ISSN 2536-569X | eISSN 2536-5703

Journal of Anthropology of Sport and Physical Education

www.jaspe.ac.me

ISSN 2536-569X

JANUARY 2024

VOL.8 No.1

JASPE

Journal of Anthropology of Sport and Physical Education

Index Coverage
DOAJ; Index Copernicus; ERIH PLUS; Google Scholar; Crossref; ROAD; Open Academic Journals Index; SHERPA/RoMEO; ASCI

Proofreading Service
Danilo Tosic

Prepress
Milicko Ceranic

Print
Art Grafika | Niksic

Print run
550

MontenegroSport

CRNOGORSKA SPORTSKA AKADEMIJA • MONTENEGRIN SPORTS ACADEMY •

ISSN 2536-569X eISSN 2536-5703

JOURNAL OF ANTHROPOLOGY OF SPORT AND PHYSICAL EDUCATION

International Scientific Journal

Vol. 8(2024), No. 1 (1-47)

TABLE OF CONTENTS

Full-text available free of charge at http://www.jaspe.ac.me/

DOI 10.26773/jaspe.240101

JASPE Journal of Anthropology of Sport and Physical Education

REVIEW PAPER

Postural status of preschool children: A narrative review

Dušan Nikolić[1], Stevan Stamenković[2], Marija Aleksić[3], Stefan Djordjević[2]

[1]Academy of Vocational Studies South Serbia, Department of High School for Teachers Bujanovac, [2]Faculty of Sports and Physical Education, University of Niš, Serbia, [3]Preschool institution "Naše dete" Vranje, Serbia

Abstract

The number of children with postural disorders is constantly increasing. The aim of this review is to analyze the research that studied the postural status of preschool children in the period from 2000 to 2022 in the territory of Serbia. We collected a total of 15 surveys. The analysis of the presented research showed that the postural status of preschool children in Serbia is not at a satisfactory level. "Bad head posture", "bad shoulder posture", "bad scapula posture" and "bad abdominal posture" are present in over 30% of children. It is similar with kyphotic, lordotic and scoliotic bad posture. It is necessary to take preventive measures in order to stop the trend of increasing prevalence of preschool children with bad postural status. Also, it is necessary to constantly carry out new research on this topic in order to constantly monitor the state of the postural status of preschool children and react in accordance with the needs.

Keywords: *postural status, preschool children, spinal column deformity*

Introduction

The number of children with postural disorders and flat feet is constantly increasing (Živković, 2009). There are three "critical" periods in a child's development, when they are especially susceptible to posture deviations, namely the child standing up, starting school and the age of puberty (Gadžić, 2019). Postural disorders occur not only in school children, but also in children of preschool age, which coincides with critical periods of growth and development. They can be found in all segments along the spinal column, trunk and lower extremities (Protić-Gava, 2014). Modern lifestyle is the most common cause of bad posture. Children exercise less and spend more time sitting and lying down (hypokinesia). Such habits significantly reduce most of their physical and functional abilities (Dedaj, 2020). The most important role in the formation and maintenance of proper body posture is played by the muscles, which as an active part of the movement apparatus should be strong enough to maintain a balanced body position. Weakness of certain muscle groups, especially the abdominal musculature or excessive and one-sided loading of certain muscles, can cause various disorders in the spinal column, thorax, upper or lower extremities, and especially in the feet (Gadžić, 2019). Changes in the bone-joint system caused by weak and inelastic muscles can lead to various deformities, both functional and structural (Drljačić, Tirić, Đupovac & Arsić, 2016). According to Srakar, bad posture refers to all irregularities in the position, relationship, and shape of the pelvis, spinal column, shoulders and lower limbs, which are not a result of damage to the skeleton or the neuromuscular apparatus, but are result of insufficient and improper muscle function. A common feature of postural disorders is that they disappear due to active muscle stretching (Živković, 2009). With regular corrective exercise, impaired postural status can be corrected, suggesting that exercise should be present in children's daily activities from preschool age (Andrea & Svetlana, 2021). Correct posture is important for proper growth and development (Protić-Gava, 2014; Gadžić, 2019), but also for the proper functioning of internal organs (Gadžić, 2019). Bad postural status does not only have negative consequences on the movement apparatus (Drljačić, Tirić, Đupovac & Arsić, 2016), it also has a harmful effect on the locomotor system, circulation, as well as on the respiratory and digestive systems (Protić-Gava, 2014), i.e. organs of thorax and abdominal cavities (Drljačić, Tirić, Đupovac & Arsić, 2016). The aim of this review is analyze the research that studied the postural

Correspondence:

Montenegro Sport

Dušan Nikolić
Academy of Vocational Studies South Serbia, Department of High School for Teachers Bujanovac, s.Katun BB, 17500 Vranje, Serbia
E-mail: nikolicdusan287@gmail.com

status of preschool children in the period from 2000 to 2022 in the territory of Serbia.

Method

A descriptive method and theoretical analysis were used for the collection, classification and analysis of targeted research, and the material was searched on: Google, Google Scholar, PubMed and Kobson. The search was limited to works published in the period from 2000 to 2022. Key words used during the search were: postural status, preschool children, and spinal column deformity. References from all papers were reviewed in order to find more studies dealing with this topic. Papers that corresponded to the purpose of the research were taken into consideration

All research is shown in Table 1. In total, we collected 15 studies. The oldest research is Sabo (2006), and the most recent is Civkaroski & Milenković (2022). All research was conducted on the territory of the Republic of Serbia. The largest number of research was conducted on the territory of Vojvodina - four, namely: Novi Sad - 2; Vojvodina - 1; Sombor, Sremska Mitrovica, Bačka Palanka - 1. Then follows: Belgrade -2; Leskovac - 1; Vranje - 1; Užice, Prijepolje, Nova Varoš - 1; Kruševac - 1; Mladenovac - 1; Šabac – 1; Kragujevac – 1; Novi Pazar – 1, while in one survey we were unable to find information about the city where the survey was conducted. The number of respondents in the analyzed works ranged from 50 respondents in the research by Cvetković & Cvetković (2018), to 1259 respondents in the research by Sabo (2006). The total number of respondents included in all works is 5235 children. All research included preschool children aged 3 to 7 years.

Results

Table 1 presents all the research found by chronological age, as well as the results obtained in the research.

Table 1. Research results - list of all papers

SPINAL COLUMN								
Reference	Sample of respondents					Results		
	N	M	F	P	Y	BOYS	GIRLS	Σ
Sabo (2006)	1259	656	603	Vojvodina	3,5-7	Dg1 (174) 13,8% Dg2 (18) 1,4% Dr1 (336) 26,7% Dr2 (10) 0,8% Rgk1 (56) 4,4% Rgk2 (7) 0,6% Dl1 (303) 24,1% Dl2 (6) 0,5% S1 (127) 10,1% S2 (3) 0,2% Dt1 (335) 26,6% Dt2 (67) 5,3% GV-Gv1 (154) 12,2% GV-Gv2 (63) 5%	Dg1 (192) 15,3% Dg2 (30) 2,4% Dr1 (308) 24,5% Dr2 (5) 0,4% Rgk1 (45) 3,6% Rgk2 (2) 0,2% Dl1 (263) 20,9% Dl2 (5) 0,4% S1 (126) 10% S2 (1) 0,1% Dt1 (365) 29% Dt2 (61) 4,8% GV-Gv1 (153) 12,2% GV-Gv2 (57) 4,5%	Dg1 (366) 29,1% Dg2 (48) 3,8% Dr1 (644) 51,2% Dr2 (15) 1,2% Rgk1 (101) 8% Rgk2 (9) 0,8% Dl1 (566) 45% Dl2 (11) 0,9% S1 (253) 20,1% S2 (4) 0,3% Dt1 (700) 55,6% Dt2 (128) 10,2% GV-Gv1 (307) 24,4% GV-Gv2 (120) 9,5%
Sabo (2007)	280	141	139	Sombor, Sremska Mitrovica, Bačka Palanka	4-7	Dg1 (38) 27% Dg2 (9) 6,4% Dr1 (63) 44,7% Dr2 (2) 1,4% Rgk1 (15) 10,6% Rgk2 (3) 2,1% Dl1 (71) 50,4% Dl2 (8) 5,7% S1 (39) 27,7% S2 (1) 0,7% Dt1 (80) 56,7% Dt2 (14) 9,9% GV-Gv1 (27) 19,1% GV-Gv2 (14) 9,9%	Dg1 (59) 42,4% Dg2 (19) 13,7% Dr1 (69) 49,6% Dr2 (1) 0,7% Rgk1 (16) 11,5% Rgk2 (2) 1,4% Dl1 (62) 44,6% Dl2 (2) 1,4% S1 (35) 25,2% S2 (0) 0% Dt1 (85) 61,2% Dt2 (18) 12,9% GV-Gv1 (31) 22,3% GV-Gv2 (12) 8,6%	Dg1 (97) 34,6% Dg2 (28) 10% Dr1 (132) 47,1% Dr2 (3) 1,1% Rgk1 (31) 11,1% Rgk2 (5) 1,8% Dl1 (133) 47,5% Dl2 (10) 3,6% S1 (74) 26,4% S2 (1) 0,4% Dt1 (165) 58,9% Dt2 (32) 11,4% GV-Gv1 (58) 20,7% GV-Gv2 (26) 9,3%
Simov, Minić & Stojanović (2011)	968	/	/	Leskovac	6-7	/	/	Pd1 (528) 54,54% Pd2+ (90) 9,3% Rgk (57) 5,88% K (66) 6,82% L (20) 2,07% S (11) 1,14%
Pavlović (2012)	638	/	/	Užice, Prijepolje, Nova Varoš	6-7	K (12) L (0) S (6) TP (19) SCL (0) GV (1)	K (5) L (2) S (6) TP (8) SCL (1) GV (1)	K (17) 2,66% L (2) 0,62% S (12) 1,88% TP (27) 4,23% SCL (1) 0,15% GV (2) 0,31%
Romanov, Stupar, Međedović & Brkin (2014)	423	213	210	Novi Sad	6-7	K (16) 7,51% L (88) 41,31% S (57) 26,76%	K (13) 6,19% L (77) 36,66% S (45) 21,43%	K (29) 6,86% L (165) 39,00% S (102) 24,11%

(continued on next page)

(continued from previous page)

Table 1. Research results - list of all papers

SPINAL COLUMN								
Reference	Sample of respondents					Results		
	N	M	F	P	Y	BOYS	GIRLS	Σ
Stanišić, Đorđević & Maksimović (2014)	60	21	39	Kruševac	6	GV-Gv1 (4) 19,1% GV-Gv2 (1) 4,7%	GV-Gv1 (6) 15,4% GV-Gv2 (0) 0%	GV-Gv1 (10) 16,7% GV-Gv2 (1) 1,6%
Drljačić, Tirić, Đupovac & Arsić (2016)	52	30	22	/	5	/	/	Dg1 (24) 46,2% Dg2 (1) 1,9% Dr1 (31) 59,6% Dr2 (19) 36,5% Rgk1 (6) 11,5% Rgk2 (0) 0,0% Dl1 (26) 50,0% Dl2 (20) 38,5% S1 (10) 19,2% S2 (0) 0,0% Dt1 (28) 53,8% Dt2 (7) 13,5% GV-Gv1 (17) 32,7% GV-Gv2 (13) 25,0%
Bićanin, Milenković, Radovanović, Gajević & Ivanovć (2017)	608	419	189	Belgrade	4-7	L (136) 32,46% K (129) 30,79% Sl (21) 5,08% St (13) 3%	L (38) 19,99% K (57) 30,15% Sl (18) 9,42% St (5) 2,62%	L (174) 28,63% K (186) 30,59% Sl (39) 6,41% St (18) 2,96%
Galić (2017)	120	/	/	Novi Sad	5-7	/	/	Dg1 (6) 5% Dg2 (0) 0% Dr1 (41) 34,16% Dr2 (1) 0,83% Dl1 (21) 17,5% Dl2 (0) 0% Ts1 (23) 19,16% Ts2 (1) 0,83% Pk1 (4) 3,33% Pk2 (0) 0% GV-Gv1 (7) 5,83% GV-Gv2 (0) 0% Dv1 (2) 1,66% Dv2 (0) 0% K1 (9) 7,5% K2 (0) 0% L1 (34) 28,33% L2 (1) 0,83% Rgk1 (5) 4,16% Rgk2 (0) 0%
Cvetković & Cvetković (2018)	50	/	/	Mladenovac	6-7	/	/	L1 (26) 52% L2 (15) 30% K1 (22) 44% K2 (18) 36%
Maksimović & Lertua (2018)	70	/	/	Šabac	5	/	/	Dg1 (18) 51,4% Dg2 (8) 22.9% Dr1 (19) 54,3% Dr2 (15) 42,9% Rgk1 (9) 25,7% Rgk2 (0) 0% Dl1 (27) 77,1% Dl2 (4) 11,4% KL1 (5) 14,3% KL2 (0) 0% Dt1 (1) 2,9% Dt2 (32) 91,4% GV-Gv 1 (15) 42,9% GV-Gv 2 (14) 40%

(continued on next page)

(continued from previous page)

Table 1. Research results - list of all papers

Reference	Sample of respondents					Results		
	N	M	F	P	Y	BOYS	GIRLS	Σ
Maksimović & Lertua (2018)				Šabac	6,5	/	/	Dg1 (20) 57,1% Dg2 (6) 17,1% Dr1 (24) 68,6% Dr2 (5) 14,3% Rgk1 (8) 22,9% Rgk2 (1) 2,9% Dl1 (26) 74,3% Dl2 (2) 5,7% KL1 (3) 8,6% KL2 (2) 5,7% Dt1 (5) 14,3% Dt2 (22) 62,9% GV-Gv 1 (27) 77,1% GV-Gv 2 (5) 14,3%
					Σ	/	/	Dg1 (38) 54,3% Dg2 (14) 20% Dr1 (43) 61,4% Dr2 (20) 28,6% Rgk1 (17) 24,3% Rgk2 (1) 1,4% Dl1 (53) 75,7% Dl2 (6) 8,6% KL1 (8) 11,4% KL2 (2) 2,9% Dt1 (6) 8,6% Dt2 (54) 77,1% GV-Gv 1 (42) 60% GV-Gv 2 (19) 27,1%
Ivanović, Gajević, Gajić & Atanasov (2018)	68	46	22	Belgrade	7	L 30,43% K 39,13%	L 17,39% K 17,39%	/
Bogdanović, Radenković, Kahrović, Murić & Špirtović (2020)	149	78	71	Kragujevac	6	L>30° (4) 5,13% L>40° (2) 2,56%	L>30° (6) 8,45% L>40° (0) 0%	L>30° (10) 6,71% L>40° (2) 1,34%
Biševac, Mahmutović, Mekić & Dolićanin (2021)	60	29	31	Novi Pazar (karate club)	3-7	S (1) 3,4% K (3) 10,3% L (0) 0%	S (2) 6,5% K (1) 3,2% L (0) 0%	/
Civkaroski & Milenković (2022)	430	/	/	Vranje	6-7	/	/	S (8) 1,86% K (13) 3,25% L (6) 1,39% Ld (150) 34,89%

Note: N - sample of respondents; M - male; F - female; Y - years of age; P - place; Dv1 - bad neck posture, first degree; Dv2 - bad neck posture, second degree; Pd1 - number and percentage of children with one postural deformity; Pd2+ - number and percentage of children with two or more postural deformities; Dg1 - bad head posture first degree; Dg2 - bad head posture second degree; Dr1 - bad shoulder posture first degree; Dr2 - bad shoulder posture, second degree; Rgk - disorder in the development of the thorax; Rgk1 - thorax development disorder first degree; Rgk2 - thorax development disorder second degree; Dl1 – bad scapula posture, first degree; Dl2 - bad scapula posture, second degree; Dt1 - bad abdominal posture, first degree; Dt2 - bad abdominal posture, second degree; Ld - bad posture; KL - kyphosis and lordosis; L>30° - lordotic bad posture with deviation greater than 30°; L>40° - lordotic bad posture with deviation greater than 40°; Ts1 - height triangles, first degree of deviation; Ts2 - height triangles, second degree of deviation; Pk1 - position of the pelvis, the first degree of deviation; Pk2 - position of the pelvis, second degree of deviation; K - kyphotic bad posture; K1 – kyphotic bad posture of the first degree; K2 – kyphotic bad posture of the second degree; L - lordotic bad posture; L1 - lordotic bad posture of the first degree; L2 – lordotic bad posture of the second degree; S - scoliotic bad posture; Sl - scoliotic bad posture in the lumbar region; St - scoliotic bad posture in the thoracic area; S1 - scoliotic bad posture of the first degree; S2 - scoliotic bad posture of the second degree; TP - thorax posture; SCL - Scapulae alatae; GV - genu valgum; GV-Gv1 - genu valgum and genu varum first degree; GV-Gv2 - genu valgum and genu varum second degree.

Head posture

The results shown in Table 1 indicate that the "head posture" of preschool children was investigated by Sabo (2006), Sabo (2007), Drljačić, Tirić, Đupovac & Arsić (2016), Galić (2017) and Maksimović & Lertua (2018). Sabo (2006) suggested that in the territory of Vojvodina, 29.1% of preschool children have bad head posture - I degree, while 3.8% of preschool children have bad head posture - II degree. A year later, Sabo (2007) obtained even more

alarming data in the cities of Sombor, Sremska Mitrovica, Bačka Palanka. Data shows that 34.6% of preschool children have bad head posture - I degree, while 10% of preschool children have bad head posture - II degree. Ten years later, Galić (2017) came up with encouraging data. He suggested that in the territory of Novi Sad, 5% of preschool children have bad head posture - I degree, while there were no children with bad head posture - II degree. Unlike Sabo (2006) and Sabo (2007), whose first survey included 1259 and the second one 280 respondents, Galić (2017) had significantly fewer respondents - 120, but the data is certainly much better ten years later. Drljačić, Tirić, Đupovac & Arsić (2016) found that 46.2% of preschool children have bad head posture - I degree, while 1.9% of children have bad head posture - II degree. Alarming data were obtained by Maksimović & Lertua (2018) on a sample of preschool children from Šabac. As many as 54.3% of preschool children have bad head posture - I degree, while 20% have bad head posture - II degree. The authors analyzed the children by age and determined that 51.4% of five-year-old children have bad head posture - I degree, while 22.9% of children of the same age have bad head posture - II degree. Their older friends, aged 6.5 years, are no better, so 57.1% of them have bad head posture - I degree, while 17.1% have bad head posture - II degree.

Shoulder posture

The results shown in Table 1 show us that the "shoulder posture" of preschool children was investigated by Sabo (2006), Sabo (2007), Drljačić, Tirić, Đupovac & Arsić (2016), Galić (2017) and Maksimović & Lertua (2018). Sabo (2006) found on a sample of preschool children from Vojvodina that 51.2% have bad shoulder posture – I degree, while 1.2% have bad shoulder posture – II degree. Sabo (2007) obtained similar data a year later in the cities of Sombor, Sremska Mitrovica, Bačka Palanka. In these cities, 47.1% of preschool children have bad shoulder posture – I degree, while 1.1% have bad shoulder posture – II degree. Drljačić, Tirić, Đupovac & Arsić (2016) confirm that the situation with head posture in preschool children is alarming. In their research, 59.6% of preschool children have bad shoulder posture – I degree, while 36.5% have bad shoulder posture - II degree. Galić (2017) obtained somewhat better data than Sabo (2006) and Sabo (2007) on a sample of preschool children from Novi Sad, but still not so great. The author determines that 34.16% of preschool children have bad shoulder posture - I degree, while 0.83% have bad shoulder posture - II degree. As with head posture, the most alarming data comes from Šabac. Maksimović & Lertua (2018) who found that 61.4% of preschool children have bad shoulder posture - I degree, while 28.6% have bad shoulder posture - II degree. The authors analyzed the children by age and determined that 54.3% of preschool children have bad shoulder posture - I degree, while 42.9% have bad shoulder posture - II degree. Their older friends, aged 6.5 years, are no better, so 68.6% of them have bad shoulder posture - I degree, while 14.3% have bad shoulder posture - II degree.

Thorax development

The results shown in Table 1 indicate that the "thorax development" of preschool children was investigated by Sabo (2006), Sabo (2007), Simov, Minić & Stojanović (2011), Pavlović (2012), Drljačić, Tirić, Đupovac & Arsić (2016).), Galić (2017) and Maksimović & Lertua (2018). Sabo (2006) observed on a sample of preschool children from Vojvodina that 8% of them have a disorder in the development of the thorax – I degree, while 0.8% have a disorder in the development of the thorax - II degree. Sabo (2007) obtained similar data a year later in the cities of Sombor, Sremska Mitrovica, Bačka Palanka. In these cities, 11.1% of preschool children have a disorder in the development of the thorax - I degree, while 1.8% have a disorder in the development of the thorax - II degree. Galić (2017) ten years later, in the territory of Novi Sad, comes to slightly better data. The author determines that 4.16% of preschool children have a disorder in the development of the thorax- I degree, while there are no children with a disorder in the development of the chest – II degree. Drljačić, Tirić, Đupovac & Arsić (2016) obtain similar data as Sabo (2006) and Sabo (2007). The authors suggest that 11.5% of preschool children have a disorder in the development of the thorax – I degree, while there are no children with a disorder in the development of the thorax- II degree. The most alarming data comes again from Šabac. Maksimović & Lertua (2018) showed that 24.3% of preschool children have a disorder in the development of the thorax - I degree, while 1.4% have a disorder in the development of the thorax – II degree. The authors analyzed the children by age and showed that 25.7% of five-year-old children have a disorder in the development of the thorax – I degree, while there are no children with a disorder in the development of the thorax – II degree at that age. Their older friends, aged 6.5 years, are not in a better position, 22.9% of them have a disorder in the development of the thorax – I degree, while 2.9% have a disorder in the development of the thorax- II degree. Simov, Minić & Stojanović (2011) also investigated thorax disorders in preschool children, but they did not classify them by degrees. The authors suggested that 5.88% of children have a disorder in the development of the thorax. Pavlović (2012) also did not classify the disorders according to degrees and he determined on a sample of preschool children from Užice, Prijepolje and Nova Varoš that 4.23% had a disorder in the development of the thorax.

Scapula posture

The results shown in Table 1 indicate that "scapula posture" of preschool children was investigated by Sabo (2006), Sabo (2007), Pavlović (2012), Drljačić, Tirić, Đupovac & Arsić (2016), Galić (2017) and Maksimović & Lertua (2018). Sabo (2006) reported that in a sample of preschool children from Vojvodina, 45% have bad scapula posture – I degree, while 0.9% have bad scapula posture – II degree. Sabo (2007) obtained similar data a year later in the cities of Sombor, Sremska Mitrovica, and Bačka Palanka. In these cities, 47.5% of preschool children have bad scapular posture - I degree, while 3.6% of children have bad scapular posture – II degree. Galić (2017) ten years later, in the territory of Novi Sad, comes to slightly better data. The author suggests that 17.5% of preschool children have bad scapula posture – I degree, while there are no children with bad scapula posture – II degree. Maksimović & Lertua (2018) found an incredibly high percentage of bad scapula posture among preschool children in Šabac. The authors come to the finding that 75.7% of children have bad scapula posture – I degree, while 8.6% have bad scapula posture – II degree. The authors analyzed the children by age and they suggeste that 77.1% of the children at the age of 5have bad scapula posture – I degree, while 11.4% of them have bad scapula posture – II degree. Seventy three % of the children at the age of 6.5 have bad scapula posture – I degree, while 5.7% have bad scapula posture – II degree. Drljačić, Tirić, Đupovac & Arsić (2016) suggest that in preschool children, scapula posture is one of the biggest problems when it comes to posture. The authors determine that 50% of children have bad scapula posture - I degree, while 38.5% have bad scapula posture – II degree. It is interesting that Pavlović (2012) on a sample of 638 preschool children from Užice, Prijepolje and Nova Varoš found that only 0.15% of them have scapulae alatae.

Abdominal posture

The results shown in Table 1 indicate that the "abdominal posture" of preschool children was investigated by Sabo (2006), Sabo (2007), Drljačić, Tirić, Đupovac & Arsić (2016) and Maksimović & Lertua (2018). Sabo (2006) determined on a sample of preschool

children from Vojvodina that 55.6% have bad abdominal posture – I degree, while 10.2% have bad abdominal posture – II degree. Sabo (2007) obtained similar data a year later in the cities of Sombor, Sremska Mitrovica, Bačka Palanka. In these cities, 58.9% of preschool children have bad abdominal posture – I degree, while 11.4% of children have bad abdominal posture – II degree. Drljačić, Tirić, Đupovac & Arsić (2016) suggest that the percentage of children with bad abdominal posture is high. The authors determine that 53.8% of preschool children have bad abdominal posture – I degree, while 13.5% of children have bad abdominal posture – II degree. Interesting data were obtained by Maksimović & Lertua (2018) among preschoolers in Šabac. According to their research, there are more children with II degree (77.1%) than with I degree (8.6%) of bad abdominal posture. The authors analyzed the children by age and identified that 2.9% of five-year-old children have bad abdominal posture - I degree, while 91.4% of them have bad abdominal posture – II degree. 14.3% of the children at the age of 6.5have bad abdominal posture – I degree, while 62.9% have bad abdominal posture - II degree.

Kyphosis

The results shown in Table 1 indicate that the "kyphotic bad posture" of preschool children was investigated by Simov, Minić & Stojanović (2011), Pavlović (2012), Romanov, Stupar, Međedović & Brkin (2014), Bićanin, Milenković, Radovanović, Gajević & Ivanović (2017), Galić (2017), Ivanović, Gajević, Gajić & Atanasov (2018), Cvetković & Cvetković (2018), Biševac, Mahmutović, Mekić & Dolićanin (2021) and Civkaroski & Milenković (2022). Simov, Minić & Stojanović (2011) found that among preschool children in Leskovac, kyphotic bad posture is represented by 6.82%. Pavlović (2012) finds that the situation in Užice, Prijepolje and Nova Varoš is somewhat better, and that 2.66% of preschool children have kyphotic bad posture. Romanov, Stupar, Međedović & Brkin (2014) on a sample of preschool children from Novi Sad obtained similar percentages as their colleagues from Leskovac and determined that 6.86% of children have kyphotic bad posture. The authors performed the analysis by gender and determined that the prevalence of kyphotic bad posture among boys was 7.51%, and among girls 6.19%. Bićanin, Milenković, Radovanović, Gajević & Ivanović (2017) came to the most alarming data on a sample of preschool children from Belgrade and determined that 30.59% of children have kyphotic bad posture. The authors performed the analysis by gender and identified that the prevalence of kyphotic bad posture among boys is 30.79%, and among girls 30.15%. Galić (2017) on a sample of preschool children from Novi Sad obtained similar percentages as his colleagues Romanov, Stupar, Međedović & Brkin (2014) three years earlier and identified that 7.5% of children have kyphotic bad posture. Ivanović, Gajević, Gajić & Atanasov (2018) suggest that kyphotic bad posture is the most prevalent among preschool children in Belgrade. The authors find that 39.13% of boys and 17.39% of girls have kyphotic bad posture. Cvetković & Cvetković (2018) report that 44% of preschool children from Mladenovac have kyphotic poor posture – I degree, while 36% have kyphotic bad posture – II degree. Biševac, Mahmutović, Mekić & Dolićanin (2021) find that 10.3% of preschool boys and 3.2% of girls from Novi Pazar have kyphotic bad posture. Civkaroski & Milenković (2022) identified that the prevalence of kyphotic bad posture in a sample of preschool children from Vranje is 3.25%.

Lordosis

The results shown in Table 1 indicate that the "lordotic bad posture" of preschool children was investigated by Simov, Minić & Stojanović (2011), Pavlović (2012), Romanov, Stupar, Međedović & Brkin (2014), Bićanin, Milenković, Radovanović, Gajević & Ivanovć (2017), Galić (2017), Cvetković & Cvetković (2018), Ivanović, Gajević, Gajić & Atanasov (2018), Bogdanović, Radenković, Kahrović, Murić & Špirtović (2020), Biševac, Mahmutović, Mekić & Dolićanin (2021)) and Civkaroski & Milenković (2022). Simov, Minić & Stojanović (2011) found that among preschool children in Leskovac, lordotic bad posture is represented by 2.07%. Pavlović (2012) finds that the situation in Užice, Prijepolje and Nova Varoš is somewhat better, and that 0.62% of preschool children have lordotic bad posture. Romanov, Stupar, Međedović & Brkin (2014) obtained devastating data on a sample of preschool children from Novi Sad that as many as 39% of children have lordotic bad posture. The authors performed the analysis by gender and determined that 41.31% of boys and 36.66% of girls have lordotic bad posture. Bićanin, Milenković, Radovanović, Gajević & Ivanović (2017) also found alarming data on a sample of preschool children from Belgrade and suggested that 28.63% of the children have lordotic bad posture. The authors performed the analysis by gender and reported that 32.46% of boys and 19.99% of girls have lordotic bad posture. Galić (2017) on a sample of preschool children from Novi Sad obtained similar percentages as his colleagues Romanov, Stupar, Međedović & Brkin (2014) three years earlier and determined that 28.33% of preschool children have lordotic bad posture – I degree, while 0, 83% have lordotic bad posture – II degree. Cvetković & Cvetković (2018), as well as with kyphotic bad posture, obtained high percentages in a sample of preschool children from Mladenovac. The authors found that 52% of children have lordotic bad posture – I degree, while 30% have lordotic bad posture – II degree. Ivanović, Gajević, Gajić & Atanasov (2018) confirm that in Belgrade there is a high percentage of preschool children with lordotic bad posture. The authors found that 30.43% of boys and 17.39% of girls have bad lordotic posture. Bogdanović, Radenković, Kahrović, Murić & Špirtović (2020) found in a sample of preschool children from Kragujevac that 6.71% of children have lordotic bad posture greater than 30° and 1.34% lordotic bad posture greater than 40°. The authors performed the analysis by gender and determined that 5.13% of boys and 8.45% of girls have lordotic bad posture greater than 30°, while 2.56% of boys and 0% of girls have lordotic bad posture greater than 40°. It is interesting that Biševac, Mahmutović, Mekić & Dolićanin (2021) found that there are no children with lordotic bad posture in a sample of preschool children from Novi Pazar. The sample in their research consisted of preschool children who are members of the karate club, so their results must be taken into special consideration. Civkaroski & Milenković (2022) found that 1.39% of children have lordotic bad posture in a sample of preschool children from Vranje. The data from Vranje is encouraging if compared to research on lordotic bad posture in other cities of Serbia.

Kypholordosis

The results shown in Table 1 show us that "kypholordosis" was investigated only by Maksimović & Lertua (2018). The authors determined that 11.4% of preschool children in Šabac have combined kyphotic and lordotic bad posture – I degree, while 2.9% have combined kyphotic and lordotic bad posture – II degree. The authors analyzed the children by age and reported that 14.3% of five-year-old children have combined kyphotic and lordotic bad posture – I degree, while there are no children at this age with combined kyphotic and lordotic bad posture – II degree. Their older friends, aged 6.5 years, are not in a better position. 8.6% of them have combined kyphotic and lordotic bad posture – I degree, while 5.7% have combined kyphotic and lordotic bad posture – II degree.

Scoliosis

The results shown in Table 1 indicates that "scoliotic bad posture" of preschool children was investigated by Sabo (2006), Sabo (2007), Simov, Minić & Stojanović (2011), Pavlović (2012), Romanov, Stupar, Međedović & Brkin (2014).), Drljačić, Tirić, Đupovac

& Arsić (2016), Bićanin, Milenković, Radovanović, Gajević & Ivanović (2017), Biševac, Mahmutović, Mekić & Dolićanin (2021) and Civkaroski & Milenković (2022). Sabo (2006) identified in a sample of preschool children from Vojvodina that 20.1% have scoliotic bad posture – I degree, while 0.3% have scoliotic bad posture – II degree. Sabo (2007) obtained similar data a year later in the cities of Sombor, Sremska Mitrovica, Bačka Palanka. In these cities, 26.4% of preschool children have scoliotic bad posture – I degree, while 0.4% have scoliotic bad posture – II degree. Simov, Minić & Stojanović (2011) found that preschool children in Leskovac, as well as with kyphotic and lordotic bad posture, have a significantly lower percentage of scoliotic bad posture compared to their peers from other cities in Serbia, and it amounts to 1.14%. Pavlović (2012) suggests that preschool children from Užice, Prijepolje and Nova Varoš also have a low percentage of scoliotic bad posture, amounting to 1.88%. Romanov, Stupar, Međedović & Brkin (2014) established that the situation with scoliotic bad posture in preschool children in Novi Sad is far worse than in the mentioned cities. The authors come to the data that 24.11% of children have scoliotic bad posture. They also performed the analysis by gender and found that 26.76% of boys and 21.43% of girls have scoliotic bad posture. Drljačić, Tirić, Đupovac & Arsić (2016) found that 19.2% of preschool children have scoliotic bad posture – I degree, while there are no children with scoliotic bad posture – II degree. Bićanin, Milenković, Radovanović, Gajević & Ivanovć (2017) investigated scoliotic bad posture in a sample of preschool children from Belgrade partially, especially for scoliotic bad posture in the lumbar area, and especially for scoliotic bad posture in the thoracic area. The authors found that 6.41% of children have scoliotic bad posture in the lumbar area, while 2.96% of children have scoliotic bad posture in the thoracic area. Also, 5.08% of boys and 9.42% of girls have scoliotic bad posture in the lumbar area, while 3% of boys and 2.62% of girls have scoliotic bad posture in the thoracic area. Biševac, Mahmutović, Mekić & Dolićanin (2021) found that 3.4% of boys and 6.5% of girls have scoliotic bad posture in a sample of preschool children from Novi Pazar. The research was conducted among children who are part of the karate club, so these data should not be considered with certainty. Civkaroski & Milenković (2022) found that 1.86% of preschool children from Vranje had scoliotic bad posture. The data from Vranje, Leskovac Užice, Prijepolje and Nova Varoš is encouraging if compared with research on scoliotic bad posture in other cities of Serbia.

Leg status

The results shown in Table 1 indicate that "leg status" was investigated by Sabo (2006), Sabo (2007), Pavlović (2012), Stanišić, Đorđević & Maksimović (2014), Drljačić, Tirić, Đupovac & Arsić (2016), Galić (2017) and Maksimović & Lertua (2018). Sabo (2006) identified in a sample of preschool children from Vojvodina that 24.4% have deviations from the normal shape of the legs – I degree, while 9.5% have deviations from the normal shape of the legs – II degree. Sabo (2007) obtained similar data a year later in the cities of Sombor, Sremska Mitrovica, Bačka Palanka. In these cities, 20.7% of children have deviations from the normal shape of the legs – I degree, while 9.3% have deviations from the normal shape of the legs – II degree. Drljačić, Tirić, Đupovac & Arsić (2016) found that 32.7% of preschool children have deviations from the normal shape of the legs - I degree, while 25% have deviations from the normal shape of the legs – II degree. Stanišić, Đorđević & Maksimović (2014) determined on a sample of preschool children from Kruševac that 16.7% have deviations from the normal shape of the legs - I degree, while 1.6% have deviations from the normal shape of the legs – II degree. Galić (2017) obtained slightly better data on a sample of preschool children from Novi Sad than Sabo (2006) ten years earlier. The author showed that 5.83% have deviations from the normal shape of the legs – I degree, while there are no children with deviations from the normal shape of the legs – II degree. Furthermore, Šabac. Maksimović & Lertua (2018) showed that 60% of preschool children have deviations from the normal shape of the legs - I degree, while 27.1% have deviations from the normal shape of the legs – II degree. The authors analyzed the children by age and determined that 42.9% of children aged five years have deviations from the normal shape of the legs - I degree, while 40% have deviations from the normal shape of the legs - II degree. Their older friends, aged 6.5 years, are not in a better position 77.1% of them have deviations from the normal shape of the legs – I degree, while 14.3% have deviations from the normal shape of the legs – II degree. Pavlović (2012) identifiedin a sample of preschool children from Užice, Prijepolje and Nova Varoš that only 0.31% of children have X-legs (Genu valgum), which is encouraging data compared to research in other cities.

In addition to the aforementioned disorders, Galić (2017) found that 3.33% of preschool children from Novi Sad have an irregular pelvic position – I degree, while there are no children with an irregular pelvic position – II degree. In addition to the aforementioned, 1.66% of children have improper posture of the neck – I degree, while there are no children with improper posture of the neck – II degree.

At the end of the review, we can add that Simov, Minić & Stojanović (2011) determined on a sample of preschool children from Leskovac that 54.54% of children have at least one postural deformity, while 9.3% of children have two or more postural deformities. Civkaroski & Milenković (2022) found that 34.89% of preschool children from Vranje had bad posture.

Discussion

The summary of the scientific evidence indicate that "bad head posture" is quite prevalent among preschool children in Serbia and that the prevalence often exceeds 30%. The situation with "shoulder posture" is even more alarming where the prevalence in many studies exceeds 50%. When it comes to "disorder in the development of the thorax" the situation is somewhat better, and the prevalence is between 10 and 20%. Research shows that "bad scapula posture" and "bad abdominal posture" are also very common postural disorders that occur in over 50% of children. When it comes to "kyphotic bad posture," research results diverge. In some studies, the prevalence is below 10%, and some studies show that the prevalence is over 30%. The most alarming data comes from Belgrade and Mladenovac. The prevalence of "lordotic bad posture" also varies from study to study. In Leskovac, Užice, Prijepolje, Nova Varoš, Novi Pazar, Vranje, Kragujevac, the prevalence is below 7%, while in Novi Sad, Belgrade and Mladenovac it exceeds 25%. It's the same with "scoliotic bad posture". The prevalence ranges from 1.14% in Leskovac to 24.11% in Novi Sad. When it comes to "deviation from the normal shape of the legs" in a large number of studies, the prevalence exceeds 20%. These findings indicate that the issue of the postural status in preschoolers in Serbia is alarming.

Sabo (2006) suggested that there are significant differences between the genders in head posture, abdominal posture (boys have better results) and arch of the foot (girls have better arch of the foot). There are no significant differences in the posture of shoulders and scapula, the development of the thorax, the deviation of the spinal column in the frontal plane and the shape of the legs. The author suggests that all deviations from the normal status are in the form of functional deformity, which means that corrective work is required to eliminate them. Sabo (2007) comes to similar results and finds that there are statistically significant differences between the genders in head posture (boys have better head posture) and arch of the foot (girls have better arch of the foot). There are no significant differences in the posture of

shoulders, scapula and abdomen, in the development of the thorax, the deviation of the spinal column in the frontal plane and the shape of the legs. Simov, Minić & Stojanović (2011) suggest that it is the duty of educators in kindergartens and parents at home to instruct children in correct posture when sitting, walking and doing physical activities. Pavlović (2012) believes that physical exercise, and therefore physical education, should be a constant and systematic process applied from an early age. The author states that children in preschool institutions are not covered by adequate professional supervision, but that the way educators work is better than passivity. Romanov, Stupar, Međedović & Brkin (2014) suggest that deviations from the normal postural status are present in a high percentage, and that they are equally represented in the population of respondents of both genders. A significant difference between the genders only occurs for the deviation from the normal status of the spinal column in the frontal plane. When boys are concerned, scoliotic bad posture is significantly more present. The authors believe that the postural status of the examined population of preschool children is worrying. Stanišić, Đorđević & Maksimović (2014) believe that the quantitative results should not be ignored because there is a large number of children (boys and girls) who have a functional stage of deformity in almost all segments of the body, and this represents a potential danger for the formation of structural changes which, to a greater or lesser extent, endanger health, the general functioning of the organism and its ability to work. Drljačić, Tirić, Đupovac & Arsić (2016) believe that the results of their research indicate the necessity of applying systematic exercise in working with children at an early age, which positively affects the postural status of children, in the form of its preservation, but also the elimination of functional deformities that could leave permanent consequences on the child's organism in the later period. Bićanin, Milenković, Radovanović, Gajević & Ivanović (2017) found that additional six-month exercise with preschool children has a positive effect on their postural status. Galić (2017) suggests that more than half of preschool children show a deviation from normal postural status, as well as that there is a statistically significant positive association between the occurrence of minimal neurological dysfunctions and bad body posture in preschool children. Cvetković & Cvetković (2018) determined that there is no relationship between the level of nutrition and kyphotic and lordotic bad posture in preschool children. The authors come to the conclusion that obesity and malnutrition do not have an impact on the occurrence of postural disorders independently, but probably in combination with other factors such as heredity, then physical inactivity, etc. Maksimović & Lertua (2018) state that the postural status of the examined children is not satisfactory, as well as the fact that there is a significant number of structural deformities of the front abdominal wall is worrying. The authors indicate the importance and necessity of measurement, monitoring and evaluation in the physical education of preschool children. Ivanović, Gajević, Gajić & Atanasov (2018) believe that untimely detection of bad posture in preschool children can cause serious health problems in adulthood. Bogdanović, Radenković, Kahrović, Murić & Špirtović (2020) believe that special attention should be paid to prevention, as well as adequate education of employees in preschool institutions. Biševac, Mahmutović, Mekić & Dolićanin (2021) found that regular performance of corrective exercises (strengthening the weakened and stretching the shortened muscles) for six months has a positive effect on certain deformities of the spinal column. Correction of kyphosis was already visible after three months, of scoliosis after six months, while correction of lordosis in the only recorded case was not achieved with corrective exercises. Civkaroski & Milenković (2022) believe that there is a need to raise awareness about spinal column deformities and their consequences, as well as the need to emphasize the importance of good posture from an early age.

Conclusion

The analysis of the presented research showed that the postural status of preschool children in Serbia is not at a satisfactory level. "Bad head posture", "bad shoulder posture", "bad scapula posture" and "bad abdominal posture" are present in over 30% of children. It is similar with kyphotic, lordotic and scoliotic bad posture. It is necessary to take preventive measures in order to stop the trend of increasing prevalence of preschool children with bad postural status. The limitations of this study were the small number of studies on this topic. The authors should conduct more research in this scientific field.

Received: 28 February 2023 | **Accepted**: 14 November 2023 | **Published**: 15 January 2024

References

Andrea, Ž. V. J., & Svetlana, B. (2021). *Corrective gymnastics-compulsory course for teachers and educators.* Sports science & health, 11 (1), 108-114.

Bićanin, P., Milenković, S., Radovanović, D., Gajević, A., & Ivanovć, J. (2017). Postural disorders in preschool children in relation to gender. *Facta Universitatis. Series: Physical Education and Sport*, 15 (1), 1-10.

Biševac, E. M., Mahmutović, E. H., Mekić, R. H., & Dolićanin, Z. Ć. (2021). Effect of corrective exercises on functional spinal deformities in preschool and school-aged children. *Specijalna edukacija i rehabilitacija*, *20* (1), 51-63.

Bogdanović, Z., Radenković, O., Kahrović, I., Murić, B., & Špirtović, O. (2020). Body height and lordotic posture in preschool children. *Facta Universitatis. Series: Physical Education and Sport*, 18 (1), 263-269.

Cvetković, N., & Cvetković, J. (2018). Nutritional levels and spine curvature disorders among preschool chidlren. *Facta Universitatis, series: Physical education and sport*, 16 (2), 309-318.

Civkaroski, D., & Milenković, S. (2022). The prevalence of spinal deformities in children and differenece between preschool and school children. *Knowledge-international journal*, 51 (4), 591-594.

Dedaj, M. (2020). Causes of improper body posture in children and possibility of prevention. *Sport, Science & Practice*, 10 (2), 71-85.

Drljačić, D., Tirić, N., Đupovac, M., & Arsić, N. (2016). Uticaj programiranog vežbanja u okviru predškolske ustanove na posturalni status dece. *PONS - medicinski časopis*, 13 (1), 9-12.

Gadžić, A. (2019). *Teorija i metodika fizičkog i zdravstvenog vaspitanja*. Beograd: Univerzitet Singidunum.

Galić, M. (2017). Minor neurological dysfunction and bad posture in children at preschool age. Doctoral dissertation. *Medical Faculty*, University of Novi Sad.

Ivanović, J., Gajević, A., Gajić, I., & Atanasov, D. (2018). Sagital plane poor posture among seven–year-old children. In Lence A. Velickovska (Ed.), *3rd International scientific conference, research in physical education, sport, and health* (pp.101-111). Skopje: Ss. Cyril and Methodius University in Skopje, Faculty of Physical Education, Sport, and Health, Skopje.

Maksimović, S., i Lertua, S. (2018). Posturalni status kao faktor planiranja u fizičkom vaspitanju predkolske dece. *Inovacije u nastavi*, 1, 119-128.

Pavlović, S. (2012). Prisustvo telesnih deformiteta dece predškolskog uzrasta. *Univerzitetska misao*, (11), 6-14.

Protić-Gava, B. (2014). The importance of postural status for the health of children and youth. *Exercise and quality of life*, *6* (1), 1-6.

Romanov, R., Stupar, D., Međedović, B., & Brkin, D. (2014). Posturalni status dece predškolskog uzrasta na teritoriji Novog Sada. *Tims. Acta: naučni časopis za sport, turizam i velnes*, 8 (2), 129-135.

Sabo, E. (2006). Postural state of preschool children on territory of Vojvodina. *Fizička kultura*, *60* (2), 157-164.

Sabo, E. (2007). Postural status in children of preschool age in areas of Sombor, Sremska Mitrovica and Backa Palanka municipalities. *Norma*, 12 (1), 125-134.

Stanišić, I., Đorđević, M., & Maksimović, S. (2014). Posturalni status nogu i svoda stopala kod dece predškolskog uzrasta i efekti korektivnog vežbanja u okviru usmerenih aktivnosti. *Sinteze*, 5, 63-71.

Simov, S. B., Minić, S. M., & Stojanović, D. O. (2011). Učestalost pojave lošeg držanja tela i ravnih stopala kod dece predškolskog uzrasta. *Apollinem medicum et aesculapium*, 9 (2), 5-8.

Živković, D. (2009). *Osnove kineziologije sa elementima kliničke kineziologije*. Niš: Fakultet sporta i fizičkog vaspitanja

DOI 10.26773/jaspe.240102

Journal of Anthropology of Sport and Physical Education

ORIGINAL SCIENTIFIC PAPER

Coaches' practices and perspectives on mental and physical preparation in amateur soccer in Skikda Province, Algeria: A pilot study

Ibrahim Zakaria Kahlouche[1] and Oussama Kessouri[2]

[1]Laboratory of studies and researches in sciences and techniques of physical and sports activities, Institute of sciences and techniques of physical and sports activities, University of Biskra, Algeria, ibrahimzakaria.kahlouche@univ-biskra.dz, [2]Department of Sciences and Techniques of Physical and Sports Activities, Faculty of Human and Social Sciences, University of Jijel, Algeria. oussama.kessouri@univ-jijel.dz

Abstract

The aim of this study was to identify the practices and perceptions of coaches on mental and physical preparation in Skikda province, Algeria. The sample consisted of 40 coaches of senior amateur soccer teams. A cross-sectional design was employed in this study. An electronic questionnaire was distributed online to collect data. It consisted of six sections, including informed consent from the coaches, demographics, mental preparation, physical preparation, the relationship between mental and physical preparation, and the challenges coaches face in preparing players mentally and physically. The results revealed that the majority of amateur soccer coaches believe that the goal of mental preparation for amateur soccer players is to enhance self-confidence, improve focus, develop decision-making skills, and alleviate pressure and anxiety before competition. They also see the goal of physical preparation as developing aerobic and anaerobic endurance, injury prevention, and enhancing strength and power. However, their practices in both mental and physical preparation were limited. Regarding the relationship between mental and physical preparation, coaches emphasized the importance of both aspects for amateur players. The absence of sports psychologists, a lack of modern technological resources for training, and limited sports facilities were identified as significant challenges hindering the process of mental and physical preparation. Based on these results, the researchers recommend addressing the identified challenges and reinforce the idea of paying more attention to amateur soccer in Algeria.

Keywords: *Mental preparation, physical preparation, amateur soccer, coaches' practices and perspectives*

Introduction

Soccer is a team sport where success depends on many factors like physical fitness (Chmura et al., 2022), technical performance (Kessouri, 2023), tactics (Memmert et al., 2017), teamwork, and how players think and feel (Sarkar, & Fletcher, 2014). These aspects are all connected, and it's hard to define which is most important (Higham et al., 2014). Additionally, external factors like weather conditions and the state of the field can also influence the game (Bangsbo et al., 2006). So, in soccer, players have to train and prepare for all these various aspects to do well in games and competitions. In particular, players need to strike the right balance between their mental and physical capabilities (Fossati et al., 2021), ensuring that their bodies and minds work harmoniously on the field.

Soccer requires mental toughness, strong focus, and the ability to handle pressure from competition. It also demands quick decision-making skills, which means that a player's mental game is crucial. To succeed in the game, players need to prepare their minds. Mental preparation involves developing various mental qualities needed for good performance in the sport and reducing anything that might hurt their performance (Junge et al., 2000; Najah, & Rejeb, 2016). Mental preparation involves techniques like managing stress, setting clear goals, and finding ways to relax mentally (Kumari, & Kumar, 2016). Coaches use this process throughout the sports season to make sure players perform at their best.

Correspondence:

Montenegro Sport

O. Kessouri
Department of Sciences and Techniques of Physical and sports activities, Faculty of Human and social sciences, University of Jijel, Algeria BP 98, Jijel, Algeria
E-mail: oussama.kessouri@univ-jijel.dz
ORCID: https://orcid.org/0000-0002-9831-1610

In parallel with this, physical preparation for soccer players is equally indispensable. It aims to enhance their anaerobic qualities encompassing various explosive elements such as acceleration, change of direction, and jumping ability (Orer, & Arslan, 2016). Also to develop their aerobic and cardiovascular endurance, to enable them to enhance recovery between those actions and complete 90 minutes of the game (Tomlin, & Wenger, 2001). Moreover, it aims to reduce the potential risk of injuries through the implementation of several preventive methods, such as physical exercises specifically designed for this purpose (Neto et al., 2016; Kessouri, 2021).

Physical preparation is not only about planning and identifying appropriate training methods. It extends to the monitoring of players through a series of physical tests and the utilization of measurements and technological devices to assess players' performance and their responses to training sessions (Miguel et al., 2021). Additionally, it involves the utilization of various recovery modalities available to accelerate the recovery process and relieve fatigue (Nédélec et al., 2013). Therefore, physical preparation serves as the cornerstone that assists players in executing various skills and implementing diverse playing strategies and plans (Modric et al., 2022).

There are many studies that aim to investigate coaches' practices and perspectives on physical and mental preparation in athletes in general. Freitas et al. (2013) concluded that the use of psychological techniques by elite Portuguese coaches was limited, as their intervention was mostly based on their extensive experience (as coaches and players). Weldon et al. (2021) found that concentric and eccentric exercises are the most used in training by professional soccer coaches, and the primary challenges they encountered were the complexities in program planning and managing training load due to scheduling constraints and time limitations.

For amateur soccer players, to the best of our knowledge, there have been no studies investigating coaches' practices and perspectives on mental and physical preparation, and for this reason, this study aimed to understand the current practices and perceptions of amateur soccer coaches in Skikda province in Algeria, regarding mental and physical preparation.

Materials and method

Sample

The sample consisted of 40 coaches working with first teams (Senior) in amateur soccer clubs in the Skikda province, which is part of the Algerian amateur divisions. Before responding to the questionnaire, informed consent was obtained from all the coaches to participate in the study, and they were granted the right to withdraw their responses before closing the questionnaire. The current study adhered to the guidelines outlined in the Helsinki Declaration for Human Studies (World Medical Association, 2013).

Study design

In this study, a cross-sectional design to investigate the practices and perspectives of soccer coaches in Skikda Province, Algeria was employed, during the 2022/2023 sports season. A structured electronic questionnaire was distributed online for 15 days after the end of all tournaments. This approach allows capturing a snapshot of coaching methods and viewpoints, shedding light on the critical aspects of mental and physical preparation in the context of amateur soccer.

Questionnaire

A questionnaire was employed as a data collection tool. To ensure content validity and reliability, the questionnaire utilized in this study was meticulously formulated, drawing upon various previous studies on coaching practices in soccer (Freitas et al., 2013; McCall et al., 2015; McCall et al., 2020; Beere, & Jeffreys, 2021; Loturco et al., 2022; McQuilliam et al., 2023). This approach aimed to encompass multifaceted aspects of mental and physical preparation specific to amateur soccer in Skikda Province, Algeria. Moreover, an essential step involved enhancing its clarity. The questionnaire underwent a thorough auditing process conducted by distinguished experts in the field of sports training. Their invaluable insights and corrections played a significant role in improving the questionnaire items and ensuring its comprehensiveness, making it suitable for the targeted group of coaches.

The version of the questionnaire was divided into 6 sections, where the first section explained the study's objectives and significance, along with a discussion of participants' rights and their acceptance or refusal to participate in the study. In the second section, demographic data about the coaches was collected. The third section contained four questions about mental preparation in amateur soccer, including its objectives, techniques, methods for assessing psychological status, and how to address mental preparation in the training process. The fourth section similarly addressed physical preparation, covering its objectives, the tests used, injury prevention methods, as well as training load management and monitoring. In the fifth section, four questions were included regarding the relationship between mental and physical preparation. As for the sixth section, it continued the discussion on the difficulties and obstacles encountered in the application of mental and physical preparation for amateur teams. Various methods were used to answer the questionnaire, including multiple-choice options, checkboxes, and providing short answers.

Statistical analysis

Descriptive statistics, including frequencies, percentages, means, and standard deviations (SD), were utilized to provide a clear and comprehensive overview of coaches' practices and perspectives on mental and physical preparation in amateur soccer. These statistical analyses were conducted using software tools such as SPSS and Microsoft Excel.

Results

Demographics

The ages of the coaches participating in the study ranged from 23 to 54 years old. As for years of experience, 45% of the coaches had more than 10 years of experience, 30% had between 6 and 10 years of experience, and 25% had experience ranging from 1 to 5 years. Looking at the coaching certifications of the trainers, 12 coaches held a CAF C certificate (30%), 7 coaches held a CAF B certificate (17.5%), 15% held the highest coaching certificate awarded by the Algerian Football Federation, FAF 3 (n=6), and 10% held the highest certificate granted by the Confederation of African Football, CAF A (n=4). Additionally, 3 coaches possessed an FAF 2 certificate (7.5%), while 3 others held a first-degree coaching certificate granted by the Algerian Ministry of Youth and Sports (7.5%). Meanwhile, only 2 coaches held second-degree coaching certificates (5%), and 3 of the coaches had university degrees in sports coaching.

Mental preparation

Regarding the main objectives of mentally preparing amateur players, 82.5% of the coaches answered that the goal is to develop self-confidence, followed by improving focus (55%), and then enhancing the ability to make decisions under pressure (45%). Additionally, 42.5% stated that the goal of mental preparation for amateur players is to manage nervousness and anxiety before the competition, while the least important objectives were improving team dynamics and communication (20%), enhancing recovery processes (10%), and avoiding overtraining and injuries (5%).

Regarding the second question in this section, which focuses on the various techniques used by coaches to mentally prepare their players, Figure 1 illustrates the coaches' responses. The most

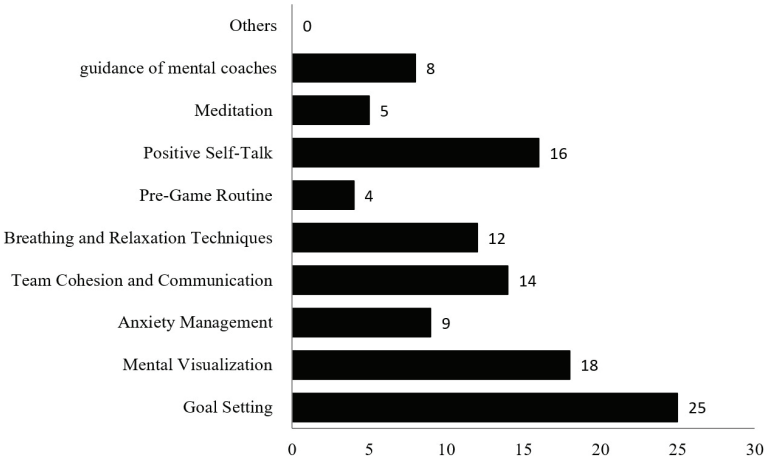


FIGURE 1 Mental preparation techniques used by the coaches

common response was 'goal setting' (n=25), followed by 'mental visualization (n=18) and 'positive self-talk.'

For the third question, which revolves around the methods used to measure the psychological state of players, it is evident from Figure 2 that the most common response was 'observing players' behaviors during training and matches' (n=20), 'Conducting standardized tests to measure psychological state' (n=20), and 'communication with the player' (n=17)

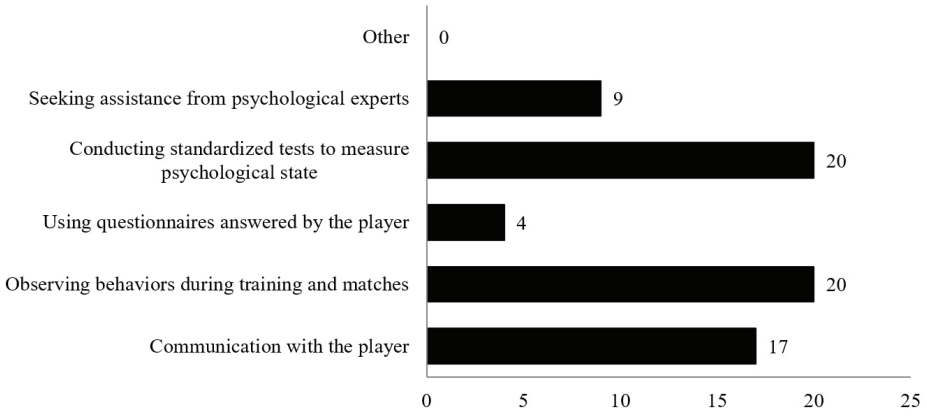


FIGURE 2 Methods employed by coaches to assess the psychological state

The last question in this section, which pertained to addressing the mental preparation of the players, where 20 coaches (50%) responded by providing players with the necessary resources for self-mental training, and 16 coaches (40%) integrated mental training sessions with regular training sessions. Additionally, 14 coaches (35%) indicated conducting separate training sessions for mental preparation. Five coaches (12.5%) mentioned conducting individual sessions for players. One coach (2.5%) provided a different response, stating that when they notice something with a player or many players, he tries to address the issue by talking to all the players to benefit from their teammates' experiences.

Physical preparation

Regarding the first question about the main objectives of

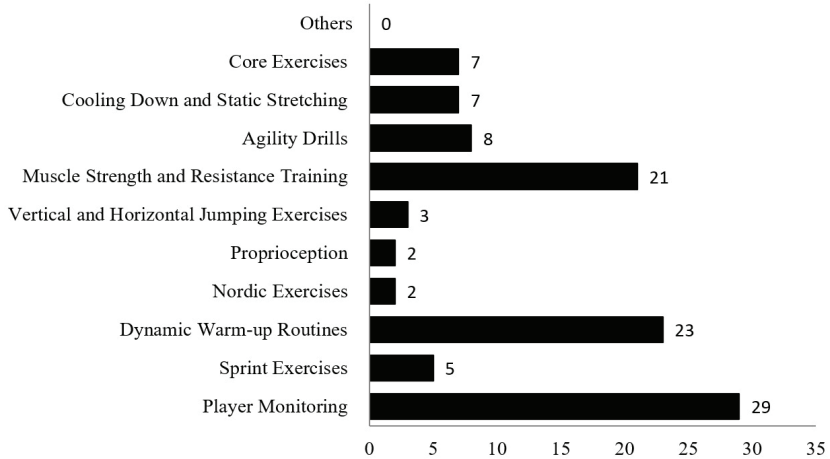


FIGURE 3 Injury prevention strategies used by the coaches

physical preparation for amateur players, 70% of the coaches answered that the goal is to improve both aerobic and anaerobic endurance, followed by injury prevention (62.5%), and then enhancing strength and power (45%). Additionally, 30% stated that the goal of physical preparation for amateur players is to improve recovery and fatigue management, while 25% mentioned that the goal is to develop agility. Furthermore, 22.5% of them indicated that the goal is to assist in carrying out tactical duties. The least important objectives were improving flexibility and mobility (15%), and one coach mentioned that all of these suggestions are the main goals of physical preparation for amateurs (2.5%).

For the strategies employed in injury prevention, the most common response was 'Player monitoring' (n=29), 'Dynamic warm-up routines' (n=23), and 'Muscle strength and resistance training' (n=21). Figure 3 highlights coaches' responses.

In the third question in this section, which focused on the tests used by coaches during the sports season, as shown in Figure 4, the most common response was 'laboratory tests' (n=19) and 'speed tests' (n=14).

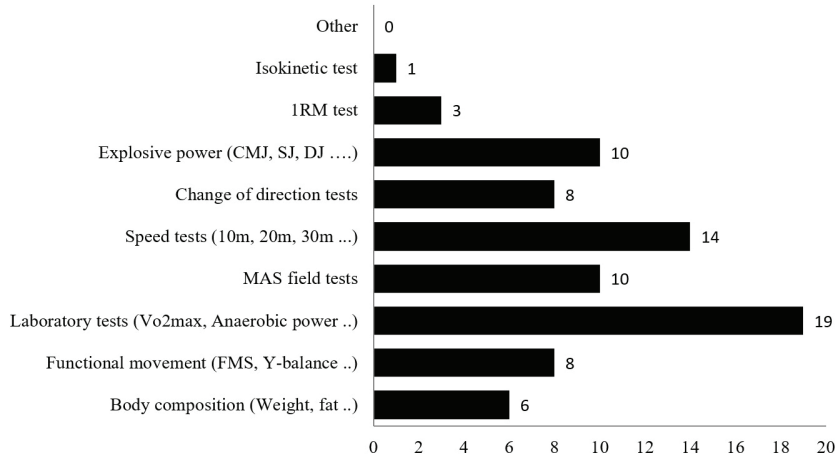


FIGURE 4 Tests used by coaches to assess their amateur players

In the last question in this section, which pertained to the management and monitoring of training load by coaches for amateur soccer players, the most common response was 'observation' (n=25), and Figure 5 provides a detailed description of the number of responses for each procedure.

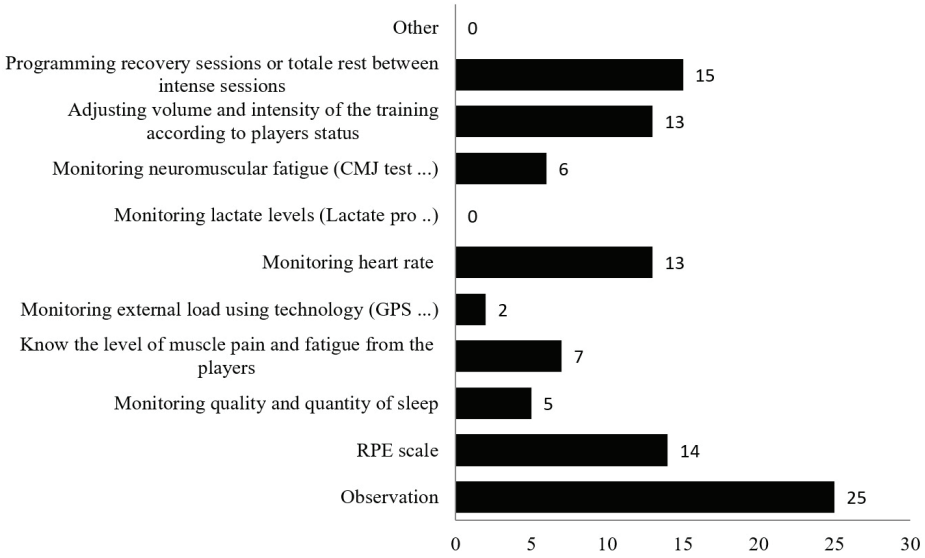


FIGURE 5 Managing and monitoring the training load procedures of the coaches

Relationship between mental and physical preparation

Regarding the two questions posed about the relationship between mental and physical preparation for amateur soccer players, 57.5% of the coaches (n=23) believe that mental strength has a significant impact on physical performance. Meanwhile, 27.5% of them (n=27.5) think that mental strength has some effect on physical performance. Only 12.5% of the coaches (n=5) believe that mental strength does not have a significant impact on physical performance. Additionally, one coach (2.5%) believes that mental strength and physical performance are somewhat unrelated.

As for the second question, which focused on how mental and physical readiness interact to improve the performance of amateur players, 57.5% of the coaches (n=23) answered that mental and physical preparation are equally important for amateur players, 32.5% of them (n=13) indicated that physical preparation is of greater importance for amateurs than mental preparation. Additionally, 7.5% of the coaches (n=3) stated that mental preparation is more important than physical preparation. One coach (2.5%) responded that both mental and physical preparation are not significantly important for enhancing the performance of amateur players.

Difficulties in mental and physical preparation

Table 1 illustrates the difficulties faced by coaches of amateur soccer teams in the process of mental and physical preparation. The most challenging difficulty was the lack of sports psychologists (67.5%), followed by the unavailability of modern training technology (52.5%), the absence of large sports facilities (50%), and the difficulty in evaluating psychological progress for the players (47.5%). The least challenging difficulty was resistance from the players (15%).

Table 1 The Difficulties that amateur soccer coaches face in mentally and physically preparing their amateur players

Ranking	Difficulties	Citations and % of teams
1st	The absence of sports psychology experts	27 (67.5%)
2nd	Unavailability of modern technology used in training	21 (52.5%)
3rd	Lack of large sports facilities	20 (50%)
4th	The difficulty of measuring psychological progress	19 (47.5%)
5th	Resistance from players	6 (15%)

Discussion

The current study aimed to identify the practices and perceptions of coaches regarding the mental and physical preparation of amateur soccer teams in the Skikda province of Algeria. To the best of our knowledge, this is the first study to investigate this topic. Therefore, we believe that these results provide a clear understanding of coaches' perceptions and practices for amateur teams.

Mental preparation

The results of the study indicate that most coaches believe that the mental preparation of amateur soccer players aims to enhance self-confidence, improve focus, enhance decision-making under pressure, and manage stress and anxiety before competitions. These goals are considered primary objectives of mental preparation in soccer (Kumari, & Kumar, 2016), especially since soccer requires confidence, focus, the ability to make decisions, and the capacity to handle pressure during play.

The findings also reveal that the majority of mental preparation techniques used by coaches involve goal setting and mental imagery. Goal setting is a common technique used by athletes to improve sports performance (Healy et al., 2018), and mental imagery is one of the most important methods used by amateur and professional athletes to enhance performance and aid in the rehabilitation process after injury (Ribeiro et al., 2015; Kahlouche, & Bezziou, 2021; Sariati et al., 2021; Seif-Barghi et al., 2012; Zach et al., 2018).

Regarding the assessment of players' psychological states, most responses indicated observations, which involve observing players' behaviors and talking to them. This aligns with the findings of Freitas et al. (2013), where most professional Portuguese soccer coaches rely on communication and observation as psychological preparation techniques, drawing on their coaching experience and past playing experiences. Additionally, most coaches reported using standardized psychological measures, which are considered important and reliable tools for assessing players' psychological states (McAuley, & Gill, 1983; Kawabata, & Zhang, 2018).

Furthermore, most coaches provide players with the necessary resources for self-mental training, integrate mental training sessions with other training components, and conduct separate mental training sessions. This underscores the significant importance of mental preparation for amateur soccer coaches, in line with previous research on mental imagery training for amateurs (Kahlouche, & Bezziou, 2021).

Physical preparation

Regarding physical preparation, coaches believe that physical preparation for amateur teams aims to develop aerobic and anaerobic endurance, prevent injuries, and improve strength and power. These objectives are considered fundamental in soccer physical preparation (Turner, & Stewart, 2014). This is especially important in soccer, which requires performing numerous explosive activities repeatedly during a match (Stølen et al., 2005), such as jumps, accelerations, and changes of direction, all of which demand significant muscular strength and power, as well as aerobic capacities to complete 90 minutes and recover between explosive actions (Tomlin, & Wenger, 2001). Given that players are susceptible to injuries (López-Valenciano et al., 2019), physical preparation must work to reduce the risk of these injuries. However, physical preparation aims to develop various components of physical fitness, including flexibility, mobility, agility, and speed, and not just aerobic and anaerobic endurance, strength, and ability. (Walker, & Hawkins, 2017).

Concerning injury prevention strategies, common practices include player monitoring, dynamic warm-up routines, muscular strength, and resistance training. All these strategies are widely used by amateur and professional teams to prevent injuries (McCall et al., 2015; McCall et al., 2020; Kebaili et al., 2023). Interestingly, coaches' responses reveal a lower reliance on neuromuscular and proprioception exercises and eccentric exercises, such as the Nordic exercise, which are essential in injury prevention for professional teams (McCall et al., 2015; McCall et al., 2020) and have proven effective in reducing the risk of ankle, knee and hamstring injuries (Hübscher et al., 2010; Schiftan et al., 2015; Elerian et al., 2019; Peterson et al., 2011).

For the tests used for player evaluation, most coaches rely on laboratory tests such as VO2max and field tests such as speed tests. These practices differ from those of professional soccer teams. Loturco et al. (2022) showed that Brazilian professional teams perform various tests, notably body composition, muscular strength, muscular endurance, anthropometric measurements, cardiovascular endurance, linear speed, change of direction speed, and anaerobic capacity. Similarly, McQuilliam et al. (2023) found that most professional soccer teams assess linear speed, jumping, aerobic fitness, change of direction speed, maximal strength, and power. Beere and Jeffreys (2021) also reported that the most common tests used by professional soccer teams include cardiac screening, body composition, and jump tests like the countermovement jump test.

As for the management and monitoring of the training load, most amateur soccer coaches rely heavily on observation. This method is traditional (Foster et al., 2017) and differs from the practices of professional teams, which utilize modern technological means such as GPS devices and various player monitoring scales (Foster et al., 2017; Loturco et al., 2022; Beere & Jeffreys, 2021). This technology assists in tracking players and providing precise data on the number and type of activities they have engaged in. Consequently, it aids in optimizing training loads and helps in injury prevention (Ehrmann, 2016). The coaches' responses have shown that the least utilized means are technological

tools. This aligns with their answers regarding the difficulties they face in the physical preparation process, as these teams often lack access to and the utilization of technological resources in their training routines.

Limitations and future research

The current study has several limitations. It included coaches in Skikda province only, and the sample size is very small. However, it will serve as a starting point for future investigations. Therefore future studies should include larger samples of coaches and consider to validate the assessment tool. While the current study provided valuable insights into the practices and perceptions of coaches regarding the mental and physical preparation of amateur soccer players in Skikda province, there are areas that merit further exploration in future research. Future investigations could delve into specific aspects that go beyond the scope of our study. This includes conducting detailed examinations of psychological practices integrated into training and pre-competition contexts. Moreover, exploring comprehensive training methods targeting various components of physical fitness and structuring inclusive preparation programs can significantly enrich the existing body of knowledge. Additionally, broadening the study scope beyond Skikda province by including a more extensive and diverse sample of trainers would offer a more comprehensive understanding of practices and perceptions across diverse regions.

Conclusion

In conclusion, this study examined the practices and perceptions of coaches regarding the mental and physical preparation of amateur soccer players in the Skikda province, Algeria. Through the analysis of the results, it became evident that the beliefs of the coaches about mental and physical preparation are largely sound and align with existing literature. Their practices also resemble those of professional teams, although they are somewhat limited. Coaches do not rely on a wide range of psychological preparation techniques, injury prevention exercises, physical tests, and monitoring and managing training loads. Several factors may contribute to this limitation, including the absence of sports psychologists in the field, a lack of large sports facilities, and limited access to modern training technology.

Based on the findings, the researchers suggest the need to improve amateur soccer in Algeria and provide essential resources to support it. This could involve the introduction of sports psychology expertise, investment in sports facilities, and the adoption of modern training technology. Such enhancements would likely contribute to the overall development of amateur soccer in the region.

Acknowledgments

The authors would like to thank all the coaches who participated in this study.

Disclosure of interest

All authors declare no conflict of interest.

Received: 21 September 2023 | **Accepted**: 28 November 2023 | **Published**: 15 January 2024

References

Bangsbo, J., Mohr, M., Poulsen, A., Perez-Gomez, J., Krustrup, P. (2006). Training and testing the elite athlete. *Journal* of *Exercise* Science and *Fitness,* 4(1), 1-14.

Beere, M., Jeffreys, I. (2021). Physical testing and monitoring practices in elite male football. *Professional strength and conditioning*, 62, 29-42.

Chmura, P., Oliva-Lozano, J. M., Muyor, J. M., Andrzejewski, M., Chmura, J., Czarniecki, S., Kowalczuk, E., Rokita, A., & Konefał, M. (2022). Physical Performance Indicators and Team Success in the German Soccer League. *Journal of human kinetics*, *83*, 257–265. https://doi.org/10.2478/hukin-2022-0099

Ehrmann, F. E., Duncan, C. S., Sindhusake, D., Franzsen, W. N., & Greene, D. A. (2016). GPS and Injury Prevention in Professional Soccer. *Journal of strength and conditioning research*, *30*(2), 360–367. https://doi.org/10.1519/JSC.0000000000001093

Elerian, A. E., El-Sayyad, M. M., and Dorgham, H. (2019). Effect of Pre-training and Post-training Nordic Exercise on Hamstring Injury Prevention, Recurrence, and Severity in Soccer Players. *Annals of rehabilitation medicine,* 43(4), 465–473. doi: https://doi.org/10.5535/arm.2019.43.4.465

Fossati, C., Torre, G., Vasta, S., Giombini, A., Quaranta, F., Papalia, R., & Pigozzi, F. (2021). Physical Exercise and Mental Health: The Routes of a Reciprocal Relation. *International journal of environmental research and public health*, *18*(23), 12364. https://doi.org/10.3390/ijerph182312364

Foster, C., Rodriguez-Marroyo, J. A., & de Koning, J. J. (2017). Monitoring Training Loads: The Past, the Present, and the Future. *International journal of sports physiology and performance*, *12*(Suppl 2), S22–S28. https://doi.org/10.1123/ijspp.2016-0388

Freitas, S., Dias, C., Fonseca, A. (2013). How do elite soccer coaches prepare their players and teams psychologically? *Journal of Physical Education and Sport*, 13(3), 321-329.

Healy, L., Tincknell-Smith, A., & Ntoumanis, N. (2018). Goal Setting in Sport and Performance. Oxford Research Encyclopedia of Psychology. https://doi.org/ 10.1093/acrefore/9780190236557.013.152

Higham, D. G., Hopkins, W. G., Pyne, D. B., & Anson, J. M. (2014). Performance indicators related to points scoring and winning in international rugby sevens. *Journal of sports science & medicine*, *13*(2), 358–364.

Hübscher, M., Zech, A., Pfeifer, K., Hänsel, F., Vogt, L., & Banzer, W. (2010). Neuromuscular training for sports injury prevention: a systematic review. *Medicine and science in sports and exercise*, *42*(3), 413–421. https://doi.org/10.1249/MSS.0b013e3181b88d37

Kahlouche, I.Z., Bezziou, A. (2021). The use of mental imagery strategy in improving technical performance by coaches of youth soccer. *Journal of Sport Science Technology and Physical Activities*, 18(4), 89-98. https://www.asjp.cerist.dz/en/article/169992

Kawabata, M., Zhang, L. (2018). Validity and reliability of the Sport Motivation Scale-II for Chinese athletes. *International Journal of Sport and Exercise Psychology, 16*(1), 51–64. https://doi.org/10.1080/1612197X.2016.1153130

Kebaili, L., Kessouri, O., Talhi, I., & Chelighem, A. (2023). Exercise-Based Injury Prevention in Amateur Soccer: A Survey of Current Practices of 52 Algerian Teams. *Journal of Anthropology of Sport and Physical Education, 7*(2), 13-17. 10.26773/jaspe.230403

Kessouri, O. (2023). Match performance difference between African and Top Five teams in the group stage of the 2022 World Cup. *Trends in Sport Sciences*, 30(1), 5-11. 10.23829/TSS.2023.30.1-1

Kessouri, O., Dachri, H. (2021). Effect of neuromuscular warm up on explosive strength and change of direction ability of soccer players. *Journal of Sport Science Technology and Physical Activities*, 18(1), 154-165. 10.54031/2070-018-001-013

Kumari, S., Kumar, J. (2016). MIND TRAINING TECHNIQUES AND SPORTS PSYCHOLOGY: AN INTEGRATED APPROACH TO MENTAL SKILLS FOR ACHIEVING OPTIMUM PERFORMANCE. *International Journal of Advanced Research*. 4(3). 523-535.

López-Valenciano, A., Ruiz-Pérez, I., García-Gómez, A., Vera-García, F.J., De Ste Croix, M., Myer, G., and Ayala, F. (2019).Epidemiology of injuries in professional football: A systematic review and meta-analysis. *British Journal of Sports Medicine,* 54 (12), 711-719. doi: 10.1136/bjsports2018-099577

Loturco, I., Freitas, T. T., Alcaraz, P. E., Kobal, R., Hartmann Nunes, R. F., Weldon, A., & Pereira, L. A. (2022). Practices of strength and conditioning coaches in Brazilian elite soccer. *Biology of sport*, *39*(3), 779–791. https://doi.org/10.5114/biolsport.2022.108703

McAuley, E. & Gill, D.L. (1983). Reliability and validity of the Physical Self-Efficacy Scale in a competitive sport setting. *Journal of Sport & Exercise Psychology*, 5, 410-418.

McCall, A., Davison, M., Andersen, T. E., Beasley, I., Bizzini, M., Dupont, G., Duffield, R., Carling, C., & Dvorak, J. (2015). Injury prevention strategies at the FIFA 2014 World Cup: perceptions and practices of the physicians from the 32 participating national teams. *British journal of sports medicine*, *49*(9), 603–608. doi: https://doi.org/10.1136/bjsports-2015-094747

McCall, A., Pruna, R., Van der Horst, N., Dupont, G., Buchheit, M., Coutts, A.J., Impellizzeri, F.M. and Fanchini, M. (2020). Exercise-Based Strategies to Prevent Muscle Injury in Male Elite Footballers: An Expert-Led Delphi Survey of 21 Practitioners Belonging to 18 Teams from the Big-5 European Leagues. Sports Medicine, 50(9), 1653-1666. doi: 10.1007/s40279-020-01282-z

McQuilliam, S. J., Clark, D. R., Erskine, R. M., & Brownlee, T. E. (2023). Physical testing and strength and conditioning practices differ between

coaches working in academy and first team soccer. *International Journal of Sports Science & Coaching*, *18*(4), 1045–1055. https://doi.org/10.1177/17479541231155108

Memmert, D., Lemmink, K. A. P. M., & Sampaio, J. (2017). Current Approaches to Tactical Performance Analyses in Soccer Using Position Data. *Sports medicine (Auckland, N.Z.)*, *47*(1), 1–10. https://doi.org/10.1007/s40279-016-0562-5

Miguel, M., Oliveira, R., Loureiro, N., García-Rubio, J., & Ibáñez, S. J. (2021). Load Measures in Training/Match Monitoring in Soccer: A Systematic Review. *International journal of environmental research and public health*, *18*(5), 2721. https://doi.org/10.3390/ijerph18052721

Modric, T., Malone, J. J., Versic, S., Andrzejewski, M., Chmura, P., Konefał, M., Drid, P., & Sekulic, D. (2022). The influence of physical performance on technical and tactical outcomes in the UEFA Champions League. *BMC sports science, medicine & rehabilitation*, *14*(1), 179. https://doi.org/10.1186/s13102-022-00573-4

Nédélec, M., McCall, A., Carling, C., Legall, F., Berthoin, S., & Dupont, G. (2013). Recovery in soccer : part ii-recovery strategies. *Sports medicine (Auckland, N.Z.)*, *43*(1), 9–22. https://doi.org/10.1007/s40279-012-0002-0

Neto, M., Da silva., M.M., Araujo, A.D., De Jesus, F.L.A., Carvalho, V.O., da Conceicao, C.S. (2016). Effects of the FIFA 11 training program on injury prevention and performance in football players: A systematic review with meta-analysis. *Physical Therapy in Sport*, 18(1), 1-9. 10.1016/j.ptsp.2015.11.024

Orer, G.E., Arslan, E. (2016). The relationships among acceleration, agility, sprinting ability, speed dribbling ability and vertical jump ability in 14-year-old soccer players. *IOSR Journal of Sports and Physical Education*, 3(2), 29-34. 10.13140/RG.2.1.3165.4008

Petersen, J., Thorborg, K., Nielsen, M. B., Budtz-Jørgensen, E., and Hölmich, P. (2011). Preventive effect of eccentric training on acute hamstring injuries in men's soccer: a cluster-randomized controlled trial. *The American journal of sports medicine, 39*(11), 2296–2303. doi: https://doi.org/10.1177/0363546511419277

Ribeiro, J., Madeira, J., Dias, C., Stewart, L.R., Côrte-Real, N., & Fonseca, A.M. (2015). The Use of Imagery by Portuguese Soccer Goalkeepers. *Journal of Imagery Research in Sport and Physical Activity, 10*, 17 - 9.

Sariati, D., Zouhal, H., Hammami, R., Clark, C. C. T., Nebigh, A., Chtara, M., Hackney, A. C., Souissi, N., Granacher, U., & Ben Ounis, O. (2021). Association Between Mental Imagery and Change of Direction Performance in Young Elite Soccer Players of Different Maturity Status. *Frontiers in psychology*, *12*, 665508. https://doi.org/10.3389/fpsyg.2021.665508

Sarkar, M., & Fletcher, D. (2014). Psychological resilience in sport performers: a review of stressors and protective factors. *Journal of sports sciences*, *32*(15), 1419–1434. https://doi.org/10.1080/02640414.2014.901551

Schiftan, G. S., Ross, L. A., & Hahne, A. J. (2015). The effectiveness of proprioceptive training in preventing ankle sprains in sporting populations: a systematic review and meta-analysis. *Journal of science and medicine in sport*, *18*(3), 238–244. https://doi.org/10.1016/j.jsams.2014.04.005

Seif-Barghi, T., Kordi, R., Memari, A. H., Mansournia, M. A., & Jalali-Ghomi, M. (2012). The effect of an ecological imagery program on soccer performance of elite players. *Asian journal of sports medicine*, *3*(2), 81–89. https://doi.org/10.5812/asjsm.34703

Stølen, T., Chamari, K., Castagna, C., & Wisløff, U. (2005). Physiology of soccer: an update. *Sports medicine (Auckland, N.Z.)*, *35*(6), 501–536. https://doi.org/10.2165/00007256-200535060-00004

Tomlin, D.L., Wenger, H.A. (2001). The Relationship Between Aerobic Fitness and Recovery from High Intensity Intermittent Exercise, *Sports medicine*, 31(1), 1-11. 10.2165/00007256-200131010-00001

Turner, A., Stewart, P. (2014). Strength and Conditioning for Soccer Players. *Strength and Conditioning Journal,* 36(4), 1-13. 10.1519/SSC.0000000000000054

Walker, G.J., & Hawkins, R.D. (2017). Structuring a Program in Elite Professional Soccer. *Strength and Conditioning Journal*. 40(3), 72-82. 10.1519/SSC.0000000000000345

Weldon, A., Duncan, M. J., Turner, A., Sampaio, J., Noon, M., Wong, D. P., & Lai, V. W. (2021). Contemporary practices of strength and conditioning coaches in professional soccer. *Biology of sport*, *38*(3), 377–390. https://doi.org/10.5114/biolsport.2021.99328

World Medical Association (2013). World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. *JAMA*, *310*(20), 2191–2194. https://doi.org/10.1001/jama.2013.281053

Zach, S., Dobersek, U., Filho, E., Inglis, V., Tenenbaum, G. (2018). A meta-analysis of mental imagery effects on post-injury functional mobility, perceived pain, and self-efficacy. *Psychology of Sport and Exercise*, 34, 79-87. https://doi.org/10.1016/j.psychsport.2017.09.011

Junge, A., Dvorak, J., Rösch, D., Graf-Baumann, T., Chomiak, J., & Peterson, L. (2000). Psychological and sport-specific characteristics of football players. *The American journal of sports medicine*, *28*(5 Suppl), S22–S28. https://doi.org/10.1177/28.suppl_5.s-22

Najah, A. and Rejeb, R. (2016) Psychological Characteristics of Male Youth Soccer Players: Specificity of Mental Attributes According to Age Categories. *Advances in Physical Education*, **6**, 19-26. doi: 10.4236/ape.2016.61003.

DOI 10.26773/jaspe.240103

Journal of Anthropology of Sport and Physical Education

ORIGINAL SCIENTIFIC PAPER

Longitudinal dimensionality affects repetitive strength in skiers

Slavka Durlević[1], Milica Mijajlović[2], Marija Durlević[2], Igor Ilić[2]

[1]Faculty of sport and physical education, Novi Sad, Serbia, [2]Faculty of Sport and Physical Education, University of Priština in Kosovska Mitrovica

Abstract

Skiing belongs to a group of activities that take place in special conditions of the external environment, and success in skiing primarily depends on morphological characteristics, motor and functional abilities. Accordingly, the aim of the research is to identify the structure of longitudinal dimensionality and repetitive power of skiers, and then examine the potential influence of longitudinal dimensionality on repetitive power of skiers. The sample of respondents consisted of 21 skiers with chronological age 16.04±2.51. The sample of measuring instruments consisted of nine variables, five variables for the assessment of morphological characteristics: body height (BH), leg length (LL), upper leg length (LUL), lower leg length (LLL) and arm length (LA), and four variables for repetitive strength testing: push-ups until failure (PUF), sit ups until failure (SUF), chin ups until failure (CUF) and squats until failure (SQUF). The influence of longitudinal dimensionality on the repetitive strength of skiers was determined using linear regression analysis. All statistical analyzes were performed with the statistical package IBM SPSS Statistics (Version 20). The results showed that the area of longitudinal dimensionality is dominantly defined by body height (BH), while the area of repetitive strength is defined by the squat until failure test (SQUF). Using linear regression, it is confirmed that there is a statistically significant influence of longitudinal dimensionality on the repetitive strength of skiers.

Keywords: *skiing, longitudinal dimensionality, repetitive strength, influence*

Introduction

Skiing is a motorically and energetically complex and demanding individual sports activity (Cigrovski & Matković, 2019). According to the criterion of structural complexity, this sport belongs to the group of monostructural activities in which there is one or more closed acyclic type movement structures that are successively repeated (Andersen & Montgomery, 1988; Cigrovski & Matković, 2019). Skiing is not only about going down the slope, but also involves turning, climbing, walking, very frequent change of direction movements, jumps and different landings that require specific morphological characteristics from the skier, as well as motor and functional abilities (Neumayr et al., 2003; Krsmanović & Lukman, 1993; Željaskov, 2004). Without a doubt, it can be suggested that skiing requires synthesis of conative characteristics, physical and cognitive abilities (Cigrovski & Matković, 2019). Numerous studies were carried out to determine the areas with greatest projections on success in skiing. All these studies focused on the influence of morphological charcteristics, motor and functional abilities (Ryabov et al., 2023; Scherge et al., 2021; Turković et al., 2020). Previous research has confirmed that certain morphological characteristics and motor skills have a very significant influence on success in skiing (Hadžić & Nikšić, 2022). Morphological characteristics and motor abilities are closely related to each other and influence the realization of motor tasks in skiing (Roczniak et al., 2020). Morphological characteristics of a person exclusively mean a certain system of basic anthropometric latent dimensions (Simić et al., 2022; Željaskov, 2004; Kurelić et al., 1975). Morphological characteristics are of particular importance for orientation and selection both in other sports and in skiing (Milanović, 1980; Kurelić, 1975). Of the morphological characteristics, longitudinal dimensionality has the greatest genetic predisposition, voluminousness is somewhat lower, while subcutaneous fat tissue is the least affected (Sergienko, 1999; Malacko & Popović, 2001; Đurašković, 2001). The longitudinal dimensions of the body as the best indicator of the growth of the human organism, are the result of a complex process of ontogenetic development and the action of biotic and abiotic factors in a certain environment. In

Correspondence:

S. Durlević
University of Novi Sad, Faculty of Sport and Physical Education, Lovćenska 16, 21000 Novi Sad, Serbia
E-mail: durlevicslavka3@gmail.com

addition to the longitudinal characteristics that affect success in skiing, motor abilities are also highlighted, which to a certain extent represent an indicator of success in this sport (Delas et al., 2008). A motor ability that stands out in addition to explosive strength is repetitive strength (Turković et al., 2020). Repetitive strength can be defined as the ability of a muscle to exert force in a long-term work mode when it is necessary to overcome an appropriate external load up to 75% of the maximum (Zatsiorsky & Kraemer, 2009; Kukolj, 2006; Željaskov, 2004; Kurelić, 1975; Malacko & Rađo, 2004). The positive influence of morphological characteristics on the strength of skiers has been confirmed in a large number of studies (Joksimović et al., 2011; Mujanović & Krsmanović, 2008).

The aim of the research is to identify the structure of longitudinal dimensionality and repetitive power of skiers, and then determine the potential influence of longitudinal dimensionality on repetitive power of skiers.

Methods

A sample of respondents

The research was conducted on a sample of 21 skiers, whose age was defined on the basis of chronological age, so that the research included respondents from 16.04±2.51 years. Respondents who participated in this research had to meet several conditions: they were male, they were permanent members of their ski clubs, they were healthy (not injured) and they were registered members of the ski association. For each participant in this study, their parents gave written consent prior to participation.

Sample variables

The following variables were used to measure the longitudinal dimensionality of skiers: body height (BH), leg length (LL), upper leg length (LUL), lower leg length (LLL) and arm length (LA). The repetitive strength of the skiers in this study was tested with the following battery of tests: push-ups until failure (PUF), sit ups until failure (SUF), chin ups until failure (CUF) and squats until failure (SQUF).

A sample of measuring instruments

Measurements and testing of skiers were carried out in the premises of the clubs for which the skiers perform in the morning hours. Before repetitive strength testing, general and specific warm-up exercises that increase the range of motion of individual body parts were performed.

Statistical analysis

In order to adequately determine the structure of the observed spaces of repetitive strength and longitudinal dimensionality of the tested skiers, the method of principal components will be applied. The influence of longitudinal dimensionality on the repetitive strength of skiers will be examined using linear regression analysis. All statistical analyzes were implemented within the statistical package IBM SPSS Statistics (Version 20).

Results

The results of descriptive statistical analysis of studied population are presented in Table 1.

Table 1. Descriptive analysis studied population

	N	Min	Max	Mean	SD	S-W
CUF	21	11.00	17.00	13.90	1.51	0.634
PUF	21	13.00	22.00	17.85	2.26	0.929
SUF	21	40.00	47.00	43.47	1.80	0.833
SQUF	21	52.00	66.00	58.23	4.82	0.083
BH	21	156.00	185.00	170.38	6.62	0.898
LL	21	79.02	95.00	88.43	4.30	0.771
LUL	21	43.60	52.00	47.51	2.22	0.634
LLL	21	30.30	45.00	40.97	3.31	0.001
LR	21	43.00	53.50	48.59	2.99	0.534

Legend: CUF - chin ups until failure; PUF – push-ups until failure; SUF - sit ups until failure; SQUF - squats until failure; BH - body height; LL - leg length; LUL - upper leg length; LLL - lower leg length; LA - length arm

Parameters of the arithmetic mean and standard deviation show the expected values for this level of the group of respondents taking into account their chronological age. In order to determine the normality of the distribution of the investigated parameters, the Shapiro-Wilk was applied. The Shapiro-Wilk normality test indicates that the lower leg length variable (LLL) had a statistically significant

Table 2. Factor analysis of the longitudinal dimensionality studied population

Variable	Factor
	1
BH	0.954
LL	0.914
LUL	0.873
LR	0.938
Eigenvalue	3.389
% of Variance	84.716
Cumulative %	84.716
KMO	0.769

Legend: BH - body height; LL - leg length; LUL - upper leg length; LA - length arm

deviation from the normal distribution in one test. The lower leg length (LLL) variable will be removed from further tests as it does not meet the conditions of a normal distribution. After the statistical analysis and normality tests were applied, an exploratory analysis of the main components was performed below in order to isolate the number of specific factors that describe the space.

The result of the KMO (Kaiser-Meyer-Olkin) measure of sample adequacy indicates that the stated value of 0.769 is satisfactory. These parameters show the justification of applying the method of principal components to the selected set of variables. In Table 2, it is noted that one component extracted is a significant variable which explains 84.71% of the total variance. Looking at Table 2, it can be concluded that it is body height (BH) with an isolated factor of 0.954.

Table 3. Factor analysis of the repetitive strength studied population

Variable	Factor
	1
CUF	0.981
PUF	0.980
SUF	0.946
SQUF	0.984
Eigenvalue	3.786
% of Variance	94.642
Cumulative %	94.642
KMO	0.770

Legend: CUF - chin ups until failure; PUF – push-ups until failure; SUF - sit ups until failure; SQUF - squats until failure

The result of the KMO (Kaiser-Meyer-Olkin) measure of sample adequacy indicates that the stated value of 0.770 is satisfactory. These parameters show the justification of applying the method of principal components to the selected set of variables. In Table 3, it can be seen that one component extracted is a significant variable which implies 94.64% of the total variance. Analyzing the Table 3, we note that it is squats until failure (SQUF) with an isolated factor of 0.984.

Using factor analysis, latent dimensions were extracted and factorially calculated scores using regression methods. After these procedures, linear regression was applied to establish a potential statistically significant influence of longitudinal dimensionality (LD) on repetitive strength (RS) of skiers.

Table 4. Linear regression analyses

Variables	Repetitive strength						
	B	SE	β	t	p	95% CI	
						LL	UL
Longitudinal dimensionality	0.961	0.063	0.961	15.135	<0.0001	0.828	1.094

The results in Table 4 indicate a high correlation between the variables of repetitive strength and longitudinal dimensionality (R=0.961), while this observed high correlation is statistically significant ($p<0.0001$). Regression analysis was used to examine whether there is a statistically significant effect of longitudinal dimensionality on skiers' repetitive strength. The regression analysis indicates that longitudinal dimensionality explains 92.3% of the variance of skiers' repetitive strength. Based on this, it can be concluded that longitudinal dimensionality significantly affects the repetitive strength of skiers.

Discussion

The results in this research showed that the space of longitudinal dimensionality is dominantly defined by body height (BH), while the space of repetitive strength is defined by the squat until failure test (SQUF). Using linear regression, it is confirmed that there is a statistically significant influence of longitudinal dimensionality on the repetitive strength of skiers.

Morphological characteristics describe the structure of the body, that is, the somatotype characteristics of athletes (Milanović, 1980). Today we know that the overall constitution and structure of the body is a predisposition that, along with other external factors, will be an important component for success in sports, including skiing. However, the review papers of Jarić (2002) and (2003) show that the influence of morphological characteristics on the results of motor ability tests is often neglected, that is, that the normalization of measurement results is inadequate or even non-existent. Given that the aim of this research was to explore the latent structure of the longitudinal dimensionality and repetitive strength, as well as to determine the influence of longitudinal dimensionality on the repetitive strength of skiers, one factor was isolated in the space of longitudinal dimensionality, named body height (BH), and the space of repetitive strength of skiers was dominantly defined by one factor that describes that dimension named squats until failure (SQUF). The squat test is a valid and reliable test for the assessment of lower extremity performance considering its correlation with the isokinetic test, as well as its excellent relative and acceptable absolute reliability (Beato et al., 2021). Zoppirolli et al. (2020) in the conducted research reported that the success in skiing is more influenced by the strength of the lower extremities as opposed to the upper extremities. Especially with the constant change of direction during the movement. Using linear regression, a statistically significant influence of longitudinal dimensionality on the repetitive strength of skiers was established. The results obtained in this research are in accordance with previous research when it comes to the influence of body height (BH) on the manifestation of repetitive strength of the muscles of the lower extremities, i.e. test squats

until failure (SQUF) (Vuković & Srdić, 2015). Also, in the research conducted by Mujanović & Krsmanović (2008) on a large number of respondents, they came to the conclusion that morphological characteristics significantly affect success in skiing, and that the most dominant morphological characteristic is body height (BH). Branković et al. (2012) obtained a statistically significant influence of morphological characteristics on repetitive strength in elementary school students. Joksimović et al. (2011) conducted research with the aim of determining the degree of influence of morphological characteristics and motor skills on the efficiency of performing technical elements. They obtained a statistically significant influence of morphological characteristics and motor skills on the success of performing technical elements in skiing (Joksimović et al., 2011), again in line with our findings.

Conclusion

Morphological characteristics and motor skills are recognized as very important factors in the final success in skiing and in other sports, both in theory and in practice. The results showed that the space of longitudinal dimensionality is dominantly defined by the measure body height (BH), while the space of repetitive strength is defined by the variable squats until failure (SQUF). In addition, we observed a statistically significant influence of longitudinal dimensionality on the repetitive strength of skiers. Since the limitation of this research is the small number of participants which are males, it is very important to focus future research on a larger sample and inclusion of female participants as well.

Authors contributions

Durlević Slavka designed the study and wrote the first draft of the manuscript. Durlević Marija and Mijajlović Milica collected and analyzed the data. Durlević Slavka performed statistical analyses. Ilić Igor compressed the tables, contributed to the technical editing of the manuscript and critically reviewed the manuscript. All authors approved the final submission for publication.

Received: 16 September 2023 | **Accepted**: 30 November 2023 | **Published**: 15 January 2024

References

Andersen, R.E., & Montgomery, D.L. (1988). Pshysiology of Alpine skiing. *Sports Medicine*, *6*, 210-221.

Beato, M., Fleming, A., Coates, A., & Dello Iacono, A. (2021). Validity and reliability of a flywheel squat test in sport. *Journal of sports sciences*, *39*(5), 482-488.

Branković, N., Milanović, S., Pavlović, R., & Simonović, Z. (2012). Kanoničke relacije morfoloških dimenzija i repetitivne snage kod učenica srednjih škola. *Glasnik Antropološkog društva Srbije, 47*, 35-40.

Cigrovski, V., & Matković, B. (2019). *Sportovi na snijegu*. Zagreb: Sveučilište u Zagrebu, Kineziološki fakultet.

Delas, S., Miletic, A., & Miletic, Dj. (2008). The influence of motor factors on performing fundamental movement skills - the differences between boys and girls. *Physical Education and Sport*, *6*, 31-39.

Hadžić, R., & Nikšić, E. (2022). The analysis of alpine skiing techniques adoption based on anthropometric performances. *Anthropologie*, *60*(1), 161-172.

Jaric, S. (2002). Muscle strength testing: use of normalisation for body size. *Sports medicine*, *32*, 615-631.

Jaric, S. (2003). Role of body size in the relation between muscle strength and movement performance. *Exercise and sport sciences reviews*, *31*(1), 8-12.

Joksimovic, A., Acimovic, D., & Hadzic, R. (2011). The methodology of shaping situational training in the case of alpine skiing. *Sport Mont*, *9*(28,29,30), 28-29.

Krsmanovic, R, & Lukman, L. (1993). *Technique and methodology of skiing* (Tehnika i metodika smucanja). Novi Sad: Fakultet fizicke kulture.

Kukolj, M. (2006). *Antropomotorika*. Beograd: Fakultet sporta i fizičkog vaspitanja.

Kurelic N., Momirovic, K., Stojanovic, M., Radojevic, Ž., & Viskic-Štalec, N. (1975). *The structure and development of morphological and motor dimensions of youth*, Belgrade: Institut for scientific reserches of Faculty of Physical Education.

Kurelić, N. (1975). *Struktura i razvoj morfoloških i motorikih dimenzija omladine*. Beograd: Fakultet za fizičku kulturu.

Malacko, J., & Rađo, I. (2004). *Tehnologija sporta i sportskog treninga*. Sarajevo: Fakultet sporta i tjelesnog odgoja.

Milanović, D. (1980). Kanonička povezanost morfoloških i motoričkih karakteristika i rezultata u nekimatletskim disciplinama. *Kinesiology*, *10*(1-2), 25-33.

Mujanović, E., & Krsmanović, R. (2008). Predictive value of motor abilities on the result in criteria variable ski short turns. *Sport–scientific and practical aspects, international scientific journal of kinesiology*, *5*(1&2), 61-65.

Neumayr, G., Hoertnagl, H., Pfister, R., Koller, A., Eibl, G., & Raas, E. (2003). Physical and physiological factors associated with success in professional alpine skiing. *International journal of sports medicine*, *24*(08), 571-575.

Roczniak, K., Babuśka–Roczniak, M., Wojtanowska–Kaczka, M., Racz, O., Roczniak, A., Lyubinets, O., ... & Roczniak, W. (2020). Morphological and motor skills condition among 10-11 year old children engaged in cross-country skiing attending Sports Primary School in Suprasl. *Journal of Education, Health and Sport*, *10*(6), 68-81.

Ryabov, A. A., Ryabova, E. K., Zebzeev, V. V., & Chumakov, V. N. (2023). Model characteristics of morphological indicators of the body composition of ski jumpers and nordic combined skiers. *Theory and Practice of Physical Culture, 2*, 40-42.

Savić, Z., Stojanović, T., Stojiljković, N., & Jorgić, B. (2013). Differences in the space of motor skills between younger male and female skiiers. *Facta Universitatis: Series Physical Education & Sport*, *11*(2).

Scherge, M., Stoll, M., & Moseler, M. (2021). On the influence of microtopography on the sliding performance of cross country skis. *Frontiers in Mechanical Engineering*, 7, 659995.

Simić, M., Ilić, I., Durlević, S., Zadražnik, M., & Popović-Ilić, T. (2022). Struktura i uticaj morfoloških karakteristika rukometaša na eksplozivnu snagu. U Stanković, V., Lilić, Lj., Stojanović, T., Cicović, B., & Ilić, I. (Urednici), *9. Međunarodna naučna konferencija „Antropološki i teoantropološki pogled na fizičke aktivnosti".* Zbornik radova, (pp. 223–230). Kopaonik.

Turković, B., Lakota, R., Hodžić, A., & Podrug-Arapović, M. (2020). The contribution of motor skills in predictiing the success of performing the basic elements of alpine skiing. *Homo Sporticus*, *1*, 33-37.

Vuković, S., & Srdić, V. Uticaj tjelesne mase na ispoljavanje sile ruku i ramenog pojasa. U M. Jovanović & Dj. Nićin, In *Peta međunarodna konferencija"Sportfiske nauke i zdravlje"*. (p. 82-90).

Zatsiorsky, V., & Kraemer, W. (2009*). Nauka i praksa u treningu snage (Science and practice in strength training)*. Belgrade: Data status.

Zoppirolli, C., Hébert-Losier, K., Holmberg, H. C., & Pellegrini, B. (2020). Biomechanical determinants of cross-country skiing performance: A systematic review. *Journal of sports sciences*, *38*(18), 2127-2148.

Željaskov, C. (2004). *Kondicioni trening sportista*. Beograd: Sportska akademija.

DOI 10.26773/jaspe.240104

Journal of Anthropology of Sport and Physical Education

ORIGINAL SCIENTIFIC PAPER

Face-to-face versus online physical education classes: A comparative study

Fidanka Vasileva[1,2], Serjoza Gontarev[3], Anna Prats-Puig[1,4], Raquel Font-Lladó[1,5], Angjel Vasilev[6], Víctor López-Ros[5,7], Dusko Bjelica[8], Borko Katanic[9], Georgi Georgiev[3]

[1]University of Girona, University School of Health and Sport, Girona, Spain, [2]Biomedical Research Institute of Girona Dr. Josep Trueta, Girona, Spain, [3]University Ss. Cyril and Methodius, Faculty of Physical Education, Sport and Health, Skopje, Macedonia, [4]Research Group of Clinical Anatomy, Embryology and Neuroscience, Department of Medical Sciences, University of Girona, Girona, Spain, [5]Research Group of Culture, Education and Human Development, Institute of Educational Research, University of Girona, Girona, Spain, [6]Elementary School "Dimkata Angelov Gaberot-Vatasha", Kavadarci, Macedonia, [7]Chair of Sport and Physical Education – Centre of Olympic Studies, University of Girona, Girona, Spain, [8]University of Montenegro, Faculty for Sport and Physical Education, Niksić, Montenegro, [9]University of Nis, Faculty of Sports and Physical Education, Nis, Serbia

Abstract

Physical education (PE) curriculum is consisted of specific motor content that requires practice and movement. The main goal of the PE curriculum is development of motor abilities. The objective is to compare the effectiveness of both – face-to-face and online PE classes, in achieving the main goal of the PE curriculum. Data were extracted from the archive of records of the academic transcripts for 118 participants – school adolescents aged 14-15 years: 1) N=56 students (32M & 24F) from the academic year 2018/2019 (face-to-face classes); and 2) N=62 students (34M & 28F) from the academic year 2020/2021 (online classes). Motor abilities (abdominal muscle strength, lower back muscle strength, upper limbs muscle strength, lower limbs muscle strength, explosive leg power and flexibility of lower back and hamstring muscles) were assessed at the beginning and at the end of the second school term. Percentage change between the beginning and the end of the second school term in terms of these particular motor abilities was calculated as proposed by Weir & Vincent (2021). Subsequently, Student's t-test was applied to compare the changes induced by face-to-face and online PE classes. Cohen's D was also calculated to assess the magnitude of the difference between the changes induced by face-to-face and online PE classes. All statistical analyses were performed with SPSS 23 statistical package. Higher improvement in abdominal muscle strength, lower back muscle strength and explosive leg power was induced by face-to-face classes. These findings indicate that face-to-face classes appear to be more effective than the online PE classes.

Keywords: *evaluation, physical education, curriculum, adolescents, face-to-face classes, online classes*

Introduction

Physical education (PE) curriculum is clearly distinct from general knowledge-based subjects since it is mainly based on motor contents which require practice and movement (Ekberg, 2020). PE provides the opportunity for regular and structured physical activity participation (Fairclough & Stratton, 2005). Moreover, for some sedentary children and adolescents, PE classes represent the most important context in which they experience physical exercise and motor challenges (Ramer et al., 2021). Therefore, PE classes are mandatory at both - primary and secondary levels (Ekberg, 2020). However, PE classes require special preparation, communication and delivery in order to achieve the required goals (Jeong & So, 2020).

The main goal of the PE curriculum is to develop motor abilities (Fairclough & Stratton, 2005). Motor abilities are specific abilities that allow performing motor skills, affect performance

Correspondence:

F. Vasileva
Biomedical Research Institute of Girona Dr. Josep Trueta, Department of Pediatrics, Parc Hospitalari Martí i Julià (Edifici M2), C/ Dr. Castany s/n, 17190 Salt (Girona), Spain
E-mail: fvasileva@idibgi.org

and are also very important for the activities of the daily living (Fairclough & Stratton, 2005). For instance, strength, explosive leg power and flexibility are among the most essential abilities which contribute to the development of locomotor skills and facilitate the activities from everyday life (Liu et al., 2023). During PE classes students take part in sport and physical activities, they gain sufficient knowledge, as well as they get physically literate and motivated to stay physically active outside school and throughout life (Fairclough & Stratton, 2005). In addition, delivered contents during PE classes should provide a diverse range of physical exercise so that students will have the opportunity to improve their motor abilities, skills and performance (Silva et al., 2018). To achieve this, PE teachers are sometimes required to adapt PE classes and modify teaching methods according to: class size, available space, organizational strategies and content (Landi et al., 2016).

During academic 2020/2021, PE classes almost all over the world were held online (Ferri et al., 2020). Along with the coronavirus disease (COVID-19) outbreak and World Health Organization (WHO) declaring a pandemic on 11th of March 2019, many changes in educational environments were initiated as they began teaching online classes (Dhawan, 2020; Ferri et al., 2020). Teachers used digital devices and online platforms in order to deliver educational contents to students (Roe et al., 2021). Digital communication infrastructure was an obvious prerequisite for integrating online education while students were distanced from their classrooms (Ferri et al., 2020). However, many schools faced difficulties to provide one-to-one (1:1) access - meaning one digital device per student (Blikstad-Balas & Davies, 2017; Gil-Flores et al., 2017; Blikstad-Balas & Klette, 2020). Thus, inadequate digital infrastructure was a key barrier for successful implementation of online education (Bingimlas, 2009; Gil-Flores et al., 2017).

Recent study that evaluated the advantages and disadvantages of online and face-to-face PE, reported difficulties in the delivery of the content, as well as reduced movement capability during online classes as compared to face-to-face classes (Nyberg et al., 2022).

Based on previous findings and taking in consideration the specificity of PE content, our objective is to compare the effectiveness of face-to-face and online PE classes in achieving the main goal of the PE curriculum, i.e., development of motor abilities in school adolescents. More precisely, we will examine muscle strength (abdominal, lower back, upper limbs and lower limbs), explosive leg power and flexibility (lower back and hamstring muscles).

Methods

In order to realize the particular objective, an approval to access the archive of records of the academic transcripts of students at 9th grade was obtained from the principal of the Elementary School Dimkata Angelov Gaberot - Vatasha, Kavadarci (Macedonia). Participation consents from the parents of each student that participated in the study were obtained as well. The study was realized in accordance with the Helisnki Declaration.

Participants

Data were extracted for 118 participants – school adolescents from the Elementary School Dimkata Angelov Gaberot - Vatasha, aged 14-15 years (14.67±0.72). N=56 students (32M & 24F) from the academic year 2018/2019 who attended face-to-face classes, and N=62 students (34M & 28F) from the academic year 2020/2021 who attended online classes. All measurements and evaluations were performed by the PE teacher as regular evaluations required by the PE curriculum, and with respect to all prevention and protection protocols due to COVID-19. They were performed twice – at the beginning and at the end of the second school term of the corresponding academic year.

Instruments

Anthropometric characteristics (height, body mass and BMI) were measured according to WHO manual (WHO, 2007). Participants were barefoot and wearing light clothes during the measurement procedure. Height was measured using a wall mounted stadiometer (SECA SE206). Body mass was measured with a calibrated digital scale (TANITA TBF 300). BMI was calculated from height and body mass as follows: .

Muscle strength (abdominal, lower back, upper limbs and lower limbs), explosive leg power and flexibility (lower back and hamstring muscles) were assessed by applying the modified EUROFIT testing battery (EUROFIT, 1993) proposed by Jovanovski (1998): (1) Abdominal muscle strength test (AMST): abdominal crunches in 1 min; (2) Lower back muscle strength test (LBMST): back extensions in 1 min; (3) Upper limbs muscle strength test (ULMST): push-ups in 1 min; (4) Lower limbs muscle strength test (LLMST): squats in 1 min; (5) Standing long jump (SLJ): standing long jump (cm); (6) Flexibility test (FT): flexibility of lower back and hamstring muscles (cm).

Online PE classes

During the academic year 2020/2021 PE classes were held online. PE teachers were delivering content through video demonstration on the online platform "Microsoft Office Teams". Teachers were using free videos that were available online in order to visualize the specific content. After demonstrating and verbally explaining the content to the students, the class continued with an interactive discussion and implementation of the current content in "home exercising" conditions.

Face-to-face PE classes

During the academic year 2018/2019 PE classes were held face-to-face. PE teachers were delivering content in-person, and students were attending PE classes at the sports establishments of the school. At the beginning of each class, students were doing the general and the specific warm-up consisted of activities that aimed to prepare the cardiovascular system for the up-coming effort during the class, as well as exercises that increased the range of motion of the particular parts of the body that are going to be implied during the main curricular activity of the current class.

Data analysis

Kolmogorov-Smirnov test was applied to test the normality of the distribution. Appropriate statistical methods were used to calculate descriptive statistical parameters. Percentage change between the beginning and the end of the second school term in terms of motor abilities was calculated as proposed by Weir & Vincent (2021). Subsequently, Student's t-test was applied to compare the changes induced by face-to-face and online PE classes. Cohen's D was also calculated to assess the magnitude of the difference between the changes induced by face-to-face and online PE classes. All statistical analyses were performed with SPSS 23 statistical package (SPSS Inc, Chicago, IL, United States). Significance level was set to $p<0.05$.

Results

According to Table 1, 2, 3 and 4, data of students attending face-to-face and online classes are normally distributed, with a normal asymmetry considered when values for Skewness are in range between -1.00 to 1.00, and Kurtosis values that are in range between -3.00 to 3.00 as proposed by Kallner (2013).

Table 1. Descriptive statistical parameters of school-children at the beginning of the school term – face-to-face PE classes

	N	Min	Max	X	SD	Skewness	Kurtosis	K-S
Body mass (kg)	56	43.00	88.00	56.97	13.21	0.72	-0.16	p > 0.20
Height (cm)	56	160.00	185.00	169.70	6.87	0.84	1.28	p > 0.20
BMI	56	15.67	26.73	20.28	4.49	0.79	-0.46	p > 0.20
AMST (rep)	56	20.00	42.00	30.63	6.89	0.32	-1.18	p > 0.20
LBMST (rep)	56	10.00	35.00	22.75	6.81	-0.03	-0.55	p > 0.20
ULMST (rep)	56	3.00	17.00	10.44	3.83	-0.04	-0.55	p > 0.20
LLMS (rep)	56	25.00	40.00	35.13	4.10	-0.99	1.19	p > 0.20
SLJ (cm)	56	105.00	240.00	168.44	36.41	0.28	0.28	p > 0.20
FT (cm)*	56	29.00	64.00	42.25	11.19	0.75	-0.60	p > 0 .20

*Variable with an opposite metric orientation

Table 2. Descriptive statistical parameters of school-children at the end of the school term – face-to-face PE classes

	N	Min	Max	X	SD	Skewness	Kurtosis	K-S
Body mass (kg)	56	43.00	86.00	56.48	14.26	0.81	-0.15	p > 0.20
Height (cm)	56	160.00	185.00	169.70	6.87	0.84	1.28	p > 0.20
BMI	56	15.67	25.90	20.14	4.43	0.76	-0.44	p > 0.20
AMST (rep)	56	20.00	42.00	30.63	6.89	0.32	-1.18	p > 0.20
LBMST (rep)	56	10.00	35.00	22.75	6.81	-0.03	-0.55	p > 0.20
ULMST (rep)	56	3.00	17.00	10.44	3.83	-0.04	-0.55	p > 0.20
LLMS (rep)	56	25.00	40.00	35.13	4.10	-0.99	1.19	p > 0.20
SLJ (cm)	56	105.00	240.00	168.44	36.41	0.28	0.28	p > 0.20
FT (cm)*	56	29.00	64.00	42.25	11.19	0.75	-0.60	p > 0.20

*Variable with an opposite metric orientation

Table 3. Descriptive statistical parameters of school-children at the beginning of the school term - online PE classes

	N	Min	Max	X	SD	Skewness	Kurtosis	K-S
Body mass (kg)	62	41.00	90.00	57.69	14.26	0.81	-0.15	p > .20
Height (cm)	62	158.00	185.00	167.56	7.03	0.95	1.34	p > .20
BMI*	62	14.70	28.80	20.45	4.43	0.81	-0.44	p > .20
AMST (rep)	62	20.00	42.00	31.00	6.58	0.32	-1.07	p > .20
LBMST (rep)	62	15.00	30.00	21.13	5.18	0.49	-0.82	p > .20
ULMST (rep)	62	3.00	17.00	10.56	4.11	-0.17	-0.92	p > .20
LLMS (rep)	62	25.00	40.00	33.75	4.84	-0.62	-0.56	p > .20
SLJ (cm)	62	105.00	240.00	171.88	37.50	0.11	0.01	p > .20
FT (cm)*	62	26.00	60.00	42.81	11.31	0.07	-1.29	p > .20

*Variable with an opposite metric orientation

Table 4. Descriptive statistical parameters of school-children at the end of the school term - online PE classes

	N	Min	Max	X	SD	Skewness	Kurtosis	K-S
Body mass (kg)	62	44.00	90.00	57.78	13.77	0.73	-0.35	p > 0.20
Height (cm)	62	158.00	185.00	167.56	7.03	0.95	1.34	p > 0.20
BMI	62	14.77	28.93	20.47	4.31	0.79	-0.41	p > 0.20
AMST (rep)	62	20.00	42.00	29.63	6.35	0.27	-0.16	p > 0.20
LBMST (rep)	62	15.00	30.00	21.69	4.01	0.10	-0.02	p > 0.20
ULMST (rep)	62	3.00	20.00	11.06	4.65	0.38	-0.52	p > 0.20
LLMS (rep)	62	25.00	42.00	35.06	5.16	-0.34	-0.96	p > 0.20
SLJ (cm)	62	115.00	225.00	168.13	34.39	0.32	-0.66	p > 0.20
FT (cm)*	62	24.00	60.00	42.88	11.06	-0.09	-1.12	p > 0.20

*Variable with an opposite metric orientation

Figure 1 presents a comparison of percentage change in terms of motor abilities between students that attended face-to-face and online classes. According to Figure 1, higher change in terms of: (1) abdominal muscle strength; (2) lower back muscle strength; (3) upper limbs muscle strength; (4) lower limbs muscle strength; (5) explosive leg power; and (6) flexibility of lower back and hamstring muscles was induced by the face-to-face classes.

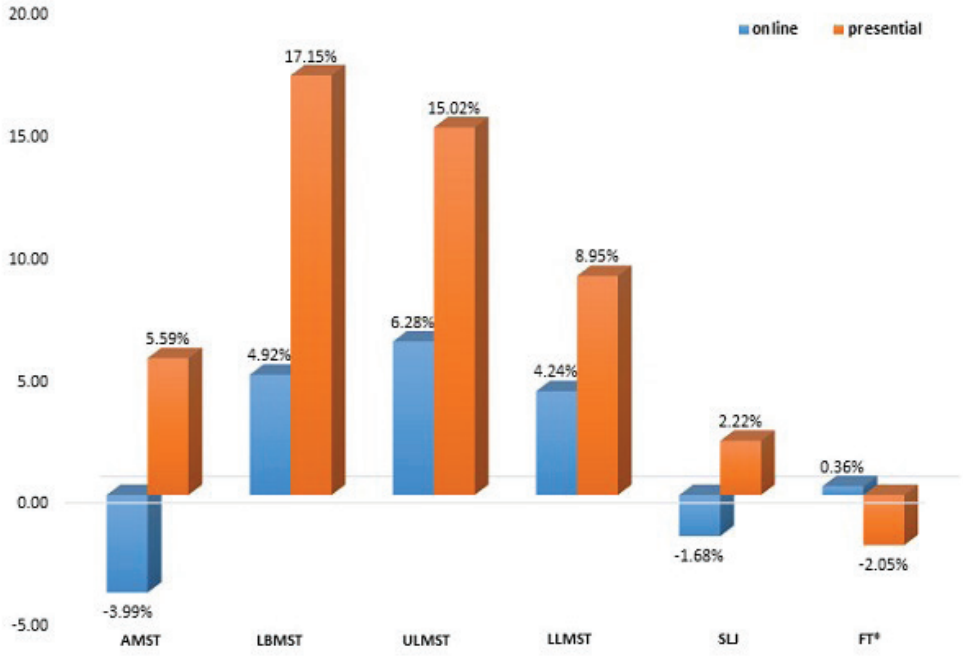


FIGURE 1. Comparison of the percentage change (%) in terms of motor abilities between students that attened face-to-face and online classes

Based on Table 5, there is large magnitude of the difference in percentage change for: (1) abdominal muscle strength; (2) lower back muscle strength; and (3) explosive leg power, and medium magnitude of the difference in percentage change for: (4) upper limbs muscle strength; (5) lower limbs muscle strength; and (6) flexibility of lower back and hamstring muscles. However, it was statistically significant only for: (1) abdominal muscle strength; (2) lower back muscle strength; and (3) explosive leg power.

Table 5. T-test. significance level and effect size of the percentage change (%) in terms of motor abilities between students that attened face-to-face and online classes

	percentage change (%)				
	online	face-to-face	t-test	p-level	Cohen's D
AMST	-3.99	5.59	-2.35	0.03	0.83
LBMST	4.92	17.15	-2.53	0.02	0.89
ULMST	6.28	15.02	-1.21	0.23	0.43
LLMST	4.24	8.95	-1.40	0.17	0.49
SLJ	-1.68	2.22	-2.67	0.01	0.94
FT*	0.36	-2.05	1.55	0.14	0.55

*Variable with an opposite metric orientation

Discussion

The outcome of this study showed that higher improvement in terms of abdominal muscle strength, lower back muscle strength and explosive leg power was induced by face-to-face classes. These findings indicate that face-to-face classes are more effective than the online classes in achieving the main goal of the PE curriculum.

To the best of authors' knowledge, there are no previous studies that compared the effectiveness of face-to-face and online PE classes in achieving the main goal of the PE curriculum, i.e., development of motor abilities in school adolescents. However, recent study investigated the advantages and disadvantages of online and face-to-face PE (Nyberg et al., 2022). Authors found that there were certain difficulties for the PE teachers to deliver the content, as well as they observed reduced movement capability during online classes as compared to face-to-face classes (Nyberg et al., 2022). Another study evaluated the effectiveness of online PE classes during the COVID-19 pandemic in university students (Yu et al., 2021). In line with the findings of the presents study, authors reported that the implemented online learning interventions were not feasible neither effective (Yu et al., 2021). Moreover, during the implementation phase, students reported that they were uncertain about the accuracy of the exercises they do (Yu et al., 2021). PE teachers also reported unenthusiastic involvement of their students (Yu et al., 2021).

It is obvious that PE thematic content requires correct instruction and practical application (Mercier et al., 2021). However,

these aspects were challenging during the online PE classes (Jeong & So, 2020). Most of the teachers have never used video instructions to deliver class before the pandemic (Mercier et al., 2021). The sudden shift to online classes left teachers unprepared and struggling with unfamiliar teaching methods (Jeong & So, 2020). It seems that inadequate online teaching strategies and low teachers' and students' preparation for this type of education, resulted in difficult transition (Do, 2020). Moreover, previous study reported that 20% of the PE teachers were less effective during online teaching than face-to-face teaching (Mercier et al., 2021). Even though teachers were seeking and introducing online resources that have the capability to be tailored to the contextual needs of the PE curriculum (such as online training programs to improve specific motor abilities: strength, explosive power of legs, flexibility, etc.), these resources were not sufficient to satisfy students' needs (D'Agostino et al., 2021). In this line, the findings of our study also indicate that online classes were not as effective as face-to-face classes in achieving the main goal of the PE curriculum.

Students engaged in online PE classes at the present study were also complaining that are not able to follow and effectively take part in activities and tasks assigned during the class because of the limited space and limited access to supplies and equipment in their homes. Limited access to sports equipment and facilities may affect the effectiveness of the delivered class (Jeong & So, 2020). Accordingly, previous study has reported that students' access to online learning as well as conditions at their home were also challenging during the COVID-19 pandemic (Pavlovic et al., 2021).

Taking everything in consideration, students were probably able to gather only the basic theoretical knowledge for the concepts that are part of the thematic plan of the PE curriculum during the online PE classes. However, there were common limitations for students that did not allow them to follow the practical part of the class appropriately. Also, we believe that it has been difficult for the PE teachers to deliver the correct instructions for the exercises, and to accurately monitor students while performing the exercises in front of the computer camera. As a result, changes in terms of motor abilities during the online classes were not induced to the same extend as changes during the face-to-face classes. We assume that higher frequency, intensity, and volume than the ones applied during "home exercising" conditions might be necessary to induce higher changes in terms of motor abilities.

Conclusion

A better improvement in terms of abdominal muscle strength, lower back muscle strength and explosive leg power was induced by the face-to-face classes. These findings indicate that face-to-face classes are more effective than online classes, probably due to the specificity of the PE content that requires correct instruction, practice and movement.

Limitations

Potential limitation of this study may be the lack of PA questionnaire or accelerometer records that would register children's extra scholar physical activity. Further studies should take this in consideration because extra scholar activities may potentially contribute to the development of motor abilities as well.

Acknowledgements

Authors are grateful to all students that took part in the study, their parents that gave consent for participation, and the school's principal that gave an approval and a proper authorization for the study to be realized.

Funding

Authors declare no funding sources for the present study. However, FV holds a fellowship from the Secretariat for Universities and Research of the Ministry of Business and Knowledge of the Government of Catalonia and the European Social Fund (2022FI_B1 00074).

Competing interests

Authors have no relevant financial or non-financial interests to disclose.

Authors' contributions

FV conceived and designed the study, collected data, performed the statistical analyses, analyzed data, interpreted results and wrote the first draft of the manuscript. SG conceived and designed the study, analyzed data, interpreted results, edited and critically reviewed the manuscript, and supervised the research. AP-P interpreted results, edited and critically reviewed the manuscript. RF-L interpreted results, edited and critically reviewed the manuscript. AV collected data, interpreted results, edited and critically reviewed the manuscript. VL-R interpreted results, edited and critically reviewed the manuscript. DB interpreted results, edited and critically reviewed the manuscript. BK interpreted results, edited and critically reviewed the manuscript. GG conceived and designed the study, analyzed data, interpreted results, edited and critically reviewed the manuscript, and supervised the research. All authors approved the final version submitted for publication.

Received: 07 October 2023 | **Accepted**: 05 December 2023 | **Published**: 15 January 2024

References

Bingimlas, K. A. (2009). Barriers to the Successful Integration of ICT in Teaching and Learning Environments: A Review of the Literature. *Eurasia Journal of Mathematics, Science and Technology Education*, *5*(3), 235–245. https://doi.org/10.12973/EJMSTE/75275

Blikstad-Balas, M., & Davies, C. (2017). Assessing the educational value of one-to-one devices: have we been asking the right questions? *Oxford Review of Education*, *43*(3), 311–331. https://doi.org/10.1080/03054985.2017.1305045

Blikstad-Balas, M., & Klette, K. (2020). Still a long way to go. Narrow and transmissive use of technology in the classroom. *Nordic Journal of Digital Literacy*, *15*(1), 55–68. https://doi.org/10.18261/ISSN.1891-943X-2020-01-05/ASSET/395E7C64-CE22-4A99-AE17-7C94809E2CC0/ASSETS/GRAPHIC/NJDL-2020-01-05-05.JPG

D'Agostino, E. M., Urtel, M., Webster, C. A., McMullen, J., & Culp, B. (2021). Virtual Physical Education During COVID-19: Exploring Future Directions for Equitable Online Learning Tools. *Frontiers in Sports and Active Living*, *3*. https://doi.org/10.3389/FSPOR.2021.716566

Dhawan, S. (2020). Online Learning: A Panacea in the Time of COVID-19 Crisis. *Journal of Educational Technology Systems, 49*(1), 5–22. https://doi.org/10.1177/0047239520934018

Do, J. W. (2020). An Investigation of Design Constraints in the Process of Converting Face-to-face course into Online Course. *Journal of Education & Culture*, *26*, 153–173.

Ekberg, J. E. (2020). Knowledge in the school subject of physical education: a Bernsteinian perspective. *Physical Education and Sport Pedagogy, 26*(5), 448–459. https://doi.org/10.1080/17408989.2020.1823954

EUROFIT. (1993). *Handbook for the EUROFIT Tests of Physical Fitness*. Sports Division Council of Europe Publishing and Documentation Service. https://books.google.es/books/about/EUROFIT.html?id=Hi0KyAEACAAJ&redir_esc=y

Fairclough, S., & Stratton, G. (2005). 'Physical education makes you fit and healthy'. Physical education's contribution to young people's physical activity levels. *Health Education Research*, *20*(1), 14–23. https://doi.org/10.1093/HER/CYG101

Ferri, F., Grifoni, P., & Guzzo, T. (2020). Online Learning and Emergency Remote Teaching: Opportunities and Challenges in Emergency Situations. *Societies 2020, Vol. 10, Page 86*, *10*(4), 86. https://doi.org/10.3390/SOC10040086

Gil-Flores, J., Rodríguez-Santero, J., & Torres-Gordillo, J. J. (2017). Factors that explain the use of ICT in secondary-education classrooms: The role of teacher characteristics and school infrastructure. *Computers in Human Behavior*, *68*, 441–449. https://doi.org/10.1016/J.CHB.2016.11.057

Jeong, H. C., & So, W. Y. (2020). Difficulties of Online Physical Education Classes in Middle and High School and an Efficient Operation Plan to Address Them. *International Journal of Environmental Research and Public Health 2020, Vol. 17, Page 7279*, *17*(19), 7279. https://doi.org/10.3390/IJERPH17197279

Jovanovski, J. (1998). *Basics in psychomotorics*. University Ss. Cyril and Methodius - Faculty for Physical Education.

Kallner, A. (2013). Laboratory Statistics: Handbook of Formulas and Terms. In *Laboratory Statistics: Handbook of Formulas and Terms*. Elsevier Inc. https://doi.org/10.1016/C2013-0-00579-8

Landi, D., Fitzpatrick, K., & McGlashan, H. (2016). Models based practices in physical education: A sociocritical reflection. *Journal of Teaching in Physical Education*, *35*(4), 400–411. https://doi.org/10.1123/JTPE.2016-0117

Liu, C., Cao, Y., Zhang, Z., Gao, R., Qu, G. (2023). Correlation of fundamental movement skills with health-related fitness elements in children and adolescents: A systematic review. *Frontiers in Public Health*. doi:10.3389/FPUBH.2023.1129258

Mercier, K., Centeio, E., Garn, A., Erwin, H., Marttinen, R., & Foley, J. (2021). Physical Education Teachers' Experiences With Remote Instruction During the Initial Phase of the COVID-19 Pandemic. *Journal of Teaching in Physical Education*, *40*(2), 337–342. https://doi.org/10.1123/JTPE.2020-0272

Nyberg, G., Backman, E. & Tinning, R. (2022). Moving online in physical education teacher education. *Sport, Education and Society.* DOI: 10.1080/13573322.2022.2142776

Pavlovic, A., DeFina, L. F., Natale, B. L., Thiele, S. E., Walker, T. J., Craig, D. W., Vint, G. R., Leonard, D., Haskell, W. L., & Kohl, H. W. (2021). Keeping children healthy during and after COVID-19 pandemic: meeting youth physical activity needs. *BMC Public Health*, *21*(1), 1–8. https://doi.org/10.1186/S12889-021-10545-X/FIGURES/3

Ramer, J. D., Houser, N. E., Duncan, R. J., Bustamante, E. E., Ramer, C. :, Houser, J. D. ;, Duncan, N. E. ;, Bustamante, R. J. ;, Marinho, A., Pereira Neiva, H., Manuel, R., & Ferraz, P. (2021). Enjoyment of Physical Activity—Not MVPA during Physical Education—Predicts Future MVPA Participation and Sport Self-Concept. *Sports 2021, Vol. 9, Page 128*, *9*(9), 128. https://doi.org/10.3390/SPORTS9090128

Roe, A., Blikstad-Balas, M., & Dalland, C. P. (2021). The Impact of COVID-19 and Homeschooling on Students' Engagement With Physical Activity. *Frontiers in Sports and Active Living*, *0*, 205. https://doi.org/10.3389/FSPOR.2020.589227

Silva, D. A. S., Chaput, J. P., Katzmarzyk, P. T., Fogelholm, M., Hu, G., Maher, C., Olds, T., Onywera, V., Sarmiento, O. L., Standage, M., Tudor-Locke, C., & Tremblay, M. S. (2018). Physical Education Classes, Physical Activity, and Sedentary Behavior in Children. *Medicine and Science in Sports and Exercise*, *50*(5), 995–1004. https://doi.org/10.1249/MSS.0000000000001524

Yu, J., Jee, Y. (2021). Analysis of Online Classes in Physical Education during the COVID-19 Pandemic. *Education Sciences*, *11*(1). https://doi.org/10.3390/educsci11010003

Weir, J. P., & Vincent, W. J. (2021). *Statistics in kinesiology* (5th ed.). Human Kinetics.

World Health Organization. (2007). *Anthro for Personal Computers Manual Software for assessing growth and development of the world's children*.

DOI 10.26773/jaspe.240105

Journal of Anthropology of Sport and Physical Education

REVIEW ARTICLE

Narrative review on the importance of yoga in physical education and sports

Selliah Joniton[1], Mohamed Shafras[2], Dilani Chathumali Jayasekara[1]

[1]Department of Sport Sciences and Physical Education, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka,
[2]Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka

Abstract

One of India's spiritual systems, yoga, emphasizes the value of working with the human body to develop good thoughts and behaviours. Additionally, yoga assists in balancing our physical and mental conditions. However, lack of understanding about the impact of yoga in sports seems to have led to a decline in yoga practise specifically among sportsmen and sportswomen. Thus, this narrative review is designed for sportsmen and sportswomen, physical education students, teachers, yoga students, health professionals, and those who are inclined to study yoga. This review identifies a leaner relationship between the systems of yoga and sports, and provides information on the value of yoga in physical education and sports. All the data in this article were collected using search terms including "yoga", "physical education", "asana" and "sports". Various beneficial yoga factors influence sport performance, and these important factors are outlined with appropriate evidence. All the findings included in this review paper highlight the importance of yoga in physical education and sports, and warrant the need of special awareness of the system of yoga in health, physical and sports education.

Keywords: *Yoga, Asana, Physical education, Sports, Athletic Injuries*

Introduction

In the modern push-button age, the involvement of physical activity becomes less to execute the daily routine work which leads to less physical fitness and various diseases. This necessitates the human being to perform exercise daily to avoid health-related problems. Exercise is the easiest and the best system to maintain good health (Chatterjee & Mondal, 2014). All parts of the body will grow and become healthy if it is utilised sparingly and gets exercise. Growth will be slowed, it becomes more susceptible to illness, and it ages more quickly if it is neglected and kept idle.

Physical education aims to improve human performance and enhances human development through the medium of physical activities. The goals of physical education include the development of motor skills, maintaining overall fitness, advancing knowledge, and the encouragement of a good attitude towards physical activity. Thus, physical education is an integral part of a healthy life (Bailey, 2006).

A person whose participation is motivated by a combination of intrinsic and extrinsic factors defines sports as a formalised competitive activity that involves vigorous physical effort or the use of relatively complex skills. Sports are becoming increasingly popular, and this trend is likely to continue in the future. Physical and sports disciplines are now considered international disciplines because they foster international understanding and universal brotherhood. As a result, each nation's moral and social responsibility is to promote physical education and sports (Mosler et al., 2022).

Yoga is an extraordinary and unique Indian technique for developing inner awareness. By vibration and pulsation with the body, mind, and intellect levels, one can master the external and internal forces. Yoga is a discipline, which provides perfection, purity, and life's fulfilment. Womb to the tomb, man is basically in search of happiness and there are numerous yoga methods available to meet the needs of various people in society. Holistic living entails practising yoga consciously to reap its full benefits (Hayes & Timalsina, 2017).

While most of the studies provide important insights into the nature of yoga and their common benefits, there is a paucity of

Correspondence:

M. Shafras
Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka
Email: way2shafraz@gmail.com

special details on the importance of yoga in physical education and sports. This is primarily the case since the majority of studies do not discuss the application of yoga as a means of mitigating the side effects and adverse effects of sports. Thus this study was aimed to compile the literature related to yoga and sports. The main objective of this study was to provide detailed information on yoga, its benefits in general and specific importance in mitigating/ preventing side effects arising from the sports.

Systems of yoga and its importance

Yoga is divided into several systems in the scriptures, such as Karma yoga, Bhakthi yoga, Janana yoga, Hatha yoga, Mantra yoga, Yantra yoga, Laya and Kundalini yoga, Tantra yoga, and Raja yoga (Hayes & Timalsina, 2017). Following Karma yoga entails doing your duty without regard for yourself. Karma yoga's main goal is to control and eventually let go of your ego (Pallathadka et al., 2022). Bhakti yoga is also known as the path of devotion or the yoga of love. The goal of Bhakti yoga practice is to achieve the impression of Rasa (essence), a state of pure bliss attained through devotional surrender to the divine. Janana yoga is the way of accomplishing knowledge of the true nature of reality through the way of meditation, self-inquiry, and contemplation (Hayes & Timalsina, 2017). Hatha yoga is a type of yoga that uses physical techniques to try protecting and channel the vital force or energy (Petrič et al., 2014). Mantra yoga is a meditation practice that focuses on chanting sacred syllables while also practicing conscious breathing and meditative focus to quiet the mind, cultivate spiritual energy, and achieve states of enlightenment (Vaidik et al., 2020). Yantra yoga employs a seven-phase movement sequence that is linked to seven-phase breathing. The position in the central phase of each movement, in particular aids in the creation of specific breath retentions that work on a deep, subtle level (Rathore et al., 2017). Laya and Kundalini yoga focus on highly influential achievements or experiences of dharma or the life purpose of liberating oneself from the Karma, the bondage of life. Raja yoga is the type of yoga that controls mind and body, with an emphasis on meditation and energetics (KR, 2019; Hayes & Timalsina, 2017). All yoga systems are beneficial for yoga practitioners and they have different benefits (Roland et al., 2011).

Raja Yoga or Astanga Yoga

Out of the above types of yoga, Raja yoga is the most powerful tool to tune the body. Raja yoga is also called Astanga yoga. The Sanskrit term "Ashtanga" emphasises the eight stages of Raja yoga (Figure 01): Yama, Niyama, Asana, Pranayama, Pratyahara Samadhi, Dharana, and Dhyana (KR, 2019). These limbs are given in ascending hierarchical order, and each limb leads to the next. Each limb must be mastered before practising the next limb. The utility of each stage differs for specific benefits for players (Y. Sharma et al., 2018).

FIGURE 1. Eight Limbs of Ashtanga Yoga

Yama

Yama is a universal moral commandment. It is the general discipline (social attitude), and it is the control of the body, mind, and speech. There are five Yama that a player should understand to have the best sportsmanship qualities (Ross & Thomas, 2010).

Yama:
Ahimsa - Non- violence
Satya - Truthfulness
Asetya - Non- stealing
Brahmcharya - Faithfulness
Aparigraha - Non-greed

Niyama

Niyama is self-purification by discipline or obedience to proper conduct (personal discipline). Niyama is devotion, surrender to a higher infinite power and the rule for living. It emphasises remembering God and surrendering everything to him. Niyama is five in number and players should follow the principles of Niyama to maintain discipline with opponents, teammates, physical education teachers, coaches, officials, family members, and society members (Y. Sharma et al., 2018). These Yamas and Niyamas prepare the individual mentally and physically for the asana postures.

Niyamas:
Saucha - Cleanliness
Santosha - Contentment
Tapas - Self-discipline
Svadhyaya - Self-study
Ishvara pranidhana - Surrendering to the divine and high power

Asana

Among the eight limbs of yoga, the third limb is Asana. It is closely associated with physical education and sports (Ross & Thomas, 2010). It is the oldest science of self-development for physical, mental, and spiritual control. People of both sex and all age groups, irrespective of profession, can practise asana (Jose & Shailesh, 2021). Asana can be applied in physical education and sports for enormous purposes depending upon the creativity of physical education experts, coaches, and players (Cowen & Adams, 2005).

The primary purpose of applying asana in the field of physical education and sports are two folds namely: a) to develop a healthy body b) to gain self-control and better psychological stability (Ross & Thomas, 2010). A human being is a psychosomatic organism and a sound body with a sound mind is essential for players to achieve the goal. Asana coordinates the actions of the body and mind of players (Bal & Kaur, 2009; Chatterjee & Mondal, 2014). Different yoga asanas are illustrated in Figure 02.

FIGURE 2. Yoga Asanas

Pranayama

Pranayama means control of breath and it involves three main phases: Puraka (inhalation), Kumbhaka (retention), and Rechaka (exhalation). These are best practiced in the early hours of the morning or after sunset. Pranayama practise made use of the diaphragm fully by drawing the air into the lowest and largest part of the lungs (Sengupta, 2012). Due to the regular practice of Pranayama, (a) respiratory efficiency is improved (b) The vital capacity of the lungs is increased (c) during Kumbhaka, there is a slowing down of heart rate (V. Sharma et al., 2013), (d) the training to tolerate mild hypoxia, e.g., during Kumbhaka can stimulate the myocardium to increase its vascularisation as recorded at higher altitudes, and (e) synchronisation of different activities of the organism with respiration is increasing. Hence, the systematic practise of Pranayama is useful for athletes in different sports and disciplines (Telles & Naveen, 2008). It is more useful for athletes who compete in aerobic activities.

Pratyahara

Pratyahara is the introversion of various sense organs by restraining them from worldly objects (Ross & Thomas, 2010). It requires compelling determination and repression of the senses. The word "Pratyharya" derived from a Sanskrit word. There are two Sanskrit words included here: word "Prati", which means "to withdraw", and other root word is "Ahara", which means "Food". Here "Food" refers to anything external stimuli that peoples consume with their mind (Himashree et al., 2016). To explain further, "Ahara" can refer to anything people put into their bodies and mind physically and mentally. This phenomenon helps the athletes to control their senses and thereby improving fitness, health and ultimately enhance their performance (Taneja, 2014).

Dharana

Dharana is the concentration of an object. It is the beginning of the last stage of meditation of Samadhi. The aim of Dharana is to bind a person's consciousness to one particular object, idea or place (KR, 2019). The diversion of attention during training and especially in competition leads to failure in sports. Events such as archery, shooting, chess, etc. require more concentration. Further, goalkeepers of football, hockey, handball, etc. require maximum concentration than field players (Y. Sharma et al., 2018).

Dhyana

Dhyana is the stage of meditation and requires complete meditation on the object of concentration. Meditation is the most effective mental and physical tonic. It opens the door to intuitive knowledge, realms of external bliss and results in a calm and steady mind. Regular meditation practices assist the players in relaxing the mind and body which supports in the development of better psychological stability (Mastun et al., 2020; L. Sharma, 2015).

Samadhi

Samadhi is the pinnacle of yogic attainment. It is a true sense of communication and peace. Samadhi simply refers to the complete stillness of the mind that allows the individual to merge with the universe (KR, 2019). This settling of mind is the heart of yoga, where the senses have been transcended by complete refinement of the body and mind. This is the last and most important stage of yoga and it is not widely applicable for athletes.

General importance of yoga

The benefits of yoga can be classified as physical, physiological, biochemical, and psychological benefits (Büssing et al., 2012). Various physical benefits of yoga can be achieved, especially by following yoga asana training and maintaining correct posture (Petrič et al., 2014; Y. Sharma et al., 2018). One can achieve physical fitness while improving strength and variety of flexibility namely, lower back flexibility, hamstring flexibility, and shoulder flexibility (Tracy & Hart, 2013). Thus improves overall general health while strengthening the weak part of the body (Ross & Thomas, 2010; L. Sharma, 2015).

Pranayama mainly contributes to the physiological benefits of yoga. During the slow deep breathing, it stretches the lung tissues by the action of slowly adapting receptors (Zaccaro et al., 2018). This increases the respiratory and cardiovascular efficiency while increasing the volume of the lungs and intake of oxygen (Cooper, 2003). Thus, the blood pressure and pulse rate were automatically regularized. Also, this improves the vital capacity. Pranayama also effects to enhance Neuro- muscular coordination and immunity power (V. Sharma et al., 2013; Telles & Naveen, 2008).

Several biochemical benefits of yoga (significant drop in the values for total cholesterol, low-density lipoprotein, triglycerides, and blood urea) have been reported (Himashree et al., 2016). Yoga practices also alter the breathing capacity which increases the VO2 max. (the amount of oxygen that the body intakes), and thus the haemoglobin count in the blood increases. Yoga has also been indicated to lower the stress hormones in the body while increasing beneficial brain chemicals such as gamma aminobutyric acids and endorphins. These chemicals also help in improving the mood and reduce the anxiety level (Y. Sharma et al., 2018).

Psychological benefits of yoga achieved by improving mental concentration, attention, self-control, self-acculturalization psychological stability, social skills including relationships with parents and peers and decreasing some psychological issues namely anxiety, aggression, depression, inattention and social stress through the yoga practices (Khalsa et al., 2012; Mehta & Sharma, 2010).

Importance of yoga for sports and innate side effects of sports

Sports give the whole world a chance to mingle together, exchange values, and improve relationships. Sporting events provide an ideal setting for human-to-human exchange. Generally, most people participate in a sporting event for the enjoyment of it as well as to achieve fitness and tone up their bodies (Chen & Sun, 2017). However, games have also become a procession. Competitive sports are fundamentally different from recreational sports activities. Competitive sports necessitate long periods of strenuous training. Furthermore, athletes have a keen interest in succeeding in the competition. Injury is quite common in competitive sports (Finch & Staines, 2017). One main consideration is that most sporting activities rely on the usage of one part of the body, and this creates asymmetry and overuse of limbs which leads to high levels of physical and mental stress for the athletes (Bailey, 2006). Further, as sports are becoming more and more professional, athletes suffer from stress. Yoga is an excellent method for protecting an athlete's mind and body (Ross & Thomas, 2010). Professional athletes should understand that yoga is an invaluable tool for achieving and maintaining peak physical and mental strength (Banerjee et al., 2007; Sahu & Yadav, 2020).

Importance of Yoga for Athletes – Running

There is a tendency for a long-distance runner to push the body to a high level of training without recognising the danger signals. The assistance of running is at the cost of the internal organs; the lungs and heart are irritated and the constant movement disturbs the abdominal organs and causes cramping of the circulatory flow (Bramble & Lieberman, 2004). Further, athletes' endurance capacity cannot be maintained for long periods due to ageing. Yoga stretches to soften the hamstring muscles, which are tough and hard from hours of running (Cowen & Adams, 2005). Sitali Pranayama removes excess heat in the body, which is good for marathon runners (Telles et al., 2020). Furthermore, back, and forward bends and twisting in asanas such as Supta Virasanaand Urvottanasana, protect the heart, lungs, and the abdominal organs. Also, these asanas help strengthen the core muscles around the reproductive organs (Cowen & Adams, 2005). Bridge poses, shoulder stands, and restorative poses also help stimulate the glands that help produce hormones and increase hormone production by stimulating the major reproductive glands (Chatterjee & Mondal, 2014).

Importance of Yoga for Athletes in disciplines that include jumping

The movements in the different jumps involve only one leg. The repeated use of the same side of the body results in asymmetry. The groin muscles are opened only on one side, and the hip joints are also strained on one side (McClanahan, 2002). Thus, for a jumper, asana that opens the groin (Upavishta Konasana, Samakonasana, Buddha Konasana, and Supta Padangusthasana) are very beneficial in preventing imbalances (Solakoğlu et al., 2021). Hanumanasana optimises muscle usage in triple and long jumpers. Balancing asana helps pole vaulters train both sides of their bodies for load bearing (Jose & Shailesh, 2021). One-sided balances such as Kasyapasana and Vasishtasana train the sides of the body and the latissimus dorsi muscles (Rathore et al., 2017).

Importance of Yoga for Athletes in disciplines that include throwing

Most throwing events use only a single arm. The imbalance between the overused and underused muscles causes problems eventually (McCLANAHAN, 2002). For example, when throwing the discus, the palm of one hand is constantly folded, while the other is not utilized. In shot-put throw, the one-sided effect can last for years after the sport has ended. The common problem is that of the spine being rotated always to the right (except the lefthander). Unnecessary strain on the facet joints causes uneven and premature wear and tear, as well as a scholastic deformity (Russell et al., 2012). Twisting and Lateral bends asana are beneficial for preventing spinal strain and maintaining healthy evenness of usage (Holtzman & Beggs, 2013).

Importance of Yoga for Archery

In archery, one eye and one shoulder are overly strained, and one side of the brain is used more than the other side (Sahu & Yadav, 2020). Over the years, the archer develops a nodule in the trapezius. In standing poses, use the eyes symmetrically and assist the archer in training both sides of the orbital muscles and eye focusing (Jose & Shailesh, 2021). Handstand, elbow stand, balance poses, and unilateral balancing poses like Vasisthasana, as well as dog poses done both ways with fingers on the wall and in the opposite direction, are useful for achieving a balance of both sides of the body, including the hands and overcome the visual discomfort (Telles et al., 2006). The contemplative type of Pranayama, and Nadi suddhi is highly useful for the archer who is incapable to concentrate (Sahu & Yadav, 2020).

Importance of Yoga for Shooting

The eyes are strained to the limit in both archery and shooting. Forward bends with the bandage on the eyes and Shanmukhi mudra and asanas are beneficial for relieving eye strain (Telles et al., 2006). When considering the shooting game, balance and

flexibility also require holding their gun for a long period without bouncing it. Yoga practices also help enhance flexibility and balance (Cowen & Adams, 2005). Further, it also strengthens and refine connective tissues (Iftekher et al., 2017; Bühlmayer et al., 2017).

Importance of Yoga for Boxing

It is irrational to allow two humans to participate in a sport that entails hitting each other with a substantial chance of injury. The method of crowding the hands close to the body prevents the hand and torso muscles from stretching and healthy breathing is hindered. For the spine, back bends take preference over forward bends. Asana that provides a proper extension of the arms, such as handstand, Urdhva dhanurasana, elbow balance, and dog pose and working with the wall ropes to safeguard the extension of the spine is very effective to expanding the frontal torso (Telles et al., 2006). Uttanasana, seated forward bends, dog pose, and headstand, and shoulder stand along with Viparita and asanas are extremely beneficial for calming the mind, brain and senses agitated by the constant pounding (Banerjee et al., 2007).

Importance of Yoga for Wrestling

Wrestling is an ancient sport, which is relatively not so fierce for the body and mind. There are many styles that wrestlers maintain, but one thing they all have in common is that the body must be fattened and kept heavy (Yamauchi et al., 2004). Sumo wrestling is the mildest variation, to push the opponent out of the ring. Sumo wrestlers, who are grossly overweight, have hypertension, diabetes (Mouzan et al., 2010), and premature degenerative disorders of the spine, hip, ankle, and knee joints. Once the wrestler retires, the inactivity joint with the overweight destroys the body easily. Wrestlers often change their diet for weight loss to qualify for a particular category and this is damaging to the body's metabolism. Standing asana protects the hip and knees joints. Asana, which opens the groin, ensures proper alignment and a proper blood supply (Shaw & Kaytaz, 2021; Lehecka et al., 2021).

Importance of Yoga for Weightlifting

Weightlifting exposes the entire body to powerful forces. The extra weight placed on the body puts a constant strain on the lungs, heart, and abdominal organs. The cervical spine is strained due to excessive loading, and chronic low back pain is usual (Alabbad & Muaidi, 2016). Twisting poses are extremely beneficial for softening the weightlifter's hardened muscles (Cowen & Adams, 2005). Passive backbends relieve back strain by resting the posterior muscles of the spine (Keogh & Winwood, 2016). Forward bends increase blood flow to the posterior spinal muscles, which are always constrained when weightlifting (Ernst, 2016). The pelvic organs, which are pressurised in the squat position, get relief from Upavistha and Baddha konasana (Hemmerich et al., 2019). Ujjayi pranayama assists to release tension in the senses, mind, heart, and lungs (Sahu & Yadav, 2020). The weightlifter is forced to perform Kumbhaka as the elevator is done. This constricts the diaphragm and slows the unrestricted circulation. This strain is relieved by Pranayama with a long exhalation (Holtzman & Beggs, 2013; Lynn & Basso, 2023).

Importance of Yoga for Gymnastics

Gymnastics is one of the most graceful and stylish sports that many people enjoy. The Gymnastic performance is frequently interrupted by extension movements. This causes ligaments and muscles to be looser than usual (Kerr et al., 2015). Lower lumbar muscle sprains and spine injuries are common (Kruse & Lemmen, 2009). As gymnastics is highly sophisticated, long hours of practice are needed. In yoga, every cell is kept in alignment and then balanced (Jose & Shailesh, 2021). Backbends provide endurance for both the body and the mind during times of emotional depression (Bal & Kaur, 2009). Yoga shows the correct geometry of poses to prevent injuries (V. Sharma et al., 2013). Pranayama is supported to relieve stress on the mind and senses.

Importance of Yoga for Swimming

In swimming, both the upper and lower extremities are used symmetrically. This precludes the harmful impact of field sports. A person with lower back pain can swim easily, as the buoyancy prevents the load on the back (Smith et al., 2006). Body weight maintenance leads to nutritional deficits (Hoogenboom et al., 2009). As the swimmer moves from land to water, the glandular system may experience temperature fluctuations. Because swimmers spend more time in water, the muscles become accustomed to various types of stimulus in terms of G force, and the body's capacity to withstand physiological stress and strain on land may change (Kline et al., 2007). To prevent this, it is important to practise some types of exercise on land every day. This exercise should be a non-stressful exercise to support with recuperation. Asana likes handstands, dog pose, back bends, elbow balance and teaching the proper arms stretch nullifying strain (Jose & Shailesh, 2021). Inversions relieve weariness in the eyes, sinuses, ears, and legs. Backbends assist the body sweat to dissipate internal heat (Keogh & Winwood, 2016). The groins, which are repetitively constricted, are promoted by Upavishta and Baddha konasana (Bal & Kaur, 2009). Pranayama assists in maintaining well coordination between inhalation and exhalation, which is very necessary as the upper respiratory organs dip in and out of water (Chatterjee & Mondal, 2014). It also aids in the efficient evacuation of nasal secretions, and lower and upper respiratory tracts. Kumbhaka improves fit endurance for water sports (Ross & Thomas, 2010; Telles & Naveen, 2008).

Importance of Yoga for Rowing

The rower is constantly bent forward. The spine, groin, and hands are among the body parts that suffer. Because of repeated flexion stresses, the spine can degenerate prematurely over time and dorsal spine is excessively bowed (Thornton et al., 2016). Because of constant pressure, the points of the buttock bones become sensitive to discomfort. The muscles of the spine can suffer premature degeneration and the arms face the stress of asymmetrical usage (Hosea & Hannafin, 2012). The knees need to be stretched out. The posture puts strain on the circulatory and respiratory systems (Kohli et al., 2019). Use of elbow balance, handstand, and backbends teach better arms extension and maintain blood flow and suppleness (Tran et al., 2001). Standing poses provide relief to the oarsman's spinal muscles and lower limbs (Jose & Shailesh, 2021). Baddha and Upavishta konasana initiate the constricted groin area and enhance blood circulation, and inversions cool the brain, which is constantly in the flexed position (Bhavanani, 2013). Pranayama increases endurance while decreasing strain on the sense organs. Rowers should not overlook the advantages of yoga (Das & Yoga, 2022).

Importance of Yoga for Football

Tears in the semi-lunar cartilage are more common in this game than in any other. With the added strain of weight bearing, the knee rotates outward yogic exercises are ideally suited. All standing poses of yoga are important, and it strengthens realign and massages the cartilages and improves weight bearing (Liu et al., 2021). The player will benefit if Padmasana and Virasana, which massage the joints, are trained daily before and after the game (Acharya et al., 2010; Raub, 2002).

Importance of Yoga for Hockey

In hockey, the knees, shoulders, and spine are the most strained. During tackling, a hockey player must always bend to one side. The spine is usually bent to one side, with one arm extended and contracted with the other arm. The dominant shoulder was strained (Barboza et al., 2018). The forearm muscle and inner biceps are taxed. Asymmetry is also used with the legs and with greater emphasis on the back knee (Cowen & Adams, 2005). Long-term issues include low back pain, knee wear and tear, and cervical muscle strain (Barboza et al., 2018). The mind and senses are required to follow the ball and become exhausted. Dog pose is best to correct the imbalance in the spinal muscles (Govindaraj et al., 2016). Virasana and Padmasana are good for resting overworked knees (Kohli et al., 2019). Backbends like Viparita dandasana and Urdhva dhanurasana are supported by providing symmetry in the posture and mobility of the hands and shoulders (Tran et al., 2001). Supine pranayama and forward bends with the band will relax the mind and eyes (Bühlmayer et al., 2017).

Importance of Yoga for Cricket

Cricket is one of the world's most popular games and it is becoming very rough today. Players must use headgear and other protective equipment to shield themselves to avoid injury. In the major game, the problems and requirements of yoga differ depending upon the playing position (Gamage et al., 2017).

The Batsman

The right-handed batters must constantly incline and bend forward the spine and eyes to the left. The left hip and shoulder always project in the same direction. The right shoulder is always lower than the left, and the clavicle area is hollowed out on the left. The inner knee, like the inner ankle, is more prone to weight bearing. Forward bends keep the body cool after being exposed to the sun for long periods (De Zavala et al., 2017). Backbends provide the batsman with the energy he must play for several hours without tiring (Mohanty et al., 2019).

The Bowler

Forward bends help to keep the body cool after long periods of sun exposure (De Zavala et al., 2017). Also, Backbends give the bowler with the energy, player should play for several hours without getting tired. The trapezius muscle of the non-dominant shoulder is always contracted, resulting in the formation of a nodule eventually. Standing Marichyasana and Bharadwaj asana are rotational movements that provide neck relief (Li et al., 2019). Neck and shoulder relief can be obtained by extending the neck on the rope, holding the bar behind the back, and performing back bends with the rope. Backbends provide the necessary endurance to the pace bowler (Cowen & Adams, 2005). Ardha halasana is important for recuperation at the end of the day (Fishman, 2021).

The Wicket Keeper

Every day, the wicketkeeper must squat and rise several times. Overuse of the neck causes continual flexion and extension, this can cause tiredness of the spinal muscles and groin muscles, as well as low back and cervical aches (Mount et al., 2014). The organs of perception are also overused, as the keeper must study the movement of the ball and remain vigilant. Rotations and lateral standing poses release the strain on the back (Solakoğlu et al., 2021). Baddha and Upavishta konasana assuage the strain on the groin along with Supta Baddha konasana. Ardha halasana and Forward bends soothe the senses. The training of Shanmukhi mudra is assisted to lighten the strain on the eyes and mind (Holtzman & Beggs, 2013).

The Fielder

Fielders are less prone to postural issues. Sun exposure and salt and fluid loss deplete energy. Supta virasana and Passive inversions are excellent for relieving fatigue (Muñoz-Vergara et al., 2022).

Importance of Yoga for Tennis

Tennis players use the serving arm excessively. The dominant hand's forearm is thicker, and the other arm is grossly under used. If the players have a practise of top spinning the ball, the wrist and medial elbow are overused (Marcora, 2009). The other upper arm and forearm muscles are preferred if the backhanded stroke is single-handed. Furthermore, normally tennis elbow, shoulder and knee pain are usually caused by tennis (Pluim et al., 2006). Asana-like handstands, dog pose, including the upward dog, and balancing poses help for relieving shoulder and elbow pain (Evans, 2013). Vitrita karani followed by Sputa virasana is useful to give the whole neuro-endocrine system that should rest and recover (Govindaraj et al., 2016). The achilles tendon and hamstrings are kept elastic by asana like Supta and Hasta padangusthasana (Luo & Xu, 2023). Virasana and Padmasana protect the knees (Kohli et al., 2019). Pranayama increases endurance while playing sports (Mohanty et al., 2019).

Importance for netball

Netball requires strong leg muscles because it is essential to move quickly. Also, strength and flexibility components are essential for players. Passing and shooting skills require proper upper body strength, good balance, and coordination required when defending another player (Cowen & Adams, 2005). Netball is a non- contact game that involves some bumping and jostling. Players follow risk -stepping, shifting, and quick turning in the game. Therefore, the chances of injuries are high. Such injuries that affect netball playing include ankle sprains, muscle strains, finger sprains, and knee sprains (Joseph et al., 2019). Tree pose is such a balancing act that helps get ankle strength and balance (Solakoğlu et al., 2021). Uktasana also supports preventing knee sprains. It's that support to strengthen the knee joint, hamstring muscle, quadriceps muscle, abdominal and lower body region (Zhu et al., 2021). Ekapadasana pose can enhance balance and coordination and Pranayama provides endurance and it assists to play matches for a long duration (Tekur et al., 2012).

Conclusion

Main findings of the present study indicate that yoga may improve a range of health-related outcome indicators, including physical, physiological, biochemical, and psychological benefits. This review reinforces the idea that yoga has a significant impact on various sports performances, its side effects and any person in general. Further, yoga can play a huge role in developing the mind regulation, physical conditioning and focus that benefits sports performance. Yoga practices are beneficial for keeping healthy in all sports and in general life.

Received: 08 October 2023 | **Accepted**: 02 December 2023 | **Published**: 15 January 2024

Reference

Acharya, B. K., Upadhyay, A., Upadhyay, R. T., & Kumar, A. (2010). Effect of Pranayama (voluntary regulated breathing) and Yogasana (yoga postures) on lipid profile in normal healthy junior footballers. International Journal of Yoga, 3(2), 70. https://doi.org/10.4103/0973-6131.72633

Alabbad, M. A., & Muaidi, Q. I. (2016). Incidence and prevalence of weight lifting injuries: An update. Al-Dawriyat Al-sa udiyat Li-l-ṭib Al-riyaḍi, 16(1), 15. https://doi.org/10.4103/1319-6308.173476

Bailey, R. M. (2006). Physical Education and Sport in Schools: A Review of Benefits and Outcomes. Journal of School Health, 76(8), 397–401. https://doi.org/10.1111/j.1746-1561.2006.00132.x

Bal, B. S., & Kaur, P. (2009). Effects of selected asanas in hatha yoga on agility and flexibility level. Journal of Sport and Health Research, 1(2), 75–87. http://www.journalshr.com/papers/Vol%201_N%202/V01_2_2.pdf

Banerjee, B., Vadiraj, H., Ram, A., Rao, R., Jayapal, M., Gopinath, K. S., Ramesh, B. S., Rao, N., Kumar, A., Raghuram, N., Hegde, S., Nagendra, H. R., & Hande, M. P. (2007). Effects of an Integrated Yoga Program in Modulating Psychological Stress and Radiation-Induced Genotoxic Stress in Breast Cancer Patients Undergoing Radiotherapy. Integrative Cancer Therapies, 6(3), 242–250. https://doi.org/10.1177/1534735407306214

Barboza, S. D., Joseph, C., Nauta, J., Van Mechelen, W., & Verhagen, E. (2018). Injuries in Field hockey Players: A Systematic review. Sports Medicine, 48(4), 849–866. https://doi.org/10.1007/s40279-017-0839-3

Bhavanani, A. B. (2013). Yoga practices for prevention and management of lifestyle disorders. Annals of SBV, 2(2), 32–40. https://doi.org/10.5005/jp-journals-10085-2220

Bramble, D. M., & Lieberman, D. E. (2004). Endurance running and the evolution of Homo. Nature, 432(7015), 345–352. https://doi.org/10.1038/nature03052

Bühlmayer, L., Birrer, D., Röthlin, P., Faude, O., & Donath, L. (2017). Effects of Mindfulness Practice on Performance-Relevant Parameters and Performance Outcomes in Sports: A Meta-Analytical Review. Sports Medicine, 47(11), 2309–2321. https://doi.org/10.1007/s40279-017-0752-9

Büssing, A., Michalsen, A., Khalsa, S. B. S., Telles, S., & Sherman, K. J. (2012). Effects of yoga on Mental and Physical Health: A short summary of reviews. Evidence-based Complementary and Alternative Medicine, 2012, 1–7. https://doi.org/10.1155/2012/165410

Chatterjee, S., & Mondal, S. (2014). Effect of Regular Yogic Training on Growth Hormone and Dehydroepiandrosterone Sulfate as an Endocrine Marker of Aging. Evidence-based Complementary and Alternative Medicine, 2014, 1–15. https://doi.org/10.1155/2014/240581

Chen, H., & Sun, H. (2017). Effects of active videogame and sports, play, and Active Recreation for kids Physical Education on Children's Health-Related fitness and Enjoyment. Games for Health Journal, 6(5), 312–318. https://doi.org/10.1089/g4h.2017.0001

Cooper, S. (2003). Effect of two breathing exercises (Buteyko and pranayama) in asthma: a randomised controlled trial. Thorax, 58(8), 674–679. https://doi.org/10.1136/thorax.58.8.674

Cowen, V. S., & Adams, T. B. (2005). Physical and perceptual benefits of yoga asana practice: results of a pilot study. Journal of Bodywork and Movement Therapies, 9(3), 211–219. https://doi.org/10.1016/j.jbmt.2004.08.001

Das, S., & Yoga, P. (2022). Effects on Pilates exercise for rowing player. International Journal of Health Sciences (IJHS), 4739–4745. https://doi.org/10.53730/ijhs.v6ns6.11453

De Zavala, A. G., Lantos, D., & Bowden, D. (2017). Yoga poses increase subjective energy and state Self-Esteem in comparison to 'Power poses.' Frontiers in Psychology, 8. https://doi.org/10.3389/fpsyg.2017.00752

Ernst, A. (2016). 7-weeks of yoga training and its effects on flexibility, rate of force development, and jump height in olympic weightlifters. [Master of Exercise Science Thesis]. Northern Michigan University.

Evans, S. (2013, October 1). Iyengar Yoga and the use of props for pediatric chronic pain: a case study. PubMed Central (PMC). https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3836371/

Finch, C. F., & Staines, C. (2017). Guidance for sports injury surveillance: the 20-year influence of the Australian Sports Injury Data Dictionary. Injury Prevention, 24(5), 372–380. https://doi.org/10.1136/injuryprev-2017-042580

Fishman, L. M. (2021). Yoga and Bone Health. Orthopaedic Nursing, 40(3), 169–179. https://doi.org/10.1097/nor.0000000000000757

Gamage, P. J., Fortington, L. V., & Finch, C. F. (2017). Perceived Injury Risk among Junior Cricketers: A Cross Sectional Survey. International Journal of Environmental Research and Public Health, 14(8), 946. https://doi.org/10.3390/ijerph14080946

Govindaraj, R., Karmani, S., Varambally, S., & Gangadhar, B. N. (2016). Yoga and physical exercise – a review and comparison. International Review of Psychiatry, 28(3), 242–253. https://doi.org/10.3109/09540261.2016.1160878

Hayes, G. A., & Timalsina, S. (2017). Introduction to "Cognitive Science and the Study of Yoga and Tantra." Religions, 8(9), 181. https://doi.org/10.3390/rel8090181

Hemmerich, A., Bandrowska, T., & Dumas, G. (2019). The effects of squatting while pregnant on pelvic dimensions: A computational simulation to understand childbirth. Journal of Biomechanics, 87, 64–74. https://doi.org/10.1016/j.jbiomech.2019.02.017

Himashree, G., Mohan, L., & Singh, Y. (2016). Yoga Practice Improves Physiological and Biochemical Status at High Altitudes: A Prospective Case-control Study. PubMed, 22(5), 53–59. https://pubmed.ncbi.nlm.nih.gov/27622961

Holtzman, S., & Beggs, R. T. (2013). Yoga for Chronic Low Back Pain: A Meta-Analysis of Randomized Controlled Trials. Pain Research & Management, 18(5), 267–272. https://doi.org/10.1155/2013/105919

Hoogenboom, B. J., Morris, J., Morris, C. T., & Schaefer, K. (2009). Nutritional knowledge and eating behaviors of female, collegiate swimmers. PubMed. https://pubmed.ncbi.nlm.nih.gov/21509109

Hosea, T. M., & Hannafin, J. A. (2012). Rowing injuries. Sports Health: A Multidisciplinary Approach, 4(3), 236–245. https://doi.org/10.1177/1941738112442484

Iftekher, S. N. M., Bakhtiar, & Rahaman, K. S. (2017). Effects of yoga on flexibility and balance: a quasi-experimental study. Asian Journal of Medical and Biological Research, 3(2), 276–281. https://doi.org/10.3329/ajmbr.v3i2.33580

Jose, J., & Shailesh, S. (2021). Yoga Asana Identification: A Deep Learning Approach. IOP Conference Series, 1110(1), 012002. https://doi.org/10.1088/1757-899x/1110/1/012002

Joseph, C., Naughton, G., & Antcliff, A. (2019). Australian netball injuries in 2016: An overview of insurance data. Journal of Science and Medicine in Sport, 22(12), 1304–1308. https://doi.org/10.1016/j.jsams.2019.07.016

Keogh, J. W. L., & Winwood, P. (2016). The epidemiology of injuries across the Weight-Training sports. Sports Medicine, 47(3), 479–501. https://doi.org/10.1007/s40279-016-0575-0

Kerr, Z. Y., Hayden, R., Barr, M., Klossner, D., & Dompier, T. P. (2015). Epidemiology of National Collegiate Athletic Association Women's Gymnastics Injuries, 2009–2010 through 2013–2014. Journal of Athletic Training, 50(8), 870–878. https://doi.org/10.4085/1062-6050-50.7.02

Khalsa, S. B. S., Hickey-Schultz, L., Cohen, D. A., Steiner, N. J., & Cope, S. (2012). Evaluation of the Mental Health Benefits of Yoga in a Secondary School: A Preliminary Randomized Controlled Trial. Journal of Behavioral Health Services & Research, 39(1), 80–90. https://doi.org/10.1007/s11414-011-9249-8

Kline, C. E., Durstine, J. L., Davis, J. H., Moore, T. A., Devlin, T. M., Zielinski, M. R., & Youngstedt, S. D. (2007). Circadian variation in swim performance. Journal of Applied Physiology, 102(2), 641–649. https://doi.org/10.1152/japplphysiol.00910.2006

Kohli, P., Patel, P., Waybase, H., Gore, S., & Nadkarni, S. (2019). The value of cross legged sitting: Virtue or vice for health.A review from sports medicine, physiology and yoga.Implications in joint arthroplasty. International Journal of Orthopaedics Sciences, 5(3), 607–610. https://doi.org/10.22271/ortho.2019.v5.i3k.1596

Kr, R. (2019). Important Benefits of Astanga Yoga. Journal of Advanced Research in Ayurveda, Yoga, Unani, Siddha and Homeopathy, 06(01), 26–27. https://doi.org/10.24321/2394.6547.201904

Kruse, D. W., & Lemmen, B. (2009). Spine injuries in the sport of gymnastics. Current Sports Medicine Reports, 8(1), 20–28. https://doi.org/10.1249/jsr.0b013e3181967ca6

Lehecka, B., Stoffregen, S., May, A., Thomas, J. K., Mettling, A., Hoover, J., Hafenstine, R., & Hakansson, N. H. (2021). Gluteal Muscle Activation During Common Yoga Poses. The International Journal of Sports Physical Therapy, 16(3). https://doi.org/10.26603/001c.22499

Li, Y., Liu, S., Jiang, J., & Yuan, S. (2019). Effects of yoga on patients with chronic nonspecific neck pain. Medicine, 98(8), e14649. https://doi.org/10.1097/md.0000000000014649

Liu, A., Chu, I., Lin, H., Liang, J., Hsu, H., & Wu, W. (2021). Training benefits and injury Risks of standing yoga applied in musculoskeletal problems: Lower limb Biomechanical analysis. International Journal of Environmental Research and Public Health, 18(16), 8402. https://doi.org/10.3390/ijerph18168402

Luo, X., & Xu, H. (2023). The effects of a yoga intervention on balance and flexibility in female college students during COVID-19: A randomized controlled trial. PLOS ONE, 18(3), e0282260. https://doi.org/10.1371/journal.pone.0282260

Lynn, S., & Basso, J. C. (2023). Development and validation of the multidimensional impacts of movement scale (MIMS) for yoga, weightlifting, and running. Frontiers in Psychology, 14. https://doi.org/10.3389/fpsyg.2023.1078996

Marcora, S. M. (2009). Perception of effort during exercise is independent of afferent feedback from skeletal muscles, heart, and lungs. Journal of Applied Physiology, 106(6), 2060–2062. https://doi.org/10.1152/japplphysiol.90378.2008

Mastun, S. N., Daud, D. M. A., & Nazarudin, M. N. (2020). Anthropometric and physical performance profiles of Sabah youth netball player. International Journal of Physical Education, Sports and Health, 7(4), 156–159. https://www.kheljournal.com/archives/2020/vol7issue4/PartC/7-4-31-614.pdf

McCLANAHAN, B. S. (2002, November 1). Side-To-Side comparisons of bone mineral density in upper and lower limbs of collegiate athletes. PubMed Central (PMC). https://www.ncbi.nlm.nih.gov/pmc/articles/

PMC5240784/
Mehta, P., & Sharma, M. (2010). Yoga as a Complementary Therapy for Clinical Depression. Complementary Health Practice Review, 15(3), 156–170. https://doi.org/10.1177/1533210110387405
Mohanty, S., Venkataramanujam, S., Pradhan, B., & Hankey, A. (2019). Development and validation of a yoga module for children with visual impairment: A feasibility study. British Journal of Visual Impairment, 37(1), 64–73. https://doi.org/10.1177/0264619618814069
Mosler, A. B., Carey, D. J., Thorborg, K., Weir, A., Eirale, C., Van Dyk, N., Hölmich, P., Whiteley, R., Gabbett, T. J., & Crossley, K. M. (2022). In Professional Male Soccer Players, Time-Loss Groin Injury Is More Associated With the Team Played for Than Training/Match Play Duration. Journal of Orthopaedic & Sports Physical Therapy, 1–26. https://doi.org/10.2519/jospt.2022.10845
Mount, S., Moore, I. S., & Ranson, C. (2014). INJURY TYPES AND RATES IN AN INTERNATIONAL CRICKET TEAM: APPLICATION OF SUBSEQUENT INJURY CATEGORISATION. British Journal of Sports Medicine, 48(7), 642.2-642. https://doi.org/10.1136/bjsports-2014-093494.218
Mouzan, M. I. E., Foster, P., Herbish, A. S. A., Salloum, A. a. A., Omer, A. A., Qurachi, M. M., & Kecojevic, T. (2010). Prevalence of overweight and obesity in Saudi children and adolescents. Annals of Saudi Medicine, 30(3), 203–208. https://doi.org/10.4103/0256-4947.62833
Muñoz-Vergara, D., Grabowska, W., Yeh, G. Y., Khalsa, S. B. S., Schreiber, K. L., Huang, C. A., Zavacki, A. M., & Wayne, P. M. (2022). A systematic review of in vivo stretching regimens on inflammation and its relevance to translational yoga research. PLOS ONE, 17(6), e0269300. https://doi.org/10.1371/journal.pone.0269300
Pallathadka, L. K., Pallathadka, H., Devi, T. B., & Pushparaj, N. (2022). An Empirical Study on the Importance of Karma Yoga in Modern Society. Integrated Journal for Research in Arts and Humanities, 2(6), 99–106. https://doi.org/10.55544/ijrah.2.6.13
Petrič, M., Vauhnik, R., & JakovljeviÄ, M. (2014). The Impact of Hatha Yoga Practice on Flexibility: A Pilot Study. Alternative & Integrative Medicine, 03(02). https://doi.org/10.4172/2327-5162.1000160
Pluim, B. M., Staal, J. B., Windler, G. E., & Jayanthi, N. (2006). Tennis injuries: occurrence, aetiology, and prevention. British Journal of Sports Medicine, 40(5), 415–423. https://doi.org/10.1136/bjsm.2005.023184
Rathore, M., Trivedi, S., Abraham, J., & Sinha, M. (2017). Anatomical correlation of core muscle activation in different yogic postures. International Journal of Yoga, 10(2), 59. https://doi.org/10.4103/0973-6131.205515
Raub, J. A. (2002). Psychophysiologic Effects of Hatha Yoga on Musculoskeletal and Cardiopulmonary Function: A Literature Review. Journal of Alternative and Complementary Medicine, 8(6), 797–812. https://doi.org/10.1089/10755530260511810
Roland, K. P., Jakobi, J. M., & Jones, G. (2011). Does Yoga Engender Fitness in Older Adults? A Critical Review. Journal of Aging and Physical Activity, 19(1), 62–79. https://doi.org/10.1123/japa.19.1.62
Ross, A., & Thomas, S. (2010). The Health Benefits of Yoga and Exercise: A Review of Comparison Studies. Journal of Alternative and Complementary Medicine, 16(1), 3–12. https://doi.org/10.1089/acm.2009.0044
Russell, C. M., Choo, A. M., Tetzlaff, W., Chung, T., & Oxland, T. R. (2012). Maximum Principal Strain Correlates with Spinal Cord Tissue Damage in Contusion and Dislocation Injuries in the Rat Cervical Spine. Journal of Neurotrauma, 29(8), 1574–1585. https://doi.org/10.1089/neu.2011.2225
Sahu, K., & Yadav, J. S. (2020). An experimental study on shooting ability of male archers: With reference to specific yoga exercises. International Journal of Physical Education, Sports and Health, 7(4), 153–155. https://www.kheljournal.com/archives/2020/vol7issue4/PartC/7-4-28-773.pdf
Sengupta, P. (2012). Health Impacts of Yoga and Pranayama: A State-of-the-Art Review. DOAJ (DOAJ: Directory of Open Access Journals). https://doaj.org/article/34aa65e60ffd404e8fb71bf0ef3e6726
Sharma, L. (2015). Benefits of Yoga in Sports –A Study. International Journal of Physical Education, Sports and Health, 1(3), 30–32. https://www.kheljournal.com/archives/2015/vol1issue3/PartA/29.1.pdf
Sharma, V., Trakroo, M., Subramaniam, V., M, R., Bhavanani, A. B., & Sahai, A. (2013). Effect of fast and slow pranayama on perceived stress and cardiovascular parameters in young health-care students. International Journal of Yoga, 6(2), 104. https://doi.org/10.4103/0973-6131.113400
Sharma, Y., Sharma, S. K., & Sharma, E. (2018). Scientific benefits of Yoga: A Review. Zenodo (CERN European Organization for Nuclear Research). https://doi.org/10.5281/zenodo.1341773
Shaw, A., & Kaytaz, E. S. (2021). Yoga bodies, yoga minds: contextualising the health discourses and practices of modern postural yoga. Anthropology and Medicine, 28(3), 279–296. https://doi.org/10.1080/13648470.2021.1949943
Smith, R. R., Shum-Siu, A., Baltzley, R., Bunger, M., Baldini, A. D., Burke, D. A., & Magnuson, D. S. (2006). Effects of Swimming on Functional Recovery after Incomplete Spinal Cord Injury in Rats. Journal of Neurotrauma, 23(6), 908–919. https://doi.org/10.1089/neu.2006.23.908
Solakoğlu, Ö., Karatekin, B. D., Yumuşakhuylu, Y., Mesci, E., & İçağasıoğlu, A. (2021). The effect of yoga Asana "Vrksasana (Tree pose)" on balance in patients with postmenopausal osteoporosis. American Journal of Physical Medicine & Rehabilitation, 101(3), 255–261. https://doi.org/10.1097/phm.0000000000001785
Taneja, D. K. (2014). Yoga and health. Indian Journal of Community Medicine, 39(2), 68. https://doi.org/10.4103/0970-0218.132716
Tekur, P., Nagarathna, R., Chametcha, S., Hankey, A., & Nagendra, H. R. (2012). A comprehensive yoga programs improves pain, anxiety and depression in chronic low back pain patients more than exercise: An RCT. Complementary Therapies in Medicine, 20(3), 107–118. https://doi.org/10.1016/j.ctim.2011.12.009
Telles, S., & Naveen, K. V. (2008). Voluntary Breath Regulation in Yoga: Its Relevance and Physiological Effects. Applied Psychophysiology and Biofeedback. http://www.resourcenter.net/images/AAPB/Files/Biofeedback/2008/biof_breathing_regulation.pdf
Telles, S., Gandharva, K., Sharma, S. K., Gupta, R. K., & Balkrishna, A. (2020). Body temperature and energy expenditure during and after yoga breathing practices traditionally described as cooling. Medical Science Monitor Basic Research, 26. https://doi.org/10.12659/msmbr.920107
Telles, S., Naveen, K., Dash, M., Deginal, R., & Manjunath, N. K. (2006). Effect of yoga on self-rated visual discomfort in computer users. Head & Face Medicine, 2(1). https://doi.org/10.1186/1746-160x-2-46
Thornton, J. S., Vinther, A., Wilson, F., Lebrun, C. M., Wilkinson, M., Di Ciacca, S. R., Orlando, K., & Smoljanović, T. (2016). Rowing Injuries: An updated review. Sports Medicine, 47(4), 641–661. https://doi.org/10.1007/s40279-016-0613-y
Tracy, B. L., & Hart, C. E. F. (2013). Bikram Yoga Training and Physical Fitness in Healthy Young Adults. Journal of Strength and Conditioning Research, 27(3), 822–830. https://doi.org/10.1519/jsc.0b013e31825c340f
Tran, M. D., Holly, R. G., Lashbrook, J., & Amsterdam, E. A. (2001). Effects of hatha yoga practice on the Health-Related aspects of physical fitness. Preventive Cardiology, 4(4), 165–170. https://doi.org/10.1111/j.1520-037x.2001.00542.x
Vaidik, J., Vaidik, S. K., & Sharma, K. (2020). MANTRA YOGA: A TOOL FOR A HEALTHY MIND. Journal of Biomedical and Pharmaceutical Research. https://doi.org/10.32553/jbpr.v9i1.715
Yamauchi, T., Abe, T., Midorikawa, T., & Kondo, M. (2004). Body composition and resting metabolic rate of Japanese college Sumo wrestlers and non-athlete students: are Sumo wrestlers obese? Anthropological Science, 112(2), 179–185. https://doi.org/10.1537/ase.040210
Zaccaro, A., Piarulli, A., Laurino, M., Garbella, E., Menicucci, D., Neri, B., & Gemignani, A. (2018). How Breath-Control Can Change Your Life: A systematic review on Psycho-Physiological correlates of slow breathing. Frontiers in Human Neuroscience, 12. https://doi.org/10.3389/fnhum.2018.00353
Zhu, R., Wang, W., Li, H., & Mao, S. (2021). Comparisons of tai chi and Iyengar yoga intervention effects on muscle strength, balance, and confidence in balance. Journal of Sports Medicine and Physical Fitness, 61(10). https://doi.org/10.23736/s0022-4707.20.11752-3

Guidelines for Authors

Revised October 2017

*** Please use the bookmark function to navigate within the guidelines. ***

When preparing the final version of the manuscripts, either NEW or REVISED authors should strictly follow the guidelines. Manuscripts departing substantially from the guidelines will be returned to the authors for revision or, rejected.

1. UNIFORM REQUIREMENTS

1.1. Overview

The *Journal of Anthropology of Sport and Physical Education* (JASPE) applies the Creative Commons Attribution (CC BY) license to articles and other works it publishes.

There is no charge for submissions and no page charge for accepted manuscripts. However, if the manuscript contains graphics in color, note that printing in color is charged.

JASPE adopts a double-blind approach for peer reviewing in which the reviewer's name is always concealed from the submitting authors as well as the author(s)'s name from the selected reviewers.

JASPE honors six-weeks for an initial decision of manuscript submission.

Authors should submit the manuscripts as one Microsoft Word (.doc) file.

Manuscripts must be provided either in standard UK or US English or Montenegrin language. Chosen language standards should be consistent throughout the manuscripts.

Format the manuscript in A4 paper size; margins are 1 inch or 2.5 cm all around.

Type the whole manuscript double-spaced, justified alignment.

Use Times New Roman font, size eleven (11) point.

Number (Arabic numerals) the pages consecutively (centering at the bottom of each page), beginning with the title page as page 1 and ending with the Figure legend page.

Include line numbers (continuous) for the convenience of the reviewers.

Apart from chapter headings and sub-headings avoid any kind of formatting in the main text of the manuscripts.

1.2. Type & Length

JASPE publishes following types of papers:

Original scientific papers are the results of empirically- or theoretically-based scientific research, which employ scientific methods, and which report experimental or observational aspects of anthropology of sport and physical education from five major fields of anthropology: cultural, global, biological, linguistic and medical. Descriptive analyses or data inferences should include rigorous methodological structure as well as sound theory. Your manuscript should include the following sections: Introduction, Methods, Results, and Discussion.

☑Open Submissions ☑Indexed ☑Peer Reviewed

Original scientific papers should be:

- Up to 3000 words (excluding title, abstract, tables/figures, figure legends, Acknowledgements, Conflict of Interest, and References);
- A structured abstract of less than 250 words;
- Maximum number of references is 30;
- Maximum combined total of 6 Tables/Figures.

Review papers should provide concise in-depth reviews of both established and new areas, based on a critical examination of the literature, analyzing the various approaches to a specific topic in all aspects of anthropology of sport and physical education from five major fields of anthropology: cultural, global, biological, linguistic and medical.

☑Open Submissions ☑Indexed ☑Peer Reviewed

Review papers should be:
- Up to 6000 words (excluding title, abstract, tables/figures, figure legends, Acknowledgements, Conflict of Interest, and References);
- A structured abstract of less than 250 words;
- Maximum number of references is 100.

Editorials are written or commissioned by the editors, but suggestions for possible topics and authors are welcome. It could be peer reviewed by two reviewers who may be external or by the Editorial Board.

☐Open Submissions ☑Indexed ☑Peer Reviewed

Editorials should be:
- Up to 1000 words (excluding title, abstract, tables/figures, figure legends, Acknowledgements, Conflict of Interest, and References);
- A structured abstract of less than 250 words;
- Maximum number of references is 10.

Short reports of experimental work, new methods, or a preliminary report can be accepted as two page papers. Your manuscript should include the following sections: Introduction, Methods, Results, and Discussion.

☑Open Submissions ☑Indexed ☑Peer Reviewed

Short reports should be:
- Up to 1500 words (excluding title, abstract, tables/figures, figure legends, Acknowledgements, Conflict of Interest, and References);
- A structured abstract of less than 250 words;
- Maximum number of references is 15.

Peer review - fair review provides authors who feel their paper has been unfairly rejected (at any journal) the opportunity to share reviewer comments, explain their concerns, and have their paper reviewed for possible publication in JASPE.

☑Open Submissions ☑Indexed ☐Peer Reviewed

Peer review - fair review should be:
- Up to 1500 words (excluding title, abstract, tables/figures, figure legends, Acknowledgements, Conflict of Interest, and References);
- A structured abstract of less than 250 words;
- Maximum number of references is 15.

Invited papers and award papers include invited papers from authors with outstanding scientific credentials. Nomination of invited authors is at the discretion of the JASPE editorial board. JASPE also publishes award papers selected by the scientific committee of the publisher's conferences.

☐Open Submissions ☑Indexed ☐Peer Reviewed

Invited papers and award papers should be:
- Up to 3000 words (excluding title, abstract, tables/figures, figure legends, Acknowledgements, Conflict of Interest, and References);
- A structured abstract of less than 250 words;
- Maximum number of references is 30;
- Maximum combined total of 6 Tables/Figures.

1.3. Submission

JASPE only accepts electronic submission to the e-mail of the Journal Office: **office.jaspe.mne@gmail.com; vasileva.jaspe@gmail.com**.

Submitted material includes:

- A manuscript prepared according to the Guidelines for the Authors;
- A signed form that states the study was not previously published, nor has been submitted simultaneously for consideration of publication elsewhere, that states that all of the authors are in agreement with submission of the manuscript to JASPE, and that, for studies that use animal or human individuals, authors must include information regarding their institution's ethics committee, and which identifies the official approval number;
- A signed form that there is no conflict of interest.

Name the files according to the family name of the first author. Authors submitting revised versions of the manuscript can use the identification number of their manuscript as provided by the Journal Office. *See* example:

- ✓ FAMILY NAME-manuscript.doc – (main manuscript file)
- ✓ FAMILY NAME-statement.PDF – (authorship statement)
- ✓ FAMILY NAME-declaration.PDF – (declaration of potential conflict of interest)
- ✓ FAMILY NAME-fig1.tiff – (Figure 1)

1.4. Peer Review Process

A manuscript submitted for publication will be submitted to the review process as long as it fits the following criteria:

- The study was not previously published, nor has been submitted simultaneously for consideration of publication elsewhere;
- All persons listed as authors approved its submission to JASPE;
- Any person cited as a source of personal communication has approved the quote;
- The opinions expressed by the authors are their exclusive responsibility;
- The author signs a formal statement that the submitted manuscript complies with the directions and guidelines of JASPE.

The editors-in-chief and associate editors will make a preliminary analysis regarding the appropriateness, quality, originality and written style/grammar of the submitted manuscript. The editors reserve the right to request additional information, corrections, and guideline compliance before they submit the manuscript to the ad-hoc review process.

JASPE uses ad-hoc reviewers, who volunteer to analyze the merit of the study. Typically, one or two expert reviewers are consulted in a double-blind process. Authors are notified by e-mail when their submission has been accepted (or rejected). Minor changes in the text may be made at the discretion of the editors-in-chief and/or associate editors. Changes can include spelling and grammar in the chosen language, written style, journal citations, and reference guidelines. The author is notified of changes via email. The final version is available to the author for his or her approval before it is published.

1.5. Open Access License and Publisher Copyright Policies

JASPE applies the Creative Commons Attribution (CC BY) license to articles and other works it publishes. If author(s) submit its paper for publication by JASPE, they agree to have the CC BY license applied to their work. Under this Open Access license, the author(s) agree that anyone can reuse their article in whole or part for any purpose, for free, even for commercial purposes. Anyone may copy, distribute, or reuse the content as long as the author(s) and original source are properly cited. This facilitates freedom in re-use and also ensures that JASPE content can be mined without barriers for the needs of research. On the other hand, the author(s) may use content owned by someone else in their article if they have written permission to do so. If the manuscript contains content such as photos, images, figures, tables, audio files, videos, et cetera, that the author(s) do not own, JASPE will require them to provide it with proof that the owner of that content has given them written permission to use it, and has approved of the CC BY license being applied to their content. Otherwise, JASPE will ask the author(s) to remove that content and/or replace it with other content that you own or have such permission to use. JASPE provides a form the author(s) can use to ask for and obtain permission from the owner.

In addition, the author(s) may freely use the content they previously published in a paper through another publisher and they own the rights to that content; however, that's not necessarily the case and it depends on the license that covers the other paper. Some publishers allow free and unrestricted reuse of article content they own, such as under the CC BY

license. Other publishers use licenses that allow reuse only if the same license is applied by the person or publisher reusing the content. If the article was published under a CC BY license or another license that allows free and unrestricted use, the author(s) may use the content in the submitted manuscript provided that the author(s) give proper attribution, as explained above. If the content was published under a more restrictive license, the author(s) must ascertain what rights they have under that license. JASPE advices the author(s) not to include any content in the submitted manuscript which they do not have rights to use, and always give proper attribution.

The editors of JASPE consider plagiarism to be a serious breach of academic ethics. Any author who practices plagiarism (in part or totality) will be suspended for six years from submitting new submissions to JASPE. If such a manuscript is approved and published, public exposure of the article with a printed mark ("plagiarized" or "retracted") on each page of the published file, as well as suspension for future publication for at least six years, or a period determined by the editorial board. Third party plagiarized authors or institutions will be notified, informing them about the faulty authors. Plagiarism will result in immediate rejection of the manuscript.

JASPE only publishes studies that have been approved by an institutional ethics committee (when a study involves humans or animals). Fail to provide such information prevent its publication. To ensure these requirements, it is essential that submission documentation is complete. If you have not completed this step yet, go to JASPE website and fill out the two required documents: Declaration of Potential Conflict of Interest and Authorship Statement. Whether or not your study uses humans or animals, these documents must be completed and signed by all authors and attached as supplementary files in the originally submitted manuscript.

1.6. After Acceptance

After the manuscript has been accepted, authors will receive a PDF version of the manuscripts for authorization, as it should look in printed version of JASPE. Authors should carefully check for omissions. Reporting errors after this point will not be possible and the Editorial Board will not be eligible for them.

Should there be any errors, authors should report them to the Office e-mail address **jaspe@ucg.ac.me.** If there are not any errors authors should also write a short e-mail stating that they agree with the received version.

1.7. Code of Conduct Ethics Committee of Publications

JASPE is hosting the Code of Conduct Ethics Committee of Publications of the **COPE** (the Committee on Publication Ethics), which provides a forum for publishers and Editors of scientific journals to discuss issues relating to the integrity of the work submitted to or published in their journals.

2. MANUSCRIPT STRUCTURE

2.1. Title Page

The first page of the manuscripts should be the title page, containing: title, type of publication, running head, authors, affiliations, corresponding author, and manuscript information. *See* example:

Analysis of Dietary Intake and Body Composition of Female Athletes over a Competitive Season

Original Scientific Paper

Diet and Body Composition of Female Athletes

Svetlana Nepocatych[1], Gytis Balilionis[1], Eric K. O'Neal[2]

[1]Elon University, Department of Exercise Science1, Elon, NC 27215
[2]University of North Alabama, Department of Health, Physical Education and Recreation, Florence, AL 35632

Corresponding author:

S. Nepocatych

Elon University

Department of Exercise Science

100 Campus Dr.

2525 CB

Elon, NC 27244

United States

E-mail: snepocatych@elon.edu

Word count: 2,946

Word count: 4259

Abstract word count: 211

Number of Tables: 3

2.1.1. Title

Title should be short and informative and the recommended length is no more than 20 words. The title should be in Title Case, written in uppercase and lowercase letters (initial uppercase for all words except articles, conjunctions, short prepositions no longer than four letters etc.) so that first letters of the words in the title are capitalized. Exceptions are words like: "and", "or", "between" etc. The word following a colon (:) or a hyphen (-) in the title is always capitalized.

2.1.2. Type of publication

Authors should suggest the type of their submission.

2.1.3. Running head

Short running title should not exceed 50 characters including spaces.

2.1.4. Authors

The form of an author's name is first name, middle initial(s), and last name. In one line list all authors with full names separated by a comma (and space). Avoid any abbreviations of academic or professional titles. If authors belong to different institutions, following a family name of the author there should be a number in superscript designating affiliation.

2.1.5. Affiliations

Affiliation consists of the name of an institution, department, city, country/territory (in this order) to which the author(s) belong and to which the presented / submitted work should be attributed. List all affiliations (each in a separate line) in the order corresponding to the list of authors. Affiliations must be written in English, so carefully check the official English translation of the names of institutions and departments.

Only if there is more than one affiliation, should a number be given to each affiliation in order of appearance. This number should be written in superscript at the beginning of the line, separated from corresponding affiliation with a space. This number should also be put after corresponding name of the author, in superscript with no space in between.

If an author belongs to more than one institution, all corresponding superscript digits, separated with a comma with no space in between, should be present behind the family name of this author.

In case all authors belong to the same institution affiliation numbering is not needed.

Whenever possible expand your authors' affiliations with departments, or some other, specific and lower levels of organization.

2.1.6. Corresponding author

Corresponding author's name with full postal address in English and e-mail address should appear, after the affiliations. It is preferred that submitted address is institutional and not private. Corresponding author's name should include only initials of the first and middle names separated by a full stop (and a space) and the last name. Postal address should be written in the following line in sentence case. Parts of the address should be separated by a comma instead of a line break. E-mail (if possible) should be placed in the line following the postal address. Author should clearly state whether or not the e-mail should be published.

2.1.7. Manuscript information

All authors are required to provide word count (excluding title page, abstract, tables/figures, figure legends, Acknowledgements, Conflict of Interest, and References), the Abstract word count, the number of Tables, and the number of Figures.

2.2. Abstract

The second page of the manuscripts should be the abstract and key words. It should be placed on second page of the manuscripts after the standard title written in upper and lower case letters, bold.

Since abstract is independent part of your paper, all abbreviations used in the abstract should also be explained in it. If an abbreviation is used, the term should always be first written in full with the abbreviation in parentheses immediately after it. Abstract should not have any special headings (e.g., Aim, Results…).

Authors should provide up to six key words that capture the main topics of the article. Terms from the Medical Subject Headings (MeSH) list of Index Medicus are recommended to be used.

Key words should be placed on the second page of the manuscript right below the abstract, written in italic. Separate each key word by a comma (and a space). Do not put a full stop after the last key word. *See* example:

Abstract

Results of the analysis of

Key words: *spatial memory, blind, transfer of learning, feedback*

2.3. Main Chapters

Starting from the third page of the manuscripts, it should be the main chapters. Depending on the type of publication main manuscript chapters may vary. The general outline is: Introduction, Methods, Results, Discussion, Acknowledgements (optional), Conflict of Interest (optional), and Title, Author's Affiliations, Abstract and Key words must be in English (for both each chosen language of full paper). However, this scheme may not be suitable for reviews or publications from some areas and authors should then adjust their chapters accordingly but use the general outline as much as possible.

2.3.1. Headings

Main chapter headings: written in bold and in Title Case. *See* example:

- ✓ **Methods**

Sub-headings: written in italic and in normal sentence case. Do not put a full stop or any other sign at the end of the title. Do not create more than one level of sub-heading. *See* example:

- ✓ *Table position of the research football team*

2.3.2 Ethics

When reporting experiments on human subjects, there must be a declaration of Ethics compliance. Inclusion of a statement such as follow in Methods section will be understood by the Editor as authors' affirmation of compliance: "This study was approved in advance by [name of committee and/or its institutional sponsor]. Each participant voluntarily provided written informed consent before participating." Authors that fail to submit an Ethics statement will be asked to resubmit the manuscripts, which may delay publication.

2.3.3 Statistics reporting

JASPE encourages authors to report precise p-values. When possible, quantify findings and present them with appropriate indicators of measurement error or uncertainty (such as confidence intervals). Use normal text (i.e., non-capitalized, non-italic) for statistical term "p".

2.3.4. 'Acknowledgements' and 'Conflict of Interest' (optional)

All contributors who do not meet the criteria for authorship should be listed in the 'Acknowledgements' section. If applicable, in 'Conflict of Interest' section, authors must clearly disclose any grants, financial or material supports, or any sort of technical assistances from an institution, organization, group or an individual that might be perceived as leading to a conflict of interest.

2.4. References

References should be placed on a new page after the standard title written in upper and lower case letters, bold.

All information needed for each type of must be present as specified in guidelines. Authors are solely responsible for accuracy of each reference. Use authoritative source for information such as Web of Science, Medline, or PubMed to check the validity of citations.

2.4.1. References style

JASPE adheres to the American Psychological Association 6th Edition reference style. Check "American Psychological Association. (2009). Concise rules of APA style. American Psychological Association." to ensure the manuscripts conform to this reference style. Authors using EndNote® to organize the references must convert the citations and bibliography to plain text before submission.

2.4.2. Examples for Reference citations

One work by one author
- ✓ In one study (Reilly, 1997), soccer players
- ✓ In the study by Reilly (1997), soccer players
- ✓ In 1997, Reilly's study of soccer players

Works by two authors
- ✓ Duffield and Marino (2007) studied
- ✓ In one study (Duffield & Marino, 2007), soccer players
- ✓ In 2007, Duffield and Marino's study of soccer players

Works by three to five authors: cite all the author names the first time the reference occurs and then subsequently include only the first author followed by et al.
- ✓ First citation: Bangsbo, Iaia, and Krustrup (2008) stated that
- ✓ Subséquent citation: Bangsbo et al. (2008) stated that

Works by six or more authors: cite only the name of the first author followed by et al. and the year
- ✓ Krustrup et al. (2003) studied
- ✓ In one study (Krustrup et al., 2003), soccer players

Two or more works in the same parenthetical citation: Citation of two or more works in the same parentheses should be listed in the order they appear in the reference list (i.e., alphabetically, then chronologically)
- ✓ Several studies (Bangsbo et al., 2008; Duffield & Marino, 2007; Reilly, 1997) suggest that

2.4.3. Examples for Reference list

Journal article (print):

Nepocatych, S., Balilionis, G., & O'Neal, E. K. (2017). Analysis of dietary intake and body composition of female athletes over a competitive season. *Montenegrin Journal of Sports Science and Medicine, 6*(2), 57-65. doi: 10.26773/mjssm.2017.09.008

Duffield, R., & Marino, F. E. (2007). Effects of pre-cooling procedures on intermittent-sprint exercise performance in warm conditions. *European Journal of Applied Physiology, 100*(6), 727-735. doi: 10.1007/s00421-007-0468-x

Krustrup, P., Mohr, M., Amstrup, T., Rysgaard, T., Johansen, J., Steensberg, A., Bangsbo, J. (2003). The yo-yo intermittent recovery test: physiological response, reliability, and validity. *Medicine and Science in Sports and Exercise, 35*(4), 697-705. doi: 10.1249/01.MSS.0000058441.94520.32

Journal article (online; electronic version of print source):

Williams, R. (2016). Krishna's Neglected Responsibilities: Religious devotion and social critique in eighteenth-century North India [Electronic version]. *Modern Asian Studies, 50*(5), 1403-1440. doi:10.1017/S0026749X14000444

Journal article (online; electronic only):

Chantavanich, S. (2003, October). Recent research on human trafficking. *Kyoto Review of Southeast Asia, 4*. Retrieved November 15, 2005, from http://kyotoreview.cseas.kyoto-u.ac.jp/issue/issue3/index.html

Conference paper:

Pasadilla, G. O., & Milo, M. (2005, June 27). *Effect of liberalization on banking competition*. Paper presented at the conference on Policies to Strengthen Productivity in the Philippines, Manila, Philippines. Retrieved August 23, 2006, from http://siteresources.worldbank.org/INTPHILIPPINES/Resources/Pasadilla.pdf

Encyclopedia entry (print, with author):

Pittau, J. (1983). Meiji constitution. In *Kodansha encyclopedia of Japan* (Vol. 2, pp. 1-3). Tokyo: Kodansha.

Encyclopedia entry (online, no author):

Ethnology. (2005, July). In *The Columbia encyclopedia* (6th ed.). New York: Columbia University Press. Retrieved November 21, 2005, from http://www.bartleby.com/65/et/ethnolog.html

Thesis and dissertation:

Pyun, D. Y. (2006). *The proposed model of attitude toward advertising through sport.* Unpublished Doctoral Dissertation. Tallahassee, FL: The Florida State University.

Book:
Borg, G. (1998). *Borg's perceived exertion and pain scales*: Human kinetics.

Chapter of a book:
Kellmann, M. (2012). Chapter 31-Overtraining and recovery: Chapter taken from Routledge Handbook of Applied Sport Psychology ISBN: 978-0-203-85104-3 *Routledge Online Studies on the Olympic and Paralympic Games* (Vol. 1, pp. 292-302).

Reference to an internet source:
Agency. (2007). Water for Health: Hydration Best Practice Toolkit for Hospitals and Healthcare. Retrieved 10/29, 2013, from www.rcn.org.uk/newsevents/hydration

2.5. Tables

All tables should be included in the main manuscript file, each on a separate page right after the Reference section.

Tables should be presented as standard MS Word tables.

Number (Arabic) tables consecutively in the order of their first citation in the text.

Tables and table headings should be completely intelligible without reference to the text. Give each column a short or abbreviated heading. Authors should place explanatory matter in footnotes, not in the heading. All abbreviations appearing in a table and not considered standard must be explained in a footnote of that table. Avoid any shading or coloring in your tables and be sure that each table is cited in the text.

If you use data from another published or unpublished source, it is the authors' responsibility to obtain permission and acknowledge them fully.

2.5.1. Table heading

Table heading should be written above the table, in Title Case, and without a full stop at the end of the heading. Do not use suffix letters (e.g., Table 1a, 1b, 1c); instead, combine the related tables. *See* example:

- ✓ **Table 1.** Repeated Sprint Time Following Ingestion of Carbohydrate-Electrolyte Beverage

2.5.2. Table sub-heading

All text appearing in tables should be written beginning only with first letter of the first word in all capitals, i.e., all words for variable names, column headings etc. in tables should start with the first letter in all capitals. Avoid any formatting (e.g., bold, italic, underline) in tables.

2.5.3. Table footnotes

Table footnotes should be written below the table.

General notes explain, qualify or provide information about the table as a whole. Put explanations of abbreviations, symbols, etc. here. General notes are designated by the word *Note* (italicized) followed by a period.

- ✓ *Note.* CI: confidence interval; Con: control group; CE: carbohydrate-electrolyte group.

Specific notes explain, qualify or provide information about a particular column, row, or individual entry. To indicate specific notes, use superscript lowercase letters (e.g. $^{a, b, c}$), and order the superscripts from left to right, top to bottom. Each table's first footnote must be the superscript ^{a}.

- ✓ ^{a}One participant was diagnosed with heat illness and n = 19.^{b}n =20.

Probability notes provide the reader with the results of the texts for statistical significance. Probability notes must be indicated with consecutive use of the following symbols: * † ‡ § ¶ || etc.

- ✓ *P<0.05,†p<0.01.

2.5.4. Table citation

In the text, tables should be cited as full words. *See* example:

- ✓ Table 1 (first letter in all capitals and no full stop)
- ✓ ...as shown in Tables 1 and 3. (citing more tables at once)
- ✓ ...result has shown (Tables 1-3) that... (citing more tables at once)
- ✓ ....in our results (Tables 1, 2 and 5)... (citing more tables at once)

2.6. Figures

On the last separate page of the main manuscript file, authors should place the legends of all the figures submitted separately.

All graphic materials should be of sufficient quality for print with a minimum resolution of 600 dpi. JASPE prefers TIFF, EPS and PNG formats.

If a figure has been published previously, acknowledge the original source and submit a written permission from the copyright holder to reproduce the material. Permission is required irrespective of authorship or publisher except for documents in the public domain. If photographs of people are used, either the subjects must not be identifiable or their pictures must be accompanied by written permission to use the photograph whenever possible permission for publication should be obtained.

Figures and figure legends should be completely intelligible without reference to the text.

The price of printing in color is 50 EUR per page as printed in an issue of JASPE.

2.6.1. Figure legends

Figures should not contain footnotes. All information, including explanations of abbreviations must be present in figure legends. Figure legends should be written bellow the figure, in sentence case. *See* example:

- ✓ **Figure 1.** Changes in accuracy of instep football kick measured before and after fatigued. SR – resting state, SF – state of fatigue, *p>0.01, †p>0.05.

2.6.2. Figure citation

All graphic materials should be referred to as Figures in the text. Figures are cited in the text as full words. *See* example:

- ✓ Figure 1
  - × figure 1
  - × Figure 1.
  - ✓ ….exhibit greater variance than the year before (Figure 2). Therefore…
  - ✓ ….as shown in Figures 1 and 3. (citing more figures at once)
  - ✓ ….result has shown (Figures 1-3) that... (citing more figures at once)
  - ✓ ….in our results (Figures 1, 2 and 5)... (citing more figures at once)

2.6.3. Sub-figures

If there is a figure divided in several sub-figures, each sub-figure should be marked with a small letter, starting with a, b, c etc. The letter should be marked for each subfigure in a logical and consistent way. *See* example:

- ✓ Figure 1a
- ✓ …in Figures 1a and b we can…
- ✓ …data represent (Figures 1a-d)…

2.7. Scientific Terminology

All units of measures should conform to the International System of Units (SI).

Measurements of length, height, weight, and volume should be reported in metric units (meter, kilogram, or liter) or their decimal multiples.

Decimal places in English language are separated with a full stop and not with a comma. Thousands are separated with a comma.

Percentage	Degrees	All other units of measure	Ratios	Decimal numbers
✓ 10%	✓ 10º	✓ 10 kg	✓ 12:2	✓ 0.056
× 10 %	× 10 º	× 10kg	× 12 : 2	× .056

Signs should be placed immediately preceding the relevant number.		
✓ 45±3.4	✓ p<0.01	✓ males >30 years of age
× 45 ± 3.4	× p < 0.01	× males > 30 years of age

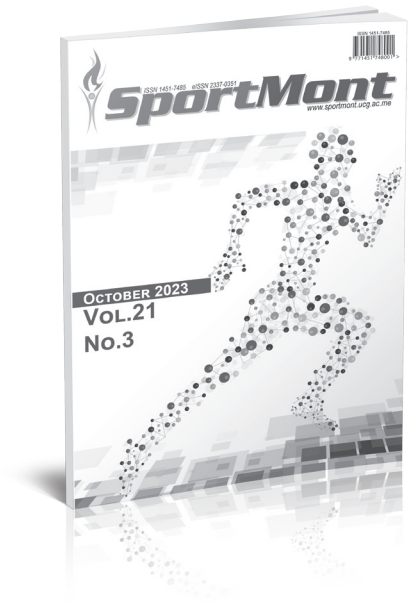
2.8. Latin Names

Latin names of species, families etc. should be written in italics (even in titles). If you mention Latin names in your abstract they should be written in non-italic since the rest of the text in abstract is in italic. The first time the name of a species appears in the text both genus and species must be present; later on in the text it is possible to use genus abbreviations. *See* example:

- ✓ First time appearing: *musculus biceps brachii*

Abbreviated: *m. biceps brachii*

ISSN 1451-7485 eISSN 2337-0351
SportMont
www.sportmont.ucg.ac.me



ISSN 1451-7485

Sport Mont Journal (SMJ) is a print (ISSN 1451-7485) and electronic scientific journal (eISSN 2337-0351) aims to present easy access to the scientific knowledge for sport-conscious individuals using contemporary methods. The purpose is to minimize the problems like the delays in publishing process of the articles or to acquire previous issues by drawing advantage from electronic medium. Hence, it provides:

- Open-access and freely accessible online;
- Fast publication time;
- Peer review by expert, practicing researchers;
- Post-publication tools to indicate quality and impact;
- Community-based dialogue on articles;
- Worldwide media coverage.

SMJ is published three times a year, in February, June and October of each year. SMJ publishes original scientific papers, review papers, editorials, short reports, peer review - fair review, as well as invited papers and award papers in the fields of Sports Science and Medicine, as well as it can function as an open discussion forum on significant issues of current interest.

SMJ covers all aspects of sports science and medicine; all clinical aspects of exercise, health, and sport; exercise physiology and biophysical investigation of sports performance; sport biomechanics; sports nutrition; rehabilitation, physiotherapy; sports psychology; sport pedagogy, sport history, sport philosophy, sport sociology, sport management; and all aspects of scientific support of the sports coaches from the natural, social and humanistic side.

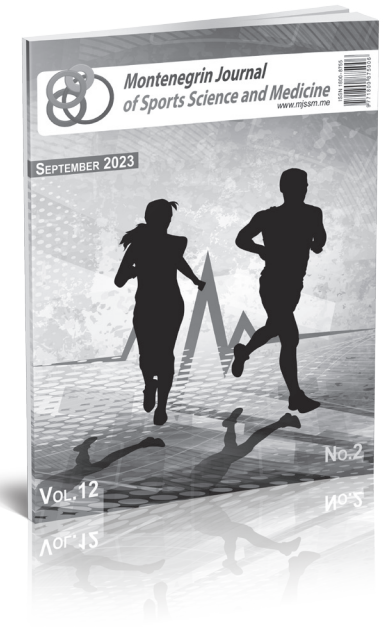
Prospective authors should submit manuscripts for consideration in Microsoft Word-compatible format. For more complete descriptions and submission instructions, please access the Guidelines for Authors pages at the SMJ website: http://www.sportmont.ucg.ac.me/?sekcija=page&p=51. Contributors are urged to read SMJ's guidelines for the authors carefully before submitting manuscripts. Manuscripts submissions should be sent in electronic format to sportmont@ucg.ac.me or contact following Editors:

Dusko BJELICA, Editor-in Chief – sportmont@t-com.me
Zoran MILOSEVIC, Editor-in Chief – zoranais@eunet.rs
Borko KATANIC, Managing Editor – borkokatanic@gmail.com
Nedim COVIC, Managing Editor – nedimcovic@gmail.com

Publication date: Winter issue – February 2024
Summer issue – June 2024
Autumn issue – October 2024

Montenegrin Journal of Sports Science and Medicine

MONTENEGRIN JOURNAL OF SPORTS SCIENCE AND MEDICINE



ISSN 1800-8755

CALL FOR CONTRIBUTIONS

Montenegrin Journal of Sports Science and Medicine (MJSSM) is a print (ISSN 1800-8755) and electronic scientific journal (eISSN 1800-8763) aims to present easy access to the scientific knowledge for sport-conscious individuals using contemporary methods. The purpose is to minimize the problems like the delays in publishing process of the articles or to acquire previous issues by drawing advantage from electronic medium. Hence, it provides:

- Open-access and freely accessible online;
- Fast publication time;
- Peer review by expert, practicing researchers;
- Post-publication tools to indicate quality and impact;
- Community-based dialogue on articles;
- Worldwide media coverage.

MJSSM is published biannually, in September and March of each year. MJSSM publishes original scientific papers, review papers, editorials, short reports, peer review - fair review, as well as invited papers and award papers in the fields of Sports Science and Medicine, as well as it can function as an open discussion forum on significant issues of current interest.

MJSSM covers all aspects of sports science and medicine; all clinical aspects of exercise, health, and sport; exercise physiology and biophysical investigation of sports performance; sport biomechanics; sports nutrition; rehabilitation, physiotherapy; sports psychology; sport pedagogy, sport history, sport philosophy, sport sociology, sport management; and all aspects of scientific support of the sports coaches from the natural, social and humanistic side.

Prospective authors should submit manuscripts for consideration in Microsoft Word-compatible format. For more complete descriptions and submission instructions, please access the Guidelines for Authors pages at the MJSSM website: http://www.mjssm.me/?sekcija=page&p=51. Contributors are urged to read MJSSM's guidelines for the authors carefully before submitting manuscripts. Manuscripts submissions should be sent in electronic format to office@mjssm.me or contact following Editors:

Dusko BJELICA, Editor-in Chief – sportmont@t-com.me
Damir SEKULIC, Editor-in Chief – damirsekulic.mjssm@gmail.com

Publication date: Spring issue – March 2024
Autumn issue – September 2024

MONTENEGRIN SPORTS ACADEMY

Founded in 2003 in Podgorica (Montenegro), the Montenegrin Sports Academy (MSA) is a sports scientific society dedicated to the collection, generation and dissemination of scientific knowledge at the Montenegrin level and beyond.

The Montenegrin Sports Academy (MSA) is the leading association of sports scientists at the Montenegrin level, which maintains extensive co-operation with the corresponding associations from abroad. The purpose of the MSA is the promotion of science and research, with special attention to sports science across Montenegro and beyond. Its topics include motivation, attitudes, values and responses, adaptation, performance and health aspects of people engaged in physical activity and the relation of physical activity and lifestyle to health, prevention and aging. These topics are investigated on an interdisciplinary basis and they bring together scientists from all areas of sports science, such as adapted physical activity, biochemistry, biomechanics, chronic disease and exercise, coaching and performance, doping, education, engineering and technology, environmental physiology, ethics, exercise and health, exercise, lifestyle and fitness, gender in sports, growth and development, human performance and aging, management and sports law, molecular biology and genetics, motor control and learning, muscle mechanics and neuromuscular control, muscle metabolism and hemodynamics, nutrition and exercise, overtraining, physiology, physiotherapy, rehabilitation, sports history, sports medicine, sports pedagogy, sports philosophy, sports psychology, sports sociology, training and testing.

The MSA is a non-profit organization. It supports Montenegrin institutions, such as the Ministry of Education and Sports, the Ministry of Science and the Montenegrin Olympic Committee, by offering scientific advice and assistance for carrying out coordinated national and European research projects defined by these bodies. In addition, the MSA serves as the most important Montenegrin and regional network of sports scientists from all relevant subdisciplines.

The main scientific event organized by the Montenegrin Sports Academy (MSA) is the annual conference held in the first week of April.

Annual conferences have been organized since the inauguration of the MSA in 2003. Today the MSA conference ranks among the leading sports scientific congresses in the Western Balkans. The conference comprises a range of invited lecturers, oral and poster presentations from multi- and mono-disciplinary areas, as well as various types of workshops. The MSA conference is attended by national, regional and international sports scientists with academic careers. The MSA conference now welcomes up to 200 participants from all over the world.

It is our great pleasure to announce the upcoming 21th Annual Scientific Conference of Montenegrin Sports Academy “Sport, Physical Activity and Health: Contemporary Perspectives” to be held in Dubrovnik, Croatia, from 18 to 21 April, 2024. It is planned to be once again organized by the Montenegrin Sports Academy, in cooperation with the Faculty of Sport and Physical Education, University of Montenegro and other international partner institutions (specified in the partner section).

The conference is focused on very current topics from all areas of sports science and sports medicine including physiology and sports medicine, social sciences and humanities, biomechanics and neuromuscular (see Abstract Submission page for more information).

We do believe that the topics offered to our conference participants will serve as a useful forum for the presentation of the latest research, as well as both for the theoretical and applied insight into the field of sports science and sports medicine disciplines.

USEFUL CONTACTS

Editorial enquiries and journal proposals:
Dusko Bjelica
Damir Sekulic
Editors-in-Chief
Email: **damirsekulic.mjssm@gmail.com**

Selcuk Akpinar
Executive Editor
Email: **office@mjssm.me**

Marketing enquiries:
Fidanka Vasileva
Marketing Manager
Email: **damirsekulic.mjssm@gmail.com**

Sports Science and Medicine Journals
from Montenegrin Sports Academy

We have expanded the quality of our journals considerably over the past years and can now claim to be the market leader in terms of breadth of coverage.

As we continue to increase the quality of our publications across the field, we hope that you will continue to regard MSA journals as authoritative and stimulating sources for your research. We would be delighted to receive your comments and suggestions, mostly due to the reason your proposals are always welcome.

Look Inside!

Sport Mont Journal

Editors-in-Chief: **Dusko Bjelica**, Montenegro; **Zoran Milosevic**, Serbia
Managing Editor: **Borko Katanic**, Montenegro; **Nedim Covic**, Bosnia and Herzegovina

Volume 21, 2023, 3 issues per year; Print ISSN: 1451-7485, Online ISSN: 2337-0351

Sport Mont Journal is a scientific journal that provides: Open-access and freely accessible online; Fast publication time; Peer review by expert, practicing researchers; Post-publication tools to indicate quality and impact; Community-based dialogue on articles; Worldwide media coverage. SMJ is published three times a year, in February, June and October of each year. SMJ publishes original scientific papers, review papers, editorials, short reports, peer review - fair review, as well as invited papers and award papers in the fields of Sports Science and Medicine, as well as it can function as an open discussion forum on significant issues of current interest.

www.sportmont.ucg.ac.me

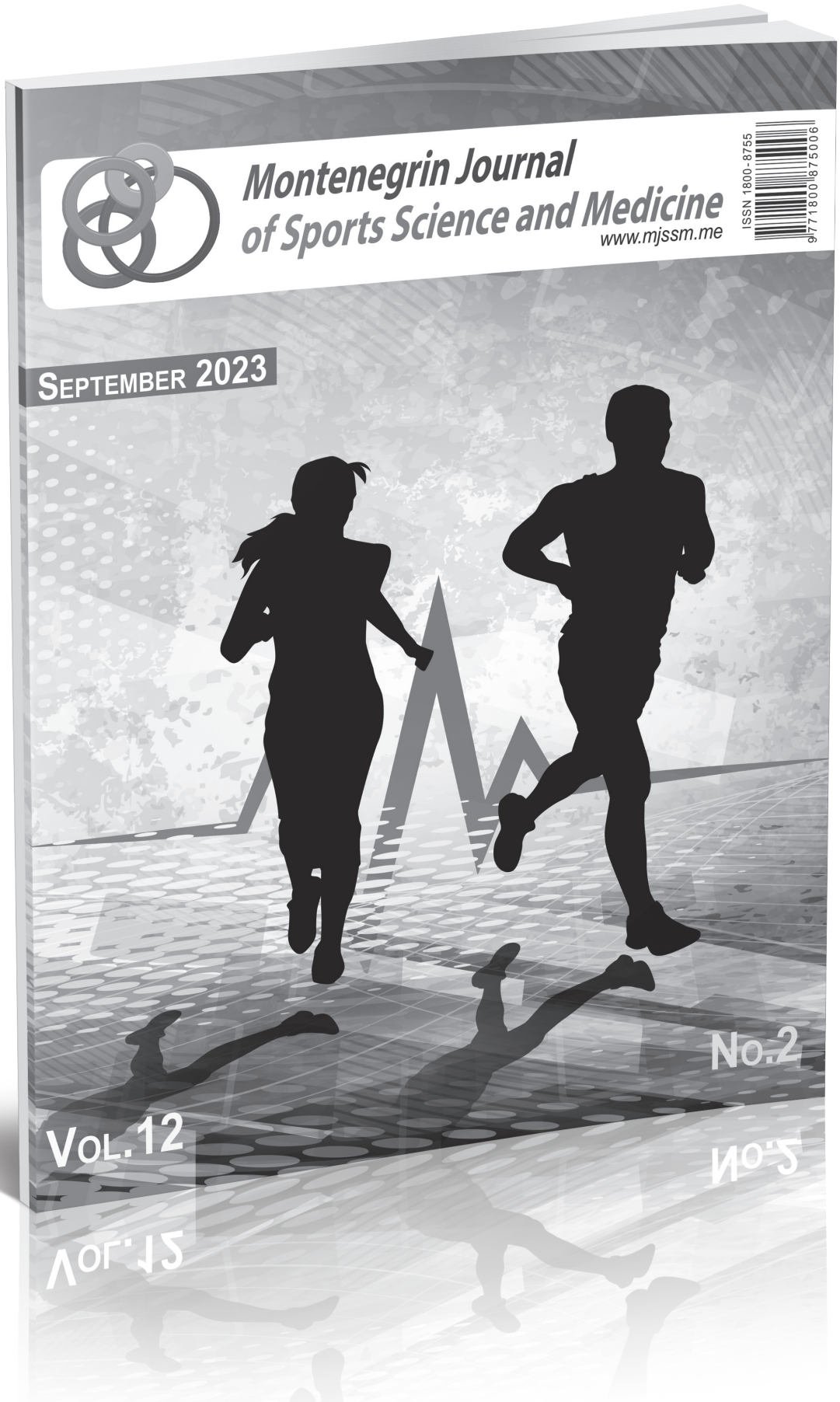
Montenegrin Journal of Sports Science and Medicine

Editors-in-Chief: **Dusko Bjelica**, Montenegro; **Damir Sekulic**, Croatia
Executive Editor: **Selcuk Akpinar**, Turkey
Associate Editors: **Mehmet Uygur**, USA; **Catalina Casaru**, USA; and **Predrag Bozic**, Serbia

Volume 12, 2023, 2 issues per year; Print ISSN: 1800-8755, Online ISSN: 1800-8763

Montenegrin Journal of Sports Science and Medicine (MJSSM) is published biannually, in September and March of each year. MJSSM publishes original scientific papers, review papers, editorials, short reports, peer review - fair review, as well as invited papers and award papers in the fields of Sports Science and Medicine, as well as it can function as an open discussion forum on significant issues of current interest. MJSSM covers all aspects of sports science and medicine; all clinical aspects of exercise, health, and sport; exercise physiology and biophysical investigation of sports performance; sport biomechanics; sports nutrition; rehabilitation, physiotherapy; sports psychology; sport pedagogy, sport history, sport philosophy, sport sociology, sport management; and all aspects of scientific support of the sports coaches from the natural, social and humanistic side.

www.mjssm.me


Montenegrin Journal
of Sports Science and Medicine
www.mjssm.me
ISSN 1800-8755
SEPTEMBER 2023
VOL. 12
No. 2

CRNOGORSKI OLIMPIJSKI KOMITET
MONTENEGRIN OLYMPIC COMMITTEE

CIP – Каталогизација у публикацији
Национална библиотека Црне Горе, Цетиње

ISSN 2536-569X
COBISS.CG-ID 33826832

MSA Conference 2024

21th Annual Scientific Conference of Montenegrin Sports Academy "Sport, Physical Activity and Health: Contemporary perspectives"

http://www.csakademija.me/conference/

CRNOGORSKA SPORTSKA AKADEMIJA • MONTENEGRIN SPORTS ACADEMY •

18th - 21th April 2024,
Dubrovnik - Croatia