characterization of physical education in primary school through methodological proposals.

1 *Teaching styles in physical education*

The motor teaching-learning process in physical education has traditionally developed on models and practices marked by dualistic relationships (theory and practice, object and subject, mind and body, quantity and quality, etc.). This assumption affected teaching styles and the consequent approaches to learning that have been affected, and still are, by causal and linear visions and by prescriptive methodological-didactic systems. Teaching style means the modality of interaction between teacher and pupil to pursue certain educational objectives [15]. There is no teaching style par excellence, but it depends on the objectives, the type of task, the pupils, the context and the teacher. The available evidence suggests that the physical education teaching method is still linked to the traditional one based on a model's command, demonstration, and reproduction. The linear cognitive approach determines learning methods based on imitation and conditioning. These are learning based on the repetition of the task with predefined and inflexible organizational and environmental methods. Due to their predictability and repetitiveness, when skills are acquired, perfected, and automated, they produce an inversely proportional effect in terms of cognitive commitment (e.g., reduction of attention and motivation levels) [16]. With this teaching style, the teacher determines the motor task, the intensity, the duration, the constraints, etc. This educational-didactic approach is the one most used at school in physical education. Teaching is influenced by spatial and temporal constraints, spaces, equipment, reproduction styles, predefined tasks, and motor responses. In this sense, this learning modality only promotes the awareness of how motor skills are learned and not the transferability of these motor acquisitions in other disciplinary and extra-disciplinary areas [17]. The linear cognitive approach, despite the consolidated practices and the theoretical foundations in support, does not allow us to comprehensively understand the complexity of the mechanisms that are established in the realization of human movement, especially regarding the complex interaction between the individual and the environment and the circular relationship between perception and action, only understandable thanks to an ecological-dynamic approach [18].

On the other hand, the ecological-dynamic

approach is phenomenological. It describes the laws and principles on which the motor control system is based and is endowed with self-organizing properties [19]. For this approach, solutions to motor tasks appear to be the synthesis of attempts to solve the problems that arise from time to time in the environment. According to this teaching style, the teacher must limit himself to assisting the student in the autonomous search for motor solutions [20]. If the learning task is particularly complex, the teacher will not have to indicate in a prescriptive manner how to simplify motor execution but will have to modify the constraints of the environment. Self-regulation is the main element; it is, therefore, necessary to allow the free expressiveness of movement in interaction with others and within the limits of the context [21]. The ecological-dynamic approach also promotes motor learning in heuristic form through didactic experiences that are based on the variability of tasks, the modification of environmental constraints, and the appropriate use of feedback (intrinsic and extrinsic motivation) to develop original and creative motor movements [22]. The didactic proposal that the ecological-dynamic approach intends to pursue enhances learning by trial and error. Students explore new solutions to context-generated motor tasks by selecting the simplest, most immediate, and direct executive model. Consequently, even the decoding of stimulating situations in the environment becomes automatic, gradually discarding those that do not lead to the result, choosing the most appropriate ones to achieve the purpose [23].

2 *State of the art of physical education teaching in Italian primary school*

The current framework of the Italian primary school focuses on the figure of the generalist teacher, who teaches all disciplines except the discipline of religion [9]. This organizational model is consolidated in operational practices and provides for the assignment of a single weekly hour of physical education to the generalist teacher who, currently, does not possess any specific competence in the discipline, being in most cases a graduate in primary education sciences. A further step towards the "specialization" of teaching the discipline of physical education was made with the application of law no. 107 of 13 July 2015 (so-called "Buona Scuola" reform) [10]. This reform represented a valid attempt to institutionally introduce specialist teachers in primary school through "the use of generalist teachers with certified skills as well as teachers qualified to teach also for other levels of education as specialists". Nevertheless, the "certified skills", generically indicated and not declined in the specific cases, have increased the complexity, as the plurality deriving from the training models can produce the so-called "certified skills" from national and local sports bodies, from recognized training bodies without, however, relying on the university which has the specific task of training. This generic nature has generated confusion, risking betraying one of the guiding principles of the reform, which, then as now, concerns the proposition of targeted interventions by adequately and uniquely qualified teachers through the degree courses relating to the master's degree classes in motor science and sports (LM47, LM67, and LM68). Furthermore, even in the presence of these criticalities, there has been no evident sign to date of the application of the "Buona Scuola" reform concerning physical education, which, already using the strengthening staff, could have developed the objective of the "strengthening of sports disciplines and development of behaviours inspired by a healthy lifestyle". Physical education in primary school, on the other hand, continued to be taught in a non-systematic way.

Over the years, we have witnessed the succession of various proposals and attempts to implement, also through special projects with the partnership of the Italian National Olympic Committee (CONI), and recently with the government agency "Sport e Salute Spa", educational courses on physical and sporting activity [11]. After many years of curricular and special planning, culminating with the national project "Scuola Attiva Kids", this year re-proposed with the ministerial circular of 22/09/2021, the application of the recent legislative innovation introduced by article 103 of the 2022 Budget Law is awaited [12]. These physical and sporting activity education courses, albeit systematic, did not involve all schools and all students, although they were well structured. Only recently have tangible and sustainable measures taken shape thanks to the determinations and resources of the National Recovery and Resilience Plan (NRRP), which makes it possible to implement physical activity in primary school through the introduction and mandatory of further 2 hours to be allocated to physical education, held by specialist teachers, without prejudice to the possibility of co-presence for classes that adopt full-time. Government bill no. 992/2018, approved only by the Chamber of Deputies, while already introducing the innovation of the specialist teacher, presented some problems/criticalities ascribed to the non-consideration of the organizational-didactic and methodological peculiarities of the primary segment of education, as well as of the teaching discipline and of teacher training, which made it difficult to apply without specific amendments. In summary, the primary school framework and organizational-didactic practices and methodological choices, common to all disciplines, were not considered [13]. The criticalities referred to in the government bill 992/2018 have been overcome by the current law; the formulation of article 103 has provided in detail the methods of implementing this innovative measure for primary school and is

therefore imminent application by the Ministry of Education. Specifically, the implementation of the legislation provided for the fifth class starting from the 2022/2023 school year and for the fourth class starting from the 2023/2024 school year, in paragraph 329 provides the introduction of physical education teaching in primary school, held by teachers with suitable qualifications and enrollment in the related competition class "Physical education and sports sciences in primary school." Subjects with a master's degree obtained in "Sciences and Techniques of Preventive and Adapted Physical Activities" (LM-67), in "Sports Sciences and Techniques" (LM-68), or in "Management of Sport and Physical Activities" (LM-47) can participate in the aforementioned insolvency procedures. According to the decree of the Minister of Education of 9 July 2009, those in possession of qualifications equivalent to the previous master's degrees, who have also obtained 24 ECTS, acquired in curricular, additional, or extracurricular form in anthropological, psychological, and pedagogical disciplines, can also participate [4].

3 *The desirable educational characterization of physical education in Italian primary school*

For the new reform to be applied in the best possible way, it is a priority and useful to promote the development of knowledge on the organization and methods of teaching/learning in physical education in primary school. It is useful to start from the motivational cornerstones of the provision for a correct application of the law, which intends:

- respond to the emerging and urgent needs of the child population, especially in terms of health and well-being and education for correct and healthy lifestyles;
- make the educational offer of schools adequate both in qualitative and quantitative terms;
- bring Italy into line with European standards where the figure of the specialist teacher in the primary segment of education is quite widespread;
- adequately consider the guidelines of the World Health Organization on the benefits that physical activity brings to the body, its structures, and functions in a bio-psycho-social synthesis.

Therefore, the educational characterization of physical education must be related to the scientific foundations of the body, movement, sports, and recreational activity, the latter understood as mediators of learning and vehicles of educational principles [13]. Above all, the health aspects must be developed with the aim of psychophysical well-being and education for correct lifestyles. Therefore, the methodological choices in Physical Education must be deepened and analyzed according to the peculiarities that characterize the fundamental theoretical approaches to motor control and learning according to the specific learning objectives and skills development goals to be achieved at the end of primary school [14]. It is, therefore, necessary to focus the action of scientific-cultural development on the teaching methods of physical education in primary school from a specialist point of view and, consequently, disciplinary methodology to address the peculiarities of the discipline in the primary segment and the problems connected to the three application levels of the reform:

- The teaching of physical education by the specialist teacher only in the fourth and fifth primary classes and, if necessary, parallelly to that of the generalist teacher. The law introduced, without changing the staffing of teachers, the compulsory teaching of physical education for at least two hours a week by specialist teachers only in the fourth and fifth primary classes; these two hours are added to the ordinary curriculum for classes that do not adopt full time, all in compliance with the current model of the "single teacher" who should continue to teach curricular physical education as already planned by the individual schools in the respect for one's autonomy.
- Teaching in full-time classes with the joint ownership of generalist and specialist teacher. The co-presence will bring out further critical issues both in the co-planning and in the conduct and implementation of teaching activities when necessarily the generalist and specialist teachers will have to mutually adapt to find a design and operational balance in the application of teaching methods to prevent that physical education and motor skills are reductively generalist or rigidly specialist;
- teaching in the first, second and third primary classes by the generalist teacher who is, in any case, called to take into consideration the "body in motion" in teaching, both on an interdisciplinary and transversal level (life skills) and on a disciplinary level (for the achievement of specific learning objectives and goals for the development of skills relating to the body and its relationship with space and time; to the body and movement as an expressive and communicative modality; to play, sport, rules and fair play; health and well-being, safety and prevention).

Discussion

The didactic strategies to enhance heuristic learning and stimulate spontaneous solutions to motor problems are based on a single principle: exploiting executive variability or implementing a process of searching for motor solutions that pass through the continuous variation of gestures [24]. This means that it may be useful to carry out the process of solving a certain motor task by varying the speed of execution or by modifying

the environmental conditions. The variability of the practice is fundamental in quality motor activity for children. It is, therefore, necessary to understand this concept, make it enter our baggage as educators and apply it in the teaching of physical education [25]. Movement games are particularly suitable for developing physical efficiency and motor coordination [26]. Due to their characteristics of relative instability and continuous change of conditions in every playful moment generate an alternation of balance and imbalance. The practice of movement games allows the exploration of diversified motor areas, with procedures that favour the acquisition of skills and abilities essential to learn, in the future, both actions functional to everyday life and specific movement techniques, own of different sports disciplines [27]. To stimulate motor creativity, it is necessary to propose semi-defined tasks, i.e., activities in which the initial phase and the objective of the task are clearly explained, while the procedure for achieving the goal is not defined, and there is no single correct answer [28]. The indications given do not leave the child completely free but instead define his activity with few rules. This seems to facilitate the creative process, as, on the one hand, the difficulties related to understanding the task and its goal are excluded. On the other hand, the presence of the purpose stimulates the creative process, providing a theme around which to concentrate efforts [29]. The movement game also presents further perceptual and behavioural connotations, which guarantee its great educational value; it represents a particular way of organizing social relations, creating bonds, and living and understanding life.

The diversification, interchangeability, and alternation of roles between players in the game phases, typical of different playful contents in movement games, call for the development of the social skills essential to obtain a shared result [30]. The aim is not so much to invent new techniques or new exercises but to stimulate the development of both the body pattern and the postural patterns and basic motor patterns in a varied way, without losing sight of the objective of improving physical efficiency for the health. The teacher may also decide to use pre-sports games (or game-sports), i.e. activities that have a relationship with structured sports activities [32]. With them, the educator can effectively offer children a multi-sports approach, which encourages learning new and multiple motor patterns and adapting those already learned in a context that offers the possibility of experimenting with a stimulating and entertaining approach. Finally, it is useful for children to become aware of the usefulness of working out in the gym and the possibility of transferring the skills they have learned to master [33]. For example, the teacher can guide reflection by promoting communication activities like techniques borrowed from psychology, such as focus groups, peer tutoring, circle time, etc. Through them, students can self-elaborate, self-determine and self-regulate in activities, replacing the prescriptive action of the teacher.

Conclusions

The historical excursus and the analysis of the school's programmatic documents and specific design experiences have revealed the need to proceed towards structuring dynamic ecological teaching methodologies that, through a heuristic approach, favour learning by trial and error. According to the European Parliament, there is a need to seek the value of a new approach in teacher training that guarantees the acquisition of key competencies [34, 35]. This perspective can be easily realized within the use of a core curriculum uniformly applied at the national level. The study should be submitted to those who may influence any consultations, the reference scientific and pedagogical societies, to verify whether the problems highlighted can be resolved with the recent regulatory prospect or some changes must be made.

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PEDAGOGY of Physical Culture and Sports

ORIGINAL ARTICLE

The effects of knee flexion on muscle activation and performance during chin-up exercise

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Abstract

Background and Study Aim: Chin-up is an exercise that is done to improve the strength, muscular endurance and size of the upper back and arm muscles. There are many ways to perform chin-up exercises including by performing it with different forms of knee flexion. This study aims to examine the effects of knee flexion on muscle activation and performance during chin-up exercise.

Material and Methods: A total of twenty-one healthy trained male (age 20-25 years old) were recruited and were instructed to perform chin-up exercises in three knee conditions: i) knee fully flexed, ii) partial knee flexed, and iii) straight knee. Chin-up performance was measured by the number of repetitions performed in three sets. Muscle activation was measured using EMG and taken from latissimus dorsi (LD), posterior deltoid (PD), and biceps brachii (BB) during both concentric and eccentric phase. One-way repeated measure Analysis of Variances (ANOVA) were conducted to compare the muscle activation and number of repetitions performed across the three variation of chin-up exercise.

Results: Findings showed that during the concentric phase, BB recorded higher muscle activation during straight knee compared to knee fully flexed and partial knee flexed, $p < .05$. In addition, chin-up performance during straight knee and partial knee flexed were better than knee fully flexed, $p < .05$.

Conclusions: The results of this study demonstrated the importance to consider techniques manipulation during exercises due to its effects on acute responses as shown by number of repetitions and muscle activation in this study that might also affect the long-term outcomes.

Keywords: chin-up, knee, muscle activation, strength, conditioning, performance

Introduction

Strength and conditioning practitioner often include chin-up into their resistance training routines. Chin-up is an activity that can strengthen the upper body and muscle mass, especially for bicep brachii, posterior deltoid, pectoralis major, and latissimus dorsi muscles [1, 2]. The chin-up exercise is performed by hanging the entire body from a horizontal bar and then pulling all the way up till the chin is above the bar [1]. During the chin-up, the palms are facing towards the individual.

Like other exercises, changing or manipulating the techniques during the exercise execution may influence the biomechanics of the movement. Previous studies had shown the manipulation of techniques influences movement mechanics of squat [3, 4], push up [5, 6], deadlift [7, 8] and many more. Among the variables of interest to be seen as a result of techniques manipulation includes the muscle activation. Muscle activation reflect the contraction if muscle during certain movement. Muscle activation could be obtained through the use of electromyography (EMG) method.

EMG is a method for assessing muscle activation in which the EMG detects the amount of neural drive or voluntary activity in a muscle [9]. A previous study has examined muscle activation using EMG between chin-up exercise and lat pulldown [10]. The findings demonstrated that biceps brachii displayed more muscle activation in the concentric phase of the chin-up than the lat pulldown. The results also showed that in the concentric phase, the agonists' biceps brachii and latissimus dorsi exhibited more muscle activation than the antagonists' pectoralis major and triceps brachii.

Chin-up is a type of strength training exercise that is commonly used to assess or to train upper-body strength [11, 12]. As a simple yet challenging exercise to be done, the exercise can be randomly performed in many ways, such as straight knee, partial knee flexed, and knee fully flexed. However, the study that examined chin-up exercise is scarce. Little information is known on how manipulating the knee conditions would affect acute responses such as performance and muscle activation. Therefore,

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the study aims to compare the muscle activation of latissimus dorsi, posterior deltoid, bicep brachii, and successful repetition performance during chin-ups using various knee conditions (straight knee, partial knee flexed, and knee fully flexed).

Materials and Methods

Participants

Twenty-one university undergraduate male students aged between 20 to 25 years old participated in this study. Participants are trained men and physically active who have experience in strength and endurance tests. The inclusion criterion of participants involved in the study was that they did not have any previous shoulder injury. Participants will be excluded from the research if they have had a past shoulder injury or any injuries that need rehabilitation sessions.

Before the intervention, participants were given a brief explanation of the research's aims, the procedures to be followed, the risks and advantages of participating in the study. The Physical Activity Readiness Questionnaire (PAR-Q) and a consent letter were completed by the participants before data collection. Participants were informed that they could withdraw from the study at any moment and without having to offer a reason. The Ethics Committee of Human Research at Sultan Idris Education University approved the study.

Procedure

The study employed a repeated measure design. Each participant was asked to perform a chin-up using three different knee conditions (i.e., straight knee, partial knee flexed, and knee fully flexed). Figure 1, Figure 2 and Figure 3 showed the chin-up with three knee conditions. Since the study uses a repeated measure design, there may be sequence effects that influence the participants' behavior (e.g., practice effect or tiredness). The counterbalancing approach can be used to address this problem [13]. Thus, participants were randomly divided into three groups, each with seven people (Group A, B, and C). To ensure that the order of the tasks did not affect the findings, each group performed the chin-ups with different orders of the knee position. Participants in Group A performed the chin-ups starting with a straight knee, partial knee flexed, and knee fully flexed. Participants in Group B completed chin-ups with partial knee flexed, knee fully flexed, and straight knee. Participants in Group C conducted chin-ups with a knee fully flexed, a straight knee, and partial knee flexed. Participants have been tested for chin-up using one knee position in a day to avoid fatigue.

Testing procedure

EMG Marker placement

An EMG device and wireless electrodes (Trigno, Delsys, USA) were utilized to measure muscle activation based on the SENIAM guidelines. The surface EMG for non-invasive evaluation of muscles (SENIAM) was applied for muscle determination. Before using the EMG, participants were given 10 minutes to warm up. After that, the participants' skin was cleaned using an alcohol swab, as alcohol was allowed to evaporate so that the skin was dry before the electrodes were attached. As sweating might make the electrodes' adherence to the skin deteriorate, the skin preparation was done after the warm-up [1].

The area where the electrodes would be attached was shaved and cleansed for a better placement and touch the needed area. The electrodes were placed to the latissimus dorsi (LD), posterior deltoid (PD), and bicep brachii (BB) muscles on both sides of the participants. During the test period, participants were encouraged to wear comfortable but minimum clothes (short and close-fitting athletic shorts) to increase the accuracy of EMG reading. The mean value of muscle activation level during eccentric and concentric phases was observed.

Protocol

In the ready position, the shoulders of the individual are in a straight position while the feet are in a propped position, i.e. standing on the toes. In this phase, the mortar joint aids movement in the shoulder joint. The elbow closes the angular opening to make it easier for the shoulder to close the chin and this movement is called an elevation movement. At this time, the fingers of the hand grasp the bar with the strength of the digitorum extensor muscle. The chin-up began with the arms straight and completely extended on a bar. The participants must pull themselves up until the chain reaches the top of the bar. The test ends when the participant stops or rests for a while. Participants were asked to repeat these procedures for each knee condition. The number of repetitions for each knee condition was recorded in three sets.

Statistical analysis

The Shapiro-Wilk test was utilized to determine the data normality. The results confirmed that the data was normally distributed. The mean and standard deviation of muscle activation and the number of repetitions during the chin-up for each knee condition were calculated using descriptive statistics. One-way repeated measure analysis of variances (ANOVA) was used to compare the muscle activation and the number of repetitions performed. The significance level was set to $p < 0.05$. The data were analyzed using Statistical Package of Social Science (SPSS) version 20.

Results

Physical characteristics

Table 1 showed the physical characteristics of participants in this study.

Start

Middle

Figure 1. Starting and middle position of straight knee chin-up

Start

Middle

Figure 2. Starting and middle position of partial knee flexed chin-up

Table 1. Physical characteristics of participants

Variables	Mean ± SD
Age (years)	23.50 ± 0.72
Body mass (kg)	68.20 ± 1.02
Height (cm)	170.35 ± 2.10

EMG during concentric phase

Muscle activation in LD, PD, and bicep brachii BB was compared during the concentric phase between straight knee, partial knee flexed, and knee fully flexed (see Table 2). The results of one-way ANOVA demonstrated that there was a significant effect on the BB, $F(1, 20) = 301.56$, $p < .05$ during the concentric phase between the three knee conditions. However, there was no significant main effect on the LD, $F(1, 20) = 2.02$, $p > .05$, and PD, $F(1, 20) = 1.82$, $p > .05$ during the concentric phase between the three knee conditions.

EMG during eccentric phase

Muscle activation in LD, PD, and BB was compared during the eccentric phase between the three knee conditions (see Table 3). The results of one-way ANOVA demonstrated that there was no

Start

Middle

Figure 3. Starting and middle position of full knee flexed knee chin-up

Table 2. EMG reading of concentric phase during chin up between positions

EMG	Straight knee	Partial knee flexed	Knee fully flexed
LD mean (% MVIC)	70.50 ± 6.09	72.99 ± 3.15	71.25 ± 6.10
PD mean (% MVIC)	55.10 ± 4.21	56.20 ± 7.47	57.99 ± 5.15
BB mean (% MVIC)	69.38 ± 4.97 [b, c]	61.51 ± 5.21 [a]	60.35 ± 3.85 [a]

[s]Significantly difference from straight knee position; [b]Significantly difference from partial knee flexed position; [c]Significantly difference from knee fully flexed position; LD - latissimus dorsi; PD - posterior deltoid; BB - bicep brachii; MVIC - maximum voluntary isometric contraction

Table 3. EMG reading of eccentric phase during chin up between positions

EMG	Straight knee	Partial knee flexed	Knee fully flexed
LD mean (% MVIC)	50.71 ± 3.72	51.87 ± 2.39	50.83 ± 2.06
PD mean (% MVIC)	41.76 ± 2.12	40.85 ± 3.83	40.42 ± 4.74
BB mean (% MVIC)	48.01 ± 4.48	48.00 ± 5.37	50.54 ± 6.40

[a]Significantly difference from straight knee position; [b]Significantly difference from partial knee flexed position; [c]Significantly difference from knee fully flexed position; LD - latissimus dorsi; PD - posterior deltoid; BB - bicep brachii; MVIC - maximum voluntary isometric contraction

Table 4. The number of chin-up repetitions using three positions

Variable	Straight knee	Partial knee flexed	Knee fully flexed
Number of repetitions	13.50 ± 0.77[c]	13.78 ± 0.95[c]	11.03 ± 0.99[ab]

[a]Significantly difference from straight knee position; [b]Significantly difference from partial knee flexed position; [c]Significantly difference from knee fully flexed position

significant main effect on the LD, F (1, 20) = 1.63, p > .05, PD, F (1, 20) = 0.32, p > .05, and BB, F (1, 20) = 1.79, p > .05, during the eccentric phase between the three knee conditions.

Number of repetitions

Analysis of the number of chin-up repetitions showed that there was no significant difference between the three knee positions, F (1, 20) = 0.40, p > .05. Using the pairwise comparison on the number of chin-up repetitions showed that there was a significant difference between the straight knee and knee fully flexed, p = 0.003; and partial knee flexed and knee fully flexed, p = .004. However, there was no significant difference in the number of chin-up repetitions between the straight knee and partial knee flexed, p > .05. Table 4 displayed the mean (SD)

value of the number of repetitions for each knee position during the chin-up exercise.

Discussion

The study aims to compare the muscles' activation and performance during chin-up exercise using a straight knee, partial knee flexed, and knee fully flexed. The findings showed that there was no significant difference in the activation of muscles for LD and PD during the concentric phase between straight knee, partial knee flexed, and knee fully flexed. It shows that LD and PD have the same level of muscle activation when using all three knee conditions. Results in BB showed that straight knee was significantly higher than in partial knee flexed and knee fully flexed position during the concentric phase. Performing the chin-up exercise using a straight knee would produce higher muscle activation in BB during the concentric phase compared to other positions. The muscle activation was also found to be greater during concentric phase compared to eccentric phase, consistent with what has been found in previous study by Doma and Deakin [14], it showed that muscle activation of triceps brachii, pectoralis major, erector spinae, BB and LD was higher when performing chin up in concentric phase might be due to the muscle fibres producing more force during lifting the body upward to overcome inertia compared to the eccentric phase (lowering the body) due to the absence of inertia factor.

Based on the EMG results during the eccentric phase, there was no significant difference between the three knee conditions in LD, PD, or BB. It means that all muscles have the same level of muscle activation in all three positions during the eccentric phase. For the chin-up performance, the straight knee and partial knee flexed position were significantly higher than the knee fully flexed in the number of repetitions. Therefore, this study proves that the use of partial knee flexed and straight knee position are more effective to improve performance and is suitable for muscular endurance training. Furthermore, individuals would generate the similar outcome in both postures, either straight knee or partial knee flexed, throughout the chin-up exercise.

Based on the results, during the concentric phase, doing the chin-up exercise with a straight leg produces more muscle activation in BB. This finding was consistent with a prior study that revealed that BB produced more muscular activation during chin-ups than lat pulldowns [12]. The stability of the chin-up was a factor in the outcome, as opposed to the lat pulldown. The chin-up exercise is considered unstable because the lower body can move freely when the body is suspended when the hands cling to the horizontal bar. When grasping, the lower arm muscles (flexor and extensor carpi radialis) exert a lot of traction, which leads the BB muscle to activate a lot [15].

The LD was shown to have the highest percentage of muscle activation throughout the concentric and eccentric phases in all three knee conditions, followed by the BB and PD. The findings were supported by the previous study where Doma and Deakin [10] found that during the chin-up and lat pulldown exercise, both exercises produced greater muscle activity in the agonists' LD and BB compared to the antagonists' pectoralis major and triceps brachii. A previous study also found that supinated grips stimulated more BB, while pronated grips activated more LD [12, 16].

The current study findings add the knowledge on how manipulating techniques during an upper back exercise affect the muscle activation and performance by individuals [17, 18, 19, 20]. More study is warranted to be conducted on the chronic effects of the exercises performed in various techniques manipulation on physical and physiological adaptation.

Conclusions

This study demonstrated that the BB muscle shows the average production of the highest average level of muscle activation while performing chin-up activity using a straight knee in the concentric phase. The LD and PD muscles demonstrate identical muscular activity when performing the chin-up in concentric and eccentric phases. The combination of partial knee flexed and the straight knee is the most beneficial for enhancing performance and is excellent for muscular endurance training. Therefore, the coach must realize that each method used will change the movement's acute impacts, which are supposed to have a long-term impact.

Conflicts of Interest

The authors declare no conflicts of interest.

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ORIGINAL ARTICLE

The negative effects of the pandemic on human behavior; alienation and social anhedonia: the example of sport sciences students

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Authors' Contribution: A-Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

Abstract

Background and Study Aim: The social change brought about by the pandemic process all over the world has led to the restructuring of human behavior and daily life practices. This process has brought with it some social-psychological problems (such as alienation and social anhedonia) for social segments. For this reason, the aim of the research is to examine the alienation and social anhedonia levels of the students studying at the faculty of sport sciences during the pandemic process.

Material and Methods: The sample of the research consists of students studying at the faculties of sport sciences of different universities in Turkey. A total of 423 students (271 males, 152 females) participated in the study. Due to the normal distribution of the data, the t-test, one of the parametric tests, was performed for paired groups, and the relationship between Social Anhedonia Scale and Alienation Scale sub-dimensions was tested with Pearson correlation analysis. Statistical analyzes were performed with the "Statistical Package for the Social Sciences" commercial software (SPSS for Windows, version 26.0, SPSS). The significance level was determined as $p<0.05$ in the analyzes, and skewness and kurtosis values were considered for the normality analysis.

Results: According to the results obtained, it can be said that the pandemic process negatively affected the social anhedonia and alienation levels of male students studying at the faculty of sport sciences compared to female students. Again, it is seen that the level of alienation of the students who do sports at the professional level is higher than the students who do sports at the amateur level. Similarly, it is seen that the students of the faculty of sport sciences dealing with team sports have higher levels of social isolation, which is one of the sub-dimensions of the alienation scale, compared to the students who are engaged in individual sports. Finally, there is a negative and low-level significant relationship between social anhedonia and alienation scale sub-dimensions ($p<0.05$; $r=-0.187$; $r=-0.164$; $r=-132$).

Conclusions: As a result, it can be said that the pandemic process has had similar negative effects on the students studying in the faculties of sport sciences, as in other social segments.

Keywords: pandemic, alienation, social anhedonia, sport science students

Introduction

The view that humans are a social species has long been an accepted reality. As a social being, human has fundamental motivations such as belonging or needing another [1]. These principal motivation components are one of the basic acceptances and important research topics in both sociology and social psychology [2, 3, 4, 5]. Just as a person needs another person, feeling that he/she is needed by others is also an important motivation for people [6]. Thus, the entity that we call human from the historical process to the present continues its life in mutual interaction with other people. Today, this interaction process has significantly increased compared to the past. The main reason for this increase is the transformations caused by humanity such as social progress and social change. In this process, the society became more complex, and a new lifestyle emerged, which was created by sociological processes such as the social division of labor. This lifestyle has caused significant changes in human life, and modern people have reached a more comfortable lifestyle with various components of development such as technological development, increase and acceleration of production, urbanization, and urban life. This period is the promise of modernity which refers to the period when people's pleasure and desires are met. However, despite all these developments, two fundamental change processes experienced today affect human life in various ways. One of these fundamental changes is the phenomenon of "isolation in crowds", which emerged as a result of modernization and with the effect of technological developments, and another is the "global epidemic" experienced all over the world [7]. The lifestyles that emerged as a result of these processes of social change have removed people from traditional types of social order in an unprecedented way. It can be said that these transformations faced by humanity are different and more effective than the forms

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of change peculiar to previous periods in terms of both their prevalence and intensity. Especially after the epidemic, studies have focused on the mental problems associated with the COVID 19 pandemic, such as negative mood states, anxiety and depression symptoms, and post-traumatic stress in humans [8, 9, 10]. When the studies are examined in detail, it is seen that this process is often associated with two different concepts separately. These concepts are the concept of "alienation", which is one of the research areas of social psychology, and "social anhedonia", which is a neuropsychological concept [11-14].

Although the concept of alienation has been expressed in different ways in the relevant literature, there is considerable overlap in various definitions [15]. In its most general explanation, it is a feeling of distancing from society [16]. In other words, it is the distancing of individuals from each other or a specific social environment or process [17]. It is accepted by many researchers that the use of the concept of alienation in many and quite different meanings in the disciplines of religion, metaphysics, philosophy, sociology, and psychology raises an intractable definition problem [17, 18]. This research deals with the concept of alienation from a social psychological perspective. In other words, alienation should be understood as the feeling of distancing between the individual and the general society or an element of the society, as expressed in similar ways above.

Social Anhedonia (SA), on the other hand, is behaviorally characterized as a relative failure to derive pleasure from previously enjoyed activities or stimuli [12, 19]. In other words, it is described as not taking pleasure in interpersonal relationships [20]. SA is associated with the risk of psychopathology, such as reduced social interaction and social/ emotional dysfunction. Socially anhedonic people may face loneliness and apathy in social interaction. In addition, it is stated that various factors such as gender, socio-economic level, place of residence (urban and rural areas) have positive-negative effects on SA [21].

Considering that social research cannot be independent of social changes, the two important concepts mentioned above have become a universal phenomenon in today's world life. In other words, the speed of social change and the current COVID 19 pandemic are similar in terms of affecting human behavior all over the world [8, 22, 23, 24]. When the literature on the subject is examined, it is possible to come across studies that reveal the effects of the mentioned social events on various social groups [13, 25]. However, when the relevant studies were reviewed, no research was found in which the sample group consisted of students studying in the field of sports. The fact that no study has been conducted specifically for this group makes this study different from other studies. In addition, considering the positive effects of sports on socialization and collective feelings in the axis of functionalist theory, it is crucial to determine to what extent the current social change affects alienation and SA levels on this group (students receiving sports training). In this context, the aim of the research is to examine the alienation and SA levels of the students studying at the faculty of sport sciences during the COVID 19 process.

Material and Methods

Participants

The sample of the research consists of students studying in the faculties of sport sciences of different universities in Turkey. A total of 423 students (271 males, 152 females) participated in the study.

The criteria for inclusion in the research are as follows:

- Voluntary participation in the study,
- Being a student at the Faculty of Sport Sciences,
- Having no comprehension, vision, hearing, or mental or cognitive impairment.

Students who fell outside the specified criteria were not included in the study. Information about the sample group is presented in Table 1. Data collection tools were distributed to students via "Google Forms" through e-mail. Research data were collected in March and April of 2022. This period coincides with the period when COVID 19 cases started to decline in Turkey [26].

Research Design

In the study, "Personal Information Form" to collect students' personal information, "The Dean Alienation Scale" developed by Dean [27] and adapted to Turkish by Yalçın and Dönmez [17], and "The Revised Social Anhedonia Scale" developed by Eckblad et al. [28] and adapted to the Turkish language by Cihan et al. [20], was used.

Dean Alienation Scale (DAS): The scale, which was developed by Dean [27] and adapted to the Turkish language by Yalçın and Dönmez [17], consists of a total of 17 items and 3 sub-dimensions. The powerlessness sub-dimension consists of 7 items (items 1, 3, 9, 12, 13, 14 and 16), the sub-dimension of normlessness consists of 5 items (items 2, 4, 6, 7, and 10), and social isolation consists of 5 items (5, 8, 11, 15 and 17). The fifth, eighth and fifteenth items in the scale were reverse coded. The scale was designed as a 5-point Likert type scale. The original Cronbach Alpha coefficient of the scale is 0.84.

The Revised Social Anhedonia Scale (RSAS): The scale, which was developed by Eckblad et al. [28] and adapted to the Turkish language by Cihan et al. [29], consists of a total of 40 items and a single sub-dimension. The scale was designed as a "Yes" and "No" scale. The original Cronbach Alpha coefficient of the scale is 0.84.

Statistical analysis

Statistical analyzes were performed with the "Statistical Package for the Social Sciences" commercial software (SPSS for Windows, version 26.0, SPSS). The significance level was determined as p<0.05 in the analyzes, and skewness and kurtosis values were taken into account for the normality analysis. Descriptive statistical analyzes were made for the personal information of the students participating in the study, and frequency (n) and percentage (%) values were calculated (Table 1). Due to the normal distribution of the data, the t-test, one of the parametric tests, was performed for paired groups, and the relationship between the Revised Social Anhedonia Scale and the Dean Alienation Scale sub-dimensions was tested with Pearson correlation analysis.

Results

In this part of the study, statistical test results and interpretations of the data obtained are included.

According to Table 1, 64.2% (n=271) of the students participating in the research were male and 35.9% (n=152) were female. It is seen that the students are mostly interested in team sports (54.1%, n=229) at the professional level (87.0%, n=368). In addition, the majority of the students (72.3%, n=306) were not infected with the COVID-19 virus.

As a result of the analyzes made, it is seen that the data provided the assumption of normality and the reliability coefficient was at an acceptable level (Table 2). For the normality test, skewness and kurtosis values are taken into account in social sciences and studies where the Likert type scale method is used, and if these values are in the range of ±2, the distribution is considered normal [30].

The findings of the difference test, which was conducted to examine the difference between the genders of the students and the sub-dimensions of RSAS and DAS, are shown in Table 3. When the table is examined, a statistically significant difference was found in favor of male students in the sub-dimension of normlessness (t=-2.63; p=0.00) and social anhedonia (t=2.61; p=0.00).

According to Table 4, in the powerlessness sub-dimension (t=3.06; p=0.00), normlessness sub-dimension (t=2.22; p=0.02) and social isolation sub-dimensions (t=2.34) ; p=0.01) was found to be a significant difference. When the arithmetic averages are examined, the powerlessness sub-dimension (professional $\bar{X}$ =3.73, amateur $\bar{X}$ =3.41), the normlessness sub-dimension (professional $\bar{X}$ =3.96, amateur $\bar{X}$ =3.74) and the social isolation sub-dimension (professional $\bar{X}$ =3 , 66, amateur $\bar{X}$ =3, 45), it was determined that there is a statistical difference in favor of students who do professional sports.

According to Table 5, no significant difference was found in other sub-dimensions and Social Anhedonia scale, except for the Social Isolation sub-dimension (t=-2.01; p=0.04). When the arithmetic averages were examined, it was determined that there was a statistical difference in favor of the students doing team sports in the Social Isolation sub-dimension (individual sports $\bar{X}$ =3.57, team sports $\bar{X}$ =3.69).

According to Table 6, it was determined that there was no statistically significant difference between

Table 1. Frequency and Percentage Distribution of Students by Demographic Information

Characteristics	Groups	n	(%)
Gender	Male	271	64, 1
	Female	152	35, 9
Licensed athlete category	Individual Sports	194	45, 9
	Team Sports	229	54, 1
Athlete category	Professional	368	87, 0
	Amateur	55	13, 0
Situation of catching coronavirus	Yes	117	27, 7
	No	306	72, 3
	Total	423	100

Table 2. Reliability and normality values of the Alienation Scale and the Social Anhedonia Scale

Dimensions	α (Original)	α (Research data)	Skewness	Kurtosis
Dean Alienation Scale (DAS)	0, 84	0, 79	-0, 216	-0, 265
Revised Social Anhedonia Scale (RSAS)	0, 84	0, 66	0, 019	1, 401

Table 3. Differences between the sub-dimensions of RSAS and DAS according to the gender of the students

Sub-Dimensions	Groups	n	X̄	SD	df	t	p
Powerlessness	Male	271	3, 65	0, 70	421	-1, 48	0, 13
	Female	152	3, 76	0, 75			
Normlessness	Male	271	3.87	0, 68	421	-2, 63	0, 00*
	Female	152	4, 05	0, 70			
Social Isolation	Male	271	3, 61	0, 66	421	-1, 01	0, 31
	Female	152	3, 68	0, 60			
Social Anhedonia	Male	271	1, 43	0, 13	394	2, 61	0, 00*
	Female	152	1, 40	0, 09			

p<0.05.

Table 4. The differences between the sub-dimensions of RSAS and DAS according to the athlete status of the students

Sub-Dimensions	Groups	n	X̄	SD	df	t	p
Powerlessness	Professional	368	3, 73	0, 71	421	3, 06	0, 00*
	Amateur	55	3, 41	0, 74			
Normlessness	Professional	368	3, 96	0, 67	421	2, 22	0, 02*
	Amateur	55	3, 74	0, 81			
Social Isolation	Professional	368	3, 66	0, 63	421	2, 34	0, 01*
	Amateur	55	3, 45	0, 63			
Social Anhedonia	Professional	368	1, 42	0, 12	421	-0, 292	0, 77
	Amateur	55	1, 43	0, 12			

p<0.05.

Table 5. The differences between the sub-dimensions of RSAS and DAS according to the sports category of the students

Sub-Dimensions	Groups	n	X̄	SD	df	t	p
Powerlessness	Individual Sports	194	3, 66	0, 74	421	-0, 71	0, 47
	Team Sports	229	3, 71	0, 71			
Normlessness	Individual Sports	194	3, 94	0, 68	421	0, 02	0, 98
	Team Sports	229	3, 93	0, 71			
Social Isolation	Individual Sports	194	3.57	0, 63	421	-2, 01	0, 04*
	Team Sports	229	3.69	0, 64			
Social Anhedonia	Individual Sports	194	1, 42	0, 12	421	-0, 15	0, 87
	Team Sports	229	1, 42	0, 11			

p<0.05

the variable of students' catching the corona virus and the sub-dimensions of RSAS and DAS.

When Table 7 is examined, it is seen that there is a negative and low-level significant relationship between revised social anhedonia scale and dean alienation scale sub-dimensions (p<0.05; r=-0.187; r=-0.164; r=-132).

Discussion

In this study, alienation and SA levels of the students of the faculty of sport sciences were examined considering the COVID 19 pandemic process. Bearing in mind that social research cannot be independent of social changes. The findings of this research reveal some behavioral changes in the daily life practices of the students of the faculty of sport sciences during the pandemic process. The new lifestyle, fed by the sociological and psychological changes created by the pandemic, together with the modern lifestyle, leads to a number of unique values and daily practices. In this context, with the pandemic process, which is thought to affect these new daily life practices, the alienation and SA levels of the students studying at the faculty of sport sciences are discussed in this section from the perspective mentioned above.

In the results of the study, first of all, students' SA and alienation levels were compared according to their gender (Table 3), and significant differences were found in favor of male students in the normlessness sub-dimension of the alienation scale and the SA scale (p<0.05). In the relevant literature, normlessness is defined based on Durkheim's concept of anomie. According to Durkheim, anomie refers to the loss of commonly accepted beliefs, behaviors, and values that give direction or purpose to life [31]. From this point of view, according to the research findings, it can be said that male students studying at the faculty of sport sciences have higher levels of normlessness and SA than female students. Zhu et al. [10] in their study on adult people, stated that the level of alienation of male and female participants increased due to the COVID 19 process. Lee, Yoo and Youn [32] in their study on a sample of secondary and high school students, stated that male and female students participating in physical education classes had partial changes in the level of alienation in the COVID 19 period compared to previous periods. Again, Wieman et al. [33] stated in their study among university students that university students have higher anhedonia levels, especially in the first months of the pandemic. However, no difference was found between genders in the related study. On the other hand, Fekih-Romdhane, Dissem, and Cheour [34] stated in their study among university students that female students have higher levels of schizotypal personality disorder than male students. Similarly, Kaçoğlu, Çobanoğlu, and Şahin [35] stated in their study that female athletes experience more fear of COVID-19 than male athletes. It seems that the results related to gender in the current study differ from the relevant literature. This difference may be due to the fact that the number of female participants participating in the study is lower than that of male participants.

Looking at Table 4, where the alienation and SA levels of the students are examined according to the amateur or professional level of sports; The alienation levels of the students who do sports at the professional level were found to be higher than

Table 6. Differences between the sub-dimensions of RSAS and DAS according to the status of students catching the Corona virus

Sub-Dimensions	Groups	n	X̄	SD	df	t	p
Powerlessness	Yes	117	3, 76	0, 62	251, 18	1, 30	0, 19
	No	306	3, 66	0, 75			
Normlessness	Yes	117	3, 98	0, 67	421	0, 77	0, 44
	No	306	3, 92	0, 70			
Social Isolation	Yes	117	3, 63	0, 62	421	-0, 03	0, 97
	No	306	3, 63	0, 64			
Social Anhedonia	Yes	117	1, 41	0, 10	421	-1, 60	0, 10
	No	306	1, 43	0, 12			

p>0.05.

Table 7. Pearson correlation table between RSAS and DAS sub-dimensions

Sub-Dimensions	Powerlessness	Normlessness	Social Isolation
Social Anhedonia	-0, 187**	-0, 164**	-0, 132**

p<0.05.

the students who do sports at the amateur level ($p<0.05$). In the comparison of SA levels, it can be stated according to the research findings that the amateur or professional level of sports does not have a positive or negative effect on SA. The alienation and mental health problems of professional athletes had already become a prominent topic in the sports medicine and sport psychology literature prior to the COVID-19 pandemic [36]. It can be said that these negative processes continue to increase with the effect of the pandemic process. As a matter of fact, a number of studies support this situation [37, 38]. According to the current research, the higher levels of alienation in the professional sports group can be explained by the fact that the pandemic process caused more radical changes in professional sports and the daily life practices of professional athletes.

Looking at Table 5, where alienation and SA levels are examined according to the sports category (individual or team sports) of the students. In the social isolation sub-dimension of the alienation scale, it is seen that the average scores of the students who do team sports are higher than the students who do individual sports ($p<0.05$). In the comparison of SA levels, it can be stated according to the research findings that students' individual or team sports do not have a positive or negative effect on SA. The social isolation dimension of alienation scale indicates that the individual does not value the beliefs and goals that are valued by the society. The isolated individual is separated from the group and its standards [17]. Ağduman [39] in his study reported that the levels of catching the virus, anxiety, and socialization anxiety of the athletes who are interested in team sports are higher than those who are engaged in individual sports. The relevant study is in line with the findings of our research. Çifci and Demir [40] on the other hand, in their study, state that professional football players (doing team sports) fear catching the virus during the COVID 19 process, and the stress levels they perceive accordingly are moderate. Similarly, Lima et al. [41] stated in their study that the depression, anxiety, and stress scores of elite athletes who play team sports are significantly lower than elite athletes who do individual contact sports. Therefore, it is seen that different results have been reached in the relevant literature. The main reason for this difference can be explained by the fact that the data collection periods and sample groups of the studies are different from each other.

In another evaluation, when we look at Table 6, where the SA and alienation levels of the students are examined according to the state of being caught to Corona virus; It was determined that there was no statistically significant difference between the variable of the students' status of contracting COVID-19 and their alienation and SA levels ($p>0.05$). There are significant results regarding alienation and SA in relation to COVID-19 in the relevant literature [42, 43, 44]. It seems that our research findings do not overlap with the relevant literature. The reason for this difference may be that the majority of the participants (72.3%) who participated in our research have never been diagnosed with COVID-19. In addition, the fact that the participants who make up the research sample are athletes may suggest that they spend this process more comfortably compared to other people. There are also studies supporting that athletes are less affected by this process [40].

Finally, in Table 7, where the relationship between SA and alienation is examined, it is seen that there is a negative and low-level significant relationship between SA and the sub-dimensions of the alienation scale ($p<0.05$; $r=-0.187$; $r=-0.164$; $r=-132$). In other words, students' SA levels and alienation levels show a negative correlation with a low level of variation. As the SA level increases, the level of alienation decreases. Considering once again that the research data were collected at a time when the number of COVID 19 cases in Turkey was on the decline, it would be understood that these two behavioral changes, which are supposed to be positively related, do not positively affect each other.

Conclusions

The social change brought about by the pandemic process all over the world has led to the restructuring of human behavior and daily life practices. This process has had a significant impact on human and social life. The emerging new behavior patterns have reproduced some social-psychological problems. In this context, in the axis of SA and alienation, which constitute the main theme of our research, this process has been discussed in the sample of students from the faculty of sport sciences. According to the research results, it can be said that this process negatively affects the SA and alienation levels of male students studying at the faculty of sport sciences compared to female students. Again, it is seen that the level of alienation of the students who do sports at the professional level is higher than the students who do sports at the amateur level. Finally, it is seen that the level of social isolation, which is one of the sub-dimensions of the alienation scale, of the students of the faculty of sport sciences dealing with team sports, is higher than the students who are in the category of individual sports.

It is recommended to conduct studies with different sample groups and broader participation. In addition, research conducted at various stages of the pandemic process has reached different results on the subject. For this reason, to better understand the negative impact of the relevant process on human behavior, it is recommended to consider the data collection periods of the studies conducted during the process.

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ORIGINAL ARTICLE

Development of balance training program to improve balance control among Malaysian sports schools athletes

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Abstract

Background and Study Aim: Complex sports specific movements often require balance ability. This is accountable for injury prevention as well. Balance control is vital to athletes for all sports activities. It is the objective of the current study to develop and identify balance training program effectiveness in improving dynamic balance among athletes in Malaysian National Sport Schools.

Material and Methods: This study used a true experimental with control group design, involved dynamic balance control measures before and after intervention. A total of 72 male and female athletes were randomly assigned into experimental group or control group after screening process for eligibility. The experimental group underwent 12 sessions of balance training program and the control group continued their usual training routine. The Y-Balance Test was utilized to quantify dynamic balance for both groups. Data was analyzed using independent and paired sample t-test.

Results: The study finding indicated that the experimental group demonstrated significant improvement in the post-test compared to pre-test ($p = 0.000$, $p < 0.001$) but no significant changes happened to control group ($p = 0.353$, $p > 0.05$). Independent t-test showed during post-test, the experimental group attained better score compared to the control group ($p = 0.000$, $p < 0.001$).

Conclusions: It is suggested that coaches and athletes may include this balance training program in their training regimen, hoping to help in improving dynamic balance, thus, to reduce risk of lower extremity injuries. Future studies are suggested to increase more variances of balance training and make comparison on their effectiveness as a way to obtain a more effective training program.

Keywords: balance control, multisensory system, visual, proprioception, vestibular

Introduction

Lower extremity injuries often occur on sports and physical activities that required individuals for rapid dynamic movements such as running, jumping, turning and changing direction. Lower extremity is considered as the most common injury location accounted to 51.1%, and 66.5% respectively for Malaysian athletes who participated in contact and non-contact sports [1, 2]. According to Lee & Lee, poor postural stability is a contributing factor for lower extremity injures [3].

Several studies have reported that sports and physical activity that necessitate one to a sudden stop or a cutting movement triggering greater chance to get injured. From the total injuries occurred for both contact and non-contact sports, it is reported that 75% of ankle injuries are accounted as ankle sprain [4]. Athletes with ankle sprains need to spend more money for health care costs and resources.

Above and beyond, the injured athlete also experiencing significant time loss from sports participation, indirectly causing him or her performance declined. Recurrent ankle sprain has become a menace to athlete's performance. The signs and symptoms of ankle sprains indicate tendency for repeated ankle sprains such as ankle giving way, pain sensation, weakness, and instability has been reported to occur on 40% to 70% of individuals who have sustained a lateral ankle sprain or chronic ankle instability [5, 6].

Most of the sports required a certain level of stability to execute complex sport movements [7]. The ability to maintain center of body mass over base of support without falling is considered as having bodily equilibrium [8]. Athlete who suffered ankle sprain will definitely depict instability, hence decrease in balance control. Normally, balance is categorized into static balance when athletes maintain in fix position with little or without moving center of gravity, whereas dynamic balance require athlete to maintain postural stability when body is in motion. For activities that required athlete to frequently changing base of support without falling or injured, the athlete must have excellent dynamic balance to complete the task efficiently and safely [9].

Balance can be defined as the ability to maintain a position, the reaction to external disturbance, and postural adjustment to voluntary movements [10]. An intact balance system permits athletes to identify orientation with gravity, determine

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motion's direction and speed, and make automatic postural adjustments to maintain stability in various conditions during activities. These abilities are vital in most of the sports in order to perform effectively and to prevent risk of injury.

However, are authorities of Malaysian National Sport Schools aware about the importance of balance control to athletes? Do sports coaches realize the importance of balance control for athletes to perform effectively? Are athletes being educated in physical education and sports science subjects by their teachers and coaches regarding the importance of balance control during sporting activities? Are athletes being trained on their balance control during sports training session? These adolescent athletes from national sports schools are considered as our country asset that have great potential to boost Malaysia sports achievement to international level. If the athletes are agonized with injuries particularly lower extremity injuries such as ankle sprain, their balance ability will be reduced undeniably. A deteriorated balance control will limit athletes' performance in short-term and there is a tendency to last for long-term, thus causing time loss for an athlete to prepare and compete. Indirectly, the injured athlete's performance will declined, hence, causing him or her became less comparative to their teammates.

The researchers realized about this misconception and ignorance towards the importance of balance control in sports performance and injury risk among sports authorities, coaches, physical educators and sports science teachers. Realizing this, the investigators proposed to engender awareness to all sports communities regarding the importance of athlete's balance control ability in helping to reduce and to prevent injuries particularly over lower extremities especially ankle sprain. Consequently, this study is directed to develop a balance training program to train athlete's balance control. Meanwhile, to determine the effectiveness of this newly developed balance training program on improving dynamic balance control among athletes in Malaysian National Sports Schools.

Materials and Methods

Population and Sampling

Study population was adolescent athletes studying in Malaysia National Sport Schools. Cluster sampling method was used in this study. The selected Malaysia National Sport Schools consisted of: 1) Bukit Jalil Sport School, Kuala Lumpur, 2) Gambang Sport School, Pahang, and 3) Bandar Penawar Sport School, Johor. The first 36 male and 36 female athletes' age ranging from 13 to 16 years old who met the inclusion criteria and agreed to participate were recruited from three selected national sport schools. Averagely, 12 male and 12 female athletes (total N=24) voluntarily participated from each selected national sport schools with the permission from their guidance. An informed concern was obtained from every volunteered athlete. After screening process using a self-report questionnaire under supervision of the researchers, these athletes were then randomly assigned to experimental group (N=36) who undergone balance training program three sessions a week for four weeks, in a total of 12 sessions and control group (N=36) remained normal training without any intervention. This study was approved by the Sultan Idris Education University Ethics Committee.

Study Design

This study used a true experimental with pre-test post-test control group design that involved measurement of balance control before and after balance training intervention to determine the effectiveness of newly developed balance training program in improving dynamic balance control among athletes in Malaysia National Sport Schools.

Balance Training Program

The balance training program consisted of 24 variations that involve physical activities that focused on enhancing balance control. All the selected variations were designed to challenge and manipulated multisensory system to integrate visual, proprioception and vestibular inputs. These multisensory systems were altered or modified to trigger rapid integration among all inputs when being challenged with unexpected disturbance. The visual inputs were altered with eyes open and eyes closed conditions. The proprioception inputs were altered or modified by base of support i.e. unilateral stance and bilateral stance. Perturbations were applied on some variations to trigger more challenge on vestibular inputs with and without subjects' notice.

The combination of activities such as jumping, hopping, turning, pivoting, while throwing and catching ball with unilateral stance or bilateral stance were designed to optimally challenged all multisensory inputs for balance control. These variations seem to be the most challenging variations that can trigger one to integrate all multisensory inputs rapidly in order to stay balance.

The intensity of exercises was progressively increase to prevent plateau occur and boredom. Intensity of variations was increased by changing the difficulty level of exercises from bilateral stance to unilateral stance in order to challenge proprioception input; eyes open to eyes closed condition to challenge visual input; from without perturbation to with unexpected perturbation to challenge vestibular input; and lastly the combination of challenging all three multisensory inputs while executing sporting activities (Figure 1). Athletes in experimental group were instructed

to undergo this newly develop balance training program three times a week for four weeks, with a total of 12 balance training sessions. All athletes were administrated to warm-up before and cool-down after training sessions to prevent injury occurrence. A one-minute rest between sets was allowed. Each training variations were conducted with a two minutes rest in between. The training duration is estimated approximately 45 minutes per session.

Measurement Tool

Y-Balance Test (YBT) was utilized to quantify dynamic balance. This test was developed and simplified from the Star Excursion Balance Test and it is used to measure dynamic balance control that often involves completing a functional task without compromising one's base of support.

The YBT evaluated participant's strength, stability and balance in various directions. The participant is required to maintain on a base of support with one leg while maximally reaching in two directions with the opposite leg, without compromising base of support on the stance leg. In this study, all athletes in both training group and control group were instructed to balance on one leg while simultaneously reaching as far as possible with the other leg in three different directions i.e., anterior, posterolateral and posteromedial (Figure 2) during pre-test and post-test. They were allowed for a practice trial before two measurements were recorded.

Y-Balance Test were reported having excellent test-retest reliability for all three directions with test-retest Intraclass Correlation Coefficients (ICCs) i.e. 0.98, 0.98, and 0.99 on anterior, posteromedial, and posterolateral directions respectively [11].

Data Collection

Pre-test and post-test of dynamic balance were measured using Y-Balance Test for pre-test and post-test before and after balance training program to determine its effectiveness in improving dynamic balance control. During testing sessions, all athletes were permitted to complete two trials for each direction for pre-test and post-test. The mean scores of absolute reaches in centimeters from the two trials were calculated for data analysis to eliminate possible measurement errors.

Statistical analysis

Mean and standard deviation of Y-Balance Test were tabulated as dynamic balance before and after balance training program. Independent sample T-test in Statistical Package for Social Science (SPSS; version 28) was utilized to analyze the comparison of pre-test and post-test between experimental group and control group to determine the effectiveness of this newly developed balance training program. The paired sample T-test was used to determine the improvement on dynamic balance within experimental group before and after balance training program to identify the effectiveness of this intervention in improving dynamic balance among athletes in Malaysia National Sport Schools. Significant level of this study was predominated with $p<0.05$ prior to research.

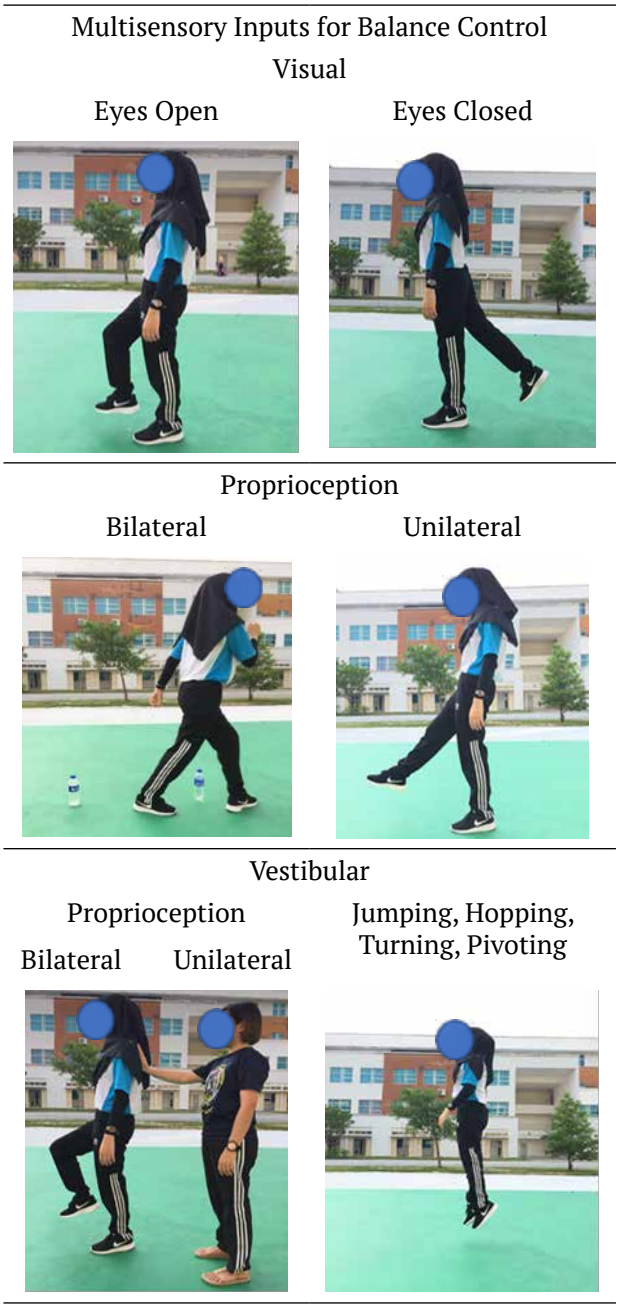

Figure 1. Balance training variations to challenge multisensory inputs for balance control

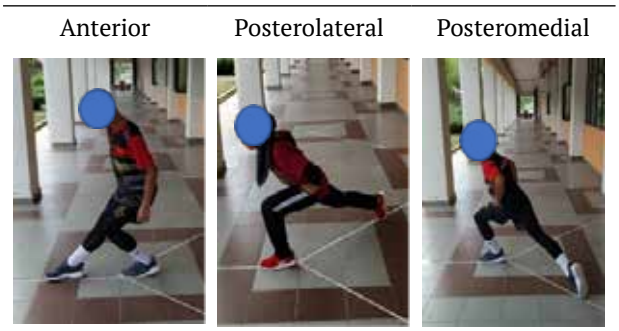

Figure 2. Y-Balance Test

Results

The demographic data of both experimental group and control group were similar in age, height and weight for both gender groups, indicating that the study subjects were recruited from homogeneous group to eliminate sampling bias. The descriptive characteristics for the subjects in this study were presented in Table 1.

As Table 2 portrayed study finding, there was no significant difference for pre-test of dynamic balance when compared between experimental group and control group, indicating that both experimental group and control group were recruited from homogeneous group [t(70) = 0.621, p = 0.537) before balance training intervention.

Table 2 tabulated the comparison between pre-test (81.47 ± 9.57 cm) and post-test (81.40 ± 9.06 cm) of control group, indicated that there was no significant difference for dynamic balance [t(35) = -0.532, p = 0.353]. The control group did not improve in dynamic balance because they did not undergo the four weeks balance training program but remained normal training.

Table 2 also illustrated the comparison of post-test scores between experimental and control group. The result demonstrated that there was a significant difference for dynamic balance [t(70) = -3.945, p=0.000*]. Study finding indicated that the balance training program is effective in improving dynamic balance of athletes who studied in Malaysia National Sport Schools after undergone the 12 sessions of balance training intervention.

This study finding revealed there was significant improvement in dynamic balance after intervention [t(35) = -5.497, p = 0.000*] when compared the results before (pre-test) and after (post-test) 12 sessions of balance training program. The mean scores for dynamic balance of experimental group indicated an increment of 9.85 cm i.e., from 80.19 ± 7.72 cm to 90.04 ± 9.51 cm after intervention (Table 2).

Discussion

This study finding revealed that the four weeks balance training program is effective in improving dynamic balance among athletes in Malaysian National Sport Schools. Balance is defined as a complex process involving: a) coordinated activities of reception and integration of multiple sensory inputs, b) motor components for planning and execution of movement, and c) biomechanical components. The position of body in relation to gravity and its surroundings is sensed by combining visual, vestibular, and somatosensory (proprioception) inputs to achieve a goal requiring upright posture without falling.

In conjunction with this concept, the researchers decided to design the balance training program in order to challenge multisensory integration by altering and modifying visual, proprioception and vestibular inputs progressively. Each of the training variation was designed to challenge and to manipulate these multisensory inputs in order to train rapid integration among them once challenges being triggered. Rapid integration among multisensory inputs upon unexpected challenges

Table 1. Demographic data of experimental and control groups

Variables/group (Mean±SD)	Experimental (N=36)	Control (N=36)
Age (years)	14.02 ± 0.62	14.04 ± 0.84
Height (cm)	159.00 ± 5.58	162.60 ± 5.72
Weight (kg)	49.28 ± 5.67	48.62 ± 5.41

Table 2. The improvement of 12 sessions exercise programs on dynamic balance (Y-balance) of subjects in experimental and control groups

Dynamic Balance (cm)		Control	Experimental t	Independent t-test p	
Test	Pre	81.47 ±9.57	80.19 ±7.72	0.621	0.537
	Post	81.40 ±9.06	90.04 ±9.51	-3.945	0.000*
Paired t-test.	t	-0.532	-5.49	-	
	p	0.353	0.000*	-	

could secure one's balance control. Postural and balance control measurements are important for performance, injury prevention and rehabilitation process. In this study, sphere on sensory motor abilities is focused especially on static and dynamic balance control abilities. Balance control is often described as maintaining a position with minimal movement i.e., static balance, and maintaining a stable base of support while completing a prescribed movement is called dynamic balance. The ability to stay steady and not falling while movement i.e., the orientation of space can be considered as good dynamic balance with intact multisensory systems.

In current study, the athletes who undergone the balance training program were asked to maintain their balance while performing various tasks on altered base of support. These tasks likely contributed to improve the athletes' balance control ability due to repeated sensory feedback. The ability of an athlete to move his or her body rapidly in different directions without losing body control requires good postural stability. It has been shown that balance can contribute to successful performance and play a major role in many athletic and sport-specific activities [12].

Proprioception is an important factor in maintaining balance and sensing the limbs position in space when both visual and vestibular inputs of balance component is removed or affected. Both visual and vestibular systems would render the only capable component to proprioception only, which consist of three receptors which is low threshold but respond to external stimuli rapidly. All these receptors work to sense the positioning of center of gravity to maintain body mass over its base of support after several successful postural perturbations.

The improvement of balance control ability after intervention of experimental group in this study demonstrated that balance disrupting force imposed by perturbation, forcing central nervous system must constantly making adjustments to keep center of mass over its base of support [13]. In study conducted by Loram and Lakie [14], subjects maintained their stability while resisting against balance disturbing force by perturbation using tension in elastic band which in turn impose an accentuated neural training effect that can improve balance ability [14].

Current study finding is in agreement with study conducted by Lee and Lim [15] who implemented sport specific trampoline training in improving dynamic balance among amateur Wushu athletes. They found that the four weeks trampoline training program was effective in improving dynamic balance among amateur Wushu athletes. The researcher stated that during trampoline training, athletes were asked to jump on trampoline, during on air, automatically, these athletes were forced to continuously respond to the change of posture and the switch of center of gravity. Whereas, while landing on trampoline, the feet as base of support which provided proprioception input needed to integrate with other sensory inputs i.e., visual inputs and vestibular inputs in order to stay balance on trampoline without falling off [15]. When an athlete was rebounding on a trampoline, his or her body requires to be repetitively in movements, his or her eyes must continuously adjust to the different levels of vision i.e., visual input was challenged, thus, forcing one's visual input to integrate effectively with vestibular input and proprioception input to stay balance. In trampoline training program, the improvements in dynamic balance are perceived due to the alterations in complex sensory motor stimulation that triggered athletes to adapt to unstable surface, forcing them to maintain their stability on trampoline simultaneously [16].

This study finding shown consistency with Lee and Tan's [17] study stated that the 18 sessions of neuromuscular training intervention could improve dynamic balance in female Futsal players significantly. They stated that nature of Futsal requires player to execute multiple movements that need rapid reaction. They designed the neuromuscular training program merely to challenge proprioception system, whereas the vestibular system was minimally challenged. In their study, the researchers focused to challenge proprioception because exercises were conducted with single-leg stance and on varies bases of support. They revealed that by challenging neuromuscular control and proprioception of lower extremities, these six weeks neuromuscular training program was found to be able to improve dynamic balance of female Futsal players significantly [17]. Similarly, Hashim & Lee's [18] study demonstrated that computerized neuromuscular control training program could successfully improve athlete's dynamic postural control ability [18].

This study finding also supported by Puzi and Lee [19], indicated that a six weeks CoBAgi training was effective in improving dynamic balance of adolescent handball players. The integration of visual, vestibular and proprioception inputs enable to control body motion in space. They stated that the improvement in muscular synergies help to minimize the displacement for center of gravity, thus, contributing better balance control while execute motor task in handball and other sports [19].

Furthermore, study conducted by Lee and Kuang [20] reported that balance training program is believed could improve balance control ability in basketball male players. The basketball players' ability on neuromuscular control was improved through these balance exercises [20]. Therefore, the players were perceived may reduce lower extremity injuries risk. A multisensory training program was

designed to specifically improve sensory function by Lee & Magee [21]. They suggested that sensorimotor or balance training with unexpected disturbance or perturbation could be incorporated into rehabilitation programs for athletic populations to improve static balance and dynamic balance [21, 22].

A study conducted by McGuine and Keene [23] reported that the four weeks progressive balance training program could significantly overcome sensorimotor constraints related to chronic ankle ability, indirectly reduce ankle sprains rates by 38% in male and female high school soccer and basketball players [23]. This is in conjunction with McKeon et al. [24] reported that the six weeks of balance training could improve sensorimotor function in individuals with chronic ankle instability [24]. Similarly, a four-week developed program that included static single-leg balance on unstable surfaces with eyes open or eyes closed or dynamic movements is believed can improve dynamic postural control of individual with chronic ankle instability [25].

The application of mobilization with movement might have some stimulating effects on mechanoreceptors and assist in neutral feedback mechanisms used to help stabilize ankle during complex activities. These can be enhanced with the proprioception balance activities. The athletes could demonstrate improvements in both sports' specific activities and daily living activities after undergone the six weeks of MobEx intervention that consisted of proprioceptive balance exercises [25, 26, 27].

Conclusions

Balance is important to every individual in order to maintain body position whilst performing a given task without instability. Numerous previous studies reported that balance training could improve balance control, thus, is believed may prevent injuries. Hence, the researchers developed these four weeks balance training program and measured its effectiveness on improving balance control in order to create awareness to sport schools' athletes, coaches, as well as sport authorities regarding the importance of balance control in injury prevention. This developed balance training program was proven to be effective in improving balance control among athletes in Malaysian National Sport Schools. It is suggested that this balance training program could be referred and implemented to all athletes especially adolescent in secondary schools. Meanwhile, the researchers would like to suggest to athletes and coaches that they may include this freshly established balance training program in their daily training routine with the purpose to reduce and prevent lower extremity injuries.

This study findings also are important to school communities, sport authorizes, coaches, and athletes in order to give awareness how to progress balance control in order to reduce and prevent lower extremity injuries. Injury free athletes could save a big budget on healthcare cost either supported by individual or government. Furthermore, these athletes who studied in national sport schools are considered as country asset. They are trained to excel in sports, and they are expected to be able to boost Malaysia sports achievement to international level. The economy and reputation of country could be boosted if high performance athletes are produced to world class level. The nation will be recognized worldwide for their excellent achievements, as showcased by Malaysian badminton players.

Conflicts of Interest

The authors declare no conflicts of interest.

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ORIGINAL ARTICLE

The effect of the 12-week judo physical activity program on the self-esteem of secondary school students during the COVID-19 period

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection.

Abstract

Background and Study Aim During the COVID-19 period, participation in physical activity decreased, and at the same time, many psychological problems occurred in children and adolescents. Therefore, this study examines the impact of secondary school students' participation in regular exercise on their self-esteem.

Material and Methods The research was carried out with an experimental method and sequential design. The study, carried out in 2 sessions, started with the first measurement in November 2021 and ended with the last measurement in January 2022. 46 volunteer students forming the study sample were divided into experimental and control groups. Students in both groups completed the 'Personal Information Form' and the 'Coopersmith Self-Esteem Inventory' in the first week and the end of the 12th week. Statistical Package for Social Sciences (SPSS) 17.0 was used for data analysis. First, a descriptive statistical test was conducted to indicate the socio-demographic characteristics of the participants. Then, normality tests (Skewness and Kurtosis) were applied to determine whether the data showed normal distribution, and it was determined that the data showed normal distribution. Finally, the independent sample t-test and Paired Samples t-test were applied because the data met the assumption of normal distribution. The significance level was determined as $p<0.05$.

Results A statistically significant difference was found between the self-esteem values of the experimental group before the physical activity program and after the exercise sessions. There was no significant difference in the self-esteem levels of the control group pre-test and post-test.

Conclusions In conclusion, this study reveals that participation in 12 weeks of regular exercise significantly increases middle school students' self-esteem.

Keywords: regular exercise, judo, physical activity, self-esteem, student

Introduction

It is known that regular participation in physical activity has a positive effect on the behavioral, academic, and psychological characteristics of children and youth [1, 2].

The World Health Organization (WHO) [3] recommends that children and adolescents aged 5-17 do at least 60 minutes of moderate-intensity, primarily aerobic, exercise once a week. In addition, at least three days a week, vigorous-intensity aerobic exercises and activities that will strengthen muscles and bones are recommended for children and adolescents. However, the COVID19 epidemic has affected the lives of individuals of all ages, including students. This situation has led to severe education, school, and exercise restrictions [4, 5]. Such adverse conditions can exacerbate stress, fear, and mental health disorders and cause psychological problems [6]. On the other hand, Qiu et al. [7] revealed that children exposed to less isolation at home experience fewer psychological problems. Therefore, it is crucial to examine the self-esteem characteristics of children and adolescents exposed to closure during the pandemic and have additional issues and determine the factors that will positively affect their self-esteem [8].

Previous periods examined the relationships between physical activity and students' cognition, depression, anxiety, and self-esteem [9]. Some meta-analyses, reviews, and studies have reported that physical activities are influential and essential in improving the mental health of adolescents and improving psychosocial states such as cognition, depression, anxiety, and self-esteem [10, 11]. One of the critical issues of our study is how effective these positive impacts will be during the pandemic period and whether similar results can be achieved with the results of the studies conducted in previous years.

When the literature is examined, it is seen that many studies have been conducted on self-esteem. Most of the studies are cross-sectional studies and involve people from most segments of society [12, 13, 14, 15]. Some studies indicate that longitudinal studies should be given more place in examining self-

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esteem [16]. There are various longitudinal studies on self-esteem in the literature [17, 18, 19, 20].

There are some criticisms about experimental studies in the literature. Some empirical studies mention a common effect between self-esteem and physical activity. While some studies show that short-term results such as 3-5 weeks can be achieved, medium and long-term outcomes are unpredictable. Some studies do not include sufficient detail in the findings [21, 18]. It has been stated that the number of longitudinal studies involving subjects selected from different cultures should increase [22]. Studies have proven that exercises increase self-esteem, but it has been emphasized that choosing mixed samples instead of only women or only men will contribute to the literature [23]. We think that testing the validity of our study in Turkish society and among secondary school students selected as a sample will contribute to our knowledge on self-esteem. In this study, physical activities (without music, combination, etc.), mixed sample, the fact that the exercises were more intense in weeks and hours compared to some studies, and the study was conducted in a different culture will help to remove some of the limitations of previous studies.

The study aims to examine the effect of secondary school students' participation in regular exercise on their self-esteem. The hypothesis of the research was formed as follows, considering that the exercises performed for 12 weeks, five days a week, and 1.5 hours a day will increase the self-esteem of the students:

H_1: Participation in 12-week regular exercise has a significant and positive effect on secondary school students' self-esteem.

Materials and Methods

Research Model

This research was conducted with an experimental and sequential design.

Participants

Experimental group, the sample consisted of 23 secondary school students (16 females and 7 males) between the ages of 10-13 who were selected by random sampling and volunteered to participate in the research. The students in the experimental group participated as athletes in the sports activities carried out by the Burdur /Bucak Youth and Sports District Directorate of Turkey. Control group, the study consisted of 23 secondary school students (11 females and 12 males) aged 10-13 who did not participate in any sports activities and volunteered to participate in the research. The control group students, selected from 73 people, study at Burdur/Bucak Gundogdu Secondary School in Turkey.

Research Design

This study was conducted by the Declaration of Helsinki. All participants were informed about the study processes, and an informed consent form was obtained from each participant. The experimental implementation phase of the research was carried out in the gym of the Burdur/Bucak Youth and Sports District Directorate for 12 weeks between November 2021 and January 2022. In addition, the scale application phase for the control group of the research was carried out in Burdur/Bucak Gündoğdu Secondary School classrooms. The scales were applied face to face with the students. In addition, the necessary permissions for the research were obtained from the Bucak Youth and Sports District Directorate (no: 92070095-100-1259915) and the Bucak District National Education Directorate (no: E-99848340-605.99-36435905).

Procedure

Judo physical activities were planned for 1.5 hours, five days a week, after the necessary safety precautions were taken, and were done in 3 parts. The first is the preparatory phase, which includes various educational games and warm-up exercises. The second stage, basic techniques specific to the branch of judo were applied. For example, basic techniques of Te-waza for the first four weeks. Nage-Waza attack and defense, Koshi-Waza, Ashi Waza, Sutemi-waza, Katame-waza, Osaekomi-waza, Shime-waza, Kansetsu-waza for later weeks. The third phase is the final phase, which includes cool-down and recovery exercises. In any phase of physical activities, the loading intensity did not exceed 50%. The intensity of exercise was determined by the Rating of Perceived Exertion (RPE).

Table 1 shows the judo exercise program.

Data Collection

The researchers created a 3-question "*Personal Information Form*" to determine the participants' demographic characteristics (gender, age, and class). The "*Coopersmith Self-Esteem Inventory*", developed by Coopersmith [24] and adapted into Turkish by Turan and Tufan [25], was used to determine the self-esteem levels of the participants.

Coopersmith Self-Esteem Inventory: The original inventory consisted of 58 items, but different versions were revised over time as the School Form, the School Short Form, and the Adult Form. In this study, a school form consisting of 25 items was used. This scale form consists of answers that can be answered as "like me" and "not like me." In items 1, 4, 5, 6, 8, 9, 14, 19, and 20, the expression "like me" is scored with 1. In items 2, 3, 7, 10, 11, 12, 13, 15, 16, 17, 18, 21, 22, 23, 24 and 25, the expression "not like me" is scored with 1. The overall score of the inventory is obtained by multiplying the total scores obtained from the items by 4. The highest score obtained from the inventory is "100", while the lowest is "0". High scores on this scale mean high self-esteem, and low scores mean low self-esteem. In the study carried out by Turan and Tufan [25],

they determined the test-retest reliability of the scale, which was performed at one-year intervals, as .65 and .76.

Statistical Analysis

Statistical Package for Social Sciences (SPSS) 17.0 package program was used for data analysis. First, a descriptive statistical test was conducted to indicate the socio-demographic characteristics of the participants. Then, normality tests (Skewness and Kurtosis) were applied to determine whether the data showed normal distribution, and it was determined that the data showed normal distribution. Finally, the independent sample *t*-test and Paired Samples *t*-test were applied because the data met the assumption of normal distribution. The significance level was determined as p<0.05.

Results

When Table 2 is examined, no significant difference was found between the experimental and control groups regarding pre-test self-esteem scores (p>0.05).

When Table 3 is examined, a significant difference was found between the experimental and control groups regarding post-test self-esteem scores (p<0.05).

Table 4 shows significant differences between pre- (72.00 ± 12) and post-test (81.65 ± 9) scores of self-esteem in the experimental group (p<0.05). On the other hand, no significant difference was found between pre- (68.78 ± 10) and post-test (67.82 ± 13) scores of self-esteem in the control group (p<0.05).

Discussion

The data obtained in this section have been tried to be examined in the light of the relevant literature.

Forty-six middle school students aged 10-13 participated voluntarily, 23 in the experimental group and 23 in the control group. According to the findings, participation in 12-week regular exercise has a significantly positive impact on the self-esteem of secondary school students. This finding reveals that participation in a 12-week regular judo exercise program significantly increases the self-esteem

Table 1. Judo exercise program

Exercises phases	1. and 2. week	3. and 4. week	5. and 6. week	7. and 8. week	9. and 10. week	11. and 12. week
	Duration	Duration	Duration	Duration	Duration	Duration
Preparation phase (games and warm-up gymnastics)	20 mins.	20 mins.	20 mins.	20 mins.	20 mins.	20 mins.
Main phase (basic techniques)	Basic techniques of te-waza 60 mins.	Basic techniques of te-waza 60 mins.	Nage-waza koshi-waza 60 mins.	Ashi waza sutemi-waza 60 mins.	Katame-waza osaekomi-waza 60 mins.	Shime-waza kansetsu-waza 60 mins.
Final phase (recovery exercises)	10 mins.	10 mins.	10 mins.	10 mins.	10 mins.	10 mins.

Table 2. Differences between experimental and control groups regarding pre-test scores of self-esteem

Group	n	X	SD	df	t	p
Experimental	23	72.00	12.41	44	3.993	.143
Control	23	68.78	10.64			

(p>0.05).

Table 3. Differences between experimental and control groups regarding post-test scores of self-esteem

Group	n	X	SD	df	t	p
Experimental	23	81.65	9.39	44	4.063	.000*
Control	23	67.82	13.34			

(p<0,05).

Table 4. Comparisons of pre-and post-test scores of experimental and control groups

Group	Test	n	X	SD	df	t	p
Experimental	Pre-test	23	72.00	12.41	22	-3.431	.002*
	Post-test	23	81.65	9.39			
Control	Pre-test	23	68.78	10.64	22	.529	.602
	Post-test	23	67.82	13.34			

(p<0.05).

levels of secondary school students. The result supports the research hypothesis (H_1: Participation in 12-week regular exercise has a significant and positive effect on secondary school students' self-esteem). When the literature is examined, it is seen that there are many study findings consistent with the results of the present study.

Ouyang et al. [22] reported that participation in sports has a significant and positive effect on self-esteem in their study examining the impact of sports participation on body image, self-efficacy, and self-esteem on Chinese undergraduate students. In the study of You et al. [26] with 3658 Korean adolescents, the relationship between body image, self-esteem and depression was examined using variables such as age, gender, and intensity of participation in exercise. The study's findings showed that exercise was a significant predictor of self-esteem in low- and moderate-weight adolescents. The results of the study conducted by Ilkım et al. [27] with 35 individuals with Down syndrome between the ages of 10-23 reported that the level of self-esteem of individuals with Down syndrome who participate in regular sports activities is significantly higher than individuals with Down syndrome who do not participate in regular sports activities. The study by Barton et al. [28], in which they examined the effects of a 6-week swimming, other social activities, and green exercise program on the self-esteem of participants with mental problems, revealed that all groups experienced improvements in their self-esteem levels after six weeks. However, individuals who did not participate in any exercise were not included in the study. In addition, the demographic characteristics of the individuals participating in the exercise group were different. In the study of Legrand [29] conducted with female participants between the ages of 18-35 and with low socioeconomic status, it was reported that 7-week (2 exercises for 1 hour per week) exercises positively affected women's self-esteem. However, it was reported that the exercise program carried out in the study was carried out in the open air, and music was used as an auxiliary instrument. Such differences may have had an indirect effect on self-esteem.

In addition to all these findings, which are consistent with the results of the current study, there are also different study findings in the literature that are not parallel with the present study findings:

In the study conducted by Kaminsky and Dewey [16] on the participation of adolescents with type 1 diabetes and comparative adolescents, it was mentioned that there was no significant relationship between participation in physical activities and self-esteem. The results of this study, in which findings inconsistent with the current study were obtained, may be due to the different demographic characteristics of the participants, such as their physical abilities, age, income, and marital status of the parents. In addition, the mentioned study is a cross-sectional survey study, and different findings may have been obtained for this reason. Different sample sizes and low response rates to questionnaires may be another reason for the inconsistencies between studies. In the study conducted by Walters and Martin [30], a group that received an intense aerobic exercise program for 13 weeks was compared with the control group. It was reported that exercise did not positively affect self-esteem at the end of the study. Therefore, the inconsistency between the present study results and this one may be the intensity of the exercises. In addition, the researchers mentioned that it is unlikely that the already high self-esteem will rise even more, referring to the studies of Walters and Martin [30], Stiffman et al. [31], who stated that the participants had high self-esteem even before starting the exercises.

Different data collection tools may cause the emergence of some inconsistencies between studies. The differences between the groups selected as samples (gender, age, etc.) and different dimensions (stress, anxiety, etc.) may change the effect of physical activity on self-esteem [32]. As can be seen in the study of Walters and Martin [30], exercise types of different intensities can lead to varying developments in self-esteem. While some studies stated that the relationship between physical fitness, body image, body mass index, self-esteem, and exercise were factors that affect each other [32], it is suggested that physical activity intensity is not effective on body image and therefore self-esteem [32]. Finally, in a meta-analysis examining the relationships between different variables such as the setting in which the exercise was performed, whether the exercise was performed as a uniform or combined exercise, and the duration of the intervention, there was very strong evidence that uniform exercises and school-based and gym-based interventions improved self-esteem compared to other settings [33].

Conclusion

In the present study, a single type of exercise, a 12-week intervention, and both school-based and gym-based participants revealed a positive and significant result between self-esteem and exercise participation. This is generally compatible with the relevant literature.

It should be noted that the demographic characteristics of the participants selected for the sample in the current study, their different mental characteristics, their relationships with the environment they live in, the type and intensity of exercise, and the biased responses they may have given to the scales are among the limitations of this study. Participants who gave incorrect answers to the scales or for different purposes were initially

excluded from the study without statistical analysis and were not included in the analysis. It was assumed that all the remaining participants gave unbiased answers to the scales.

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Conflicts of Interest

The authors declare no conflict of interest.

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ORIGINAL ARTICLE

Development, validation, and reliability of athletes' resilience index

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Abstract

Background and Study Aim: The ability to turn back from stressful experiences quickly and efficiently is essential for any athlete who performs in high-level competition. Measuring the degree to which athletes deal with adversity, setbacks, and failure has become the area of concern in the field of resilience. The main aim of the study was to develop, validate and test the reliability of a new index of measurement that can evaluate the level of athletes' resilience.

Material and Methods: The first phase of the study is developing 37 items of the Athletes Resilience Index (ARI-37) based on previous qualitative data. Meanwhile, in the second phase, the study focused on establishing the Confirmatory Factor Analysis, convergent validity, and construct reliability of the index. The sample consisted of 351 Performance Development athletes who represent the state of Perak, Malaysia in the Malaysian Games (SUKMA) 2022.

Results: Confirmatory Factor Analysis retained five risk issues in sports setting including performance, change, behavioral, psychological, and interpersonal. However, instead of 37 items, the Confirmatory Factor Analysis confirmed 26 items only. Most of the factors in ARI-26 yielded a high coefficient value of convergent validity (>0.5). Construct reliability of the index was also sufficient (0.44 to 0.62).

Conclusions: The development of ARI-26 will allow researchers to better capture the unique aspects of resilience in the sports context. Thus, the Athletes' Resilience Index (ARI-26) is revealed to be a reliable instrument for the assessment of resilience levels in high-level athletes.

Keywords: resilience, athletes' resilience index, performance development, sports adversity, confirmatory factor analysis

Introduction

Resilience means turning back from stressful experiences quickly and efficiently [1] and achieving a balanced performance status [2]. It is the ability of an individual to lead a life towards more sustainable well-being [3]. Resilience is the role of psychology in promoting personal assets that can protect individuals from distress factors [4]. Studies on resilience want to understand why some individuals are able to survive in stressful situations, and even bounce back and become better than before [5]. Although there are different definitions and concepts related to resilience, in general, resilience is a person's ability to cope and deal with adversity effectively and positively, thus improving the person's well-being [6]. This explains why the concept of resilience is more geared towards the success of individuals adapting and rebounding in difficult situations [7].

The concept of resilience is very important for individuals in various fields, including sports. Studies show that various sources of stress are experienced by athletes in competitions, while psychological characteristics help athletes adapt to the difficulties experienced during the involvement [8, 9]. Moreover, the environmental factors can cause athletes to face significant stress processes such as effort, struggle, sacrifice, overcoming challenges, rivalry, evaluation, risk of injury, assimilation of defeat, and facing and overcoming numerous adverse and stressful situations [10]. In addition, studies show injury factors, relationship factors, organisational demand, and mental health problems are a source of stress for athletes [11-14]. For this reason, resilience has been identified as a relevant variable in the context of sports and training, arousing a growing interest as an object of research over the last decades [5, 10, 15]. Thus, emphasis should be given to the extent to which athletes respond to difficulties encountered in maintaining performance. This is because only athletes who are able to recover from the impact of stress are considered resilient [16].

Over the past decades, the resilience paradigm has evolved from a stable, trait-oriented approach to an outcome-oriented approach [17]. In sports, due to the nature of athletes, they are expected to achieve long-lasting victories. Therefore, resilience is a critical attribute for them. Because of this, organizational stress continues to generate interest and research attention in sports psychology. This is largely because research evidence continues to highlight that the organizational environment is a breeding ground of stressors for athletes. For example, studies on the effects of organizational stress on well-being in competitive sports found positive relationships between both goals and

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development stressors (duration and intensity) and team and culture stressors (frequency and intensity) on negative affect [18]. Meanwhile, the study found that athletes generally respond to organizational stressors with a wide range of emotions, attitudes, and behaviors such as anger, anxiety, disappointment, distress, happiness, hope, relief, reproach, and resentment [19].

Concerning the effect of organizational stress on athletes' performance, transactional theories of stress have been considered to conceptualize stress in sport [20, 21]. Stress transactions appear to include stressors, appraisals, coping, and emotions, and they do, in fact, determine the level of adaptation and resilience. In sports situations, athletes who perform at a high competition level need to perform ideally under many stressors with their own appraisal. This is mentioned in the Integrative Model of Athletic Performance (IMAP), which highlights the three interactive phases that athletes can attain and then maintain optimal performance states [22]. Based on IMAP, individual dispositional characteristics become the most important protective factor for individuals as they respond to external demands and environmental stimuli during their preparation phase. Those potential stressors, such as personal and professional relationships, demand and organizational realities, physical and psychological needs in training and competition, financial stress, injuries and physical barriers, experience outside of sports, and life changes and transitions, become challenges for the athlete to pursue their next performance phase where they need to blend interactively in terms of affective, physiological, and behavioral processes to produce the outcome. The outcome of resilience should have resembled what it was during the post-performance phase in which athletes were either involved in sustaining involvement, re-engaging after a brief dysfunctional period, or disengaging from the activity [22]. In the long run, IMAP suggests the importance of ideal performance for the athlete is to have good protective factors in order to achieve equilibrium and adaptation.

Exposure to one or more of these stressor events does not always dictate the occurrence of negative outcomes [23]. No matter how many stressors they face, they still manage to maintain good coping behavior and adapt successfully in the face of adversity, thereby maintaining or regaining normal levels of functioning. Based on Clinical Sport Psychology, Performance Development (PD) functioning athletes are classified as those who tend to improve sports performance and are not affected by any psychological well-being issues, whereby no factors such as development, transition, behavior, interpersonal, or intrapersonal can affect their performance or require the attention of sports psychologists [22]. This classification is based on the model of the Multilevel Classification System for Sport Psychology (MCS-SP), which provides interview administration guidelines to obtain athlete performance function information. Case formulation resulting from these interviews can provide information related to risk factors and protective factors that can determine the overall athlete resilience index. There are eight elements of case formulation based on the MCS-SP model to understand athletes' risk factors and protective factors underlying performance issues, such as contextual performance needs, athlete performance level, relevant situation needs, athlete psychological characteristics, behavioral response, self-regulatory profile, willingness to change, and reactance level [24].

In Malaysia, Malaysian Game or SUKMA is a national event organized by the National Sports Council of Malaysia and State Sports Councils as well as the Malaysian Schools Sports Council (MSSM), Malaysian University Sports Council (MASUM), and the Malaysian Royal Police Sports Council. It is a 'multi-sports competition' with the concept of 'Mini Olympic Games' in Malaysia which involves young athletes. Since SUKMA is held bi-annually and alternates with the SEA Games, the focus on the development and athletes' preparation is very much emphasized. Athletes who participate in SUKMA are usually high-performing athletes and have bright hopes of producing success for their respective states. Accordingly, athletes have to undergo a rigorous training program that has been arranged by the State Sports Councils. However, the level of athlete satisfaction and the extent of athlete resilience to adversity and all forms of expectation and pressure on competition are still unclear as no empirical data has been found on this matter. Therefore, it is important for sports organizations to ensure that athletes who are preparing for high-level competitions are not only classified as Performance Development (PD) but also resilience.

Examining the interplay between stressors and protective factors is essential since it focuses on the process of adaptation in which resilience occurs. Thus, before developing sport-specific measures of resilience, the pivotal resilience-related areas of stressors and protective factors should be taken into consideration [5]. Based on our previous qualitative study, we had already explored the aspects of resilience among Performance Development (PD) athletes using semi-structured interviews based on the Multilevel Classification System for Sport Psychology (MCS-SP) [24]. The results of the study found five themes related to risk factors faced by PD athletes in maintaining developing performance, such as performance, change, behavior, psychology, and interpersonal issues. Therefore, in this study, we discuss the process of developing, validity, and reliability of the Athletes Resilience Index as

sport-specific measures of resilience among PD athletes. The objective of developing the index is to determine the extent to which athletes' performance is affected due to the presence of risk factors, with the belief that resilience occurs when athletes are buffered from the risk factors throughout their involvement in sport. It was hypothesized that the Athletes' Resilience Index would provide a reliable and valid measure of resilience index for athletes. It was further hypothesized that the index would also reveal a five-factor model, reflecting performance, change, behavior, psychology, and interpersonal issues as risk factors for PD athletes.

Material and methods

Participants

A pilot study was carried out to test the validity and reliability of Athletes Resilience Index (ARI-37). There were 351 athletes under the Performance Development (PD) category who represent the state of Perak in Malaysian Games (SUKMA) 2022 involved in this study. Among the participants, there were male (n=185, 58.7%) and female (n=130, 41.3%) athletes. The participants also represented individual sports (n=171, 54.3%) and team sports (n=144, 45.7%). Participants >200 are considered a large sample size for the factor analysis procedure [28].

Adherence to Ethical Standard

All procedure performed in this study were in accordance with ethical standard of the institutional Research Ethics Committee. Informed consent was obtained from all participants involved in this study.

Research Design

Phase 1: Item Development

Based on previous study, the Athlete Resilience Index (ARI) was developed into 37-items of self-assessment (ARI-37) to quantify an athlete's resilience index [24]. The term index is used as it reflected the characteristics of index variables [25]. First, an index is derived from multiple items that have been combined and converted into a single measurement or scale. Secondly, the individual items that form the basis of the index, measure something that is underlying, quantitative, and on a measurement continuum. Thirdly, an index variable constitutes a scale measurement that is indicative of some hypothetical construct, therefore the higher index values might indicate 'more off' and lower values 'less off', with neither being 'right' or 'wrong'.

In developing the ARI-37, five main issues were identified during the qualitative study [24]. Item analysis was performed on the responses obtained in the focus group discussion. A total of 37 items were found related to the athletes' agreement that several issues were identified as risk factors in their preparation for competition. Thus, the ARI-37 is considered as a comprehensive instrument composed of five sub-scales, which reflect five major issues or risk factors for the athletes. All the items were rated on a 5-point Likert scale as follows: 1 (strongly disagree), 2 (somewhat disagree), 3 (neither disagree nor agree), 4 (somewhat agree), and 5 (strongly agree). The sub-scales consisted of performance issues (6 items), change issues (11 items), behavioral issues (9 items), psychological issues (8 items), and interpersonal issues (4 items). The high score on the index meant high resilience.

The initial pool of items has been submitted to expert review for face and content validity. Two linguists and three psychologists were appointed for the review process. The results of the coefficient value for face validity found that all experts agreed that the language used in the instrument is simple (0.88), the language used is easy to understand (0.84), the terms used are correct (0.84), the grammar used is correct (0.80), the content of the questionnaire is well understood (0.88), and the entire questionnaire is suitable for use in the context of testing (0.92). Meanwhile, in terms of the coefficient value for content validity, all experts agree that the content of the instrument meets the target population (0.90), the instrument implementation situation is appropriate (100.0), the time allocated to answer is sufficient (0.85), the instrument successfully measures the content it should measure (0.75), and the instrument can help individuals assess their behavior (0.85). A validity coefficient value of 0.70 is considered high, indicating that all aspects of the face and content validity are acceptable [26, 27].

Phase 2: Establishing Psychometric Analysis of Athlete Resilience Scale (ARI-37)

Procedure

This study was conducted during the Covid-19 pandemic phase in July 2021. Therefore ARI-37 was transferred in google form to facilitate the distribution process to the participants. Prior to that, a briefing session by google meet was held between researchers and participants to explain the method of answering the questionnaire. Participants were given two weeks to submit the form to the researcher.

Statistical Analysis

Psychometric characteristics of the original ARI-37 were analyzed using Structural Equation Modeling (SEM) and Moment Structure (AMOS) software (SPSS Version 26). Confirmatory Factor Analysis (CFA) was used as it is a multivariate statistical procedure to test how well the measured variables represent the number of constructs in the ARI-37. Through the CFA method, researchers will be able to test for model fit, convergent validity, and also construct reliability. Assessment of model fit is based on fit indices which suggests three to four fit indices to establish model fit [29]. The recommended fit indices include Relative Chi

Square (χ2), Goodness-of-fit statistic (GFI), adjusted goodness-of-fit statistic (AGFI), Comparative fit index (CFI), Normed-fit index (NFI), Tucker-Lewis Index (TLI), and Root mean square error of approximation (RMSEA). The criteria for fit indices are shown in Table 1. In terms of the factor loading, all standardized factor loadings must be more than 0.5 [29, 30], positive, and not more than 1.0 (as > 1.0 is considered an offending estimate). Deleting indicators should be done for those who do not meet the above requirements. Using AMOS, the identification of a potential indicator to be deleted can be obtained from Modification Indices (MI).

Table 1. The criteria for Fit Indices

Fit Indices	Recommended Value
CMIN (χ^2)	Report if n between 100 200 [31]
CMIN/DF (Relative χ^2)	< 5.0 [32] < 5.0 [33] Report if n > 200 [33]
GFI	> .90 [34] > .90 [35]
CFI	> .90 [33] > .90 [36]
NFI	> .90 [37]
RMSEA	< .08 [30] < .05 [38]
SRMR	< .08 [29] < .05 [30]

Note: GFI - goodness-of-fit statistic; AGFI - adjusted goodness-of-fit statistic; CFI - comparative fit index; NFI - normed-fit index; TLI - Tucker-Lewis Index; RMSEA - root mean square error of approximation.

The method of CFA will also test the convergent validity of the instrument. Convergent validity refers to a set of indicators that are presumed to measure a construct [28]. Convergent validity is the internal consistency of a set of items or indicators [38]. It represents the strength of relationships between items that are predicted to represent a single latent construct. Therefore, to confirm that the instrument highly meets the criteria of convergent validity, the items must be strongly related to each other and represent only one factor. Convergent validity can be tested using factor loading or Average Variance Extracted (AVE). High factor loadings (0.5) on a factor indicate high convergent validity [29, 30], whereas the average variance extracted (AVE) for each construct should be at least 0.50 (> 0.5), indicating high convergent validity [39]. Construct Reliability (CR) is another criterion to be tested in CFA. It is a measure of internal consistency in scale items, much like Cronbach's alpha [40]. An instrument with CR > .70 is considered reliable [29].

Results

A screening procedure of the data has been done in order to make sure that the data meet the appropriate assumption for factor analysis. A sample of 351 is acceptable as a minimum of five subjects per variable is required for factor analysis. The absolute values of skewness and kurtosis did not indicate a violation of the normality assumption. In terms of factorability of the correlation matrix, the result of Barlet field test value χ2: 8221.555 was found as significant with a value of p<.05. In addition, it was observed that the common factor variance (Communalities) of examined items ranged between 0.475 – 0.715, meanwhile, the Kiser-Meyer-Olkin value that measure of sampling adequacy is far greater than 0.6. From this result, it is confirmed that the data is suitable for factor analysis.

Confirmatory Factor Analysis for Performance Issues

The construct of performance issues consists of five indicators. Based on observation, all the factor loading values are positive and meet the criteria of > 0.5. However, as it can be seen from Figure 1, the results of initial confirmatory factor analysis (CFA) yielded rather unacceptable model fit [$\chi2$ (5) = 28.376, p < 0.05, CFI = 0.942, RMSEA = 0.122]. Therefore, based on modification indices, the highest MI of item b3 should be deleted. After deleting b3, the model should fit well. Instead of five items, the construct of performance issues only has four items to be used, and those are b1, b3, b4, and b5.

Confirmatory Factor Analysis for Change Issues

The initial construct of change issues consists of 11 indicators. Based on observation on Fit Indices, all the criterion were not achieved [$\chi2$ (44) = 316.929, p < 0.05, CFI = 0.840, RMSEA = 0.141]. However, all factors loading values are positive and more than 0.5. Modification Indices (MI) suggested a few possibilities of the item to be deleted that is b7, b11, and b15. After deleting the items, the model fits the indices well. Instead of 11 items, the construct of change issues has eight items to be used (b6, b8. B9. B10, b12, b13, b14, and b16). The model tested shown in Figure 2.

Confirmatory Factor Analysis for Behavioural Issues

The construct of behavioral issues consists of nine initial indicators. Based on the test for Model Fit in Figure 3, the Fit Indices are not acceptable [$\chi2$ (27) = 536.364, p < 0.05, CFI = 0.704, RMSEA = 0.245]. Several factor loading values are also less than 0.5. Thus, the first action was taken to delete unfit factor loading for items b17, b18, b19, b20, and b21 as being suggested by Modification Indices. This has resulted in an appropriate loading factor (> 0.50). Instead of nine items, the construct of behavioral issues has four items to be used that is b22, b23, b24, and b25.

Confirmatory Factor Analysis for Psychological

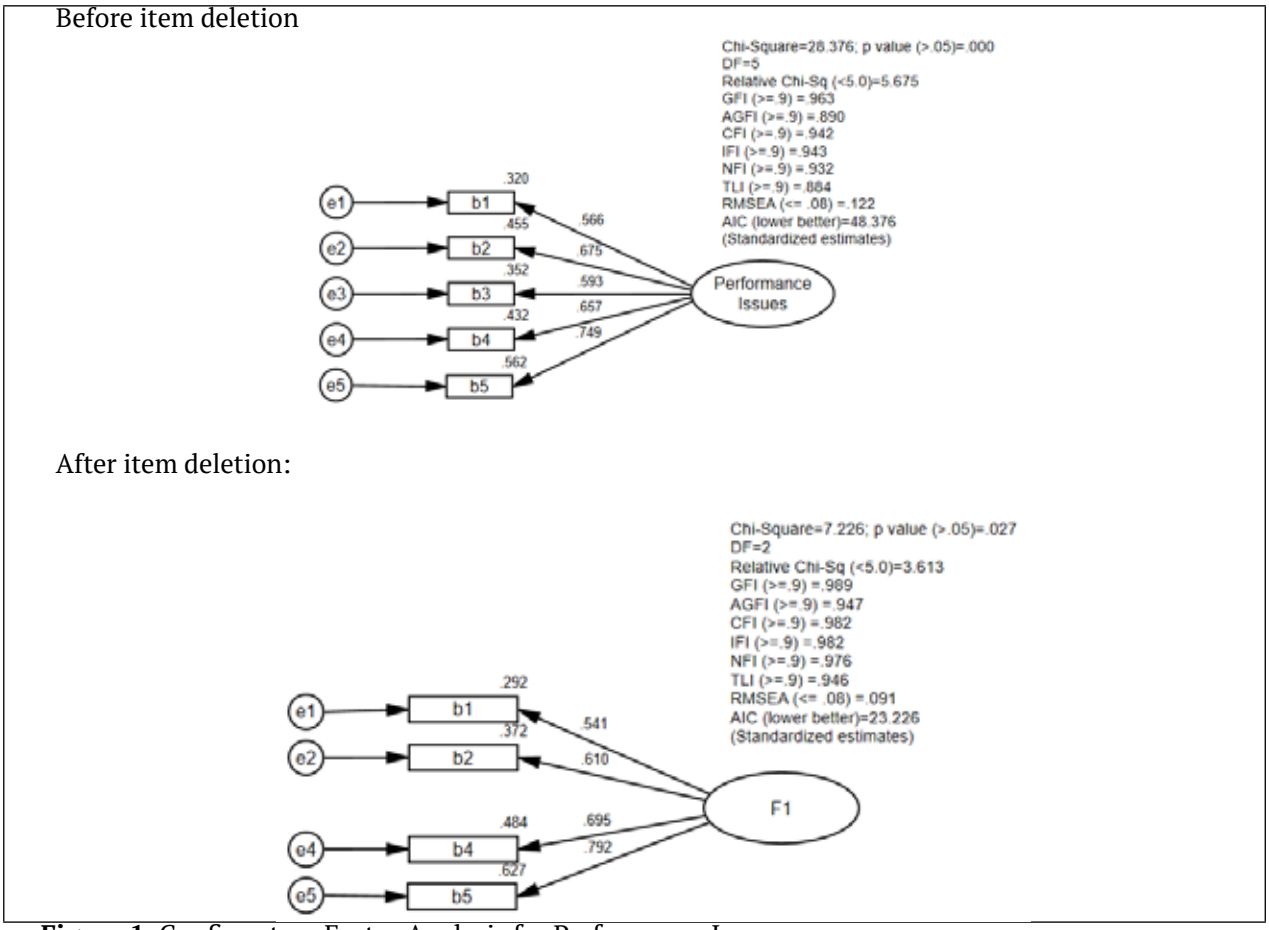

Figure 1. Confirmatory Factor Analysis for Performance Issues

Issues

Initially, the construct of psychological issues consists of eight indicators. Based on the test for Model Fit in Figure 4, all factor loading has met the criterion of > 0.5. However, the results of initial confirmatory factor analysis (CFA) yielded rather unacceptable model fit [$\chi 2$ (20) = 76.588, $p < 0.05$, CFI = 0.955, RMSEA = 0.095]. Thus, Modification Indices suggested items b29 and b32 be deleted. The construct of psychological issues has now consisted of b26, b28, b29, b31, b32, b33.

Confirmatory Factor Analysis for Interpersonal Issues

The construct of interpersonal issues consists of four initial indicators. Based on the test for Model Fit, all factor loading has met the criterion of > 0.5 as shown in Figure 5. The results of initial confirmatory factor analysis (CFA) yielded rather acceptable model fit [$\chi 2$ (20) = 11.475, $p < 0.05$, CFI = 0.985, RMSEA = 0.123]. Therefore, the number of interpersonal issue items remained the same as before.

Convergent Validity and Construct Reliability of the Instrument

In this study, the factorial validity and construct reliability of the instrument were analyzed. As shown in Table 2, all factors have yielded a high coefficient value of convergent validity (> 0.5). However, only one factor considered adequate validity weight that is performance issues. In terms of construct reliability, internal consistency reliability with Cronbach's alpha has been used to analyze the construct reliability of each factor. Results showed that all five factors exhibited a satisfactory level.

Discussion

Researchers who wish to study sports resilience in the future should think carefully about how they operationalize the construct [16]. Therefore, this study shows that athletes' resilience can be defined operationally by the degree of athletes agreed on the extent of how far the risk issue may affect their performance. The less the index indicates the higher level of resilience while the more the index indicates the lower resilience. Resilience is unique because it explains the state of adversity and positive adaptation.

The purpose of a recent study was to develop and test the validity and reliability of the Athletes' Resilience Index (ARI). Therefore, the respondent was selected among Performance Development (PD) athletes who were classified as those who tend to improve sports performance and are not affected by any psychological well-being issues, whereby no factors such as development, transition, behavior, interpersonal, or intrapersonal can affect

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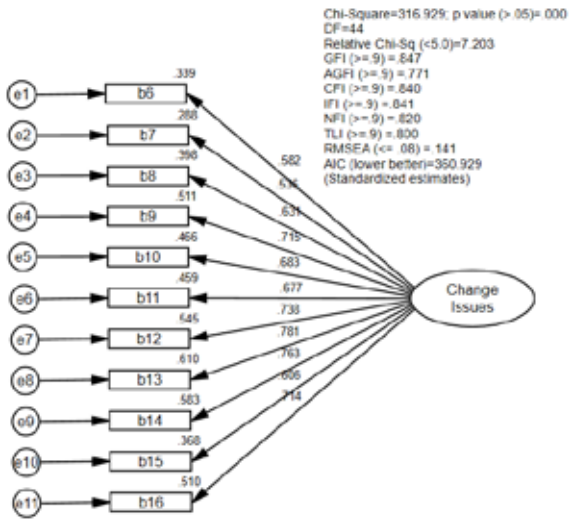

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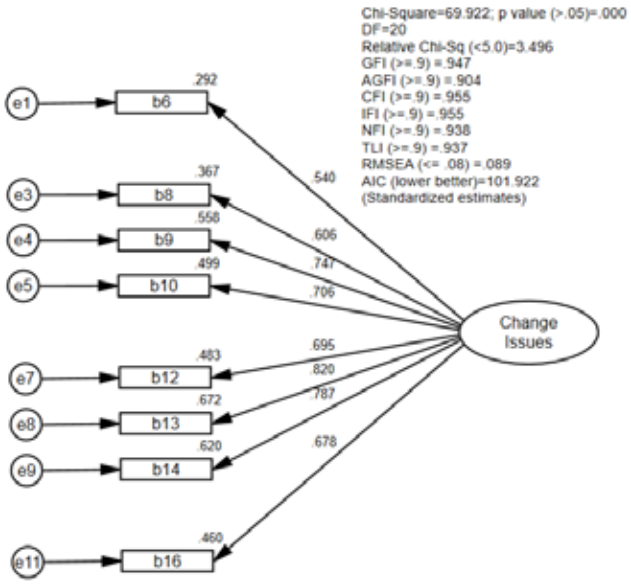

Figure 2. Confirmatory Factor Analysis for Change Issues

Table 2. Average variance Extracted and Construct Reliability of Instrument

Construct	No of Items	AVE	CR
Performance Issues	4	0.440	0.753
Change Issues	8	0.500	0.884
Behavioral Issues	4	0.720	0.897
Psychological Issues	6	0.515	0.863
Interpersonal Issues	4	0.629	0.871

Note: AVE - Average Variance Extracted; CR - Construct Reliability.

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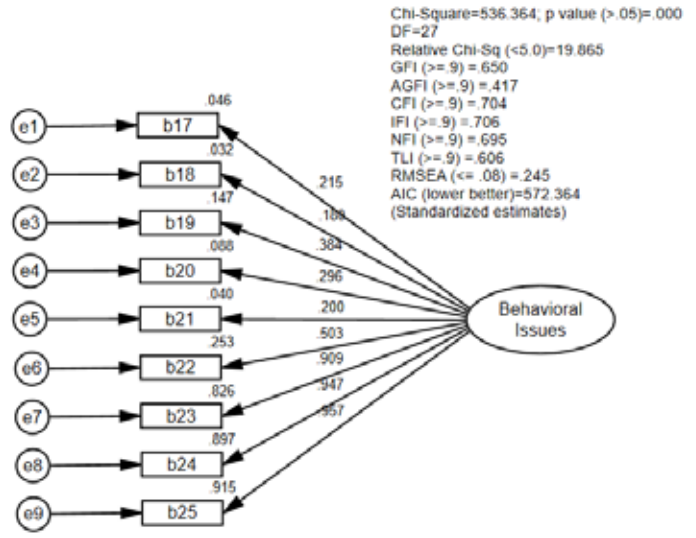

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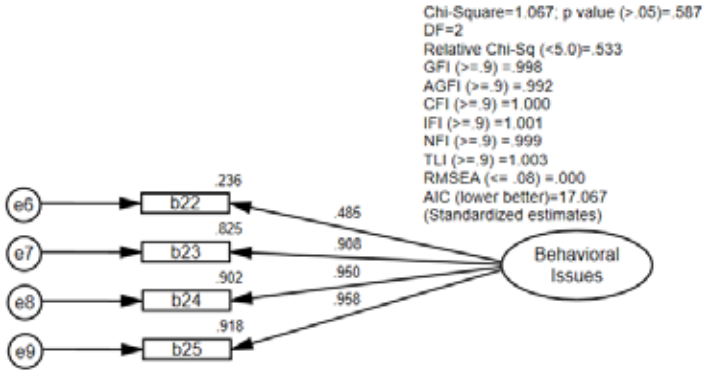

Figure 3. Confirmatory Factor Analysis for Behavioral Issues

their performance or require the attention of sports psychologists [22]. Few studies also use the same respondent with the same criteria but different terminologies such as athletes who won an Olympic gold medal [41], and current and former high-level athletes recommended by others as being resilient athletes [42].

The risk issues covered were achieved through interviews as the primary method of data collection during the previous study [24]. Confirmatory Factor Analysis (CFA) was performed on the original ARI-37 to obtain the result of model fit, convergent validity, and construct reliability. Based on CFA, the results revealed the existence of a new resilience index (ARI-26) which composed of 26 items under five constructs of risk issues, namely performance issues, change issues, behavioral issues, psychological issues, and interpersonal issues. The first construct of performance issues had a special focus on the athlete's view that some risk factors related to their performance may affect them. The distinguishing issue was due to unstable physical performance during training, a mistake while doing warm-up in training, the coach's approach during training, and the static performance shown throughout the training. The second related risk construct that may affect athletes' performance, is the change issue. Change issue composed of athletes' views that their performance may be affected due to changes in body composition, training schedule, training venue, training equipment, organizational management, sports facilities, accommodation facilities at the training venue, the pattern of relationships with family, and socialization. The third construct covers factors related to behavioral issues such as disciplinary problems throughout training, consume illegal substances and alcohol, and smoking habits. The fourth construct is psychological issues which cover the difficulty of overcoming nervousness, impatience to finish training sessions and tournaments, the difficulty of overcoming the feeling of laziness in training, difficulty in coping

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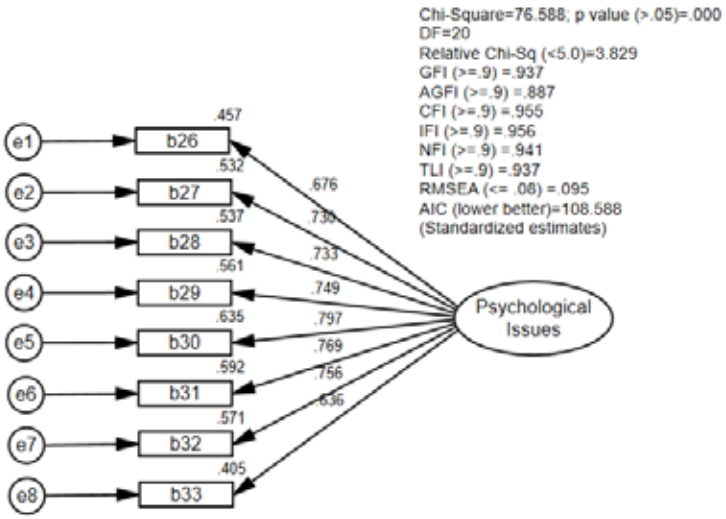

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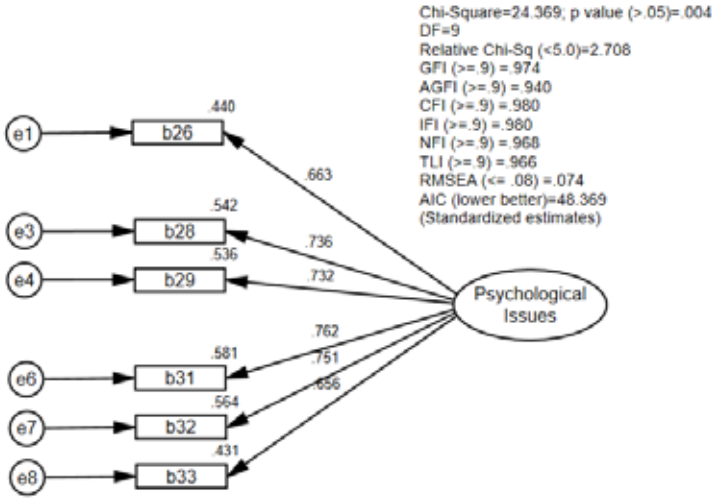

Figure 4. Confirmatory Factor Analysis for Psychological Issues

with stress, difficulty overcoming drowsiness, and difficulty coping with pain from injury. While the fifth construct is related to interpersonal issues such as conflict with the coach, conflicts with teammates, conflict with management, and conflict with family. These constructs resemble the idea that athletes who participate in sport at a high level will likely experience a number of stressors, adversities, and failures [43, 44, 45].

Several studies were also keen to work with interview techniques to understand resilience in a sport setting by analyzing the views of risk issues from athletes' perspectives. Thus, the present study gets support and offers some add-on findings related to risk issues other than general stress of training and competition [4], self-identified of most difficult adversity as an athlete [42], injury factor [11, 46], worse-than-expected performance [48, 49], effort, struggle, sacrifice, overcoming challenges, rivalry, evaluation, risk of injury, assimilation of defeat, and facing and overcoming numerous adverse and stressful situations [10], relationship factors [12], organizational demand [13], and mental health problems [14].

Conclusions

In conclusion, the development of such sport-specific measures will allow researchers to better capture the unique aspects of resilience in the sports context. The emergence of ARI-26 had provided the evidence-based measurement to measure resilience among PD athletes. The five-factor model, including performance, change, behavior, psychology, and interpersonal issues as risk factors had also been confirmed by the model fit. Thus, the Athletes' Resilience Index (ARI-26) is revealed to be a reliable

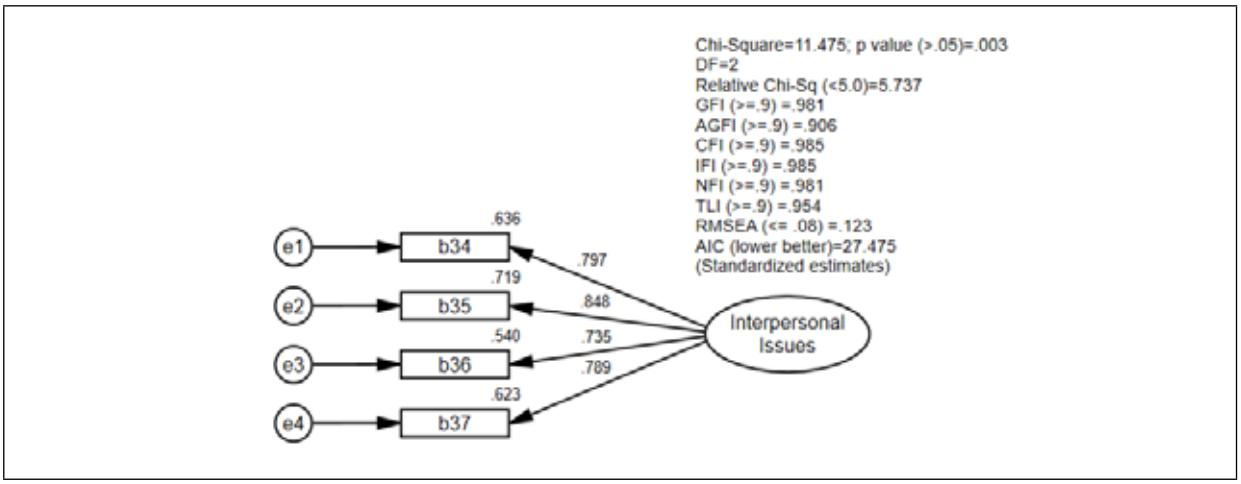

Figure 5. Confirmatory Factor Analysis for Interpersonal Issues

instrument for the assessment of resilience levels in Performance Development athletes. ARI-26 can be used in future research to explore the level of resilience in the context of sports adversities. The data from ARI-26 might provide early warning signals to the athletes and other sports practitioners, therefore prevention action can be taken before breakdowns in performance occur.

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ORIGINAL ARTICLE

Effects of Anulom Vilom Pranayama and Rope Mallakhamb Training on respiratory parameters in young females with athletic backgrounds

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Authors' Contribution: A - Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

Abstract

Background and Study Aim: To assess the effects of Anulom Vilom Pranayama (AVP) or alternative nostril breathing and Rope Mallakhamb Training (RMT) on respiratory parameters among university females with athletic backgrounds.

Material and Methods: A quasi experimental study was performed on thirty-six, university female students from the Department of Physical Education (T), Guru Nanak Dev University, Amritsar, Punjab, India. The subjects were divided in three groups. The groups were subjected to 4-weeks of intervention including: Group A (n_1=12) subjected to AVP, Group B (n_2=12) subjected to RMT, and Group C: (n_3=12) no training or control. Respiratory parameters were measured twice, pre and post intervention using a wet spirometer. All measurements were performed three times and the average values were recorded for analysis.

Results: 4-weeks of AVP resulted in positive increases for respiratory parameters measured including Tidal Volume (VT) 25.7%, Inspiratory Reserve Volume (IRV) 29.4%, Expiratory Reserve Volume (ERV) 27.1%, Vital Capacity (VC) 33.2%, and Inspiratory Capacity (IC) 31.6% compared to the control group. Also, 4-weeks of RMT had a positive impact on respiratory parameters including (VT) 19.8%, (IRV) 22%, (ERV) 19.4%, (VC) 32 % and (IC) 28.1% compared to the control group.

Conclusions: Both AVP and RMT had a positive impact on respiratory parameters. Also, AVP training has a more positive impact on respiratory parameters than RMT and may also contribute to the enhancement of concentration-based performance and voluntary control of breathing among young females from athletic backgrounds. As a result, AVP training can be more beneficial for a competitive edge in order to improve the athletes' primary need for respiratory endurance.

Keywords: anulom vilom, tidal volume, expiratory reserve volume, inspiratory reserve volume, vital capacity, inspiratory capacity.

Abbreviations:

VT: Tidal Volume
ERV: Expiratory Reserve Volume
VC: Vital Capacity
IRV: Inspiratory Reserve Volume
IC: Inspiratory Capacity
AVP: Anulom Vilom Pranayama
RMT: Rope Mallakhamb Training
PEF: Peak Expiratory Flow
VO_2 max: Maximal Oxygen Consumption

Introduction

Yoga has been practised in India for thousands of years and is one of the pre-eminent lifestyle modifications. There are many established methods available for individuals to reach the ultimate goal of a healthy life [1, 2]. Yoga is a blend of physical exercise, controlled breathing, and relaxation practice. One of the ancient forms of yoga is pranayama, which is an art form of controlling the life force of breath. Mallakhamb is another form of yoga, a traditional Indian sport in which the practitioner practices yoga-like postures and movements on a vertical wooden pole or rope.

Yoga breathing, or pranayama, is the science of breath control. It consists of a series of exercises especially intended to meet the body's needs and to keep the body in vibrant health. Pranayama is the combination of words -Prana "life force or life energy", Yama "discipline or control" and Ayama - "expansion, non-restraint, or extension". Pranayama means controlling all physical tasks including, the breath, oxygen supply, digestion, and the use of ventilatory parameters within the discipline. Furthermore, pranayama includes inhalation, exhalation and retention. Retention is further divided into inhalation retention (after inhaling) and exhalation retention (after exhaling). The significant part of pranayama is breath retention. To

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achieve breath retention effectively, the function of respiration must be gradually controlled. Therefore, in the practise of pranayama more importance is given to inhalation and exhalation at the onset of practise, in order to strengthen the lungs, balance the nervous system and to regulate the breath in preparation for the practice of breath retention. Pranayama is an important part of yoga that is thought to have an impact on the physiological systems. Pranayama and other breathing exercises have gained importance as it has been shown to improve blood oxygenation and utilization the capacity of lungs, thereby helping in the prevention of many diseases [3]. The role of pranayama has been studied extensively in different pathological diseases including asthma, chronic obstructive pulmonary diseases, systemic hypertension, post-operative management in general surgery, cardiovascular surgeries, and head and neck surgeries have also been documented [4-8].

Mallakhamb is a traditional Indian sport in which the practitioner practices yoga-like postures and movements on a vertical wooden pole or rope only. Mallakhamb is the name given to a little-known style of physical culture practiced in India. It is combination of yoga, gymnastics, and martial arts. The exercises of rope mallakhamb are performed against gravity using upward and downward movements [9]. Postures can be performed in the air with the use of appropriate equipment. There are three ways in which mallakhamb may be performed – on a fixed pole, or on a hanging pole or rope. Three decades ago, pole mallakhamb gave way to the rope mallakhamb. This is the closest type of exercise mimicking the legendary Indian rope trick and requires alertness, focus and balance. There are many studies on yoga and its effects on physical function [10] but there is a surprising lack of research in the effect of rope mallakhamb on physical function despite its popularity in the past few years.

Aerobic endurance performance also known as aerobic fitness, cardiovascular endurance, or cardiorespiratory endurance, is the ability to keep exercising at a moderate intensity for extended periods of time. Aerobic endurance performance is dependent on three important components: maximal oxygen uptake (VO2max), anaerobic threshold, and work economy. VO2max is an extensively used index for measuring the aerobic fitness of athletes and can be determined by laboratory and field tests [11, 12]. Studies suggest that pranayama has demonstrated its positive impact on respiratory parameters. A study reported the effects of short- term pranayama training over a 6-week period on 50 young adults (age = 18-35 years) related to their pulmonary function parameters. Their results indicated significant increases in all the lung parameters including forced vital capacity, forced expiratory volumes, peak expiratory flow rate and forced expiratory flow in the regular yoga practitioners compared to pre yoga practice [13]. Similarly, our previous study has shown that mallakhamb has a positive impact on respiratory parameters among high school girls. Our previous results indicated that a 4-week RMT on 24 high-school girls (age = 12-16 years) improved respiratory indices including VT, expiratory and inspiratory reserve volume, vital capacity, forced vital capacity and inspiratory capacity compared to a control group [14].

Many investigators have determined that AVP and RMT have favourable effects on respiratory parameters [15, 16]. The literature has outlined that short-term pranayama and mallakhamb practices have a positive impact on respiratory parameters of young adults, however studies related to their impact on respiratory parameters of individuals with athletic backgrounds are not readily available. Additionally, AVP and RMT as sport disciplines are very popular in India and many sports competitions are conducted at university at a national level. Both disciplines need respiratory endurance for increased performance. During physical exercise, the respiratory system is an important system of the human body that facilitates gaseous exchange and the diffusion of large amounts of oxygen into the blood [17]. During sports training, breathing and exercise have been strongly linked, and any physical effort is obviously dependent on effective lung ventilation. An increase in tidal volume (VT), expiratory reserve volume (ERV), inspiratory reserve volume (IRV), vital capacity (VC) and inspiratory capacity (IC) can be achieved in activities that place a high demand on respiratory effort [18, 19]. Therefore, athletes primarily need respiratory endurance for a competitive edge. Therefore, this study was designed to examine if AVP or RMT would be effective in improving respiratory parameters among females with athletic backgrounds.

Material and Methods

Participants.

A quasi-experimental study was conducted on thirty-six, girls (age 21-26 years) from the Department of Physical Education (T), in Guru Nanak Dev University, Amritsar, Punjab, India. All the subjects were informed about the objective and protocol of the study. Subjects with history of any infective or respiratory ailment condition were excluded from the study. The subjects were purposively divided into three groups: Group-A: AVP (n1=12), Group-B: RMT (n2=12) and Group-C: Control (n3=12). Purposive sampling was used keeping in view of administrative feasibility. The participants participated in the study voluntarily and all the subjects were also informed about the objective and protocol of the study. The informed

consent of participants was not conducted or granted in this study because all participants' privacy and personal identity information were maintained. The study protocol was conducted at Department of Physical Education (T), Guru Nanak Dev University, Amritsar, Punjab, India.

Research Design.

All training and testing were performed at the same time of day to minimise the effects of diurnal contamination. Prior to training, data and testing all subjects were fully familiarized with training methodologies and testing procedures to minimise learning effects. During the experimental period, all subjects refrained from participation in additional exercise that was not related to the experiment. Subjects in Group-A were athlete students who were indulged in yogic practices precisely in yogic asanas and pranayama. Subjects in Group-B were athlete students who indulged in mallakhamb training (rope) only, whereas subjects in Group-C were athlete students specialized in various major and minor games other that yogic asanas, AVP and RMT. Distribution and demographics of subjects are presented in Table-1. Group A and Group B were subjected to an AVP and RMT for 4-weeks (6 days/ week) of intervention respectively. First week they practiced the intervention for 20 minutes, second week 25 minutes, third week 30 minutes and fourth week 35 minutes respectively. Whereas Group C did not receive any training. The training was provided by single trainer. In practice sessions the trainer was responsible for corrective actions. The weight and height were collected of all the participants prior to the interventions using a calibrated weighing scale and anthropometric rod. Participants were made familiar with the wet spirometer (RMS PC Based Spirometer Helios-401) and all procedures for performing the test. Pre and Post measurements of respiratory parameters including VT, IRV, ERV, VC and IC were measured in a relaxed seated position, collated and presented as means ± standard deviations (S.D). The units for the expired and inspired gases were recorded in litres. All the measurements were collected three times and average of three data sets was taken for further analysis. A study flow diagram is presented in Figure 1.

Respiratory parameters measurement:

Respiratory parameters were measured twice (pre & post) using a wet spirometer, the respective averages of three values were used in the analysis. The methods of measurement of respiratory indices are described below:

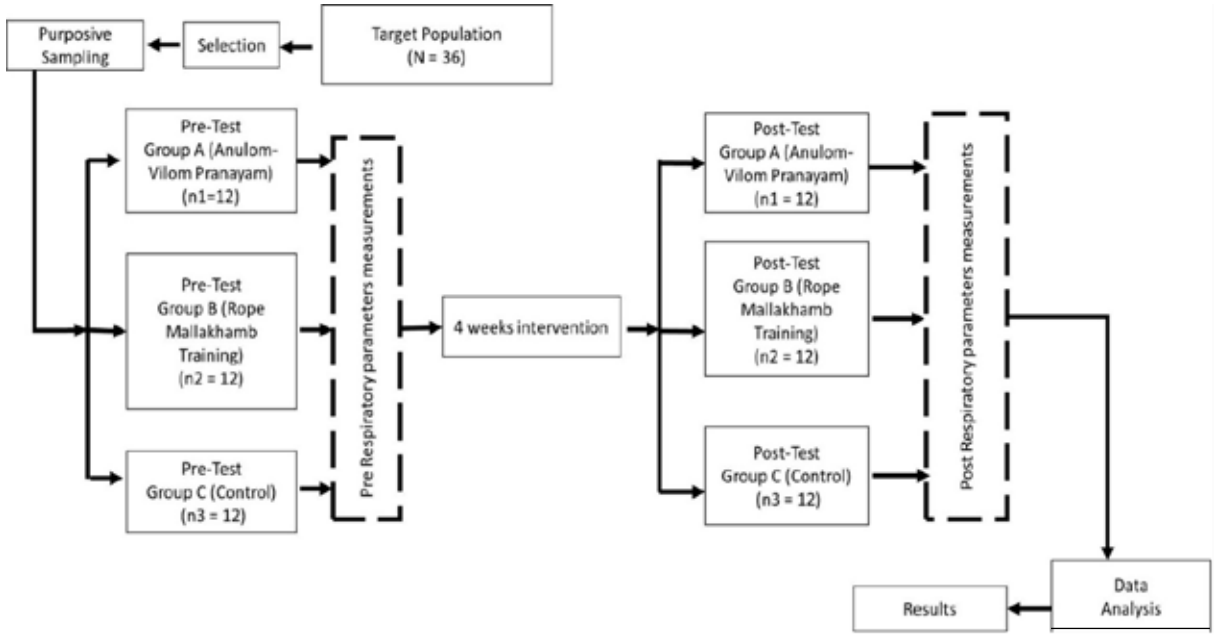

Figure 1. Study flow chart.

Table 1. Distribution and demographics of subjects.

Distribution and Demographics (Mean ± S.D.)				
Variables	**Total (N = 36)**	**Anulom Vilom Pranayama (n1 = 12)**	**Rope Mallakhamb (n2 = 12)**	**Control (n3 = 12)**
Age (yrs)	23.64 ± 1.13	23.67 ± 1.15	23.92 ± 1.16	23.33 ± 1.07
Height (cm)	158.17 ± 4.70	159.83 ± 5.95	157.75 ± 3.02	156.92 ± 4.56
Weight (kg)	56.26 ± 6.40	55.58 ± 9.73	57.34 ± 4.56	55.87 ± 3.58

VT- The subjects were asked to inhale a normal breath and were then asked to place the mouthpiece of the spirometer between the lips and exhale normally into the spirometer.

IRV- After inhaling normally and placing the mouthpiece between the lips, the subjects were asked to forcefully inhale all the additional air possible.

ERV- After exhaling normally and placing the mouthpiece between the lips, the subjects were asked to forcefully exhale all the additional air possible.

VC- Following a maximum inspiration, all the air possible was forcibly exhaled through the mouthpiece. The vital capacity was calculated as the sum of the three primary volumes that can be directly exchanged with the atmosphere (VC = IRV + VT + ERV).

IC- After exhaling normally, subjects were asked to breathe in as deeply as possible, and then were asked to place the mouthpiece and exhale normally. The inspiratory capacity was calculated as the sum of the inspiratory reserve volume and the tidal volume (IC = IRV + VT).

AVP intervention:

Participants were asked to perform preliminary exercises before doing AVP such as pre-position Padmasana and Vajrasana, neck movement, shoulder movement, hand movement and back exercises. In the AVP intervention participants were asked to close their right nostril with their thumb and exhale completely and then draw in air from their left nostril. They were then asked to release the thumb and close the left nostril with their ring finger and exhale slowly through their right nostril. Then subjects were asked to take the air in from the right nostril and then release it through the left nostril (after closing the right nostril with the thumb) (Figure 2) (20). After the AVP intervention, participants were asked to relax and were asked to perform relaxing postures including Balasana and Shavasana. The full protocol for the 4-weeks AVP intervention is presented in Table 2.

RMT intervention:

Participants were asked to perform preliminary exercises before doing RMT such as stretching exercises and climbing up and down exercises on the rope.

In RMT participants practiced the RMT postures mentioned below (Figure 3) [14]. After the AVP intervention, participants were asked to relax and were asked to perform relaxing postures including Balasana and Shavasana. The full protocol for the 4-weeks RMT intervention is presented in Table 3. Procedures followed in the RMT training are described below:

Table 2. Full protocol of 4-Weeks Anulom Vilom Pranayama Training.

4-Weeks Anulom Vilom Pranayama (AVP)			
Weeks	**Schedule**	**Time**	**Duration**
1st Week	Preliminary Yogic Exercises	5 Minute	20 Minute
	Practice of AVP	10 Minute	
	Relaxation Posture	5 Minute	
2nd Week	Preliminary Yogic Exercises	5 Minute	25 Minute
	Practice of AVP	15 Minute	
	Relaxation Posture	5 Minute	
3rd Week	Preliminary Yogic Exercises	5 Minute	30 Minute
	Practice of AVP	20 Minute	
	Relaxation Posture	5 Minute	
4th Week	Preliminary Yogic Exercises	5 Minute	35 Minute
	Practice of AVP	25 Minute	
	Relaxation Posture	5 Minute	

a. **b.** **c.** **d.**

Figure 2. Steps followed by participants in Anulom Vilom intervention [20].

Padamasana: Participants were asked to stand on a mat and then climb on the rope, subjects had to stretch out their right leg forward and bend their left leg and the individual had to pull the rope again and having both legs crossed and feet on opposite thighs. After making Padamasana on the rope participants had to lock their necks by the left side of the rope before placing their hands on knees in mudra position.

Dhanurasana: Participants were asked to stand on a mat and then climb on the rope, subjects had to perform a twisting movement of the trunk on the rope and then they made a knot. After that, every individual kept their body straight on the rope and maintained a lying position in the air by holding the rope, and then slowly, by folding their knees downward they were asked to hold their ankles of their feet with their hands.

Natrajasana: Participants were asked to stand on a mat and then climb on the rope, subjects had to lock their necks from the right side before tightening the rope with the left leg by crossing the rope along the thigh and hold the rope with the help of their foot. After that, they were asked to draw their right legs upward and hold their right ankles firmly with their hands. Then in the final position participants were asked to keep their left hands straight to made balance on the rope.

Padhastasana: Participants were asked to stand on a mat and then climb on the rope, subjects had to cross the rope from one side of their body and were asked to touch their heads with knees.

Statistical Analysis.

The normality of the data were checked by using the Shapiro-Wilk Test of Normality. Analysis of covariance (ANCOVA) was used to remove the effects of some antecedent variables. ANCOVA assessed the effect of an independent variable on dependent variable while removing the effect of the covariate factor. The level of significance was set at 0.05. The statistical techniques were used to analyze the data on Statistical Package for Social Science (SPSS) version 26.0.

Results

AVP improves respiratory parameters compared to control:

Our result indicates that there was a significant difference between Group A (AVP) and Group C (control) on respiratory parameters among girls from athletic background. Moreover, the Partial Eta Squared value showed that 4-weeks of AVP have positive impact on the respiratory parameters

Table 3. Full protocol for 4-weeks Rope Mallakhamb Training.

4-Weeks Rope Mallakhamb Training (RMT)			
Weeks	**Schedule**	**Time**	**Duration**
1st Week	Preliminary Yogic Exercises	5 Minute	20 Minute
	Practice of RMT	10 Minute	
	Relaxation Posture	5 Minute	
2nd Week	Preliminary Yogic Exercises	5 Minute	25 Minute
	RMT	15 Minute	
	Relaxation Posture	5 Minute	
3rd Week	Preliminary Yogic Exercises	5 Minute	30 Minute
	RMT	20 Minute	
	Relaxation Posture	5 Minute	
4th Week	Preliminary Yogic Exercises	5 Minute	35 Minute
	RMT	25 Minute	
	Relaxation Posture	5 Minute	

a. **b.** **c.** **d.**

Figure 3. Selected asanas (a) Padmasana, (b) Dhanurasana, (c) Natrajasana and (d) Padhastasana [14].

including VT 25.7 %, IRV 29.4 %, ERV 27.1 %, VC 33.2 % and IC 31.6 % on Group A compared to Group C (Table 4).

RMT improves respiratory parameters compared to control:

We found that there was a significant difference between the Group B (RMT) and Group C (control) on respiratory parameters among girls from athletic background. Moreover, the Partial Eta Squared value showed that 4-weeks of RMT have positive impact on the respiratory parameters including VT 19.8 %, IRV 22 %, ERV 19.4%, VC 32 % and IC 28.1% on Group B compared to Group C. Our results also indicate that there is a significant difference (P<0.05) between Group B compared to Group C (Table 5).

AVP improves respiratory parameters more than RMT:

AVP training helps raising the respiratory parameters above the respective values of RMT. Increase in each parameter including VT=5.9%, IRV=7.4%, ERV=7.7%, VC= 1.2% and IC=3.5 %. Thus, outcomes of the above said respiratory parameters showed that short-term AVP improves respiratory parameters more than RMT significantly. (Figure 4 & 5).

Table 4. Analysis of Covariance (ANCOVA) between Group A (AVP) and Group C (control) on respiratory parameters

Group	Mean± S.D.	F	Sig.	Partial Eta Squared
A. Respiratory Parameters (Tidal Volume (VT) (Litre)				
AVP Pre	0.365±.0117	7.279	0.013	0.257
AVP Post	0.373±.0123			
Control Pre	0.357±.0114			
Control Post	0.358±.0140			
B. Inspiratory Reserve Volume (IRV) (Litre)				
AVP Pre	1.909±.1134	8.740	0.008	0.294
AVP Post	1.945±.1206			
Control Pre	1.800±0702			
Control Post	1.808±.0686			
C. Expiratory Reserve Volume (ERV) (Litre)				
AVP Pre	0.759±.0355	7.812	0.011	0.271
AVP Post	0.773±.0403			
Control Pre	0.765±.0278			
Control Post	0.770±.0292			
D. Vital Capacity (VC) (Litre)				
AVP Pre	3.033±0.143	10.426	0.004	0.332
AVP Post	3.092±0.161			
Control Pre	2.922±0.100			
Control Post	2.937±0.102			
E. Inspiratory Capacity (IC) (Litre)				
AVP Pre	2.274±0.115	9.696	0.005	0.316
AVP Post	2.318±0.127			
Control Pre	2.157±0.080			
Control Post	2.167±0.081			

NOTE: A. Respiratory Parameters Tidal Volume (VT), B. Inspiratory Reserve Volume (IRV), C. Expiratory Reserve Volume (ERV), D. Vital Capacity (VC), E. Inspiratory Capacity (IC) among girls from university. Pre-test was taken as covariate. The P-values less than (P < 0.05) were considered significant.

Table 5. Analysis of Covariance (ANCOVA) between Group B (RMT) and Group C (control) on respiratory parameters

Group	Mean± S.D.	F	Sig.	Partial Eta Squared
A. Respiratory Parameters (Tidal Volume (VT) (Litre)				
RMT Pre	0.366±0.012	5.183	0.033	0.198
RMT Post	0.372±0.012			
Control Pre	0.357±0.011			
Control Post	0.358±0.014			
B. Inspiratory Reserve Volume (IRV) (Litre)				
RMT Pre	1.788±0.093	5.914	0.024	0.220
RMT Post	1.815±0.096			
Control Pre	1.800±0.070			
Control Post	1.808±0.068			
C. Expiratory Reserve Volume (ERV) (Litre)				
RMT Pre	0.750±0.032	5.049	0.036	0.194
RMT Post	0.759±0.031			
Control Pre	0.765±0.028			
Control Post	0.770±0.029			
D. Vital Capacity (VC) (Litre)				
RMT Pre	2.904±0.125	9.895	0.005	0.320
RMT Post	2.946±0.126			
Control Pre	2.922±0.100			
Control Post	2.936±0.102			
E. Inspiratory Capacity (IC) (Litre)				
RMT Pre	2.154±0.100	8.205	0.009	0.281
RMT Post	2.187±0.103			
Control Pre	2.157±0.080			
Control Post	2.167±0.081			

NOTE: A. Respiratory Parameters Tidal Volume (VT), B. Inspiratory Reserve Volume (IRV), C. Expiratory Reserve Volume (ERV), D. Vital Capacity (VC), E. Inspiratory Capacity (IC) among girls from university. Pre-test was taken as covariate. The P-values less than ($P< 0.05$) were considered significant.

Discussion

The Indian sage Patanjali prescribed adherence to eight limbs of yoga, aimed at quieting one's mind to achieve the union of mind, body and spirit- the ultimate aim of traditional yoga. Yoga interventions are equal or superior to other physical exercises in most outcome measures. Breathing regulation and mindfulness during yogic practice and maintenance of postures characterize yoga practices and make it distinct from other physical exercise modalities [21]. The purpose of this study was to investigate the effects of AVP and RMT on respiratory parameters among athletic young girls. It is evident from the results that 4-weeks of AVP have positive impact on the respiratory parameters including VT 25.7 %, IRV 29.4 %, ERV 27.1 %, VC 33.2 % and IC 31.6 % on AVP group. AVP is one of simplest and best yoga breathing exercises (pranayama) for health and fitness [15]. AVP exercise has therapeutic effects on metabolism performed in both healthy and pathological individuals. Previous findings show that relaxation induced by diaphragmatic breathing improves athletes' antioxidant defence status after strenuous exercise [22].

Another study concluded that yogic breathing practiced for 30 minutes every afternoon along with habitual bodily sports for 5 days a week, decreases airway resistance, increases respiration muscle endurance, and reduces variety of strokes possibly through higher autonomic reactivity, oxygen diffusion and decreased tension in competitive swimmers [16]. Researchers also suggest that yogic pranayama primarily based on totally volitional respiratory muscle training may be utilized in sports activities conditioning programme for athletes to enhance their maximal exercising performance, and as a part of rehabilitation training to recover from injury [23]. Interestingly, studies have also demonstrated that incorporating complete yoga-based breathing techniques (OM Mantra Chanting and AVP Pranayama) into one's daily routine helps to enhance lung function [24]. Additional studies acknowledged that the practice of Pranayama enhances maximal respiratory pressures, breath holding time and are particularly beneficial in increasing lung function and respiratory endurance [25]. Yoga training has been demonstrated by many researchers to increase vital capacity and improve lung function in participants [26,27,28,29]. According to previous research, pranayama training

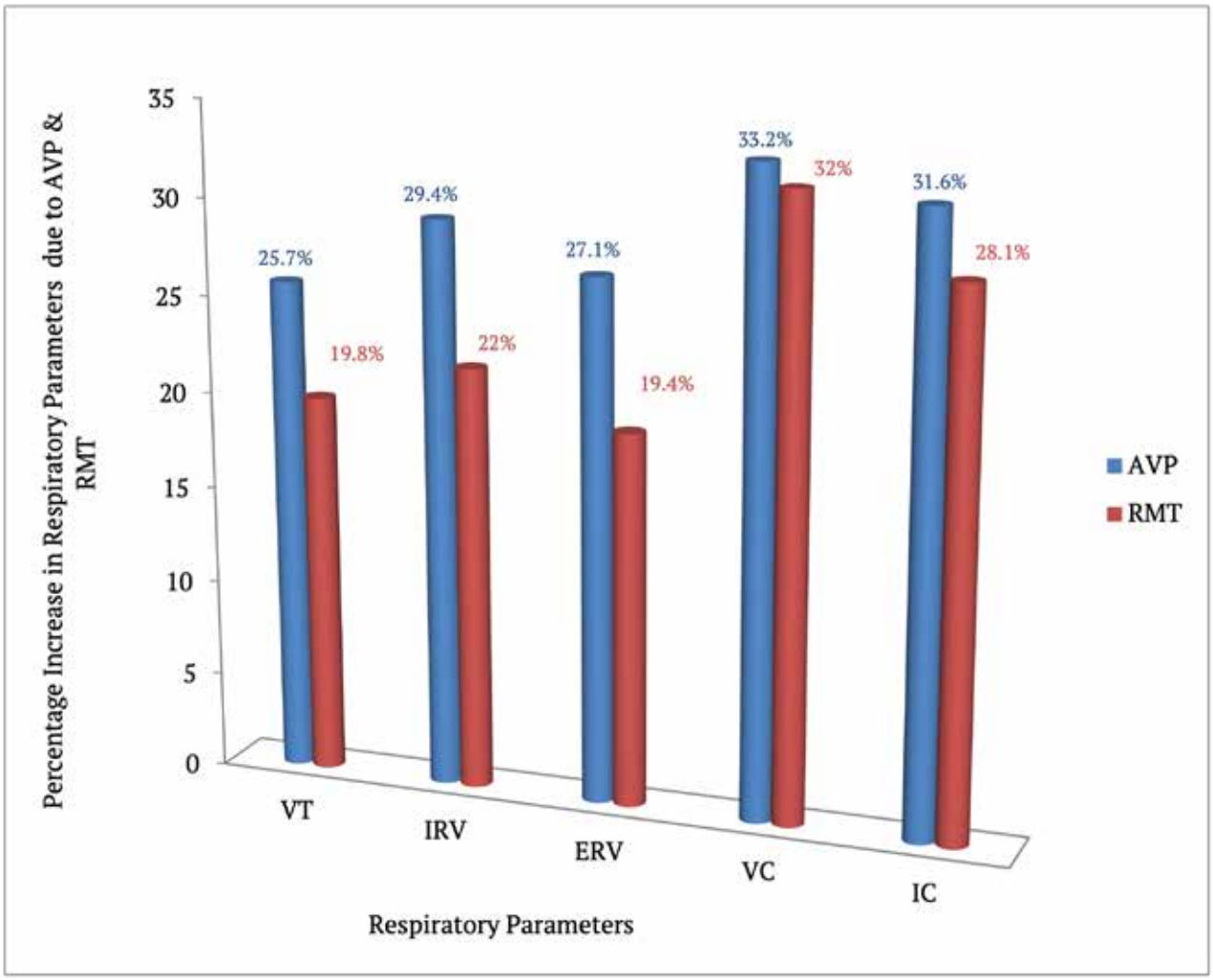

Figure 4. Comparison matrix between Group A verses Group C (VT=25.7%), (IRV=29.4%), (ERV=27.1%), (VC=33.2%) & (IC=31.6%) and Group B verses Group C (VT=19.8%), (IRV=22%), (ERV=19.4%), (VC=32%) & (IC=28.1%) of respiratory parameters including in percentage.

enhances ventilatory functions by increasing forced expiratory volume (FEV), and peak expiratory flow rates [29]. Similarly, we found that pranayama also helped to increase maximum inspiratory pressure, maximum expiratory pressure, and maximum voluntary ventilation, forced vital capacity, and forced expiratory volume in young girls from athletic backgrounds. The results of our study may be used to emphasize the role of pranayama in strengthening respiratory muscles and improving respiratory endurance, and we suggest that regular practice of pranayama may prove to be a step in the direction of a healthy lifestyle.

Furthermore, it is evident from the results that 4-weeks of RMT have significant effects on the respiratory parameters viz; VT 19.8 %, IRV 22%, ERV 19.4%, VC 32 % and IC 28.1% on RMT group. Physiological responses to physical training, including yoga, have been well studied by many investigators. Yoga, is a traditional method of learning that aims to attain the unity of mind, body, and spirit through exercise, breathing and meditation that employs means like RMT, may be expected to positively influence many physiological functions including respiration [24]. The results of this study demonstrate that RMT lasting 4-weeks significantly improved several respiratory indices. The results of this study are consistent with the results of our previous study conducted among girls (age = 12 – 16 years) [14]. In our previous study we explored the effect of 4-weeks of RMT on adolescent girls and we found that it enhanced voluntary control of breathing [14]. Our findings are supported by those of who reported that yoga exercise significantly increased chest circumferences by 15 (middle and lower) to 37% (upper) as well as several respiratory indices – Forced expiratory volume first second (FEV1), Forced Expiratory Flow between 25 and 75 (FEF 25-75%) and Forced vital capacity (FVC) by 12 – 17%) [30].

In conclusion, we found that the 4-weeks AVP and RMT on university girls from athletic backgrounds had a significant effect on their respiratory parameters (viz., VT, IRV, ERV, VC and IC). Thus, such training may be recommended to improve physical and physiological fitness-based performance. The

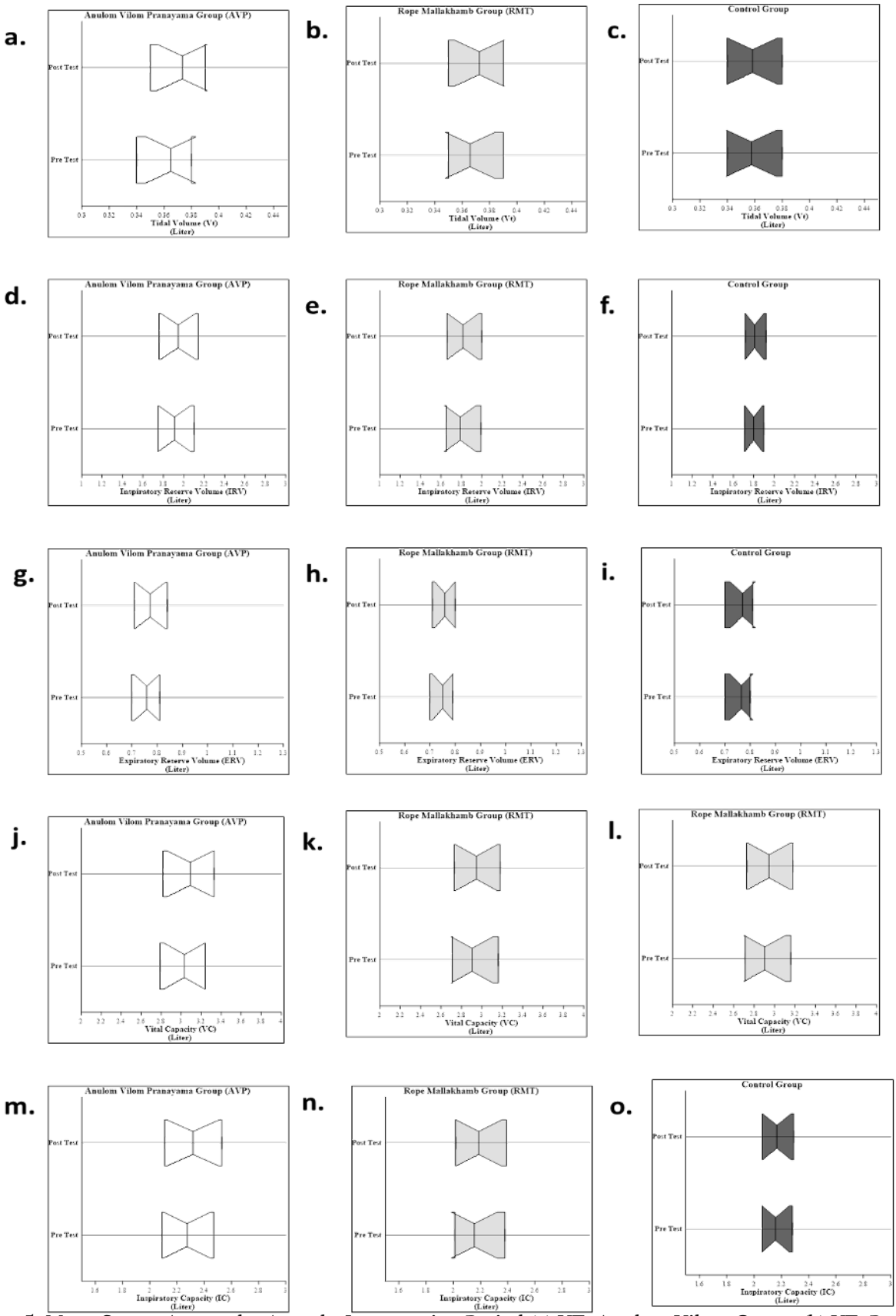

Figure 5. Mean Scores Across the 4-weeks Intervention Period (a) VT; Anulom Vilom Group, (b) VT; Rope Mallakhamb Group, (c) VT; Control Group, (d) IRV; Anulom Vilom Group, (e) IRV; Rope Mallakhamb Group, (f) IRV; Control Group, (g) ERV; Anulom Vilom Group, (h) ERV; Rope Mallakhamb Group, (i) ERV; Control Group, (j) VC; Anulom Vilom Group, (k) VC; Rope Mallakhamb Group, (l) VC; Control Group, (m) IC; Anulom Vilom, (n) IC; Rope Mallakhamb Group, and (o) IC; Control Group.

positive outcomes found in this present study might apply to athletes to improve body efficiency. The day-to-day exercise can also be components of physical health and a way of life modification to keep higher physical, intellectual and spiritual health. Also, our study suggests that AVP has a more positive impact on respiratory parameters than RMT and may contribute to enhance concentration-based performance and voluntary control of breathing. Further research is needed examine the benefits of this type of training on aerobic performance and related exercise parameters.

Declaration of competing interest

All authors declare there are no potential financial, personal, or otherwise conflicts of interest.

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Physical culture in the context of modern philosophical anthropology

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Authors' Contribution: A - Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

Abstract

Background and Study Aim: Background and study aim. Prerequisites and purpose of the study. Today, philosophical anthropology (in the context of physical culture) occupies an intermediate place between the biological sciences and existential philosophy, elements of which it uses to explain the problems of physical existence. In the deep spheres of the physical state of a man (in the continuum of his/her spiritual-moral, physical, subconscious-rational, irrational and anthrobiological subjectivity) one can find the true foundations of personal physical culture and give them an immanent-subjective expression of human strength (as a creator of culture globalized world). The purpose of the study is to characterize the physical culture of the individual in the context of philosophical anthropology.

Material and Methods: Material and methods. Sources of information were the authoritative database Web of Science Core Collection, Vernadskyi National Library of Ukraine. Extraction of data from documents was carried out by means of a search query. In total, data on 102 documents containing such keywords as philosophy, anthropology, physical culture, sport were removed from the Web of Science Core Collection. Accordingly, 18 documents were found in the catalogues of the Vernadskyi National Library of Ukraine. Further analysis was performed with these 120 documents. The results of the search query were recorded in the form of tables and a special text file, which was processed in VOSviewer. The requirements of dialectical logic, comparative method, method of phenomenological reduction, hermeneutic methods are chosen by research methods.

Results: Results. The most significant and popular thematic categories, journals, authors, articles, keywords are identified. The connection between the elements of bibliographic description of articles and individual groups of publications has been established. It is established that from the second quarter of the XX century among philosophers there is opposition to the understanding of human nature on the basis of the acceptance of some one of its essence (spiritual, physical, intellectual, emotional and volitional, etc.), which determines the existence of any person. This was a denial of the approach to a man, which was called essential (from the Latin essentia – essence). The result of this transformation was to establish an existential understanding of a man (from the Latin existentia - existence). However, a self-contained existential approach is capable of producing a worldview distortion of personal physical culture, especially in conditions of restriction of freedom (for example, during a pandemic, war). Therefore, in modern philosophical anthropology it is necessary to adhere to a balanced combination of essential and existential understanding of a man in general and his/her physical culture in particular. In this way, philosophical anthropology is able to actualize various structures of worldview, including the values of physical culture.

Conclusions: Conclusions. From the point of view of modern philosophical anthropology, athletes, in the broadest sense of the term (all those who purposefully engage in physical and sports exercises), are carriers of a set of socio-cultural values (moral and volitional qualities, morpho-functional properties, psychophysical abilities, etc.). These values, in the context of the globalization of civilizational development and the main axiological concepts (quality and standard of living, social order, well-being), should be considered as a means of activating planetary socio-cultural development.

Keywords: physical culture, people, philosophical anthropology, anthropology, values.

Glossary [1]:

physical culture, philosophy, regimen, or lifestyle seeking maximum physical development through such means as weight (resistance) training, diet, aerobic activity, athletic competition, and mental discipline. Specific benefits include improvements in health, appearance, strength, endurance, flexibility, speed, and general fitness as well as greater proficiency in sport-related activities;

sports, physical contests pursued for the goals and challenges they entail. Sports are part of every culture past and present, but each culture has its own definition of sports;

philosophical anthropology, discipline within philosophy that seeks to unify the several empirical investigations of human nature in an effort to understand individuals as both creatures of their environment and creators of their own values.

Introduction

The perception of physical culture by modern man is not always unambiguous. It is manifested

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by conflicting views (perception / non-perception) on both objective and subjective values of physical culture [2-5]. As for the objective ones, first of all, they are material values (sports facilities, inventory and equipment for health and sports activities, art objects). Second, historical (stories of great sports victories, the formation of sports, the activities of prominent people in the field of physical culture). Third, values - social relations (to sports, health, to personal carriers of physical culture). Fourth, information (publications, broadcasts in the media). Among the subjective values should include physical (physical development, physical fitness, physiological reserves of the body). As for the spiritual and moral, it is the presence of a high spiritual ideal, a vital attitude to serve noble purposes. At the same time, it is an aesthetic attitude to the world, adherence to the principles of humanism, justice, honor, the pursuit of self-development. In the context of mental values, it is necessary to highlight the following: special knowledge of motor activity; functioning of the human body; ways of health formation and health preservation and transmission of health to the next generations; interpersonal communication; personal self-affirmation. However, there is a very rapid change in lifestyle with a decrease in physical activity and direct interpersonal interaction (communication, especially in the context of the Covid-19 pandemic, war). Therefore, there is an urgent need for various forms of physical culture. One of the most important in this context is health and recreational physical activity [6-11] and of course sport in all its manifestations [12-16].

In this context, several studies can be identified. Thus, Lavin [9] emphasizes that the existing concepts and meanings of exercise and sports in the lives of schoolchildren express the dominance of biomedical discourse. This perspective is focused "on the fit and healthy, an institutionalization of a healthy and active lifestyle, an idea of a causal and linear relationship between sports / physical activity and health, an essentialist view lacking a subject in this practice". Predy et al. [10] studied the average duration and frequency of outdoor games for toddlers and pre-schoolers. The authors recommend increasing the number of outdoor games. A similar view is held by Paredes Prada [11]. The authors believe that Open Streets initiatives will allow physical activity in cities around the world. Confirmation of the feasibility of such initiatives are the results of the study of Yu [13]. The author believes that online communication between sports participants is still insufficient. Therefore, it is proposed to use a sports community called "Online to Offline (O2O)". Biernat et al. [15] studied the profiles of adults engaged in sports activities. A multilevel socio-ecological approach was used for this purpose. The results obtained by the authors emphasize the need to create and implement a subtle and diverse policy to support increased physical activity in modern societies. A similar view is held by Billings et al. [16]. The authors emphasize the role and importance of international sports organizations and scientific journals in solving problems of communication in sports. It emphasizes that aspects of diversity, from gender to race and many other forms of identity, must be developed, recognized and respected.

Some authors have studied the problems of human functioning in different situations. Thus Piwowarski et al. [17] studied the impact of safety and physical culture on individualistic, behavioral and axiological determinants of human functioning in threatening situations. The existing stereotype in the minds of people professionally related to security was also considered. The authors believe that the behavioral and axiological determinants of the behavior of the analyzed persons in threatening situations are closer to the values associated with martial arts.

Clevenger [18] studied the relationships between global and local contexts of physical culture. The author argues that the postcolonial approach to sports anthropology creates a more inclusive, nuanced framework for studying the anthropological dimensions of physical culture.

Jirasek [19] conducted a terminological analysis of modern philosophical descriptions of the culture of movement. The author defines the basic orientation of philosophical kinanthropology as a consideration and study of the meaning of human existence in the expression of the phenomena of human movement. In his other work [20], the author highlights the understanding of spirituality and explores its relationship to sports and education.

Manolachi et al. [21] analyzed the features of different crisis situations in sports. The importance of the psychological component for a person's adequate understanding of the current state of affairs is emphasized. There is a need to bring the psychology of sport closer to philosophy, especially with philosophical anthropology and ethics.

Despite several reviews in the literature on the importance of modern human perception of physical culture, none of the recently published articles has discussed the important role of individual physical culture in the context of philosophical anthropology. Therefore, in this aspect, the aim of our study is to characterize the physical culture of the individual in the context of philosophical anthropology.

Methodology

The research methods are selected the following: requirements of dialectical logic (for a comprehensive analysis of physical culture of a man and society and its objective and subjective values); comparative method (functional comparison) to compare the functions performed by the physical

culture of the individual and society; method of phenomenological reduction (to reveal the essence of the main object of study - physical culture and attitude to it in modern society); hermeneutic method (to create a holistic view of the physical culture of the individual, through the use and interpretation of data from various sciences - psychology, biology, ethology, sociology, religion, etc.).

Data sources

To analyze the information, we used the authoritative Web of Science Core Collection. The depth of the search was conducted within the limits of 2012-2022. The search query removed data on 102 documents used for analysis. Catalogues of the Vernadskyi National Library of Ukraine were also used [22]. 18 documents were selected for analysis.

Inclusion and exclusion criteria

The main criterion for choosing databases is the quality of information sources. That is why we chose the authoritative Web of Science Core Collection database. The depth of the search in this database was limited to 10 years. This is because this period contains modern views on the problem. In addition, the purpose of the article was not to analyze the problem from a historical perspective.

Vernadskyi National Library of Ukraine was chosen as the second search resource [22]. This made it possible to analyze the problem in sources in the national language. Sources containing the abbreviated name of the keywords *physical culture* in the form of *phys culture* were excluded from the search. This is due to the fact that the use of such an abbreviated title format indicates a lack of knowledge of the authors of the publications.

Research design

The first stage.

The search query was performed in the Web of Science Core Collection – keywords physical culture. Search results – 1763 articles for the period 2012-2022. The search allowed to identify the TOP-10 most important thematic categories, journals, authors and countries (Table 1).

A further search among 1763 articles was conducted on the keyword anthropology. 35 articles were received. A data set was created (menu - Export / Plain Text File / Export Records to Plain Text File / Record Options / All records on page / Full Records and Cited References). This file (35 articles; conditional title - *physical culture-anthropology-35*. txt) was used for bibliometric analysis.

A keyword search was also performed for *philosoph * / anthropology / sport*. Found 51 articles. The result was recorded in a file (conditional name - *philosoph-anthropology-sport-51*.txt), which was used for bibliometric analysis. Your search for

Table 1. The results of the analysis of the search query on the basis of Web of Science Core Collection (n = 1763)

Category, TOP-10	**Items n, %**	**Total n (%)**
Web of Science Categories	Hospitality Leisure Sport Tourism (866; 49.121%); Education Educational Research (264; 14.974%); Sport Sciences (193; 10.947%); Social Sciences Interdisciplinary (126; 7.147%); History (111; 6.296%); Multidisciplinary Sciences (87; 4.935%); Sociology (85; 4.821%); Cultural Studies (29; 1.645%); Humanities Multidisciplinary (28; 1.588%); Economics (21; 1.191%)	1512 (85,7%)
Source Titles	Physical Culture And Sport Studies And Research (282; 15.995%); Pedagogics Psychology Medical Biological Problems Of Physical Training And Sports (139; 7.884%); Pedagogy Of Physical Culture And Sports (104; 5.899%); Science And Education (70; 3.971%); Tomsk State University Journal (63; 3.573%); Physical Education Of Students (51; 2.893%); Arrancada (44; 2.496%); International Journal Of The History Of Sport (44; 2.496%); International Journal Of Applied Exercise Physiology (38; 2.155%); Routledge Research In Sport Culture And Society (29; 1.645%);	864 (49%)
Authors	Kosiewicz J (31; 1.758%); Smith RA (20; 1.134%); Heffernan C (16; 0.908%); Kudryavtsev MD (16; 0.908%); Polevoy GG (16; 0.908%); Campbell JD (15; 0.851%); Cynarski WJ (15; 0.851%); Iermakov SS (14; 0.794%); Svoboda Z (14; 0.794%); Thorpe H (10; 0.567%);	158 (8,9%)
Countries/Regions	Russia (314; 17.811%); Ukraine (291; 16.506%); Poland (204; 11.571%); USA (119; 6.750%); England (94; 5.332%); Peoples R China (80; 4.538%); Czech Republic (64; 3.630%); Canada (62; 3.517%); Cuba (60; 3.403%); Turkey (56; 3.176%).	1256 (71,2%)

Note: n – number of articles, % – percentage of the total number of articles).

*philosoph * / anthropology / physical culture* returned 9 documents. The result was recorded in a file (conditional name - *philosoph-anthropology-physical culture-9*.txt), which was used for bibliometric analysis.

7 documents were found for the search query *philosophical anthropology / sport*. The result is recorded in a file (conditional name - *philosophical-anthropology-sport-7*.txt), which was used for bibliometric analysis. In total, data from 102 articles were removed.

The second stage.

A similar search scenario was conducted at the Vernadskyi National Library of Ukraine. The search query in the section "Scientific periodicals of Ukraine / Journals and continuing publications" by keywords *anthropology / sport* showed the availability of 12 documents. The search for *anthropology / physical culture* showed 6 documents. A total of 18 documents were found, which were used to analyze the research problem.

Search queries in the Web of Science Core Collection generate data based on the most popular publications by authors, years, subject categories, and journals. Search queries also allowed to form a set of data, which was analyzed in the program VOSviewer [23]. This approach made it possible to observe the relationship between documents, authors, keywords. All this together allowed us to identify the most popular and promising areas of research on the topic of our article.

We did not remove data from the documents of the Vernadskyi National Library of Ukraine. The main reason is the lack of a service that allows to extract data from documents in VOSviewer format [23]. In addition, the program accepts only English texts. Therefore, we analyzed each of the 18 documents found separately.

Data analysis.

The purpose of the analysis of data from the documents is to identify leading leaders and trends in the problems of this study. We used the recommendations of bibliometric analysis López-Carril et al. [24], Donthu et al. [25], Ahmad et al. [26]. For this purpose, the program VOSviewer 1.6.17 was used [23]. The methodology for calculating key indicators for analysis and identification of the most significant studies is described in detail in the works of van Eck and Waltman [27, 28]. The validity of this approach is confirmed by studies of human physical activity [29-32].

As an example, the visualization of the extracted data from the search query physical culture (n = 1763) is shown in figure 1, figure 2. The most important elements of the bibliographic description (keywords - fig. 1, documents - fig. 2) are presented in a circle (fig. 1) or a rectangle (fig. 2). The size of the circle / rectangle indicates the importance of the element: the larger the size of the circle / rectangle, the more significant the keyword. The relationship of keywords is determined by lines and distance: the greater the distance, the less the relationship [28].

The result of the analysis of documents in the Web of Science Core Collection database in the VOSviewer program (fig. 1, fig. 2) allows to select groups of related documents on various topics. The articles of the last 5 years are of the greatest interest. To determine the most popular article among researchers, you need to hover over the selected document in VOSviewer. The visual result will be represented by lines of communication between documents.

Results

Since the second quarter of the twentieth century, among philosophers there is resistance to understanding human nature based on the acceptance of a single essence (spiritual, physical, intellectual, emotional and volitional, etc.), which determines the existence of any person [33-36]. This was a denial of the approach to man, which was called essential (from the Latin Essentia – essence). The result of this transformation was to establish an existential understanding of man (from the Latin. Existentia - existence) [37-40]. This paradigm was most clearly expressed by Sartre Jean-Paul: "human existence is primary in relation to its essence" [41]. Thus, the common essence for all, which inevitably guides our way of life, is rejected. Our essential possibilities and their realization depend on a way of life. In other words, the essence is generated by each person, his / her intellectual and physical activities.

However, a self-contained existential approach is capable of producing a worldview distortion of personal physical culture. This is especially true in conditions of restriction of freedom (for example, during a pandemic, war). Therefore, in modern philosophical anthropology it is necessary to adhere to a balanced combination of essential and existential understanding of man in general and his / her physical culture in particular. In this way, philosophical anthropology is able to actualize various structures of worldview, including the values of physical culture [8, 42-44]. This is especially important given the totalitarian and post-totalitarian past of physical culture in Eastern Europe, i.e. the dominance of the ideology of sociocentrism (hence the definition of "mass physical culture" rather than anthropocentrism - "physical culture of the individual").

As you know, values are a specific definition of objects that express their positive or negative meaning for man and society: good or evil, beautiful or ugly, fair or unfair, perfect and imperfect, and so on. All various objects of human activity, social relations and natural processes included in their

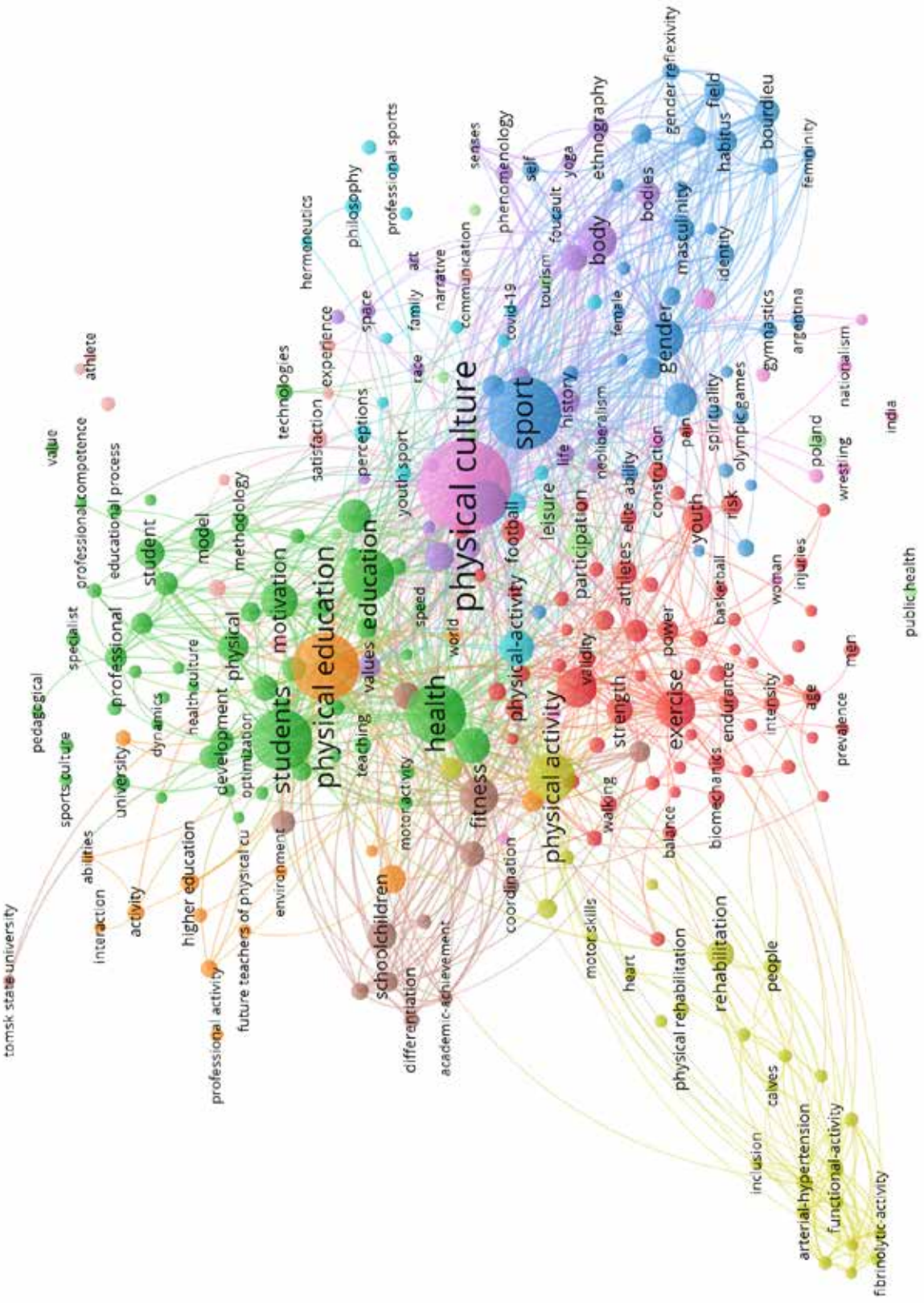

Figure 1. Visualization of data by keywords physical culture in the Web of Science Core Collection (Type of analysis: Co-occurrence; Unit of analysis: All keywords)

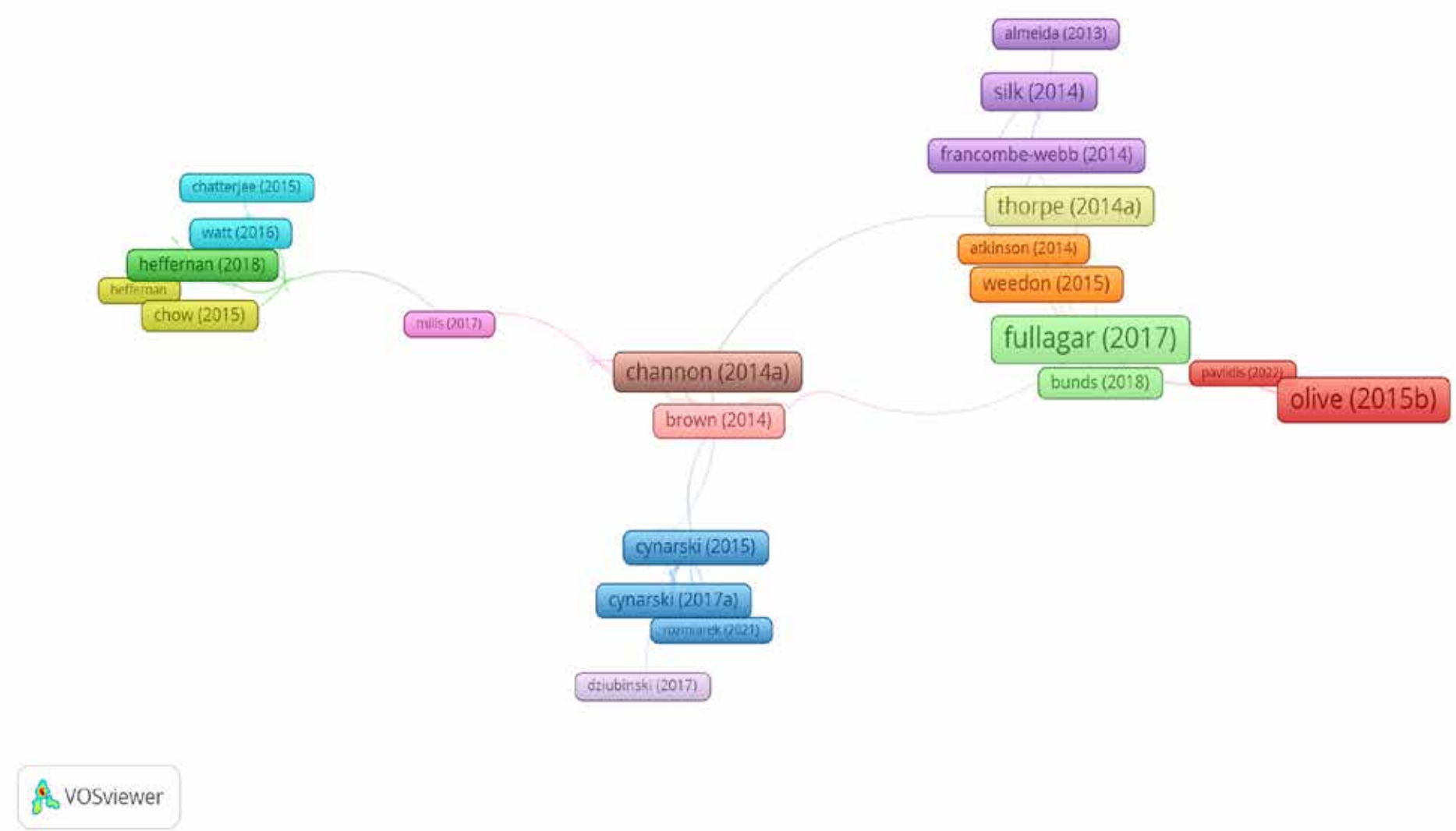

Figure 2. Visualization of data by keywords physical culture in the Web of Science Core Collection (Type of analysis: Citation; Unit of analysis: Documents)

sphere can act as "subject values" [8, 21, 42].

In personal physical culture, a person actualizes only those values that have a vital and possibly professional meaning for him / her. On this basis, the image of the cultural personality of the future professional is formed in the minds of the individual, as a set of goals, ideas, attitudes. This set adjusts the individual experience of physical practice and related experiences, beliefs, connections and relationships.

Man assimilates and transforms socially-necessary and socially-group values of physical culture. Thus a person builds his/her own system of values, the elements of which take the form of axiological functions. Note that the axiological component is a set of relatively stable values of physical culture. The subjective perception and appropriation of values in general and physical culture in particular by a person is determined by the wealth of his/her personality. It is also determined by the following: developed general cultural thinking and worldview; experience; the presence of a personal system of use of its means. All this is determined in accordance with the needs of the individual, his/her interests, the current state of psychophysical and functional capabilities and abilities (if it concerns physical culture).

Summarizing the results of a study by a number of authors [8, 21, 45-48] the values of physical culture can be differentiated by the following components:

1) Values-goals – reveal the content and meaning of individual goals of inclusion in the systematic health and sports activities. Also achievements with its help: cultural strategy and tactics of life; successful implementation of professional plans and needs of psychophysical well-being; improving and preserving the physiological reserves of the body as the basis of somatic health.

2) Values-knowledge – form an orderly system of scientific-practical (philosophical, sociological, psychological-pedagogical, medical-biological) and special knowledge (means and methods of development of physical abilities, formation of motor skills, etc.). All this knowledge is necessary for: understanding the natural and social processes of the functioning of physical culture of society and the individual; the ability to use them creatively for personal and professional self-improvement in the performance of various types of social activities (educational, professional, socio-cultural).

3) Values-tools – create a basis for achieving values-goals (mastering the principles, means, forms, methods and conditions of their use in health and sports activities) for the development of motility, significant psychophysiological qualities, control and effectiveness of their use.

4) Values-relationships – characterize a person as an active subject of physical culture with a certain motivational and personal attitude to him-/herself, professional activities, to the natural and social environment in which his/her health and sports activities.

5) Values-qualities – reveal the essence of the acquisition, development of a range of interrelated abilities and personality traits (psychophysiological, communicative, status, activity-professional). All this provides self-affirmation and self-realization of the individual in the cognitive-emotional and behavioral spheres in the implementation of health and sports activities and social life in general.

Selected groups of values allow us to understand the essential (from the Latin. Essentia - essence) understanding of physical culture (a category that combines a significant number of concepts - sports, sports for all, physical recreation and rehabilitation, physical qualities, physical training and physical fitness, sports competitions, education in physical culture, etc.).

Regarding the relationship between the above groups of values (values-goals determine the nature of values-knowledge and values-means; values-relationships are determined by the nature of values-goals and values-qualities, etc.). The system of values is the basis and criterion for the acceptance or non-acceptance of new or previously developed values. In this case, the richer the range of values of the individual, the more efficient and purposeful is the selection and accumulation of new values, their transition to the motives of health and sports behavior and activities. Note that only essential approaches to physical culture can generate ideological constructions of totalitarian and authoritarian regimes that deny individual freedom (athletes during the Soviet era were forced to seek asylum in other countries – for example, skaters Ludmilla Belousova and Oleg Protopopov, Olympic champions). Alexander Mogilny - hockey player, world champion, Viktor Korchnoi - chess player, grandmaster). In fact, they interpret it as a "conscious need" to act in favor of leaders' decisions. At the same time, a closed existential approach can produce ideological chaos, destroy consolidation in society (for example, the actions of football ultras both within the country and abroad), which is especially dangerous in crisis socio-political situations [49-51].

From the point of view of modern Ukrainian philosophical anthropology, the truth obviously lies in a balanced combination of essential and existential understanding of physical culture of both the individual and society. This balance provides a personalized approach to physical culture and determines the only correct essence for it (a component of human culture and society).

Human life in the world of sports is first of all a set of natural inclinations, which the athlete tries to realize on the principle of freedom, intelligence, creativity and activity. The athlete is forced to

overcome genetically determined boundaries, objective and subjective factors of living and social living conditions, to go beyond them, to improve their psycho-physiological capabilities. That is why modern sport should be considered as a source of the greatest freedom, the formation of personality, the general existential way of life [52, 53].

According to researchers [38, 54, 55], modern sport is a product of cultural and historical existence, one of the ways in which a person comprehends his/her existence, spiritual and material. Only in modern sports a person can experiment with him-/herself, with all possible variants of his/her subjective behavior, with other participants in sports (athletes, coaches, doctors, masseurs, etc.). At the same time, sport as a sensory definition of the physical and spiritual state of the individual is an instrument of free choice of man. However, sport today is an important means of self-realization of the individual, the possibility of social mobility, sociability. This allows the athlete to master social functions and increase their social status.

Due to sublimation (is one of the protective mechanisms of an adult, which is to overcome internal tension through the redirection of energy to socially acceptable goals) [56, 57], which the athlete shows during training and competition, he/she asserts him-/herself. The athlete has the opportunity to gain a sense of self-importance: because competition is a confrontation that takes place with the opponent, environmental factors (such as low temperature and partial pressure of oxygen in the atmosphere) and the limited capabilities of his body.

During sports, a person learns to master him-/herself, including through the development of will, the ability to reach the limit. Confrontation is often associated with risk (including for the health and life of the athlete). So, sport is a school in which the athlete learns to assess risks and, if necessary, go to them, to develop the ability to make decisions through a variety of internal and external. Sport in the context of philosophical anthropology is a sublimative expression of individual and social life, aimed at identifying mechanisms of functioning and reproduction in socio-communicative and individual space: 1) it is a mechanism of social adaptation, in which sport acts as a means of socialization, self-identification and self-realization; 2) the mechanism of regulation, in the context of which the relationship between sport and such basic social regulators as traditions, values, norms, morals, aesthetic characteristics are studied; 3) integrative mechanism, in the context of which sport is considered on the basis of the principle of humanization and implementation of humanistic functions [54, 58, 59].

Sport in all its manifestations is a phenomenal culturological phenomenon that has a comprehensive character. After all, sport acts in the culture of the individual and society in various aspects, such as: as a professional or amateur activity; as art and science; as philosophy and religion, as myth-making [52, 60-62]. The sporting achievements hide the historical experience of many generations, the work of many employees (coaches, doctors, masseurs, nutritionists, scientists, training and competitive activities of athletes) and all those involved in creating the infrastructure of sports activities.

The quintessence of sports is a sports competition – a celebration of the body in cinematic terms, exhibited on an offline / online show to a wide audience of fans. In this way, sport has an impact on the formation of the ideal of corporeality, and hence the phenomenology of sport. This allows us to consider it as a specific socio-cultural sphere of human life and society [63].

According to Merlo-Ponti [64], the physical body itself is the source of inner experiences, the perception of the world within oneself through others. “The body is what gives the world its being”. The author believes: “The union of soul and body is not bound by an arbitrary agreement between two external actors: the subject, on the one hand, the object, on the other, it is carried out every second in the movement of existence”.

In modern philosophical anthropology, there is a “boom” in the philosophical understanding of the human body and, consequently, the theory and practice of physical culture, for which it is the direct object of study.

The philosophy of sport should give the athlete and his/her coach inspiration, self-confidence, self-sufficiency, which means freedom of choice combined with personal responsibility. A sports goal, as a sports idea, must be not only scientifically substantiated, but also dreamed of, suffered. Its realization in sports is achieved through inspiration and hard work. Thus, philosophical anthropology in the discourse of the philosophy of sport drives not only intellectual but also physical and physical progress of mankind.

Discussion

In modern philosophical anthropology there is a “boom” in the philosophical understanding of the human body and, accordingly, the theory and practice of physical culture. For them, it is a direct object of study. However, most researchers confuse the concepts and categories used to describe the use of physical and sports exercises. In particular, the use of the phrase “physical culture and sports” is unacceptable. From the point of view of philosophy, “physical culture” is a category (i.e. the most general concept) that characterizes the physical state of the individual and society. Sport is a concept that is part of the category of “physical culture”. There

is also a significant discrepancy between the widely used concept of "physical education" and the very content of this process. Note that the main task of education is the process of socialization. It is carried out through the mastery of knowledge, norms and rules of conduct, the formation of feelings (stable emotional relations of man to the phenomena of reality), affirmation of beliefs (intellectual and emotional attitude of the subject to any knowledge - true / false, formation of skills and behavior) [65]. Instead, the tasks of physical culture lie in the plane of improving the human body, such as: the development of physical abilities and the formation of the fund of motor skills [66]. Thus, socialization is carried out indirectly by means of physical culture. In our opinion, this is a side effect of exercise and sports. This discrepancy must be eliminated by replacing the term "physical education" with a more adequate essence of this process - "physical training".

As for sports as a component of physical culture, philosophy should give the athlete and his/her coach inspiration, self-confidence, in their ability to be self-sufficient. This means freedom of choice combined with personal responsibility. A sports goal, as a sports idea, must be not only scientifically substantiated, but also dreamed of, suffered. Its realization in sports is achieved through inspiration and hard work. Thus, philosophical anthropology in the discourse of sports philosophy drives not only intellectual but also physical and bodily progress of mankind [33].

We cannot agree with the fact that physical culture as a social phenomenon must be considered only in the context of its existential understanding [67]. From the point of view of modern Ukrainian philosophical anthropology, the truth obviously lies in a balanced combination of essential and existential understanding of physical culture of both the individual and society. In our opinion, this balance provides a personalized approach to physical culture and determines the only correct essence for it (a component of human culture and society). At the same time, we fully agree that modern sport (a component of physical culture) should be considered as a source of the greatest freedom, formation of personality and general existential way of life [38, 68-72].

Note that modern sport is a contradictory (ambivalent) sphere of both personal and social spheres of human life. On the one hand, it encourages mutual understanding (for example, statements of famous athletes, international sports federations, the International Olympic Committee on the need to immediately stop Russia's war against Ukraine), is a means of socialization, sublimation of aggressive and destructive behavior. At the same time, it is often a source of conflict and aggression (among athletes, fans, doping agencies, competition organizers, sports organizations, politicians, etc.). At the same time, sport as a social and civilizational phenomenon was, is and will be a means of establishing the psychology of the winner (individual, ethnic group, state), and thus self-affirmation [6, 14, 52].

Conclusions

From the point of view of modern philosophical anthropology, the athlete is the bearer of a set of socio-cultural values (moral and volitional qualities, morpho-functional properties, psychophysical abilities, etc.). These values must be considered in the context of the globalization of civilization and the main axiological concepts (quality and standard of living, social order, welfare). They should also be considered as a means of intensifying planetary socio-cultural development.

Conflict of interest

The authors claim that there is no conflict of interest.

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