

Central European Journal of Sport Sciences and Medicine

a quarterly journal



University of Szczecin
Faculty of Health
and Physical Education

Contents

Alastair R. Jordan, Howie J. Carson, Brett Wilkie, Damian J. Harper	
VALIDITY OF AN INERTIAL MEASUREMENT UNIT SYSTEM TO ASSESS LOWER-LIMB KINEMATICS DURING A MAXIMAL LINEAR DECELERATION	5
Leonard Nowak, Maria Alicja Nowak	
IMPACT OF EUROPEAN UNION PROGRAMS ON THE ACTIVITIES OF THE THIRD POLISH REPUBLIC'S PARLIAMENT IN THE FIELD OF SPORT IN THE YEARS 2004–2007	17
Meltem Ince Yenilmez	
GENDER INEQUALITY AND FEMALE SPORTS PARTICIPATION IN TURKEY	27
Filip Nadobnik	
THE ROLE OF FALL PROPHYLAXIS IN THE QUALITY OF LIFE OF THE GERIATRIC PATIENTS	43
Andrea Visiedo, Jillian E. Frideres, Jose M. Palao	
EFFECT OF EDUCATIONAL TRAINING ON NUTRITION AND WEIGHT MANAGEMENT IN ELITE SPANISH GYMNASTS	53
Natalia Chukhlantseva, Inna Cherednichenko, Eduard Bruhno	
COMPARATIVE CHARACTERISTICS AND ASSESSMENT OF THE RELATIONS OF ANTHROPOMETRIC INDICATORS AND MOTOR ABILITIES OF GIRLS' BASKETBALL PLAYERS 12–14 YEARS OLD	61
Rena Majchrowicz, Karolina Karaś, Piotr Matlosz, Jarosław Herbert	
INJURIES AND CONTUSIONS IN RECREATIONAL AND SPORTS HORSE RIDING	73
Fernando J. Ribeiro, Victor M. Viana, Nuno P. Borges, Vitor H. Teixeira	
THE EMERGENCE OF ESPORTS NUTRITION: A REVIEW	81
Dorota Ortenburger, Anatolii Tsos	
PHYSICAL ACTIVITY OF SENIOR CITIZENS: QUANTITATIVE ANALYSIS OF LITERATURE DERIVED FROM SCOPUS BASE	97
Teresa Drozdek-Małolepsza	
SPORTS IN THE PROVINCE OF VOLHYNIA AS PRESENTED IN THE "ZIEMIA WOŁYŃSKA" MAGAZINE (1928–1932)	105

Zuzanna Karpiel, Katarzyna Kozikowska, Dominika Sasin

ANALYSIS OF TRAINING LOADS AMONG SWIMMERS WITH DISABILITIES
DURING SPECIFIC PREPARATION PERIOD

117

Danjuma Moudou Momoh, Toyosi, Olaseyo

DETERMINANTS OF ASSAULT ON FOOTBALL LEAGUE REFEREES DURING COMPETITIONS IN NIGERIA

127

VALIDITY OF AN INERTIAL MEASUREMENT UNIT SYSTEM TO ASSESS LOWER-LIMB KINEMATICS DURING A MAXIMAL LINEAR DECELERATION

Alastair R. Jordan,^{1, A, B, C, D} Howie J. Carson,^{2, A, B, C, D} Brett Wilkie,^{1, C, D}
Damian J. Harper^{3, A, B, C, D}

¹ School of Science Technology and Health, York St John University, Haxby Road Sports Park, York, YO31 8TA, United Kingdom

² Institute for Sport, Physical Education and Health Sciences, Moray House School of Education and Sport, The University of Edinburgh, United Kingdom

³ Institute of Coaching and Performance, School of Sport and Health Sciences, University of Central Lancashire, United Kingdom

^A Study Design; ^B Data Collection; ^C Statistical Analysis; ^D Manuscript Preparation

Address for correspondence:

Alastair R. Jordan
School of Science Technology and Health, York St John University
Haxby Road Sports Park, YO31 8TA, United Kingdom
Email: a.jordan1@yorksj.ac.uk

Abstract This study examined the validity of an inertial measurement unit system for measuring lower-limb joint kinematics during linear decelerations. A male team athlete (age 36 years, stature 1.75 m, mass 80.0 kg) performed multiple linear decelerations, following 20 m runs at 50%, 75% and 100% self-perceived effort. Inertial measurement unit sensors were strapped to lower-limb segments and retroreflective markers were adhered to the lower-limbs for 3D optical motion analysis. Ground contact time, foot to centre of mass displacement (foot-COM), peak and minimum angle, mean angular velocity and range of motion at the ankle, knee and hip during the contact phases of each deceleration were determined. Measures were valid if a very large correlation ($r \geq 0.7$) and small bias (effect size <0.6) were evident. Following 50% effort, ground contact time, foot-COM and most hip and knee kinematics were valid. Ground contact time, foot-COM and knee flexion velocity and range of motion were valid following 75% efforts. Ground contact time and knee flexion velocity were valid following 100% effort. Therefore, the inertial measurement unit system tested can be used to assess temporal-spatial parameters during a deceleration regardless of the preceding effort, and hip and knee kinematics following low intensity running.

Key words biomechanics, braking, IMU, stopping, Xsens

Introduction

An ability to decelerate is emerging as a critical component of sport performance (Harper, Jordan, Kiely, 2021; Harper, Kiely, 2018; Hewit, Cronin, Button, Hume, 2011). Analyses of team-based sports, such as soccer, have indicated as many as 430 lower intensity ($\leq -2 \text{ m.s}^{-2}$) decelerations (Mara, Thompson, Pumpa, Morgan, 2017) and approximately 43–54 high intensity decelerations ($\leq -3 \text{ m.s}^{-2}$) during a match (Bloomfield, Poman, O'Donoghue, 2008; Dalen, Ingebrigtsen, Ettema, Hjelde, Wisloff, 2016; Russell et al., 2016). Deceleration underpins many of the

hundreds of changes in movement patterns observed in a match, including stopping to evade an opponent or collision (Hewit et al., 2011) and precedes a change of direction (Chaouachi et al., 2012; Dos'Santos, Thomas, Comfort, Jones, 2018; Green, Blake, Caulfield, 2011).

Faster deceleration requires the centre of mass to be positioned more posterior to the lead foot at ground contact, thereby maximising horizontal braking force application (Cesar, Sigward, 2015; Hewit et al., 2011). Upon contact with the ground, high eccentric loading of the lower-limbs results in rapid hip and knee flexion and dorsiflexion of the ankle to disperse the impact forces effectively (Nedergaard, Kersting, Lake, 2014; Spiteri et al., 2014). Furthermore, it has been suggested that a high proportion of non-contact lower-limb injuries, such as anterior cruciate ligament or posterior chain musculature, occur during the contact phase of deceleration when the knee is at or near full extension and then undergoes rapid eccentric knee flexion (Chaouachi et al., 2012; Cochrane, Lloyd, Butfield, Seward, McGivern, 2007; Kovacs, Roetert, Ellenbecker, 2008). Consequently, execution of appropriate deceleration kinematic strategies is essential to maximising deceleration performance and minimising injury risk.

Deceleration technique can be assessed by 3-dimensional optical motion analysis (3DOMA) as the gold standard for movement analysis, however these camera-based systems are expensive, athletes must perform within the confines of a calibrated capture volume that is typically small and reflective markers can be obscured at critical moments during a dynamic performance. Inertial measurement units (IMU) consist of gyroscopes, magnetometers and accelerometers contained within unobtrusive lightweight units and could provide valid information on deceleration kinematics, without the drawbacks of 3DOMA. IMU systems are easier to set up and can be used in field-based environments where athletes are not constrained to a calibrated capture volume. A commonly researched IMU system is the Xsens Technologies B.V (Adesida, Papi, McGregor, 2019; Camomilla, Bergamini, Fantozzi, Vannozzi, 2018) and has been used to assess movement in a variety of functional movement tasks (Fleron, Ubbesen, Battistella, Dejtiar, Oliveira, 2019; Laudanski, Brouwer, Li, 2013; Zhang, Novak, Brouwer, 2013) and sporting contexts (Blair, Duthie, Robertson, Hopkins, Ball, 2018; Carson, Collins, Richards, 2014; Krüger, Edelmann-Nusser, 2009; Reenalda, Maartens, Homan, Buurke, 2016; Wouda et al., 2018).

Despite extensive usage of the Xsens IMU system, there has been limited attention to the validity of measures, particularly those associated with tasks involving whole body deceleration. Valid measures of performance are essential to provide coaches and athletes with valuable information on sport performance from injury prevention and performance enhancement perspectives. Xsens has been validated against 3DOMA and demonstrated very good – excellent validity for sagittal plane flexion and extension angles during walking, stair ascent and descent (Seel, Raisch, Schauer, 2014; Zhang et al., 2013) and treadmill running at different speeds (Wouda et al., 2018). Lower validity has been shown in frontal and transverse plane kinematics (Wouda et al., 2018; Zhang et al., 2013), whilst transitioning between acceleration and deceleration during walking (Fleron et al., 2019) and with faster lower-limb segment velocities (Blair et al., 2018; Ferrari et al., 2010). Based on these findings, validity should be reported for speed and type of movement.

Currently, the validity of Xsens IMU systems for measuring lower-limb kinematics during deceleration from various running speeds is unknown. Therefore, the aim of this study was to assess the concurrent validity of lower-limb joint kinematic measures from the Xsens IMU system compared with 3DOMA during linear decelerations from various running speeds.

Methods

Participant

Following institutional ethical approval, a male competitive soccer player (age 36 years, stature 1.72 m, mass 80.0 kg) with 15 years previous playing experience provided written consent to participate in this study. The participant regularly took part in soccer training and moderate-to-vigorous intensity physical activity (3–5 times per week) lasting between 60–90 minutes per session and was, therefore, accustomed to acceleration and deceleration type activities. This study adopted a single-participant approach, which has been used in previous research by Buchheit, Gray, Morin (2015).

Deceleration Task

The participant performed a series of acceleration-deceleration ability tests (ADA) on one occasion. As described by Harper et al. (2021), the ADA consists of a 20 m run, a maximal linear deceleration after crossing the 20 m line and backpedal to the 20 m line (Figure 1). The backpedal created a clear ‘stop’ event and indicated the end of the deceleration phase (Harper et al., 2021).

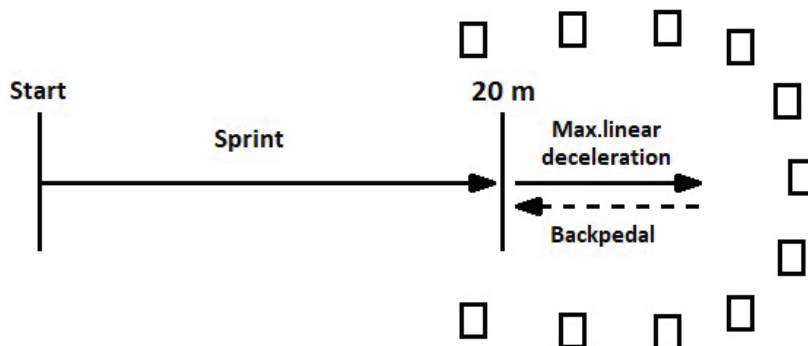


Figure 1. Acceleration-deceleration ability (ADA) test used to assess maximal linear deceleration. Symbol □ denotes position of 3D optical motion analysis cameras

To assess the validity of the Xsens IMU system when decelerating from various speeds, the participant performed 10 × 20 m runs at 50%, 75% and 100% self-perceived effort (30 trials in total) separated by 3–5 minutes of rest. A minimum 3 min rest between each ADA trial was considered sufficient recovery for the participant and exceeded the durations and work:rest ratios suggested in previous research to achieve a rested state following similar short bouts of sprint activity (Abt, Siegler, Akubat, Castagna, 2011; Balsom, Seger, Sjödin, Ekblom, 1992; Coleman, 2001; Spencer, Bishop, Dawson, Goodman, 2005). A maximum 5 min recovery was permitted to check and address the equipment calibration. Xsens IMU system captured kinematics in the entire ADA whereas 3DOMA captured the deceleration phase only.

Inertial Measurement Unit System

In accordance with manufacturer instructions, Xsens IMU sensors (MTx2, Xsens MVN Biomech, Xsens Technologies, The Netherlands) were strapped firmly to segments of the participant's lower-limbs, specifically at the feet (midpoint of the bridge of the foot), shanks (medial surface of the tibia), thighs (lateral aspect above the knee) and pelvis (midpoint of the sacrum). MVN Studio Pro software (Xsens Technologies, The Netherlands) was used to calibrate and track the IMUs (240 Hz) during the ADA. The calibration protocol began with the participant standing in the N-pose (arms neutral besides body) and a series of movements to orientate IMU sensors and functional axes of body segments. The participant's body height, arm span, foot size and anatomical landmarks of the greater trochanter (hip height from the ground), lateral femoral epicondyle (knee height from the ground), lateral malleolus (ankle height from the ground), left and right anterior superior iliac spine (hip width) were measured to estimate joint centres and segment dimensions of the model in MVN Studio Pro software.

3D Optical Motion Analysis (3DOMA)

Eleven infrared 3DOMA cameras (Oqus 300, Qualisys, Sweden) were positioned around the deceleration area (Figure 1). Qualisys Track Manager™ software (Qualisys, Sweden) was used to calibrate (average residuals of <1mm) and track (240 Hz) spherical retroreflective markers (Qualisys, Sweden) adhered to the participant's skin or the Xsens elasticated suit (Figure 2).

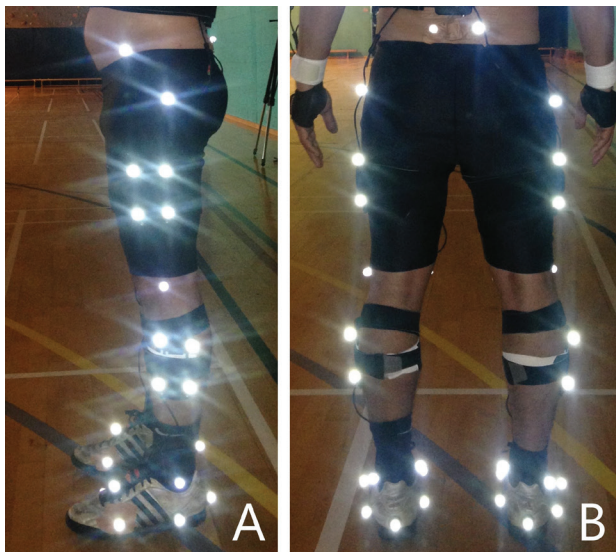


Figure 2. Sagittal (A) and posterior view (B) of the participant with Xsens IMU sensors strapped to lower-limb segments with retroreflective markers overlying anatomical landmarks and cluster markers strapped to lower-limb segments

Retroreflective markers were positioned bilaterally on the anterior superior iliac spine, posterior superior iliac spine, greater trochanter, medial and lateral femoral epicondyle, medial and lateral malleoli, calcaneus and the superior aspect of the foot, plus the 1st and 5th metatarsal heads. Cluster markers (four markers on a rigid baseplate) were positioned on the lateral aspect of the thigh and shank and affixed firmly with compression wraps (Fabrifoam, Applied Technology International Ltd., Pennsylvania, USA). Following a static capture trial (from both the 3DOMA and Xsens IMU), the medial and lateral femoral epicondyles, medial and lateral malleoli and greater trochanter markers were removed prior to performing the ADA. A single reflective marker was placed on the 20 m line to signify the beginning of the deceleration phase of the ADA.

Data Analysis

3DOMA marker trajectories during deceleration phase were labelled in Qualisys Track Manager™ software and exported to Visual 3D motion analysis software in c3d file format (C-Motion, Rockville, MD, USA) for further processing and analysis. Raw 3DOMA marker coordinate data were interpolated and filtered using a zero-lag fourth order low-pass Butterworth filter with a cut-off frequency of 30 Hz to remove clear high frequency noise in the signal (Nedergaard et al., 2014). The segment information (axes of rotation, segment dimensions and orientation) from the Xsens IMU data were also exported to c3d file format into Visual 3D software for analysis. The Xsens IMU data were filtered and processed by manufacturer software (MVN Studio Pro, Xsens Technologies, The Netherlands), therefore further filtering was not required in Visual 3D. Visual 3D created six-degrees of freedom multi-segmental models from the 3DOMA marker data and Xsens IMU data. Both systems were assigned joint centres defined by the medial and lateral markers on the proximal and distal aspects for each segment using the single frame of a static calibration trial (y-axis = anterior-posterior, x-axis = medial-lateral and z-axis = proximal-distal). Joint kinematics were calculated in flexion/extension using the distal segment relative to the local coordinate system of the proximal segment, using an X (flexion/extension), Y (medial/lateral), Z (axial) Cardan sequence.

Temporal-spatial and kinematic data were analysed for the deceleration phase only, defined as the first foot contact after the model COM passed the deceleration marker (20 m line) to the last ground contact prior to posterior movement of the model in the backpedal. Initial contacts were identified as the minimum vertical position of the calcaneus marker (heel strike) or the 5th metatarsal marker (forefoot strike) (Cesar, Sigward, 2016). Toe off was identified at the onset of vertical displacement of the 5th metatarsal (Cesar, Sigward, 2015). All initial contact and toe off events, for both 3DOMA and Xsens IMU, were verified by visual inspection. Temporal-spatial parameters of interest were ground contact time (GCT) and anterior/posterior foot to COM displacement. Sagittal plane kinematic variables of interest during trials at 50%, 75% and 100% effort included peak and minimum joint angles, average angular velocity (flexion MAV and extension MAV) and range of motion (ROM) at the hip, knee and ankle during contact phase. Approach velocity into the deceleration phase was determined in 50%, 75% and 100% efforts using the velocity of the COM in the 3DOMA.

Statistical Analysis

Mean and standard deviation (SD) of all variables during trials at 50%, 75% and 100% effort were calculated from 3DOMA and Xsens IMU system. The agreement between Xsens and 3DOMA (criterion measure) measures was assessed using a spreadsheet by Hopkins (2017). The spreadsheet calculated Pearson's correlation coefficient (r), mean difference ($\pm 90\%$ confidence limits (CL)) and effect size (ES, $\pm 90\%$ CL) and raw typical error of estimate

(TEE, $\pm 90\%$ CL) to assess strength of relationships, systematic bias and typical error between measurements, respectively. The magnitude of the Pearson's r was interpreted as ≤ 0.1 , trivial; >0.1 – 0.3 , small; >0.3 – 0.5 , moderate; >0.5 – 0.7 , large; >0.7 – 0.9 , very large; and >0.9 – 1.0 , almost perfect (Hopkins, 2002). Thresholds for ES were <0.2 , trivial; 0.2 – 0.6 , small; 0.6 – 1.2 , moderate; 1.2 – 2.0 , large; 2 – 4 , very large and >4 extremely large (Hopkins, 2002). Temporal-spatial and kinematic measures were considered valid if a very large correlation ($r \geq 0.7$) and small bias (ES < 0.6) were evident. Differences in approach velocity between 50%, 75% and 100% efforts were determined by within-subjects repeated measures ANOVA with Bonferroni pairwise comparisons (Jamovi version 0.9, Jamovi Project, Amsterdam, The Netherlands).

Results

The participant's perceptions of effort on the approach to the deceleration resulted in significant differences in approach velocities ($p < 0.05$). As perceived effort increased from 50%, 75% and 100%, approach velocity increased (3.61 ± 0.33 , 5.81 ± 0.14 and 6.45 ± 0.24 m.s $^{-1}$, respectively).

Table 1. Mean (standard deviation) of temporal-spatial parameters (Ground Contact Time (GCT) and anterior foot to centre of mass displacement (Foot-COM) and sagittal plane kinematics (peak and minimum joint angles, mean angular velocity (MAV) and range of motion (ROM)) during 10 deceleration trials preceded by 20 m runs at 50% effort (3.61 m.s $^{-1}$), measured by 3D optical motion analysis (3DOMA) and IMU system. Validity between systems assessed using Pearson correlation coefficients (r) and mean difference ($\pm 90\%$ confidence limits (CL)) with effect size (ES, $\pm 90\%$ CL). Magnitudes are presented for r and ES (m)

Variable	n	3DOMA	IMU	<i>r</i>	<i>m</i>	Mean Difference	<i>ES</i>	<i>m</i>	Raw TEE
		mean (SD)				(±90% CL)			(±90% CL)
Temporal-spatial									
GCT (s)	33	0.24 (0.04)	0.25 (0.04)	0.87	VL	0.01 (0.00 to 0.01)	0.13 (−0.02 to 0.27)	T	0.02 (0.02 to 0.02)
Foot-COM (m)	28	0.39 (0.06)	0.40 (0.05)	0.80	VL	−0.02 (−0.03 to 0.01)	−0.33 (−0.52 to −0.14)	S	0.03 (0.03 to 0.04)
Ankle									
Peak dorsiflexion (°)	33	13.9 (5.4)	15.6 (4.7)	0.06	S	1.7 (−0.4 to 3.75)	−0.37 (0.00 to 0.74)	S	5.5 (4.5 to 7.0)
Peak plantarflexion (°)	33	15.1 (3.6)	4.2 (5.4)	0.45	M	10.9 (9.4 to 12.4)	3.00 (2.60 to 3.41)	VL	3.2 (2.7 to 4.1)
ROM (°)	33	29.0 (4.7)	19.7 (6.7)	0.14	S	−9.3 (−11.5 to −7.0)	−1.61 (−2.07 to −1.15)	L	5.4 (4.5 to 6.9)
MAV dorsiflexion (°·s ^{−1})	33	229.3 (71)	146.3 (84.2)	0.39	M	−83.0 (−108.5 to −57.6)	−1.17 (−1.53 to −0.81)	M	66.4 (55.1 to 84.3)
MAV plantarflexion (°·s ^{−1})	33	307.4 (113.5)	218.3 (104.8)	0.45	<i>M</i>	−89.1 (−123.0 to −55.2)	−0.79 (−1.08 to −0.49)	M	103.1 (85.6 to 130.7)
Knee									
Minimum flexion (°)	33	20.0 (7.0)	23.9 (5.5)	0.80	VL	−3.9 (−5.2 to −2.8)	−0.57 (−0.75 to −0.40)	S	4.3 (3.5 to 5.4)
Peak flexion (°)	33	93.1 (5.4)	93.6 (7.4)	0.69	L	−0.5 (−2.1 to 1.1)	−0.09 (−0.39 to 0.20)	T	4.0 (3.3 to 5.0)
ROM (°)	33	73.1 (9.4)	69.6 (10.7)	0.93	AP	−3.5 (−4.7 to −2.3)	−0.37 (−0.50 to −0.24)	S	3.6 (3.0 to 4.6)
MAV flexion (°·s ^{−1})	33	325.0 (76.3)	303.2 (73.0)	0.98	AP	−21.8 (−25.9 to −17.8)	−0.29 (−0.34 to −0.23)	S	13.8 (11.4 to 17.4)
Hip									
Peak flexion (°)	32	48.5 (6.2)	47.2 (6.7)	0.95	AP	−1.3 (−1.9 to −0.7)	−0.21 (−0.31 to −0.11)	S	1.9 (1.6 to 2.4)
Peak extension (°)	32	37.6 (5.7)	35.7 (6.1)	0.95	AP	−1.8 (−2.4 to −1.3)	−0.32 (−0.42 to −0.22)	S	1.8 (1.5 to 2.3)
ROM (°)	32	10.9 (3.2)	11.5 (3.8)	0.83	VL	0.5 (−0.1 to 1.2)	0.17 (−0.03 to 0.36)	T	1.8 (1.5 to 2.3)
MAV flexion (°·s ^{−1})	32	90.2 (29.1)	102.6 (32.2)	0.78	VL	12.4 (6.3 to 18.5)	0.43 (0.22 to 0.64)	S	18.4 (15.3 to 23.5)
MAV extension (°·s ^{−1})	32	74.1 (42.0)	85.1 (43.4)	0.65	L	10.9 (0.1 to 21.7)	0.26 (0.00 to 0.52)	S	32.6 (27.0 to 41.5)

At 50% effort on the approach ($3.61 \text{ m}\cdot\text{s}^{-1}$, see Table 1), measures of temporal-spatial parameters and most kinematics at the knee and hip obtained by Xsens IMU were valid as per criteria ($r \geq 0.7$ and $ES < 0.6$). Large–almost perfect correlations and trivial–small ES were found in temporal-spatial parameters and kinematics at the knee and hip. Peak knee flexion and hip extension MAV were very close to meeting the criteria with large correlation and trivial–small ES ($r = 0.69$ and -0.09 ES, $r = 0.65$ and 0.26 ES, respectively). The ankle kinematics did not meet the criteria of validity due to small–moderate correlation coefficients and small–very large ES.

Table 2. Mean (standard deviation) of temporal-spatial parameters (Ground Contact Time (GCT) and anterior foot to centre of mass displacement (Foot-COM) and sagittal plane kinematics (peak and minimum joint angles, mean angular velocity (MAV) and range of motion (ROM)) during 10 deceleration trials preceded by 20 m runs at 75% effort ($5.81 \text{ m}\cdot\text{s}^{-1}$), measured by 3D optical motion analysis (3DOMA) and IMU system. Validity between systems assessed using Pearson correlation coefficients (r) and mean difference ($\pm 90\%$ confidence limits (CL)) with effect size (ES, $\pm 90\%$ CL). Magnitudes are presented for r and ES (m)

Variable	n	3DOMA mean (SD)	IMU mean (SD)	r	m	Mean Difference ($\pm 90\%$ CL)	ES	m	Raw TEE ($\pm 90\%$ CL)
Temporal-spatial									
GCT (s)	31	0.18 (0.04)	0.20 (0.04)	0.92	AP	0.02 (0.02 to 0.03)	0.48 (0.36 to 0.61)	S	0.02 (0.01 to 0.02)
Foot-COM (m)	26	0.40 (0.13)	0.42 (0.05)	0.84	VL	-0.02 (-0.06 to 0.01)	-0.18 (-0.46 to 0.11)	T	0.03 (0.02 to 0.03)
Ankle									
Peak Dorsiflexion ($^{\circ}$)	29	7.7 (4.5)	7.7 (4.9)	0.35	M	0.0 (-1.7 to 1.7)	0.00 (-0.38 to 0.38)	T	4.3 (3.49 to 5.50)
Peak Plantarflexion ($^{\circ}$)	29	22.8 (6.5)	11.5 (6.8)	0.66	L	11.3 (9.5 to 13.1)	1.73 (1.46 to 2.00)	L	5.0 (4.10 to 6.45)
ROM ($^{\circ}$)	29	30.6 (4.7)	19.2 (7.3)	0.60	L	-10.9 (-12.7 to -9.0)	-2.33 (-2.73 to -1.93)	VL	3.8 (3.13 to 4.93)
MAV Dorsiflexion ($^{\circ}\cdot\text{s}^{-1}$)	29	364.3 (78.7)	194.5 (99.8)	0.22	T	-169.8 (-205.3 to 134.2)	-2.16 (-2.61 to -1.71)	VL	77.0 (62.8 to 100.8)
MAV Plantarflexion ($^{\circ}\cdot\text{s}^{-1}$)	29	428.2 (259.6)	247.5 (184.9)	0.28	S	-180.7 (-271.6 to -89.8)	-0.70 (-1.05 to -0.35)	M	161.6 (130.6 to 214.1)
Knee									
Minimum Flexion ($^{\circ}$)	30	17.0 (4.7)	19.8 (5.1)	0.28	S	-2.8 (-4.6 to -1.0)	-0.60 (-0.99 to -0.22)	M	4.6 (3.8 to 5.9)
Peak Flexion ($^{\circ}$)	30	95.5 (5.3)	97.1 (8.7)	0.53	L	-1.6 (-3.9 to 0.7)	-0.31 (-0.74 to 0.13)	S	4.6 (3.7 to 5.9)
ROM ($^{\circ}$)	30	78.5 (5.2)	77.3 (6.9)	0.90	VL	-1.2 (-2.8 to -0.4)	-0.22 (-0.41 to -0.04)	S	2.3 (1.9 to 3.0)
MAV Flexion ($^{\circ}\cdot\text{s}^{-1}$)	30	461.6 (105.1)	417.6 (88.7)	0.93	AP	-44.1 (-56.3 to -31.8)	-0.42 (-0.54 to -0.30)	S	38.3 (31.4 to 49.5)
Hip									
Flexion ($^{\circ}$)	28	42.5 (4.3)	44.8 (9.5)	0.61	L	2.3 (-0.2 to 4.8)	0.54 (-0.04 to 1.1)	S	3.4 (2.8 to 4.5)
Extension ($^{\circ}$)	28	34.0 (5.4)	31.4 (7.5)	0.61	L	-2.6 (-4.5 to -0.6)	-0.47 (-0.83 to -0.12)	S	4.3 (3.6 to 5.6)
ROM ($^{\circ}$)	28	8.5 (2.9)	13.3 (5.2)	0.43	M	4.8 (3.3 to 6.4)	1.68 (1.15 to 2.21)	L	2.7 (2.2 to 3.5)
MAV Flexion ($^{\circ}\cdot\text{s}^{-1}$)	28	128.7 (114.0)	151.0 (63.8)	-0.05	T	22.3 (-20.69 to 65.36)	0.20 (-0.18 to 0.57)	S	116.0 (94.9 to 150.8)
MAV Extension ($^{\circ}\cdot\text{s}^{-1}$)	25	137.4 (95.6)	151.0 (81.3)	0.01	T	13.6 (-29.11 to 56.30)	0.14 (-0.30 to 0.59)	T	97.65 (79.0 to 129.4)

Following an approach at 75% effort ($5.81 \text{ m}\cdot\text{s}^{-1}$, see Table 2), the temporal-spatial parameters, knee ROM and knee flexion MAV obtained by Xsens IMU met the criteria for validity with very large–almost perfect correlation coefficients and trivial–small ES. Other measures of knee kinematics demonstrated small–moderate ES but were not valid due to small–large correlations. Likewise, only trivial–large correlations were found in other measures at the hip with trivial–small ES. Hip flexion and extension were close to meeting the validity criteria with large correlation ($r = 0.61$) and small ES (0.54 and -0.47, respectively). None of the ankle kinematics met the criteria for validity and were attributed to trivial-large correlations and trivial–very large ES.

Table 3. Mean (standard deviation) of temporal-spatial parameters (Ground Contact Time (GCT) and posterior foot to centre of mass displacement (Foot-COM) and sagittal plane kinematics (peak and minimum joint angles, mean angular velocity (MAV) and range of motion (ROM)) during 10 deceleration trials preceded by 20 m runs at 100% effort ($6.45 \text{ m}\cdot\text{s}^{-1}$), measured by 3D optical motion analysis (3DOMA) and IMU system. Validity between systems assessed using Pearson correlation coefficients (r) and mean difference ($\pm 90\%$ confidence limits (CL)) with effect size (ES, $\pm 90\%$ CL). Magnitudes are presented for r and ES (m)

Variable	n	3DOMA	IMU	r	m	Mean Difference	ES	m	Raw TEE
		mean (SD)	mean (SD)			(±90% CL)			(± 90% CL)
Temporal-spatial									
GCT (s)	68	0.19 (0.04)	0.19 (0.04)	0.86	VL	0.00 (0.00 to 0.01)	0.07 (−0.03 to 0.18)	T	0.02 (0.02 to 0.03)
Foot-COM (m)	52	0.44 (0.06)	0.45 (0.06)	0.39	S	0.01 (−0.04 to −0.05)	0.21 (−0.06 to 0.48)	S	0.18 (0.16 to 0.22)
Ankle									
Peak Dorsiflexion (°)	68	5.7 (4.8)	2.1 (5.7)	0.41	M	−3.6 (−4.7 to −2.4)	−0.74 (−0.98 to −0.49)	M	4.5 (3.9 to 5.2)
Peak Plantarflexion (°)	68	25.3 (3.5)	20.6 (5.3)	0.48	M	4.7 (3.7 to 5.6)	1.35 (1.07 to 1.63)	L	3.1 (2.7 to 3.6)
ROM (°)	68	31.0 (4.5)	22.7 (7.4)	0.53	L	−8.3 (−9.8 to −7.2)	−1.91 (2.20 to −1.62)	L	3.8 (3.3 to 4.4)
MAV Dorsiflexion (°·s ^{−1})	68	376.5 (99.9)	225.7 (114.3)	0.27	S	−150.8 (−177.0 to −124.6)	−1.51 (−1.77 to −1.25)	L	96.8 (84.8 to 113.2)
MAV Plantarflexion (°·s ^{−1})	68	483.7 (130.1)	275.8 (188.4)	0.44	M	−207.9 (−224.3 to −171.6)	−1.60 (−1.88 to −1.32)	L	117.8 (102.9 to 138.2)
Knee									
Minimum Flexion (°)	69	19.0 (8.7)	15.2 (4.3)	0.45	M	3.8 (2.2 to 5.3)	0.44 (0.26 to 0.62)	S	7.8 (6.8 to 9.1)
Peak Flexion (°)	69	95.5 (9.4)	88.7 (10.6)	0.45	M	6.8 (−8.9 to −4.7)	0.72 (0.50 to 0.95)	M	8.5 (7.4 to 9.9)
ROM (°)	69	76.5 (9.0)	73.5 (10.4)	0.29	S	−3.0 (−5.7 to −0.3)	−0.46 (−0.72 to −0.20)	S	8.7 (7.6 to 10.1)
MAV Flexion (°·s ^{−1})	69	469.4 (104.7)	441.2 (97.2)	0.84	VL	−28.2 (−39.7 to −16.8)	−0.27 (−0.38 to −0.16)	S	56.9 (49.9 to 66.4)
Hip									
Peak flexion (°)	69	42.8 (4.8)	37.9 (5.7)	0.74	VL	−4.9 (−5.7 to −4.2)	−1.03 (−1.19 to −0.87)	M	3.2 (2.8 to 3.8)
Peak extension (°)	69	32.3 (4.7)	23.1 (6.6)	0.65	L	−8.8 (−9.86 to −7.81)	−1.94 (−2.18 to −1.69)	L	3.7 (3.2 to 4.3)
ROM (°)	69	10.5 (3.4)	14.8 (5.8)	0.35	M	4.3 (3.1 to 5.4)	1.37 (0.97 to 1.78)	L	3.2 (2.8 to 3.8)
MAV Flexion (°·s ^{−1})	68	168.0 (126.5)	174.5 (62.0)	0.09	T	6.5 (−21.1 to 34.0)	0.05 (−0.17 to 0.27)	T	127.0 (11.2 to 148.4)
MAV Extension (°·s ^{−1})	69	121.2 (77.5)	159.7 (84.9)	0.37	M	40.6 (21.9 to 59.3)	0.50 (0.27 to 0.73)	S	75.6 (66.3 to 88.3)

At 100% effort on the approach ($6.45 \text{ m}\cdot\text{s}^{-1}$, see Table 3), only GCT and knee flexion MAV obtained by the Xsens IMU system met the criteria for validity with very large correlations and trivial–small ES. Other kinematics at the knee and hip demonstrated small–moderate correlations with small–moderate ES and trivial–very large with trivial–large ES, respectively. Ankle kinematics did not meet the criteria for validity due to small–large correlations and moderate–large ES.

Discussion

This study sought to assess the validity of Xsens IMU system to measure temporal-spatial and lower-limb joint kinematic measures captured during a maximal linear deceleration, preceded by 20 m runs at 50%, 75% and 100% effort, when compared with 3DOMA. The key findings from this study were that during deceleration phase, Xsens IMU system had valid measures of: (1) knee and hip sagittal plane kinematics and temporal-spatial parameters from low approach velocities ($3.61 \text{ m}\cdot\text{s}^{-1}$, 50% effort), (2) knee flexion MAV, knee ROM and temporal spatial parameters from moderate approach velocity ($5.81 \text{ m}\cdot\text{s}^{-1}$, 75% effort), and (3) only GCT, knee flexion MAV from higher approach velocity ($6.45 \text{ m}\cdot\text{s}^{-1}$, 100% effort). None of the ankle kinematics derived from Xsens IMU met the criteria of validity.

The results of this study are comparable to other studies on the validity of Xsens IMU to measure temporal-spatial parameters and joint kinematics during sport and physical activities. In this study, the hip and knee kinematics demonstrated large to almost perfect agreement ($r = 0.69$ – 0.98 and 0.5 – 0.95), trivial to small ES (-0.09 to -0.57 and -0.32 – 0.43) and comparably low typical error (TEE = 1.8 – 1.9° and 3.6 – 4.3°) when decelerating from low intensity running (50% efforts). Similarly, strong agreement between Xsens and 3DOMA ($r > 0.96$) and similar estimates of the error associated with Xsens measurements of the hip (1.8 – 5.2°) and knee (1.5 – 5.1°) kinematics were found during walking (Ferrari et al., 2010; Seel et al., 2014; Zhang et al., 2013). Wouda et al. (2018) also reported strong agreement ($r > 0.98$) between Xsens and 3DOMA at the hip and knee during treadmill running at different speeds, however when compared with our study, larger errors were observed (mean difference $<18.1^\circ$ at the hip and $<10.2^\circ$ at knee). Krüger and Edelmann-Nusser (2009) also reported strong agreement ($r = 0.77$ – 0.96) and errors of less than 5° for knee angles during a snowboarding turn, when compared with video analysis. When compared with the present study, smaller measurement error has been shown at the knee (peak flexion: 0.8° , peak extension: 1.4° and mean angular velocity: $14^\circ \cdot s^{-1}$) and hip (hip extension: 0.5°) during a kicking action (Blair et al., 2018). Such high validity might be attributable to a simpler task of kicking, relative to deceleration, which involves many co-ordinated steps in quick succession.

As approach velocity increased (75%–100%), the agreement between kinematic measures were weak at the hip ($r = 0.43$ – 0.61 and 0.35 – 0.74 , respectively) and reduced at the knee ($r = 0.28$ – 0.93 and 0.29 – 0.45 , respectively) and typical error increased at the hip (2.7 – 4.3° and 3.2 – 3.7° respectively) and knee (2.3 – 4.6° and 7.8 – 8.7° , respectively) when compared with 50% effort. Also, the mean difference and ES increased, which suggests an increased systematic bias as intensity increased, hence most Xsens IMU measurements were not valid at higher intensities. Interestingly, knee flexion MAV was valid following 75% and 100% efforts. Rapid knee flexion during deceleration is a key indicator of injury during deceleration (Cochrane et al., 2007) and therefore this measure could be useful for practitioners, however with greater approach velocity typical error increased from 38.3 to $56.9^\circ \cdot s^{-1}$. Similarly, an increase in joint kinematic error was reported as gait speed increased (0.6 – 5.0° ; Ferrari et al., 2010) and as segment velocity increased during a ball kicking action (Blair et al., 2018). The increased error with speed of movement has been attributed to the inertial sensor data gleaned from IMU, which can be compromised when sudden changes in acceleration are experienced (Fleron et al., 2019). Erroneous accelerations in IMU data might be exacerbated by greater skin and muscle movement underlying the IMUs during deceleration from faster approach velocities due to greater impact forces applied to the lower limb when compared with deceleration from slower approach velocities. Also, Xsens uses Kalman filters to fuse the IMU data, however Kalman filtering is limited during faster movements, especially from high to low segment acceleration (Adesida et al., 2019; Blair et al., 2018; Ferrari et al., 2010). Sudden changes in segmental acceleration are characteristic of deceleration and are greater in more intense decelerations, thus potentially compromising the measurement of most kinematic measures during deceleration from higher intensity running (5.81 m.s $^{-1}$ – 6.45 m.s $^{-1}$, 75%–100% effort).

Regardless of effort on the approach, ankle kinematics during linear deceleration did not meet the criteria for validity. Mixed reports of the validity of ankle measurement by IMU has been reported previously (Ferrari et al., 2010; Robert-Lachaine, Mecheri, Larue, Plamondon, 2017; Seel et al., 2014). The error of Xsens at the ankle has been reported to be low in the sagittal plane during walking (Ferrari et al.: $r > 0.99$ and 1.1 – 1.4° ; Seel et al.: 1.6°) which surpasses the validity of sagittal plane ankle measures found in this study of 3.1 – 5.5° , however others have reported weaker validity at the ankle which are somewhat comparable with this study. During treadmill running,

Wouda et al. (2018) observed strong agreement in dorsi and plantarflexion ($r > 0.97$), however mean difference and error was larger ($>7.58^\circ$ and $>8.1^\circ$, respectively) than in this study. There are several reasons for poorer validity at the ankle. The highest segment velocities are observed at the distal end of limbs and therefore the foot might be affected by the aforementioned Kalman filter, thus introducing error to the ankle, even during decelerations from low intensity running (50% efforts). The Kalman filter was purported to be responsible for sudden changes in orientation of body segments in the Xsens system during walking, most of which occurred at the ankle (Ferrari et al., 2010). This might account for the lack of valid measures at the ankle; however, the authors do not have definitive evidence of whether this was the case in this study. Another source of error could be attributed to the gyroscopes in the IMUs which are sensitive to vibrations when the foot contacts the ground. During deceleration, large impact and eccentric braking forces are observed upon contact with the ground (Hewit et al., 2011) and might introduce vibration noise to the IMU signal which was likely amplified as the intensity of deceleration increased.

The point of application of force relative to the COM is also important for deceleration performance and this study suggests that foot-COM measures lack validity during deceleration from high intensity running ($6.45 \text{ m}\cdot\text{s}^{-1}$, 100% effort) with large error observed (TEE 0.18 m) but is valid during deceleration preceded by low and moderate running ($3.61\text{--}5.81 \text{ m}\cdot\text{s}^{-1}$, 50–75% effort). Despite this, Xsens IMU system can be used to determine initial contact and toe-off and subsequently provide valid measures of GCT during linear decelerations. Ground contact time is an important determinant of deceleration as braking forces can only be applied during contact (Hewit et al., 2011). Using the methods detailed in this study, practitioners could use Xsens IMU to assess GCT during submaximal and maximal linear decelerations.

There are some limitations to acknowledge for this study. Movement artefact from underlying muscle and skin could result in displacements or translation of the IMU along the segment longitudinal axis which could affect segment orientation and subsequent calculation of joint angles. The Xsens IMU units were strapped firmly to the participant and the filtering process by Xsens might remove such movement artefact. Likewise, the 3DOMA might also be subject to movement artefact on the reflective markers, however such movements are reduced by appropriate filtering. The duration of between task and calibration of IMU system has been reported to introduce drift and error into the IMU data (Robert-Lachaine et al., 2017; Roetenberg, Luinge, Slycke, 2009). The participant undertook the calibration for both systems regularly to reduce the likelihood of drift. Fatigue of the participant from repeated ADA trials might have affected their ability to maintain consistent approach velocities for each perceived effort, especially in the repeated maximal ADA trials. The duration of recovery between the ADA trials ranged from 3–5 min, which was considered sufficient for the participant, a trained and competitive soccer player, to be rested and relatively small standard deviations were found for each approach velocity (0.33 , 0.14 and $0.24 \text{ m}\cdot\text{s}^{-1}$ at 50, 75 and 100% efforts, respectively). However, an objective physiological measure, such as heart rate monitoring, could have been used to confirm if the participant was indeed rested prior to each ADA trial. It has been noted that biomechanical model definitions might be responsible for differences and therefore caution must be taken when directly comparing joint angles from IMU and 3DOMA (Robert-Lachaine et al., 2017). The differences in the model were limited since both models were multi-segmental and the IMU model was closely aligned with anatomical landmarks used in 3DOMA.

In conclusion, Xsens IMU offers valid measures of joint kinematics of the hip and knee during linear decelerations when the approach velocity is low ($3.61 \text{ m}\cdot\text{s}^{-1}$, 50% effort) but limited to valid measures of knee flexion MAV when decelerating from higher approach velocities ($5.81\text{--}6.45 \text{ m}\cdot\text{s}^{-1}$, 75–100% efforts). Regardless

of approach velocity, Xsens IMU does not provide valid measurement of ankle kinematics during deceleration. Basic temporal-spatial parameters can be measured using Xsens IMU during deceleration following all approach velocities, except for foot-COM following 100% effort. Therefore, coaches and practitioners could use Xsens IMU to assess temporal-spatial parameters and kinematics of the hip and knee from low approach velocities ($>3.61 \text{ m}\cdot\text{s}^{-1}$) and limited knee kinematics at higher approach velocities. Despite the drawbacks of 3DOMA, it is recommended that 3DOMA should be considered for the assessment of decelerations from higher approach velocities.

References

- Abt, G., Siegler, J.C., Akubat, I., Castagna, C. (2011). The effects of a constant sprint-to-rest ratio and recovery mode on repeated sprint performance. *The Journal of Strength & Conditioning Research*, 25 (6), 1695–1702. DOI: 10.1519/JSC.0b013e3181dbdc06.
- Adesida, Y., Papi, E., McGregor, A.H. (2019). Exploring the role of wearable technology in sport kinematics and kinetics: A systematic review. *Sensors*, 19, 1597. DOI: 10.3390/s19071597.
- Balsom, P.D., Seger, J.Y., Sjödin, B., Ekblom, B. (1992). Physiological responses to maximal intensity intermittent exercise. *European Journal of Applied Physiology and Occupational Physiology*, 65 (2), 144–149. DOI: 10.1007/BF0070572.
- Blair, S., Duthie, G., Robertson, S., Hopkins, W., Ball, K. (2018). Concurrent validation of an inertial measurement system to quantify kicking biomechanics in four football codes. *Journal of Biomechanics*, 73 (1), 24–32. DOI: 10.1016/j.jbiomech.2018.03.031.
- Bloomfield, J., Polman, R., O'Donoghue, P. (2008). Deceleration and turning movements performed during FA Premier League soccer matches. In: T. Reilly, F. Korkusuz (eds.), *Science and Football VI; the Proceedings of the Sixth World Congress on Science and Football* (pp. 174–181). Routledge.
- Buchheit, M., Gray, A., Morin, J.-B. (2015). Assessing stride variables and vertical stiffness with GPS-embedded accelerometers: Preliminary insights for the monitoring of neuromuscular fatigue on the field. *Journal of Sports Science & Medicine*, 14 (4), 698–701.
- Camomilla, V., Bergamini, E., Fantozzi, S., Vannozzi, G. (2018). Trends supporting the in-field use of wearable inertial sensors for sport performance evaluation: A systematic review. *Sensors*, 18, 873. DOI: 10.3390/s18030873.
- Carson, H.J., Collins, D., Richards, J. (2014). Intra-individual movement variability during skill transitions: A useful marker? *European Journal of Sport Science*, 14 (4), 327–336. DOI: 10.1080/17461391.2013.814714.
- Cesar, G.M., Sigward, S.M. (2015). Dynamic stability during running gait termination: Differences in strategies between children and adults to control forward momentum. *Human Movement Science*, 43 (1), 138–145. DOI: 10.1016/j.humov.2015.08.005.
- Cesar, G.M., Sigward, S.M. (2016). Dynamic stability during running gait termination: Predictors for successful control of forward momentum in children and adults. *Human Movement Science*, 48 (1), 37–43. DOI: 10.1016/j.humov.2016.03.014.
- Chaouachi, A., Manzi, V., Chaalali, A., Wong, P., Chamari, K., Castagna, C. (2012). Determinants analysis of change-of-direction ability in elite soccer players. *Journal of Strength & Conditioning Research*, 26, 2667–2676. DOI: 10.1519/JSC.0b013e318242f97a.
- Cochrane, J.L., Lloyd, D.G., Buttfield, A., Seward, H., McGivern, J. (2007). Characteristics of anterior cruciate ligament injuries in Australian football. *Journal of Science and Medicine in Sport*, 10 (2), 96–104. DOI: 10.1016/j.jsams.2006.05.015.
- Coleman, A.E. (2001). Target and recovery times for speed training in baseball. *Strength & Conditioning Journal*, 23 (6), 7–8.
- Dalen, T., Ingebrigtsen, J., Ettema, G., Hjelde, G.H., Wisloff, U. (2016). Player load, acceleration, and deceleration during forty-five competitive matches of elite soccer. *Journal of Strength & Conditioning Research*, 30 (2), 351–359. DOI: 10.1519/JSC.0000000000001063.
- Dos'Santos, T., Thomas, C., Comfort, P., Jones, P.A. (2018). The effect of angle and velocity on change of direction biomechanics: An angle-velocity trade-off. *Sports Medicine*, 48 (10), 2235–2253. DOI: 10.1007/s40279-018-0968-3.
- Ferrari, A., Cutti, A.G., Garofalo, P., Raggi, M., Heijboer, M., Cappello, A., Davalli, A. (2010). First in vivo assessment of "Outwalk": A novel protocol for clinical gait analysis based on inertial and magnetic sensors. *Medical & Biological Engineering & Computing*, 48, 1–15. DOI: 10.1007/s11517-009-0544-y.
- Fleron, M.K., Ubbesen, N.C.H., Battistella, F., Dejtari, D.L., Oliveira, A.S. (2019). Accuracy between optical and inertial motion capture systems for assessing trunk speed during preferred gait and transition periods. *Sports Biomechanics*, 18 (4), 366–377. DOI: 10.1080/14763141.2017.1409259.
- Green, B.S., Blake, C., Caulfield, B.M. (2011). A comparison of cutting technique performance in rugby union players. *Journal of Strength & Conditioning Research*, 25 (10), 2668–2680. DOI: 10.1519/JSC.0b013e318207ed2a.

- Harper, D., Jordan, A., Kiely, J. (2021). Relationships between eccentric and concentric knee strength capacities and maximal linear deceleration ability in male academy soccer players. *Journal of Strength & Conditioning Research*, 35 (2), 465–472. DOI: 10.1519/JSC.0000000000002739.
- Harper, D., Kiely, J. (2018). Damaging nature of decelerations: Do we adequately prepare players? *BMJ Open Sport and Exercise Medicine*, 4, e000379. DOI: 10.1136/bmjsem-2018-000379.
- Hewitt, J., Cronin, J., Button, C., Hume, P. (2011). Understanding deceleration in sport. *Strength and Conditioning Journal*, 33 (1), 47–52. DOI: 10.1519/SSC.0b013e3181fbd62c.
- Hopkins, W.G. (2002). A scale of magnitudes for effect statistics. *A New View of Statistics*, 502, 411. Retrieved from: <https://sportsci.org/resource/stats/effectmag.html>.
- Kovacs, M.S., Roetert, E.P., Ellenbecker, T.S. (2008). Efficient deceleration: The forgotten factor in tennis-specific training. *Strength and Conditioning Journal*, 30 (6), 58–69. DOI: 10.1519/SSC.0b013e31818e5fbc.
- Krüger, A., Edelmann-Nusser, J. (2009). Biomechanical analysis in freestyle snowboarding: Application of a full-body inertial measurement system and a bilateral insole measurement system. *Sports Technology*, 2 (1–2), 17–23. DOI: 10.1002/jst.89.
- Laudanski, A., Brouwer, B., Li, Q. (2013). Measurement of lower limb joint kinematics using inertial sensors during stair ascent and descent in healthy older adults and stroke survivors. *Journal of Healthcare Engineering*, 4 (4), 555–576. DOI: 10.1260/2040-2295.4.4.555.
- Mara, J.K., Thompson, K.G., Pumpa, K.L., Morgan, S. (2017). The acceleration and deceleration profiles of elite female soccer players during competitive matches. *Journal of Science and Medicine in Sport*, 20 (9), 867–872. DOI: 10.1016/j.jsams.2016.12.078.
- Nedergaard, N.J., Kersting, U., Lake, M. (2014). Using accelerometry to quantify deceleration during a high-intensity soccer turning manoeuvre. *Journal of Sports Sciences*, 32 (20), 1897–1905. DOI: 10.1080/02640414.2014.965190.
- Reenalda, J., Maartens, E., Homan, L., Buurke, J.J. (2016). Continuous three dimensional analysis of running mechanics during a marathon by means of inertial magnetic measurement units to objectify changes in running mechanics. *Journal of Biomechanics*, 49 (14), 3362–3367. DOI: 10.1016/j.jbiomech.2016.08.032.
- Robert-Lachaine, X., Mecheri, H., Larue, C., Plamondon, A. (2017). Validation of inertial measurement units with an optoelectronic system for whole-body motion analysis. *Medical and Biological Engineering and Computing*, 55 (4), 609–619. DOI: 10.1016/j.jbiomech.2016.08.032.
- Roetenberg, D., Luinge, H., Slycke, P. (2009). *Xsens MVN: Full 6DOF human motion tracking using miniature inertial sensors*. Technical report. Xsens Technologies B.V.
- Russell, M., Sparkes, W., Northeast, J., Cook, C.J., Love, T.D., Bracken, R.M., Kilduff, L.P. (2016). Changes in acceleration and deceleration capacity throughout professional soccer match-play. *Journal of Strength & Conditioning Research*, 30 (10), 2839–2844. DOI: 10.1519/JSC.0000000000000805.
- Seel, T., Raisch, J., Schauer, T. (2014). IMU-based joint angle measurement for gait analysis. *Sensors*, 14 (4), 6891–6909. DOI: 10.3390/s140406891.
- Spencer, M., Bishop, D., Dawson, B., Goodman, C. (2005). Physiological and metabolic responses of repeated-sprint activities. *Sports Medicine*, 35 (12), 1025–1044. DOI: 10.2165/00007256-200535120-00003.
- Spiteri, T., Nimphius, S., Hart, N.H., Specos, C., Sheppard, J.M., Newton, R.U. (2014). Contribution of strength characteristics to change of direction and agility performance in female basketball athletes. *Journal of Strength & Conditioning Research*, 28 (9), 2415–2423. DOI: 10.1519/JSC.0000000000000547.
- Wouda, F.J., Giuberti, M., Bellusci, G., Maartens, E., Reenalda, J., Van Beijnum, B.F., Veltink, P.H. (2018). *On the validity of different motion capture technologies for the analysis of running*. Paper presented at the 7th IEEE/RAS-EMBS International Conference on Biomedical Robotics and Biomechatronics (Biorob), Enschede.
- Zhang, J.-T., Novak, A.C., Brouwer, B., Li, Q. (2013). Concurrent validation of Xsens MVN measurement of lower limb joint angular kinematics. *Physiological Measurement*, 34 (8), N63–N69. DOI: 10.1088/0967-3334/34/8/N63.

Cite this article as: Jordan, A.R., Carson, H.J., Wilkie, B., Harper, D.J. (2021). Validity of an Inertial Measurement Unit System to Assess Lower-limb Kinematics during a Maximal Linear Deceleration. *Central European Journal of Sport Sciences and Medicine*, 1 (33), 5–16. DOI: 10.18276/cej.2021.1-01.

IMPACT OF EUROPEAN UNION PROGRAMS ON THE ACTIVITIES OF THE THIRD POLISH REPUBLIC'S PARLIAMENT IN THE FIELD OF SPORT IN THE YEARS 2004–2007

Leonard Nowak,^{A, B, D, E} Maria Alicja Nowak^{D, E}

University of Szczecin, Faculty of Health and Physical Education, Institute of Physical Culture Sciences, Poland

^A Study Design; ^B Data Collection; ^D Manuscript Preparation; ^E Funds Collection

Address for correspondence:

Leonard Nowak

Institute of Physical Culture Sciences, University of Szczecin

Al. Piastów 40B, blok 6, 71-065 Szczecin, Poland

E-mail: leonard.nowak@usz.edu.pl

Abstract The aim of this paper is to show the impact of European Union programs on the activities of the Third Polish Republic's Parliament in the field of sport in the years 2004–2007. The Republic of Poland joined the European Union (EU) on 1 May 2004. Since then, it has been co-creating the image of sport in Europe. All activities undertaken by the Polish Parliament in the development of sport after this event were related to programs in the European Union. During the period covered in this paper, the institutions involved in sport in the European Union included the Council of the European Union, the European Parliament, the European Commission and the European Court of Justice. One year after Poland's accession to the European Union, elections were held for the fifth term of the Polish Sejm (2005–2007). The representatives of the Polish Parliament, during meetings of the Physical Culture and Sport Committee, repeatedly pointed to the possibility of adapting EU programs and their use in the development of sport in Poland. The material presented by the Ministry of Sport and the Office of the European Integration Committee in Warsaw informed about the following programs (mainly investment ones): *Sport in the structures of the European Union* and *European Union Programs for the development of sport*, implemented between 2004 and 2006.

The most important issues raised by the Committee were those contained in the two most important documents: *White Paper on Sport* and *Independent European Sport Review*.

As a result of the work of the Parliament of the Republic of Poland during the fifth term of office (2005–2007) in cooperation with the Ministry of Sport and the Parliamentary Physical Culture and Sport Committee, a plan for co-financing projects for the construction, extension or modernization of sports infrastructure under the EU structural programs and the INTERREG III A and EQUAL Community Initiatives was developed.

The effect of Poland's membership in the EU in that period was a gradual elimination of infrastructural negligence and undertaking activities related to the activation of local communities in the area of education and sport. Poland's membership in the EU so far has brought positive results: increased accessibility of sport thanks to the development of regional infrastructure co-financed by the EU funds and the enrichment of the program offer by supporting projects related to the organization of extracurricular sports activities for children and young people. The positive effects of membership in the field of sport are still being perceived by selected groups and society as a whole.

Key words Programs of the European Union, Polish Parliament, sport

Introduction

Being a member of the European Union (EU) since 1 May 2004 (Official Journal, 2004a), the Republic of Poland has co-created the image of sport in Europe. All activities undertaken by the Polish Parliament in the development of sport after this event were related to emerging programs in the structures of the European Union. From the outset, sport was not an area of EU integration and competence under Community law. The legal basis for EU action in the field of sport was only enshrined in the Lisbon Treaty of December 2007, subject to the ratification process in all Member States (Official Journal of the EU C 83 z, p. 47; Official Journal of the EU C 306 z, p. 1; Official Journal of the EU C 83 z, p. 13; Official Journal, 2004b; Official Journal of the EU C 321E z, p. 37). Sport in the European Union was seen as an important instrument in the fight against negative social phenomena such as drug abuse, alcoholism, intolerance and social exclusion. The importance of sport in the promotion of a healthy lifestyle, in the fight against diseases of affluence, including obesity and a sedentary lifestyle, was emphasized. For the first time, a reference to sport of this rank in the EU document was included in *Declaration No. 29*, annexed to the *Treaty of Amsterdam* (http://oide.sejm.gov.pl/oide/images/files/dokumenty/traktaty/Traktat_amsterdamski_PL_16.pdf (accessed on 23.01.2019)). This declaration emphasized the social importance of sport. The next document was the *Nice Declaration* of 2000 (http://ec.europa.eu/sport/pdf/doc244_en.pdf (2.01.2019); https://mfiles.pl/pl/index.php/Traktat_Nicejski (26.01.2019)) on the specific nature of sport, which recognized its social, educational and cultural functions. The next step was to consist in a provision on sport in the Constitutional Treaty (<https://uokik.gov.pl/download.php?plik=6354> (23.01.2019)). Sport was mentioned as one of the areas where the European Union could support, coordinate or complement the action taken by the Member States. The sports community attempted to strengthen the role of sport in EU institutions and to highlight its important role. The answer proved to be the *Independent European Sport Review* (Żyśko, 2009a). Representatives of the Polish Parliament, during meetings of the Physical Culture and Sport Committee, repeatedly referred to EU programs and their use in the development of sport in all areas of life (Bulletin No. 1766/V, pos. No. 70). The material presented by the Ministry of Sport and the Office of the European Integration Committee in Warsaw contained information on EU programs (mainly investment ones) implemented in the years 2004–2006 (Kałużyńska, Smyk, Wiśniewski, 2009, pp. 294–308; <https://uokik.gov.pl/download.php?plik=6354> (23.01.2019)). The majority of the parliamentary discussion focused on topics related to Poland's contribution to *Sport in the structures of the European Union* and *European Union Programs for the development of sport*. During the discussed period (2004–2007), the institutions involved in sport in the European Union were the Council of the European Union, the European Parliament, the European Commission and the European Court of Justice (Kolos, 2011).

The Council of the European Union

The European Union consisted of ministers responsible for a given department. Ministers' meetings were formal or informal, but in the case of sport they were always informal. The meetings were held under a given Presidency. In 2005–2007, the Presidency was held by three countries: Germany, Portugal and Slovenia. The joint Presidency's program included the following provision regarding sport: *The Council's attention may be drawn to various subjects of common interest: the contribution of sport and sporting events to economic development, education and employment, the role of sport in promoting public health, cooperation between Member States on anti-doping activities, EU international sports policy and cooperation in the field of sports sciences* (Bulletin No. 1766/V,

pos. No. 70, p. 7). In order to discuss particular issues, the German Presidency held two informal meetings (The first took place in Bonn on 1–2 February 2007 and the second in Stuttgart on 12–13 March 2007). One of the most important issues discussed during the meetings was the fight against doping in sport. Growing problems in sport were also the subject of the International Convention against Doping in Sport at the 33rd Session of the United Nations Educational, Scientific and Cultural Organization, hereinafter referred to as UNESCO, at its meeting in Paris on 19 October 2005 (Journal of Laws of 2007, No. 142, item 999). The *White Paper on Sport*, adopted by the European Commission in July 2007 under the Portuguese Presidency of the EU Council, also included provisions on the fight against doping. Being a non-legislative document, the *White Paper*, in Paragraph 2.2 entitled *Joining forces in the fight against doping*, identifies doping as a threat to sport around the world, a factor undermining the principles of open and fair competition. In the context of the struggle against this phenomenon in sport, the idea of creating an EU communication network of national anti-doping organizations was born (<https://msit.gov.pl/pl/sport/uczciwosc-i-bezpieczens/anty doping/609,Unia-Europejska-a-doping-w-sporcie.html> (27.01.2019)). The Presidency recognized the need to strengthen the cooperation of individual national institutions, including Polish ones, that had so far worked independently. Cooperation was undertaken occasionally, depending on the needs of a given EU Member State. It was proposed that a partnership be created between Member States' law enforcement authorities (border guards, police, customs offices, etc.), laboratories accredited by the World Anti-Doping Agency (WADA) and INTERPOL in order to exchange information on new means and methods of doping. The *White Paper* also envisaged the creation of a network of national anti-doping organizations belonging to EU Member States. All Member States accepted the implementation of this proposal. It was to be implemented with the provision that this cooperation could not result in further financial commitments (<https://msit.gov.pl/pl/sport/uczciwosc-i-bezpieczens/anty doping/609,Unia-Europejska-a-doping-w-sporcie.html> (27.01.2019)). The second, particularly important issue raised by the German Presidency, was the analysis of the economic benefits of sports investments and, in particular, of major sporting events, such as the 18th World Cup in Germany in 2006. Research conducted by the Presidency showed that investing in sport was profitable, often much more than in other areas of the economy, and the main advantage of this type of events was the development of the existing (or construction of new, often from the ground up) sports and tourist infrastructure. As a result of the above-mentioned plans, a European project called the *Sport Satellite Account* was created, which became a statistical tool for measuring the significance of sport for the European economy (Tomaszewicz, Świeczewska, Strawiński, Kulczycka, 2010, pp. 7–8). The first EU initiative to define the economic dimension of sport was the decision of the European Commission under the Austrian Presidency in 2006 to set up a Working Group on Sport and Economics. At the first meeting in Vienna on 27–28 September 2006, the main objectives of the Group's activities were identified: to determine the percentage share of the sports sector in GDP, as well as the share in employment and added value, and purchasing power in relation to national economies and at European Union level – to determine the dynamics of the sports sector over time – to obtain reliable data on which to base future decisions on the sports sector (Tomaszewicz et al., 2010, pp. 9–10).

During subsequent meetings of the Group, documents that constitute the basis for the preparation of national sport satellite accounts were developed:

1. *Vilnius definitions* – a table containing selected categories of products and economic activities related to the sports sector according to the official NACE and CPA classifications applied in the European Union.

2. *How to create a sport satellite account?* – a methodological document, prepared by experts from SportsEcon Austria, containing practical guidelines on the methodology for creating satellite accounts (Tomaszewicz et al., 2010, pp. 9–10).

The economic dimension of sport is also reflected in the following provisions of the *White Paper* adopted in 2007 by the Government of the Republic of Poland: *The Commission, in close cooperation with the Member States, will seek to develop a European statistical method for measuring the economic impact of sport as a basis for national statistics on sport, which could lead to the creation of a European satellite account for EU sport* (Tomaszewicz et al., 2010, pp. 9–10).

The European Parliament

In the European Parliament, the development of sport policy falls within the competence of the Committee on Culture and Education (CULT). The Parliament recognizes that there is a growing need for the EU to address sports issues in full respect of the principle of assistance to Member States, as sport is an important social phenomenon and a public good. The EU Parliament has powers in the fields of culture, education, audiovisual policy, youth and sport policy, and the development of sport and leisure policy (<http://www.europarl.europa.eu/factsheets/pl/sheet/143/sport> (5.02.2019)). On 14 April 2005, the European Parliament adopted a *Resolution on combating doping in sport*. The resolution stressed that the use of chemicals to enhance the ability to perform better in sport conflicts with the values of sport as a social, cultural and educational activity and called on the EU Member States and the European Commission to combat this phenomenon more effectively (<https://msit.gov.pl/pl/sport/uczciwosc-i-bezpieczens/antyding/609,Unia-Europejska-a-doping-w-sporcie.html> (27.01.2019)). In relation to this problem, the European Parliament in its resolution referred, inter alia, to the following documents: *Declaration No. 29* on sport, annexed to the Amsterdam Treaty, and Article III-282 of the Treaty establishing a Constitution for Europe; *Resolution of 7 September 2000* on combating doping in sport (Official Journal, 2001a); Official Journal, 2000; Official Journal, 2001b), *World Anti-Doping Code* adopted on 5 March 2003 in Copenhagen; report of the Committee on Culture and Education of 29 November 2004 on: *The use of doping substances in sport – an obstacle to the realization of the sporting ideal*. The Members of the European Parliament instructed its President to forward this resolution to the Council, the Commission, the governments and parliaments of the Member States, the governments of the acceding countries, the national and international sports federations, the International Federation for Equestrian Sports (FEI), the Council of Europe, the International Olympic Committee and the World Anti-Doping Agency (Official Journal of the European Union, 2006).

The European Commission

The European Commission consisted of Directorates-General. During the discussed period, the European Commission administratively consisted of 23 Directorates-General, i.e. equal to the number of Member States (Directorates-General consisted of Directorates, followed by three or four Departments). One of them was the Directorate-General for Education and Culture. The area of competence of the Directorate-General included the coordination of programs in the following fields: education and training, youth, culture, foreign languages, sport, civil society (http://ec.europa.eu/dgs/education_culture/index_en.htm (21.01.2019)). This Directorate includes the Sports Department, which was the most important partner of the Ministry of Sport in Poland, through which all information related to sport was obtained. The duties of the Sports Department also included cooperation with the European

Commission, external and national authorities and international organizations. The scope of the Commission's work included analyses of two key documents: the *White Paper on Sport* and the *Independent European Sport Review*. The *White Paper on Sport* was a document containing proposals for Community action in the field of sport. All sports institutions were able to comment on the objectives of this document. The meeting at which the impact of the European Union on the development of sport in Poland was discussed was held on 23 March 2007. Further consultations were planned for June 2007. As part of the work being undertaken, Commissioner Jan Figel (Poland) stressed the need for a legal basis for European sport. This statement was particularly important because it expressed the political will to strengthen the role of sport in Europe (Bulletin No. 1766/V, pos. No. 70). The *White Paper on Sport* was adopted by the European Commission on 11 July 2007 (<https://eur-lex.europa.eu/legal-content/PL/TXT/PDF/?uri=CELEX:52007DC0391&from=GA> (5.02.2019)). The following was communicated to the assembled: *The White Paper on Sport will not be a document that comprehensively covers sports issues. Its essence will be solely to demonstrate the political will, as well as the direction of future actions* (Bulletin No. 1766/V, pos. No. 70). The *White Paper on Sport* dealt with four main problems: 1) *The societal role of sport*; 2) *The economic dimension of sport*; 3) *The organization of sport*; 4) *Follow-up – Structured dialogue; Cooperation with Member States; Social dialogue* (<https://eur-lex.europa.eu/legal-content/PL/TXT/PDF/?uri=CELEX:52007DC0391&from=GA> (5.02.2019)). The second important document was the *Independent European Sport Review* drawn up in 2006. It was a response to the lack of sports regulations, which were not included in the Constitutional Treaty. The United Kingdom, as the country holding the Presidency in the second half of 2005, commissioned drawing up a report that would indicate to the EU institutions, governments and other entities involved in the organization of European sport how to implement the provisions on sport contained in the Nice Declaration, both at the European and national levels. José Luis Arnaut became President of the Commission. The report was discussed on the example of football, which was chosen as a discipline requiring the intervention of both governments and European institutions. The problems highlighted in the 2006 *Independent Review* included: ownership rights, control and management of clubs; legal issues such as club licenses, transfer of players, legal regulations regarding players' agents and their remuneration; corporate governance issues in football authorities; criminal activities around football, including money laundering and trafficking in young players; manifestations of racism and xenophobia, gambling and, in particular, the implications of match-fixing, corruption and illegal betting, as well as safety and security in stadiums (Żyśko, 2009b). Similar reports on handball, volleyball and basketball were to be produced in the future, depending on which Presidency would undertake such actions (Bulletin No. 1766/V, pos. No. 70). The above issues were discussed during the meetings of the Physical Culture and Sport Committee during the fifth term of office of the Sejm of the Republic of Poland (27.03.2007), chaired by Janusz Wójcik, MP. The Committee examined information on: *Sport in the structures of the European Union* and *European Union Programs for the development of sport*. With regard to the first issue, Polish parliamentarians were informed that there was a possibility of receiving subsidies from the European Parliament for the organization of sporting events. In 2006, the Directorate-General for Information announced a call for projects to raise awareness of the role of the European Parliament (EP) and its tasks. One of the points was the possibility of receiving a subsidy for the organization of events with a European dimension, i.e. fairs, exhibitions and sporting events. The planned subsidies could amount to between 15,000 and 250,000 euros, with projects to be implemented by 3 May 2007 (Bulletin No. 1766/V, pos. No. 70). With reference to the second issue: *European Union programs concerning the development of sport*, the members of the Polish Parliament acknowledged that the majority of the presented European Union programs did not concern solely

sport. Sport was part of general programs for education, culture and youth (Bulletin No. 1766/V, pos. No. 70). Anna Czyszczak, representative of the Ministry of Sport at the meeting of the Physical Culture and Sport Committee, acquainted the participants with five different EU programs:

1. The *EYES 2004* program has so far been of the greatest importance for European sport. Under this program thirteen Polish projects received subsidies totaling more than 456,000 euros. The idea behind it was to increase the awareness of educational and sports organizations concerning the need for cooperation for the development of education through sport. This concept raised great interest. The European Union co-financed 195 projects from 28 countries under this program.
2. *Norwegian Financial Mechanism* and *European Economic Area Financial Mechanism* programs did not concern solely sport, yet sport was funded from them. More than 533 million euros was allocated to Polish projects between 2004 and 2009 under these programs. As part of these initiatives, *Priority 5* was created, from which money could be allocated to sport. It was a project entitled *Healthcare and Childcare*. Its aim was to improve society's health conditions through, among others, health promotion and prevention programs, improving the quality of services in healthcare facilities, increasing accessibility and improving basic and specialist health care. All public and private institutions as well as non-governmental organizations could apply for financial assistance.
3. *Europe for Citizens* was a program operating in 2007–2013. The European Commission drew up a guide for this program. It created opportunities for co-financing sports projects, among others. The main objective of this program was to support the actions and organizations promoting active European citizenship. Organizations active in the field of amateur sport could apply for co-financing under this program. The program's budget for the period 2007–2013 was 215 million euros. The program was divided into four lines of action, each of which could provide funding for sport.
4. The program which made it possible to subsidize sport was a project concerning an integrated approach to lifestyle. This was the responsibility of the Directorate-General for Health and Consumer Protection. The total funding amounted to more than 33 million euros. It was crucial that the presented projects had an innovative character and the period of their implementation did not exceed three years.
5. *Athletes on the Labor Market* was a project that regarded solely sport. It was developed within the framework of the Equal Community Initiative. 'Development Partnership' was established in 2004 as part of this Initiative. The administrator of this project was the Polish Basketball Association, which together with five other entities developed and tested a system of career counselling for people ending their sports careers. In Poland, the project was carried out in two voivodeships: Masovian and Silesian, through a partnership of four nationwide sports associations, a consulting company and a foundation. The organizers planned to include 180 people in this project within two years. The project was addressed to people who had been professional athletes, but for various reasons were not able to continue their sporting careers (Bulletin No. 1766/V, pos. No. 70).

The European Court of Justice

Since sport in the European Union became an important topic and related issues were not regulated by Community law, a key role has been played by the case law of the European Court of Justice (ECJ). Following the case law regarding football player Jean-Marc Bosman in 1995, there were further cases clarifying the

principles of free movement of people working in sport. Due to the requirement to adapt the legal system to the *acquis communautaire* already in the pre-accession period, and at the same time due to the requirements of the International Federation of Association Football (FIFA) and the Union of European Football Associations (UEFA), resulting from the Commission's pressure on these institutions, Poland changed its legal system accordingly. The regulations abolishing transfer fees and quantitative limits of foreigners from Member States of the European Economic Area (EEA), previously defined by sports clubs, were implemented. After Poland became a member of the EU, Polish citizenship, due to its Community character, became attractive to players from outside the EU. After Poland's accession to the EU, which guaranteed freedom of movement and taking up employment on equal terms, Polish players started to go abroad on a much greater scale. The principle of non-discrimination also applied to the employment of other persons involved in sport – not only players, but also coaches. The process of their employment was facilitated by the system of mutual recognition of professional qualifications acquired in the EU Member States and European Free Trade Association (EFTA) countries (http://dms.msport.gov.pl/app/document/file/448/lista_pkt_Kontaktowych_IE.pdf?field=file1; Kałużyńska et al., 2009, p. 304). This system concerned the categories of regulated professions, which in sport include the following: coach, sport instructor, physical recreation instructor, wellness instructor, sport instructor for people with disabilities, as well as sport manager, with regard to individual sports disciplines and sporting events. Owing to these facilitations, sports clubs could afford to select the best coaches available on the labor market of the entire EU without any formal obstacles (<http://msport.gov.pl/sport-w-unii-europejskiej/360-Sport-w-strukturach-UE?retpag=/sport-w-unii-europejskiej> (23.01.2019); Kałużyńska et al., 2009, p. 304).

Summary

Poland's membership in the EU since 2004 has created the conditions for the implementation of projects co-financed from the EU structural funds. During the fifth term of office between 2005 and 2007, the Parliament of the Republic of Poland, in cooperation with the Ministry of Sport and the Parliamentary Physical Culture and Sport Committee, drew up a plan for co-financing projects for the construction, extension or modernization of sports infrastructure under the EU structural programs and the INTERREG III A and EQUAL Community Initiatives (Kałużyńska et al., 2009, p. 304). Under the EU structural funds co-financing program (approximately 536 million Polish zlotys) for 2004–2006, 453 sports infrastructure projects were implemented, most of which were related to sports fields and stadiums (120), followed by sports centers and complexes (108), sports halls and gymnasiums (89), swimming pools (11) and other projects (110), e.g.: development around sports facilities or construction of climbing walls. The majority of the above-mentioned projects were implemented in rural and urban-rural areas. Thus, public access to sports facilities was increased. This provided children and youth with suitable conditions for the development of sports activities during physical education lessons, as well as in extracurricular activities in Student Sports Clubs (UKS), as an alternative form of spending free time, or in order to improve conditions for professional sport training. Apart from the construction of football pitches with artificial football surface in the West Pomeranian voivodeship, activities in the field of education and health of children and youth were also planned, as well as the implementation of a modern football training system (Name of the operational program: ZPORR). Sports undertakings could benefit from funding under EU programs. Those were, among others, *Youth in Action* (including the European Voluntary Service), *Europe for Citizens* (promoting active European citizenship, developing intercultural dialogue) and *Daphne I* and *Daphne II* [fight against violence] (Kałużyńska et al., 2009, p. 307). Increased access to

sports infrastructure enabled a wider group of people to engage in physical recreation and sport. In the discussed period, the number of persons who exercised increased from 8% (2000–2004) to 21% in 2004–2006. The most frequently practiced sport in sports clubs was football, where the number of persons exercising in 2004–2006 increased from 197,000 to 236,000. Volleyball, practiced by 173,000 persons in 2004 and 228,000 in 2006, enjoyed a comparable interest (Central Statistical Office, 2008, p. 277). Compared to the average of the 25 EU Member States, which was 38% for people practicing sport at least once a week (Eurobarometer, Citizens of European Union and sport. Special Eurobarometer 213, November 2004, p. 3) the declared physical activity of Poles with this frequency was at a slightly lower level (33%). Only 7% of adults practiced sports on a regular basis at that time (The World Health Organization (2002). In conclusion, it can be stated that the consequence of Poland's membership in the EU was the undertaking of activities related to the activation of local communities in the area of education and sport. Poland's membership in the EU so far has brought positive effects due to the increase in the availability of sport resulting from the development of regional infrastructure co-financed by EU funds and the enrichment of the program offer, through support for projects related to the organization of extracurricular sports activities for children and youth. The effects of the membership in the field of sport are still felt both by selected groups and the whole society (Kałużyńska et al., 2009, p. 308).

References

- Bulletin No. 1766/V, pos. No. 70 of the Physical Culture and Sport Committee dated 23.03.2007.
- Central Statistical Office (2008), *Polish Statistical Pocketbook [Mały rocznik statystyczny Polski]*. Warsaw.
- Eurobarometer, *Citizens of European Union and sport*. Special Eurobarometer 213, November 2004, p. 3. (accessed on 23.01.2019).
- http://dms.msport.gov.pl/app/document/file/448/lista_pkt_Kontaktowych_IE.pdf?field=file1 (25.01.2019).
- http://ec.europa.eu/dgs_education_culture/index_en.htm (21.01.2019).
- http://ec.europa.eu/sport/pdf/doc244_en.pdf (2.01.2019).
- <http://msport.gov.pl/sport-w-unii-europejskiej/360-Sport-w-strukturach-UE?retpag=/sport-w-unii-europejskiej> (23.01.2019).
- <http://www.europarl.europa.eu/factsheets/pl/sheet/143/sport> (5.02.2019).
- <https://eur-lex.europa.eu/legal-content/PL/TXT/PDF/?uri=CELEX:52007DC0391&from=GA> (5.02.2019).
- https://mfiles.pl/pl/index.php/Traktat_Nicejski (26.01.2019).
- <https://msit.gov.pl/pl/sport/uczciwosc-i-bezpieczens/antyding/609,Unia-Europejska-a-doping-w-sporcie.html> (27.01.2019).
- <https://uokik.gov.pl/download.php?plik=6354> (23.01.2019).
- Journal of Laws of 2007 No. 142, item 999.
- Kałużyńska, M., Smyk, K., Wiśniewski, J. (eds.) (2009). *5 years of Poland in the European Union* (pp. 294–308). Office of the European Integration Committee, Chapter: Education and Sport. Warsaw.
- Kolos, A. (2011). *The problems of sport in the activity of the Sejm Physical Culture and Sport Committee in the 5th term of the Sejm of the Republic of Poland in the years 2005–2007*. A master's thesis, Faculty of Physical Culture in Gorzów Wlkp.
- Name of the operational program: ZPORR, 3.5 Local social infrastructure Project value: PLN 18,822,873.19, Value of European Union contribution: PLN 5,740,000.00, Ministry of Regional Development, *Impact of the Structural Funds and the Cohesion Fund on the Polish economy in 2004 – 1st half of 2007*, Warsaw, February 2008, 60–61.
- Official Journal (2000) C 356 of 12.12, p. 1.
- Official Journal (2001a) C 135 of 07.05, p. 270.
- Official Journal (2001b) C 135 of 07.05, p. 274.
- Official Journal (2004a) No. 90, item 864.
- Official Journal (2004b) No. 90, item 864/30.

Official Journal of the EU C 306 z, p. 1.

Official Journal of the EU C 321E z, p. 37.

Official Journal of the EU C 83 z, p. 13.

Official Journal of the EU C 83 z, p. 47.

Official Journal of the European Union (2006) 09.02.P6_TA (2005) 013.

The World Health Organization (2002). *The World Health Report 2002. Reducing risk; promoting healthy lifestyle*. Geneva.

Tomaszewicz, Ł., Świeczewska, I., Strawński, P., Kulczycka, J. (eds.) (2010). *Sport Satellite Account for Poland*. Report commissioned and financed by the Ministry of Sport and Tourism, Institute of Public Statistics, Central Statistical Office. Warsaw, December.

Żyśko, J. (2009a). *European model of sport and sport management systems in Poland and other countries*. Warsaw.

Żyśko, J. (2009b). Presentation on: *European model of sport and sport management systems in Poland and other countries* (Slide: 14, 15). Warsaw.

Cite this article as: Nowak, L., Nowak, M.A. (2021). Impact of European Union Programs on the Activities of the Third Polish Republic's Parliament in the Field of Sport in the Years 2004–2007. *Central European Journal of Sport Sciences and Medicine*, 1 (33), 17–25. DOI: 10.18276/cej.2021.1-02.

GENDER INEQUALITY AND FEMALE SPORTS PARTICIPATION IN TURKEY

Meltem Ince Yenilmez

Department of Economics, Yasar University, Izmir, Turkey

Address for correspondence:

Meltem Ince Yenilmez
Yasar University, Department of Economics
Üniversite Cad. Ağacli Yol No: 35–37
Bornova, İZMİR
E-mail: meltem.ince@yasar.edu.tr

Abstract Research Questions: Discrimination remains a sore point for women in Turkish sports. This has subsequently hindered women from participating or building thriving careers in sports in Turkey. Many women are discouraged from taking part in professional sports due to the perceptions existing around such activities. Therefore, the Turkish female sports sector is growing at a very sluggish pace. The present study evaluates Turkish women's roles regarding connections between sports and politics to revolutionize the country. This assessment is vital to understand the barriers to Turkish women's sports participation and what can be done to encourage more women to invest in professional sports.

Research Methods: The present study provides an in-depth view of the limiting factors hindering women from developing thriving professional Turkish sports careers. The research utilizes a semi-structured questionnaire to establish data from about 162 female participants (amateur and professional sportswomen) in different cities across the country.

Results and Findings: The present study highlights that unequal salaries, unavailability of sports facilities for women, media misrepresentation, and pressures from the family, are some of the factors limiting the participation of females in Turkish sports.

Inferences: The study provides insights on the vitality of sports programs and physical activities, everyone, including females. The study further emphasizes the need to create enabling environments that will foster female participation in Turkey's sports.

Key words sports, women, female athletes, gender discrimination, wage inequality, media

Introduction

Sports have always been more than a social activity; it is considered one of the most valuable social tools for connecting individuals across the local and global landscape (Velazquez, 2017). The general understanding of sports has always been positive and regarded as human-friendly engagement in day to day life (Jabeen, Marwar, Khan, Ali, 2017). On a personal scene, sports can equally play a psychological, social, emotional, mental, and physical developmental role in participants' lives (Khan, Jamil, Khan, Kareem, Imran, 2012). Therefore, sports' importance is broad and diverse, encompassing a role in individual economic value, health fitness, and promoting peacebuilding and community regeneration (Gorman, Butler, Rauh, Kiesel, Plisky, 2012; UNESCO, 2015).

Nevertheless, sports participation has always been seen as positive in promoting social capabilities and academic responsibilities. Research further proves that sports participation is valuable to developing particular attributes, including the sense of well-being, sound health, getting entertainment, and weight control (Jabeen et al., 2017). It can further be considered a part of the local culture, connecting the young and old while creating opportunities for young people to pursue a potential that is non-academic (Jaenes, 2017). Therefore, it can be seen as a tool for promoting gender equality and social inclusion for women and girls (Wangari, Kimani, Wango, 2017).

However, the reality is quite different, especially for women in sports. Many women have been exposed to discrimination and social exclusion, for example, sexism, gender inequality, and homophobia (Cleland, 2014; Wangari et al., 2017). Many sports scholars have investigated this “dark side” of sports revealing that sports have in the past reinforced damaging and dangerous social patterns such as excessive violence, homophobia, gender inequality, and racism (LaVoi, Kane, 2011).

There are countries where women are not allowed to participate in professional sports. In contrast, some other states allow participation but with severe discrimination levels in diverse areas, including the kind of picture depicted by the media (Fahmy, 2011; Hardin, Croston, 2012).

Diverse schools of thought have carried out studies about the reasons that promote female involvement in sports and physical activities in several groups. However, a handful of literature has actually discussed the problems that influence female participation in sporting activities (Ahmad, 2015; Ballantyne, Kayser, Grootegeod, 2012).

In times past, sports were considered a male-dominated world, and women were considered outsiders in the game (Wangari et al., 2017). This means that the world of sports has always been perceived as more masculine than feminine. These views are also held by diverse countries globally (Hardin, Croston, 2012; Feldman, Barnette, Shrier, Abenhaim, 2003; FIFA, 2015; Saavedra, Martha, 2010). Initially, women were perceived to be the other sex; they were not the leading insiders and were mainly considered to be latecomers or newbies who were only permitted to participate in friendly games or sports (FIFA, 2015; Pfister, Hacisoftaoğlu, 2016; Gorman et al., 2012).

Furthermore, the popular conception, equally held by women, is that the less strenuous activities are meant for women. At the same time, men can participate in a wide variety of activities (Ruseski, Humphreys, Hallmann, 2011; FIFA, 2015). For instance, there is a perception that football is a sports activity suitable to men alone, while women can take part in gymnastics (Fahmy, 2011; FIFA, 2015). Such perceptions have been around for decades and are not only gender convictions and patriarchal ideologies, but further supported by science (Feldman et al., 2003). In 1953, Buytendijk, a renowned philosopher, shed insights on female football, denoting it as a game for the full expressions of masculinity, especially as men have the physical constitution for such activities. He further stated that women have never been successfully driven to engage in the game. (Buytendijk, 1953). Many other studies also support such views, leading to a higher volume of women in low and moderate sports activities. In contrast, a higher number of men are found in activities with higher intensity (Jabeen et al., 2017).

Furthermore, a study concerning women's football in 2014 also shows a poor perception that women should not be allowed to feature in sports activities such as football (FIFA, 2015). Such perceptions are also found in Turkey. Even as the creation of the Modern Turkish Republic, after the dissolution of the Ottoman Empire, in 1923 brought about the development of laws and regulations on the grounds of inheritance issues, gender equality in divorce, rights to vote, female participation in politics, and secularization, gender inequality is still an issue in the country (Koca, Hacisoftaoğlu, 2010; Gorman et al., 2012).

Turkish Sports and The Adverse Effects of Gender Discrimination

Turkey's geographic position is a very distinctive one, especially when bearing in mind the common history shared with many other Islamic countries within the region. Nevertheless, the country remains unique and may never be effectively compared to these other countries because Turkey has made attempts in the past to adopt a secular system to become a genuinely contemporary society. One such instance, which shows this uniqueness, is policies concerning women's liberation (Koca, Hacisoftaoğlu, 2010). However, several researches also argue that patriarchy is still as dominant as it is in other Islamic countries in the region, even as the country stands out. Therefore, such ideologies are adversely impacting the perceptions and acceptance of sportswomen in the country (TUIK, 2012b).

These views are deeply entrenched, especially when ones bear in mind that sports are perceived as masculine and seen to be synonymous with aggression and force whereas, most people perceive feminine activities as those concocted with elegance, gentleness, passivity, and weakness (Pavlidis, Fullagar, 2016; Nogueira, Molinero, Salguero del Valle, Lucidi, Marquez, 2017).

Besides, women who participate in sporting activities seen as masculine in nature must contend with the restrictions and marginalization, including labeling individual sports as more appropriate for women and others as not fitting for typical female behavior (Nogueira et al., 2017).

However, in recent years there has been a significant increase in the number of women in Turkish professional sports and international sports competitions, including receiving medals for international sports competitions (Koca, Hacisoftaoğlu, 2011). The evolving roles of women, their behavioral patterns, and activities have also provided Turkish women with new opportunities and play a significant role in female representation in Turkey's professional sports (Koca, Hacisftaoglu, 2010). In 2010 alone, more women were competing in volleyball (10,599), taekwondo (9,353), basketball (4,714), karate (4,101), swimming (1,952), kickboxing (1,924), handball (1,859) and judo (1,543) (Koca and Hacisftaoglu, 2010).

There is no doubt that a country's evolution can be depicted by women's involvement in government job positions alongside their heightened sports participation (Nogueira et al., 2017; Ponseti, Borrás, Cantallops, García-Mas, 2017; Wangari et al., 2017). The issues of gender equality in the sports environment are a severe issue as research has equally shown that when there are equal opportunities for women and men, it provides personal and organizational, societal, and national benefits (Spaaji, Anderson, 2012). Therefore, when gender inequality problems abound, it limits a country's growth in social and economic aspects, which means the gender equality gap in Turkey must be filled. The sports sector is a principal area requiring significant attention. Upholding gender equality's tenets provide immense benefits to men and women alike as improving diversity, especially in Turkish sports, will further help attract the international sporting community (Bruce, 2015; Sailors, Teetzel, Weaving, 2012).

When gender equality tenets are implemented, females will be motivated to build thriving and long-term careers in sports (Burton, 2015; Pavlidis, Fullagar, 2016; Jacobs, 2017; Walker, Bopp, 2010). However, as long as social and cultural limitations, traditionalism alongside familial pressures, poverty, low literacy levels, religious rules, and unavailability of sports facilities and equipment continue existing, it discourages females from seeking a career in sports and as such as the present climate in Turkey (Koca, Hacisoftaoğlu, 2010; Öztürk, Koca, 2019). Further studies by the Hacettepe University Institute of Population Studies (2019) show that over 76.5 percent of women and girls over the age of 12 do not participate adequately in physical activities. Furthermore, their levels of participation are almost insignificant when compared to the involvement of men and boys in Turkey in physical

activities (Ministry of Health, 2014; Öztürk, Koca, 2019). Studies have also shown that participation in physical activity can only be promoted through individual, environmental, socio-cultural, and psychological factors (Brien, Lloyd, Riot, 2017; Zhang, Solmon, Gao, Kosma, 2012). Therefore, the present study will provide insights into how socioeconomic factors, limited resources, media misrepresentation, and wage inequality affect women's Turkish sports participation.

Gender Inequality and Segregation

Over the years, the emergence of women into professional sports or even physical activity has met with mixed reactions across the globe. These reactions have brought about diverse discriminatory issues that are deeply entrenched in the underlying gender gap. The Liberal Feminism theory advanced by Mary Wallstone, John Stuart Mill, and Harriet Taylor, as expressed in Wangari et al. (2017), equally evaluated these reactions. With a focus on stereotypes, gender roles, power and oppression, sex and gender, objectification, structural and economic inequality, the Liberal Feminist theorists stated that the family mostly impacts the differences seen in female sport participation, school, and media (Story, Markula, 2017). According to the Liberal Feminists, prejudice, division, and social discrimination primarily begins from birth. It may continue for life without adequate intervention. Therefore, the discriminatory practices hindering women from equal access to various professional sporting activities are enormous.

Consequently, women do not have many opportunities for competition compared to their male counterparts. Liberal Feminist theorists equally hold the positions that the number of tournaments and leagues available to women at the local, national, and international levels is insignificant compared to the numerous opportunities available to their male counterparts. Further, studies by Mean (2014), show that the media trivializes women's tournament and leagues. Even as it is widely acknowledged that sporting activities can lead to more robust health and mental development, the level of perceptions meted to women in sports is shocking (Mean, 2014). Kian, Bernstein, McGuire (2013) further identifies the lack of adequate coverage for female athletes alongside the growing fact that online media sports workers contribute to the "problematic" reproduction of traditionally gendered discourses, including asymmetry in production values and provision that frames women as feminized and outside the main category of sport, reproducing women's sport as substantively less action-packed and newsworthy than men's sport. Women sports fans as less sophisticated than men" (in page 339). Many ideologies of women's positions depict them as being responsible for household chores without the responsibility of bringing home financial income (Wangari et al., 2017). Therefore, the more significant majority draws invisible rules in the stand that terms sport "as a masculinizing activity" (Knoppers, McDonald, 2010) and identifies media sport "as a site of culture thoroughly saturated in ideologies that gives men the privilege while sidelining women, whether they appear as subjects of coverage, audience members or journalists (Bruce, 2013). Furthermore, in the past, the main ideologies by the media limiting the growth of women sports participation were that women's sports (i) yielded lower broadcast production values; (ii) women's sportswomen deserved to be called by their first names and were covered as girls and women without emphasizing their professional achievements (Jones, 2013); (iii) women's sports activities were highlighted based on non-sports related aspects such as their appearance, personality, and family; (iv) women's sports were gender-marked, and for instance, viewed as "the girl's team" or "women's events, while male sports activities were seen as the main events (Jones, 2013); (v) statements flattering female athletes as not trying hard enough and therefore, viewing their actions as inferior to their male athletes.

However, the present climate is even worse as there exist two persistent perceptions (Bruce, 2015). First, the current realities consistently emphasize the message that sportswomen do not matter. This is further emphasized by Bruce, Scott-Chapman (2010). Their studies highlighted that women's sport receives only 11 percent coverage all over the world. Secondly, the present view sexualizes women's sports, as more sportswomen appear in provocative attire and are featured in magazines interpreted as sexualization or even "soft porno" (Kane, Alavi, Labianca, Borgatti, 2014).

Apart from these ideologies, women also experience cultural and religious limitations. For example, Brunei and Qatar did not allow women to participate professionally as Football players until the 2012 Olympics because of Islamic dress codes (Wangari et al., 2017).

In the case of Turkey, the country has been in the Olympics since 1932. However, their iconic appearance at the Olympics was made in 2012 when 50 percent of the Olympics participants were women (Leigh, 2012). Nevertheless, it is quite clear that Turkish women gained access to professional sports in the 1950s. However, too much gender segregation limited the progress the country attempted making with regards to gender equality. However, many were either not paid or underpaid for their contributions (Ince Yenilmez, Çelik, 2020). It was the standard practice to hinder females from participating in "male events" and vice versa (Leigh, 2012). Furthermore, the Liberal Feminism Theory also brings to light the Underrepresentation of women in decision making positions in sports, especially in management and coaching areas. These theories were prescribed by Knoppers, 1994, and expressed in Wangari et al. (2017). It is the perception that men have more capabilities for making decisions than women and are best suited for those provisions. Therefore, the Liberal Feminism Theory brings to light these discrepancies that have led to more men in critical decision-making positions in governing and administrative functions than women, especially in sports organizations. These have led to lower allocations of funds and resources to women sports organizations resulting in unequal wages and awards.

Nevertheless, this theory does not provide a complete view of the extent of discrimination. The approach fails to highlight the difference between women and instead depicts them as a homogenous group. Therefore, the theory fails to show their differential interests and religion, family, work, and educational differences, which also affects the status of women in society (Wagner, 2016).

A different theory put in place by Bruce, Hovden, Markula (2010) shows that the media also plays a part in discrimination. The media does not fully cover women's sports than men's sports (Moradi, Yoder, 2011). Furthermore, cases where the media covers these events, these women are usually sexualized, trivialized, and marginalized; therefore, distorting their correct roles and achievements in the world of sports.

Because the media represents the male athletes by their professional achievements and the females by their personal attributes, gender inequality issues keep rising (Aslan, Koca, 2007; Jones, 2013). Therefore, as long as sportswomen are seen based on their personal attributes, it only paints the picture that their achievements are not newsworthy (Jones, 2013).

Turkey's socio-culture structure

Turkish women's discrimination in sports is not based alone on media representation but on many other social, historical, and cultural ideologies. Therefore, it is vital to look at these contextually, especially the events following the establishment of the Modern Turkish Republic and dissolving the Ottoman Empire. There are apparent incidents that show that Turkey is making progress towards reforming its policies to promote gender equality in education,

employment, and political life (Acar, Altunok, 2013; Koca, Hacisoftaoğlu, 2011). The 20th Century began with Turkey giving social, legal, and political rights to females (Müftüler-Baç, 2012). On those grounds, several past studies have documented this move to fully ascertain its effectiveness (Acar, Altunok, 2013; Toksöz, 2012). However, other policies enacted in 2015, taking the country in the backward direction as conservatism and traditionalism, are once more the people's main perceptions. Therefore, women are thus seen first as mothers and wives. So, the traditions and customs are taking the central state in the present era (Sumer, Eslen-Ziya, 2015). This further heightens the contraindications, traditionalism, and restrictions, alongside inadequate sports and recreational centers, low education levels, and family responsibilities, all of which are discouraging more women from becoming active sportswomen in the country (Koca, Hacisoftaoğlu, 2011).

Problems hindering the growth of female participation in Turkish sports

Past works of literature highlight that family pressures, overcrowding, lack of time, lack of companionship, financial issues, and distance of sports facilities limit female participation in sports activities (Stanis, Schneider, Pereira, 2010; Scott, Mowen, 2010; Kara, Demirci, 2010). Some research has further grouped these challenges into physical, economic, and socio-cultural issues (FIFA, 2015; Wangari et al., 2017). Other works also denote the lack of energy or time as one of the most critical challenges preventing female participation in sports (Story, Markula, 2017; Wangari et al., 2017). Furthermore, some works of literature have also highlighted that income level might be one of the factors limiting women's growth in sports because income is vital to gaining more significant role in sports activities than age, gender, educational level, and race (Johnson, Salzberg, Stevenson, 2011).

Methodology

Participants

The researcher distributed questionnaires to professional, amateur, and recreational female athletes over age 21. The questionnaire was dispersed to online groups, groups, universities, and public facilities where female athletes commune. In the end, over 162 females, including professionals, amateurs, and recreational sportswomen, participated in the study. Therefore, the researcher collected demographics alongside other sports-related information.

Instrument

The research follows a descriptive methodology using an 18-question semi-structured questionnaire specifically adapted for the present study. The self-administered questionnaire was prepared following the guidance from experts in sociology and Physical Education alongside other works of literature (Wilson, Spink, 2006) to assess the variables used in the present study adequately. Variables include wage inequality, sexual harassment, unavailability of sports facilities and equipment, family influence, and media representation. Sub-dimensions follow the Likert Scale ratings from 1 (Disagree) to 5 (Highly Agree).

Hypothesis

Through an in-depth study of previous works of literature, alongside the aim of the current study, the researcher proposes:

Hypothesis 2 (H2): Wage inequality, as regards their male colleagues, discourages active female participation in sports.

Hypothesis 3 (H3): Media misrepresentation adversely impacts on female involvement in Turkish sports.

Hypothesis 4 (H4): Unavailability of facilities and equipment dedicated to female teams negatively affects female participation in Turkish sports.

Hypothesis 5 (H5): High prevalence of sexual harassment hinders more women from participating in sporting activities in Turkey.

Data Analysis

Data from the questionnaire were evaluated using IBM SPSS Statistics to visualize the respondent's choices using descriptive methodologies, including the Chi-Square and Friedman tests on the grounds of the present study's hypothesis and objectives.

Results

Majority of respondents attained College (27.12%), as shown in Table 1. Table 1 also indicates that over 49.13% of respondents were between 20 and 30 years, while around 82.67% were employed in full-time positions. Over 68.77% of respondents also participated in sports activities. In comparison, 58.45% had children, and over 60.56% had participated in sports events within the last few years (see Table 1 for details).

Table 1. Demographic data of participants

Variables	Groups	N	Percent
Education Level	Elementary School	22	14.71
	Junior High School	29	20.43
	Senior High School	37	22.83
	College	34	27.12
	Graduate School	20	14.91
Age	20–30	65	49.13
	31–40	56	37.86
	41–50	17	10.58
	51–60	4	2.14
	>61 years old	0	0.00
Full-time job	Yes	115	82.67
	No	27	17.33
Have kids	Yes	89	58.45
	No	53	41.55
Married Status	Married	86	60.56
	Unmarried	56	39.43
Participated in the sports club	Yes	84	68.77
	No	58	31.23

Analysis of the data collated via the questionnaire regarding the study's hypothesis emphasizes the five variables as the main impeding factors limiting the participation of Turkish women in sports. These variables are

organized according to their effectiveness and vitality with regards to promoting the growth of women's involvement in Turkish sports, and their preference as denoted by the Friedman test is indicated below:

1. Family influence can motivate girls and women to participate actively in Turkish sports ($\chi = 4.39$ of 5).
2. Wage Inequality, in regards to their male colleagues, discourages active female participation in sports ($\chi = 4.31$ of 5).
3. Media misrepresentation adversely impacts on female involvement in Turkish sports ($\chi = 4.16$ of 5).
4. The unavailability of facilities and equipment dedicated to female teams negatively affects female participation in Turkish sports ($\chi = 4.12$ of 5).
5. High prevalence of sexual harassment hinders more women from participating in sporting activities in Turkey ($\chi = 3.89$ of 5.)

Table 2. Percentile distribution of participant's choices in completing the questionnaire

	Very High	High	Med	Low	Very low
A. Family Influence					
1. My family feels that sports participation is a waste of time	78	12	6	2	2
2. My family supports my sport's ambition	69	21	5	3	2
3. My family encourages me as a result of the vitality of sports	57	25	11	6	1
4. My family's wishes do not matter	8	11	27	23	31
B. Wage inequality					
5. The pay is lower than male counterparts	61	24	11	3	1
6. I need double jobs to create a substantial income	43	31	22	4	0
7. The awards and sponsorships for women are very low	52	39	7	2	0
C. Availability of Standard Sports Facility and Equipment					
8. Standard facilities encourage female participation	60	19	13	5	3
9. Equipment are available for female sports activities	68	18	7	4	2
10. We can only use the sports facilities if the men are not using them	62	21	12	4	1
11. Lack of proper methods for talent identification in athletics	38	30	28	1	3
D. Media misrepresentation					
12. Limited exposure to mainstream media coverage	64	19	8	4	5
13. The media fails to help attract the right sponsors	57	28	11	3	1
14. I am objectified for my body instead of my abilities	53	25	16	4	2
15. Objectified for my body rather than my abilities	42	36	15	7	0
E. Sexual Harassment					
16. Judged for my dresses/sporting attires	38	24	27	7	4
17. I have to make to with hostile or offensive statements from other people	61	23	9	5	2
18. I receive requests for sexual favors and unwelcome advances	57	26	10	4	3

Table 2 depicts wage inequality, family influence, unavailability of facilities and sports equipment, media representation, and sexual harassment as the critical variables limiting Turkish women's sports growth.

Table 3. Results of Statistical Analysis

	Hypothesis	χ^2	df	P	Accept	Decline
1.	Family influence can encourage females to take part in active sporting activities	18.715	4	0.002	Yes	
2.	Wage inequality compared to their male counterparts can discourage females from taking part actively	53.672	6	0.001	Yes	
3.	Misrepresentation by the media negatively affects women in sports	31.769	3	0.001	Yes	
4.	Lack of facilities and equipment specially installed for female teams negatively affects women in sports	22.147	6	0.001	Yes	
5.	High levels of sexual harassment negatively affect women in sports	71.916	5	0.001	Yes	

Table 3 outlines the results from the test for the hypothesis. According to the table, a vast number of hypothesis exists within the significance of 0.001. Further analysis using the χ^2 test, five factors are acknowledged, for it was recognized that five factors are limiting the growth of female participation in Turkish sports. From results, wage inequality appears to be the most significant factor discouraging women from participating and building great sports careers. Subsequently, the unavailability of facilities and sports equipment for women is also a great challenge hindering female sports participation, alongside significant sexual harassment incidents.

Discussion

As outlined from the study results, five vital variables - sexual harassment, wage inequality, funding limitations, media misrepresentation, and family influence - are responsible for impairing the future of female participation in Turkish sports.

Influence of parents

Previous studies confirm the findings that family influence is significant by Bibi, Khan, Khan, (2016) on the reviews of parental problems on sports participation in Pakistan. Pelak (2005) also asserted that parental involvement could become a critical motivational factor in sports participation. Therefore, when parents fail to show their interests, it might discourage the child from following that path (Taylor, Schweichler, Jorgensen, McKown, Teresak, 2014). These parental influences are mainly in attitude, motivation, and finance, which are essential and influential tools for females in sports. A study by MacIntosh, Nicol (2012) has equally shown that parents provide a vital support system that can aid their children in participating in sporting activities, especially seeking professional paths in that regard. The present study shows that the almost lack of parental influence affects or inhibits women's growth in professional sports in Turkey. This is also in line with the survey by Marwat, Zia-ul-Islam, Waseem, Khattak, BiBi (2014) that sports participation among female folk in Muslim countries is relatively weak. Again, Kanter, Bocarro, Casper (2015) also state that parents may prevent their female wards from participating in professional sports without a clear perception of the fruitful outcomes of professional sports.

Wage disparity

One of the great gender issues affecting Turkey alongside many other countries globally is the lingering gap in wages earned for males and women in similar jobs (Tansel, Dalgic, Guven, 2014). This enormous gap is also visible

in the sports sector and especially observed in these research results. As also confirmed from previous literature works, many male athletes earn twice as much as their female colleagues. These figures climb as far as ten times (Forbes, 2016; Monster Salary Index, 2017). In the present study, many participants highlighted that their insufficient income from sports is why they seek other full or part-time employment. However, previous literature works have highlighted that these gaps are further fueled by the fact that sportspeople receive greater media coverage, which in turn fosters the environment for endorsements and sponsorships (Moradi, Yoder, 2011).

Further analysis by Kagnicioglu (2012) observed that Turkey's lingering patriarchal ideologies play a huge role in women being paid less than men in similar positions. There is a lingering perception that women cannot put in the hard work that their male colleagues boast off. Therefore, the general perception is that women deserve a lesser wage than their male counterparts (Kagnicioglu, 2017).

Sexual harassment

From the present study results, sportswomen in Turkey deal with an untold amount of sexual harassment, and in many cases, violence. According to Westcott, Foley-Fellow (2018), these high levels of sexual harassment are witnessed by most Turkish women in paid employment positions in the Turkish labor market. Furthermore, in 2017, over 409 women were killed, and 387 children were abused primarily due to their gender (Hurriyet Daily News, 2018). Therefore, sexual harassment and the high prevalence of violence are the biggest issues discouraging females from seeking great employment positions in the country. Bibi et al. (2016) further state that societal restrictions and violence exist across all aspects of these women's lives. According to the study, fear and violence are existing social control mechanisms used in limiting women from engaging in outdoor activities, such as sports activities. In a similar study, Khan et al. (2012) further stated that the fear of violence, fear of homelessness, and fear of being seen as engaging in immoral social behavior are factors limiting women's participation, especially in sports activities.

Misrepresentation of female sports by the Media

The media plays a vital role in the growth of any country's sports climate, and Turkey is not left out. According to Lin, Liu, Lee, Tsai, Chen, Lee (2012), the growth of any sports activity, such as Turkish women's sports, is dependent on the media's mode of representing these activities and teams. Therefore, when female athletes are trivialized, depicted as sexual objects, or streamed on the grounds of their personal attributes instead of their professional achievements, the result is stunted growth. This is further confirmed by Trolan (2013), who observed that when the media trivializes, sexualizes, underrepresents, or heterosexualizes females' bodies, the media limits the growth of women's professional sports careers. Furthermore, Trolan (2013) postulates that such continuous image only increases the perceptions that men are better suited to sporting activities and, therefore, superior to women athletes. Turkish media is no exception as traditional perceptions linger in the media's handling of women's sports activities (Arslan, Koca, 2007) because traditionally, women are perceived as homemakers, dependent and framed as pliable. Their participation in sports is underplayed. Many Turkish media outlets trivialize sportswomen based on their roles as wives, mothers, and grandmothers or worse as sex objects (Ayvazoğlu, 2017).

Moran (2014) also discovered that the coverage of mass media for female sports is limited. Most times, the news articles published in Turkey are for actions they took that the public considers terrible. Usually, these connote to the preferred dressings for women. According to Moran (2014), Turkey's general society continues to hold the view that women must wear the full hijab, long dress, and full sleeves in all activities. It can be scorching

and uncomfortable for the sportswomen to do so, which has become severe barriers. Another study confirms that female athletes are usually talked about concerning their personal lives and physical appearance rather than another detail (Huffington post, 2016).

Many other findings also show that religion, culture, and mass media may together have a significant influence on the growth of women in professional sports in Muslim countries like Turkey (Tekin, 2010; Fitzgibbons, 2015; Khalaf, 2014). The media also impacts on attracting the right sponsors for women's sports activities. Without comprehensive support from the economic situation in women's sports will be bleak. It is quite apparent that when the media ignores particular sporting activities, fewer sponsors will invest in those areas (Asayesh, Karkon, Karkon, Shabani, 2013.)

Inadequate sports facilities and equipment

According to respondents in the present study, the unavailability of sports facilities and women's equipment is a considerable limitation. Previous studies by Saavedra, Martha (2010) highlight that the few available facilities and equipment are only available to women on occasions when males do not require them. Therefore, such incidents will further limit female participation in sports in the country. These views are supported by Huang, Liu, Chang, Hsieh, Lu (2019), which stated that when community sports facilities are provided, it can encourage the public to participate in sports activities. Chien (2013) further asserts this theory and also argued that the right sports environment promotes active participation. Furthermore, the researcher equally stated that provisions while bearing in mind factors such as accessibility, extensivity, safety, support, and aesthetics are crucial to providing the right motivation for improved participation. A study by Asayesh, Karkon, Karkon, Shabani (2013) equally confirms that it can discourage the growth of such sports when there is limited access to facilities and equipment.

Conclusion

The current study explores the different challenges faced by Turkish women in sports. Among the findings from the study include media misrepresentation, sexual harassment, parental influence, wage inequality, and unavailability of sports equipment and facilities. The course recognizes that these constraints can become opportunities for improvement, which will otherwise lead to an increase in Turkish women's participation in sports. Studies also reveal that despite the changes regarding women's rights implemented in the 1990s, Turkey still has a long way to completely change the role and perceptions of women in society. This is because the levels of discrimination, wage inequality, and unavailability of sports facilities are still considered restrictions that discourage the growth of women's sports in the country.

A limitation of this study was the lack of resources to adequately distribute questionnaires to diverse females in sports across Turkey. The study was also unable to assess the different sporting levels of the participants properly. The researcher acknowledges that this bias may hinder the accuracy of the data presented. However, the study did not collect data from a single locality and attempted to maintain randomness. The present study is an important finding because it explicitly limits female participation in Turkish sports. No study has evaluated the restrictions discussed in this research paper at the time of investigations. The study's findings also highlight areas that can be improved to transform the future of women's sport in Turkey.

Based on the present study's findings, the ensuing recommendations suggest ways to drive up female participation in Turkish sports and further help grow the sports climate in Turkey. First, there is a need to create

detailed policies and execution plans that will foster gender equality within sports institutions in the country. Such an enabling environment should also make provisions for women's coaching opportunities and eliminate sexist gender stereotypes in Turkish sports. Such policies and plans can help create a positive environment that increases women's participation in Turkish sports. Secondly, there should be dedicated sports and physical activity programs created for females at local and regional levels to help boost awareness about sports' vitality for both men and women. Thirdly, provisions should be made for rewards and incentives to encourage more females to invest in building their sports careers. There is also a need for awareness campaigns to help spread the positive impact of sport on women's health to all local communities and regions in the community. Concurrently, there is a need to implement policies that will obligate the media to cover female sports activities without trivializing or sexualizing female sports. Finally, it is extremely vital to promote gender equality in sports because it is beneficial not only on the individual levels but also to the country. For instance, gender equality in sports can create economic opportunities, thereby creating an enabling environment for economic growth in the country at large.

References

- Acar, F., Altunok, G. (2013). The "politics of intimate" at the intersection of neoliberalism and neo-conservatism in contemporary Turkey. *Women's Studies International Forum*, 41, 14–23.
- Ahmad, R.H. (2015). Women sports in India-constraints, challenges, complications, and its remedies. *International Journal of Applied Research*, 1 (13), 656–659.
- Asayesh, L., Karkon, H., Karkon, M., Shabani, A. (2013). The challenges of athletics in Iran: A Delphi study. *European Journal of Experimental Biology*, 3 (6), 66–72.
- Arslan, B., Koca, C. (2007). A content analysis of Turkish daily newspapers regarding sportswomen and gender stereotypes. *Annals of Leisure Research*, 10 (3), 310–327.
- Ayvazoglu, N.R. (2017). The coverage of female athletes at London 2012 summer games in Turkish sports media. *The Anthropologist*, 27 (1–3), 49–57.
- Ballantyne, K.N., Kayser, M., Grootegoed, J.A. (2012). Sex and gender issues in competitive sports: An investigation of a historical case leads to a new viewpoint. *British Journal of Sports Medicine*, 46 (8), 614–617.
- Bibi, I., Khan, S., Khan, W. (2016). Influence of socio-cultural problems on sports participation: A case of female elite athletes in Pakistan. *International Journal of Scientific and Engineering Research*, 7 (6).
- Brien, O., Lloyd, K., Riot, C. (2017). Exploring the emotional geography of the leisure-time physical activity space with mothers of young children. *Leisure Studies*, 36 (2), 220–230.
- Bruce, T., Hovden, J., Markula, P. (eds.). (2010). *Sportswomen at the Olympics: A global comparison of newspaper coverage*. Rotterdam: Sense Publishers.
- Bruce, T. Scott-Chapman, S. (2010). New Zealand: Intersections of nationalism and gender in Olympics newspaper coverage.
- Bruce, T. (2013). Reflections on communication and sport: On women and femininities. *Communication and Sport*, 1, 125–137.
- Bruce, T. (2015). Assessing the Sociology of Sport: On Media and Representations of Sportswomen. *International Review for the Sociology of Sport*, 50 (4–5), 380–384.
- Bruce, T. (2015). *New Rules for New Times: Sportswomen and Media Representation in the Third Wave, Sex Roles*. Springer Science Business Media New York.
- Burton, L.J. (2015). Underrepresentation of women in sport leadership: A review of research. *Sport Management Review*, 18, 155–165.
- Buytendijk, F.J.J. (1953). *Das Fußballspiel: Eine psychologische Studie*. Würzburg: Werkbund-Verlag.
- Chien, Y.C. (2013). *The application of IPA to examine the needs on exercise environment among the middle-aged and elder residents*. Master's Thesis, National Pingtung University of Science and Technology, Pingtung, Taiwan.
- Cleland, J. (2014). Racism, football fans, and online message boards: How social media has added a new dimension to racist discourse in English football. *Journal of Sport and Social Issues*, 38 (5), 415–431.

- Fahmy, M. (2011). Increased participation and competitions: 5th FIFA Women's Football Symposium. Frankfurt: Federation International de Football Association.
- Feldman, D.E., Barnette, T., Shrier, I., Abenheim, L. (2003). Is physical activity differentially associated with different types of sedentary pursuits? *Archives of Pediatrics and Adolescent Medicine*, 157 (8), 797–802.
- FIFA (2015). *FIFA, football and women; why reform must specify inclusion and investment*, submitted to Mr Francias Carrard, Chair of FIFA Reform Committee, October, 2015. Retrieved from: <https://img.fifa.com/image/upload/i2berd89n7syxdjl5fhq.pdf> (16.12.2019).
- Fitzgibbons, R.P. (2015). *Sports and the Catholic family*. Retrieved from: <http://www.maritalhealing.com/conflicts/sportsandfamily.php> (16.12.2019).
- Forbes (2016). *The world's highest paid athletes*. Retrieved from: <https://www.forbes.com/athletes/#3cc9b30b55ae> (15.12.2019).
- Gorman, P.P., Butler, R.J., Rau, M.J., Kiesel, K., Plisky, P.J. (2012). Differences in dynamic balance scores in one sport versus multiple sport high school athletes. *International journal of sports physical therapy*, 7 (2), 148–153.
- Hacettepe University Institute of Population Studies (2019). 2018 Turkey Demographic and Health Survey. Hacettepe University Institute of Population Studies, T.R. Presidency of Turkey Directorate of Strategy and Budget and TÜBİTAK, Ankara, Turkey.
- Hardin, M., Croston, A. (2012). The influence of gender-role socialization, media use, and sports participation on perception of gender appropriate sports. *Journal of Sport Behavior*, 32, 207-226.
- Huang, H.C., Liu, L.W., Chang, C.M., Hsieh, H.H., Lu, H.C. (2019). The effects of locus of control, agents of socialization, and sports socialization situations on women's sports participation in Taiwan. *International Journal of Environmental and Public Health*, 16, 18–41.
- Huffington Post (2016). *Women, media bias and the olympics*. Retrieved from: https://www.huffingtonpost.com/samantha_levine-/women-media-bias-and-the-_b_11459540.html (18.12.2019).
- Hurriyet Daily News (2018). *Violence is the biggest problem women face in Turkey: Poll In Hurriyet Daily News*. Retrieved from: <http://www.hurriyetdailynews.com/violence-is-the-biggest-problem-women-face-in-turkey-poll-128372> (16.12.2019).
- Jabeen, A., Marwar, K.M., Khan, A., Ali, K. (2017). Issues and challenges for female participation in physical activities at secondary school level in Sargodha division.
- Jacobs, J. (2017). *Why Do not Women Coach Men? Lawson, Geno Others At FinaL Four Say They Should*. Hartford Courant. Retrieved from: <https://www.courant.com/sports/hc-jacobs-column-women-coaches-0331-20170330-column.html>.
- Johnson, B.A., Salzberg, C.L., Stevenson, D.A. (2011). A systematic review: plyometric training programs for young children. *J Strength Cond Res*, 25, 2623–3263.
- Jones, D. (2013). Online coverage of the 2008 Olympic games on the ABC, BBC, CBC and TVNZ. *Pacific Journalism Review*, 19 (1), 244–263.
- Kagnicioglu, D. (2017). The role of women in working life in Turkey. *WIT Transactions on Ecology and The Environment*, 226, 349–358.
- Kane, G., Alavi, M., Labianca, G., Borgatti, S. (2014). What's Different about Social Media Networks? A Framework and Research Agenda. *MIS Q*, 38, 274–304.
- Kanters, M.A., Bocarro, J., Casper, J. (2015). Supported or pressured? An examination of agreement among parents and children on a parent's role in youth sports. *Journal of Sport Behavior*, 31 (1), 64–80.
- Kara, F., Demirci, A. (2010). An assessment of outdoor recreational behaviors and preferences of the residents in Istanbul. *Scientific research and essays*, 5 (1), 93–104.
- Khalaf, S.B.H. (2014) *Arabic women's participation in sport: barriers and motivation among Egyptian and Kuwaiti athletes*. Doctoral Dissertation. University of Wales.
- Khan, Y.M., Jamil, A., Khan, U.A., Kareem, U., Imran, G. (2012). Female students' opinion about women's participation in sports. *International Journal of Academic Research in Business and Social Sciences*, 2 (9), 275–283.
- Kian, E.M., Bernstein, A., McGuire, J.S. (2013). A major boost for gender equality or more of the same? The television coverage of female athletes at the 2012 London Olympic Games. *Journal of Popular Television*, 1, 143–149. DOI: 10.1386/jptv.1.1.143_1.
- Knoppers, A., McDonald, M. (2010). Scholarship on gender and sport in Sex Roles and beyond. *Sex Roles*, 63, 311–323. DOI: 10.1007/s11199-010-9841-z.
- Koca, C., Hacısoftaoğlu, I. (2010). Sport participation of women and girls in modern Turkey. In: T. Benn, G. Pfister, H. Jawad (4th eds.). *Muslim women in sport*. United Kingdom: Routledge.

- Koca, C., Hacisoftaoğlu, I. (2011). Struggling for empowerment sport participation of women and girls in Turkey. In: T. Benn, G. Pfister, H. Jawad (4th eds.), *Muslim women in sport* (pp. 154–166). London: Routledge.
- LaVoi, N., Kane, M.J. (2011). Sociological aspects of sport. In: P.M. Pederson, J.B. Parks, J. Quarterman, L. Thibault (4th eds.), *Contemporary Sport Management* (pp. 374–391). Champaign, IL: Human Kinetics.
- Leigh, K. (2012). Turkey's female athletes, like women nationwide, reap rewards. *New York Times*. Retrieved from: <https://www.nytimes.com/2012/09/09/sports/olympics/in-turkey-female-athletes-have-come-a-long-way.html> (16.12.2019).
- Lin, T.E., Liu, C.C., Lee, C.H., Tsai, F.H., Chen, Z.M., Lee, S.Y. (2012). A study of socialization into sport and motivations of athletes' participation sport. *National Pingtung University of Education*, 15, 394–406.
- MacIntosh, E.W., Nicol, L. (2012). Athletes' event experiences of the XIX Commonwealth Games in Delhi, India. *International Journal of Event and Festival Management*, 3 (1), 12–29.
- Marwat, M.K., Zia-ul-Islam, S., Waseem, M., Khattak, H., BiBi, S. (2014). Sport performance of Muslim women and different constraints in their way to participation in sport. *International Journal of Humanities and Social Science*, 4 (10), 208–214.
- Meân, L.J. (2014). Sport websites, embedded discursive action, and the gendered reproduction of sport. In: A.C. Billings, M. Hardin (eds.), *Routledge handbook of sport and new media* (pp. 331–341). New York: Routledge.
- Monster Salary Index (2017). *Women of India, Monster Salary Index (MSI) report on gender pay parity*. Retrieved from: <http://media.monsterindia.com> (8.12.2017).
- Moran, R. (2014). *Cultural influences that affect participation in sports act*. Retrieved from: <https://prezi.com/x7aybvzgpdlv/cultural-influences-that-affect-participation-in-sports-act>.
- Moradi, B., Yoder, J.D. (2011). The psychology of women. In: E.M. Altmaier, J.C. Hansen (eds.), *The Oxford Handbook of Counseling Psychology* (pp. 346–374). New York: Oxford Press.
- Müftüler-Baç, M. (2012). Gender equality in Turkey. Retrieved from: <http://research.sabanciuniv.edu/18894/1/20120207ATT37506EN.pdf>.
- Nogueira, A., Molinero, O., Salguero del Valle, A., Lucidi, F., Marquez, S. (2017). Identification of gender discrimination in sports: Training of agents of change, *Revista de Psicología del Deporte/Journal of Sport Psychology*, 27 (3), 43–49.
- Öztürk, P., Koca, C. (2019). Generational analysis of leisure time physical activity participation of women in Turkey. *Leisure Studies*, 38 (2), 232–244.
- Pavlidis, A., Fullagar, S. (2016). *Sport, gender, and power*. Oxford: Routledge.
- Pelak, C.F. (2005). Negotiating gender/race/class constraints in the new South Africa a case study of women's soccer. *International Review for the Sociology of Sport*, 40 (1), 53–70.
- Pfister, G., Hacisoftaoğlu, I. (2016). Women's Sport as a Symbol of Modernity: A Case Study in Turkey. *The International Journal of the History of Sport*, 33 (13), 1470–1482.
- Ponseti, F.X., Borrás, P.A., Cantallops, J., García-Mas, A. (2017). Fair play, cheating and gamesmanship in grassroots sports. En Proceedings ISSP 14th World Congress Sport Psychology, Sevilla (349). Madrid: Dykinson.
- Ruseski, J.E., Humphreys, B.R., Hallmann, K. (2011) Family structure, time constraints, and sport participation. *European Review Aging and Physical Activity*, 8, 57–66.
- Saavedra, E., Martha, B. (2010). Women, sport and development. *International Platform on Sport and Development*, 1, 23–30.
- Sailors, P., Teetzel, S., Weaving, C. (2012). No Net Gain: A Critique of Media Representations of Women's Olympic Beach Volleyball. *Feminist Media Studies*, 12 (3), 468–472.
- Scott, D., Mowen, A.J. (2010). Alleviating park visitation constraints through agency facilitation strategies. *Journal of leisure research*, 42 (4), 535–550.
- Spaaij, R., Anderson, A. (2012). Parents or peers: Which is it? Sport socialization and team identification in Australia: A rejoinder to Melnick and Wann. *International Review of Sociology*, 47, 526–530.
- Stanis, S.A.W., Schneider, I.E., Pereira, M.A. (2010). Parks and health: Differences in constraints and negotiation strategies for park-based leisure-time physical activity by stage of change. *Journal of physical activity and health*, 7, 273–284.
- Story, C., Markula, P. (2017). I had one year in junior, and then I was too old: structural age rules and the girlification in Canadian elite women's figure skating. *Sport in society*, 20 (9), 1223–1240.
- Tansel, A., Dalgic, B., Guven, A. (2014). *Wage inequality and wage mobility in Turkey*. Discussion paper IZA DP No. 8669. Retrieved from: <http://ftp.iza.org/dp8669.pdf> (15.12.2019).

- Taylor, A.C., Schweichler, J.T., Jorgensen, B.L., McKown, E.H., Teresak, M. (2014). Parental support behaviors for children participating in community soccer programs. *The Sport Journal*. Retrieved from: <http://thesportjournal.org/article/parental-support-behaviors-for-children-participating-in-community-soccer-programs> (15.12.2019).
- Tekin, A. (2010). The influence of religious and socio-cultural variables on the participation of female university students in leisure activities. *World applied sciences journal*, 9 (11), 1286–1293.
- Toksöz, G. (2012). The state of female labor in the impasse of the neoliberal market and patriarchal family. In: S. Dedeoğlu, A.Y. Elveren (eds.), *Gender and society in Turkey: The impact of neoliberal policies, political Islam and EU accession* (pp. 47–64). New York: I.B. Tauris.
- Trolan, E.J. (2013). The media's impact on gender inequality within the sport. *Procedia Social and Behavioral Sciences*, 91, 215–227.
- TÜİK (2012b). *İşgücü İstatistikleri*. Retrieved from: <http://www.tuik.gov.tr> (16.12.2019).
- UNESCO (2015). International Charter of Physical Education, Physical Activity and Sport. UNESCO.
- Velázquez, P. (2017). Sports values: A European perspective. *En Proceedings ISSP 14th World Congress Sport Psychology, Sevilla* (212). Madrid: Dykinson.
- Wagner, M.M. (2016). The Decline of Women's Rights in Turkey: Political Islam... or Tayyip. Undergraduate Honors thesis. Retrieved from: https://scholar.colorado.edu/cgi/viewcontent.cgi?article=2383&context=honr_theses (16.12.2019).
- Walker, N.A., Bopp, T. (2010). The Underrepresentation of Women in the Male-Dominated Sport Workplace: Perspectives of Female Coaches. *Workplace Rights*, 15 (1), 47–64.
- Wangari, G., Kimani, E., Wango, G. (2017). Challenges faced by women football players who participate in Football Leagues. *Journal of Developing Country Studies*, 2 (1), 13–35.
- Westcott, L., Foley-Fellow, J.W. (2018). World Cup harassment highlights issues female sports journalists face daily in CPJ. Retrieved from: <https://cpj.org/blog/2018/07/world-cup-harassment-highlights-issues-female-spor.php> (15.12.2019).
- Zhang, T., Solmon, M.A., Gao, Z., Kosma, M. (2012). Promoting school students' physical activity: A social ecological perspective. *Journal of Applied Sport Psychology*, 5 (1), 92–105.

Cite this article as: Yenilmez, M.I. (2021). Gender Inequality and Female Sports Participation in Turkey. *Central European Journal of Sport Sciences and Medicine*, 1 (33), 27–41. DOI: 10.18276/cej.2021.1-03.

THE ROLE OF FALL PROPHYLAXIS IN THE QUALITY OF LIFE OF THE GERIATRIC PATIENTS

Filip Nadobnik

Helios Klinikum Berlin-Buch, 13125 Berlin, Germany

Address for correspondence:

Helios Klinikum Berlin-Buch
Schwanebecker Chaussee 50, 13125 Berlin, Germany
E-mail: filipnadobnik@gmail.com

Abstract Elderly people are not only more susceptible to disease, but they are also at a higher risk of sustaining accidents such as falls, which definitely affects the quality of human life. Aging, in other words, carries with it an increased danger of illness and injuries, including those caused by falling.

Research referred to in this article consisted in collecting and analyzing anonymized data of 411 geriatric patients admitted to a hospital in Berlin, Germany, over a period of six months, between January and June 2020, and attempted to look at how fall prophylaxis can reduce the overall healthcare costs generated by senior citizens. Of the 411 geriatric patients, 105, aged between 49 and 97 (69 females and 36 males), sustained injuries due to falling and made up 34.3% of all geriatric patients.

Conclusions that the author arrived at can prove useful to determine the importance of the prevention of falls of older people in reducing the complications resulting from falls. The overall costs of senior citizens' health care were also taken into consideration. Therefore, solutions should be sought to reduce the number of falls of older people. Falls are an important public health problem causing suffering for elderly patients, worsening the comfort of further life and additionally generating relatively high costs for the economy.

Key words ageing, public health, quality of life, physical activity, walkability, geriatric patients, falls

Introduction

A growing life span of contemporary Europeans means that people all over the continent tend to remain in need of medical care longer than ever before, which oftentimes puts a considerable strain on national health care systems. It is estimated that by 2030 in some EU member states costs of broadly understood medical care will have risen up to 14% of their GDPs while, with dropping fertility rates, the number of citizens over 65 years of age will have reached approximately 24% of their populations (OECD, 2017). At the same time, however, longer life in combination with a variety of environmental factors is shortening the time in which people are expected to live in good health (WHO, 2020).

Recently, the pace of population aging in Europe has considerably picked up all across the continent. The worst demographic situation can be seen in Germany and Italy where as early as 2009 people over 60 years of age constituted over 20% of the population. The only country in which the number of seniors dropped was Ireland, while Sweden, Denmark, Great Britain, and Luxembourg witnessed a relatively small increase (Żołędowski, 2012). Experts estimate that in 2030 about 24% of the continent's population will be citizens over 65 (UN, 2019). Aging societies and a shrinking generational turnover on the one hand and the challenges of implementation of modern medical technologies on the other call for urgent decisions to be made to assure sufficient funding for the growing needs of broadly understood health care systems. It is therefore necessary to have solutions rationalizing medical spending without detriment to the quality and effectiveness of treatment, in order to provide the patients with the possibility to return home from the hospital, to live in comfortable conditions.

Maintaining universal access to medical services, including prevention, will necessitate finding new sources of financing and consolidating medical care service providers as there seems to be no turning back from the available-to-all and equal access to medical care in return for additional medical fees (Przywara, 2010). For example, German patients pay an extra EUR 10.00 out of their own pocket for each day they spend in a hospital or a sanatorium and cover 15% of costs of rehabilitation therapies. On top of these flat fees, German hospitals receive additional funds for providing emergency help, holding educational and training events, and maintaining necessary stand-by facilities. In the case of geriatric patients, it may not be possible to return to full fitness, and thus to live a comfortable life. (Jaworzyńska, 2010).

It would seem that for a medical care system to function properly and, as a result, for the general quality of life of a population to grow, it is necessary that individuals take more responsibility for their health while the system becomes reorganized so that it can render prophylactic and treatment procedures that are of high quality and economically cost-effective at the same time, assuring continuity and coordination of treatment to patients who need them the most (Delnoij, Klazinga, Velden, 2003).

One of the consequences of an aging society is a rise in the number of geriatric patients. A person growing old usually experiences a gradual deterioration of movement and posture. These changes can impair the person's balance, locomotion, and general fitness, posing a threat of injuries and premature death (Radecka, Karakiewicz, Bryczkowska, Lubkowska, 2015).

Elderly citizens (over 65 years of age) who fall down and injure themselves pose a serious problem that has medical, social, and economic consequences. Contributing factors are usually either health-related, such as: impaired vision, balance disorders that stem from dizziness or vascular conditions, and locomotive dysfunctions, or environment-related, for example: maladapted housing arrangements or bad lighting. According to Scandinavian research reports, as many as 40% of falls produce serious injuries, especially limb fractures and craniocerebral traumas (Edbom-Kolarz, Marcinkowski, 2011). 50% of elderly fall victims need hospitalization (Thornby, 1995). Some of them, when discharged home, can suffer from impaired mobility that calls for a permanent change in lifestyle. Some never recover and die (Rigler, 1999).

Involuntal changes that occur in the process of aging of the human body lead to, among other things, an impairment of the mechanisms that controls posture, a decrease in muscle tone, and balance disorders, all of which substantially heightens the risk of falls and geriatric injuries (Skalska, 2003).

According to the National Institute for Health and Clinical Excellence (NICE), there are over 400 fall risk factors, although not all of them can be controlled and prevented.

A 'fall' is defined as an instance of a patient finding themselves, suddenly and unintentionally, lying on the floor or another flat surface, without a substantial operation of outside physical forces (Ferrari et al., 2016). Some of the pathophysiological changes that predispose a person to falling are primarily deterioration in the functioning of their nervous system, muscular system, and vision (i.e. body systems that are responsible for coordination, walking, and balance), slower reaction times, and weakness in the lower limbs (Bonner et al., 2003). To people over 65, falls pose a particular hazard, having a great influence on their prognosis as patients, the type of care they receive, the quality of life in the home environment or the cost of treatment. Next to dementia and urinary incontinence, falling is considered one of the so-called 'great geriatric problems' (Synak, Bień, 2003, pp. 35–57).

Seniors fall most often while walking on a flat surface or when engaged in everyday routines (Timsina et al., 2017). Most accidents occur at home or near the home (Edbom-Kolarz, Marcinkowski, 2011), where seniors trip on a carpet, threshold, or stairs while moving about or when performing household chores. Quite often, they fall due to impaired vision, especially lack of binocular vision and, consequently, inability to judge distance caused by macular degeneration, cataract, or wearing incorrect glasses. In other words, as time goes by people who have previously grown accustomed to going down the stairs at a vigorous pace, or to getting in and out of a bathtub quickly, or to moving freely about the house with carpets and rugs on the floor and thresholds in the doorways sometimes fail to notice that their sense of distance has changed for the worse.

Conclusions of the article can be proved to be useful in order to determine the importance of the prevention of falls of older people in reducing the complications resulting from falls. The overall costs of senior citizens' health care were also taken into consideration. Therefore, solutions should be sought to reduce the number of falls of older people. Falls are an important public health problem causing suffering for elderly patients, worsening the comfort of further life and additionally generating relatively high costs for the economy.

Materials and Methods

According to the German Federal Health Administration (GBE-B), in 2012 16.2% of senior citizens over 65 in Germany sustained fall accidents that resulted in their hospitalization. Data used in this article has been sourced from reports of German health maintenance organizations (Krankenkassen), European statistical agencies, and anonymized data collected between January and June 2020 at a geriatric department in a hospital in Berlin. The data was then processed statistically and illustrated graphically with the use of 'Statistica 13' software.

Table 1. Number and age of patients hospitalized at a geriatric department between January and June 2020

cause of hospitalization	average	Age		
		N	std. deviation	percent
Fall	74.47	105	5.82	34.3
Other	79.85	306	10.13	65.7
Total	77.16	411	7.97	100.0

An analysis of statistically processed data reveals the following. Between January and June 2020, a total of 411 patients were hospitalized in one geriatric department, including 105 patients (69 women and 36 men) aged

from 49 to 97 who had suffered injuries due to a fall (Table 1). This group made up 34.3% of all patients of the geriatric department.

Results

The largest group of patients hospitalized for fall-related injuries were seniors aged between 80 and 85 (6.6% of all geriatric patients), between 60 and 65 (3.2%), and between 90 and 95 (2.9%). Numbers of patients hospitalized due to falls and those hospitalized due to other causes were relatively similar in the 55–75 group, whilst they were relatively different in the 75–95 group. The biggest increase in patients admitted to hospital due to falls was seen in the 80–85 group. The most numerous group hospitalized for reasons other than falls were patients aged 75–80. Agewise, the largest group of senior patients were those aged 75–85. In total, medical care was provided to 179 patients, i.e. 44% of all patients hospitalized at the geriatric department within the indicated timeframe (Figure 1).

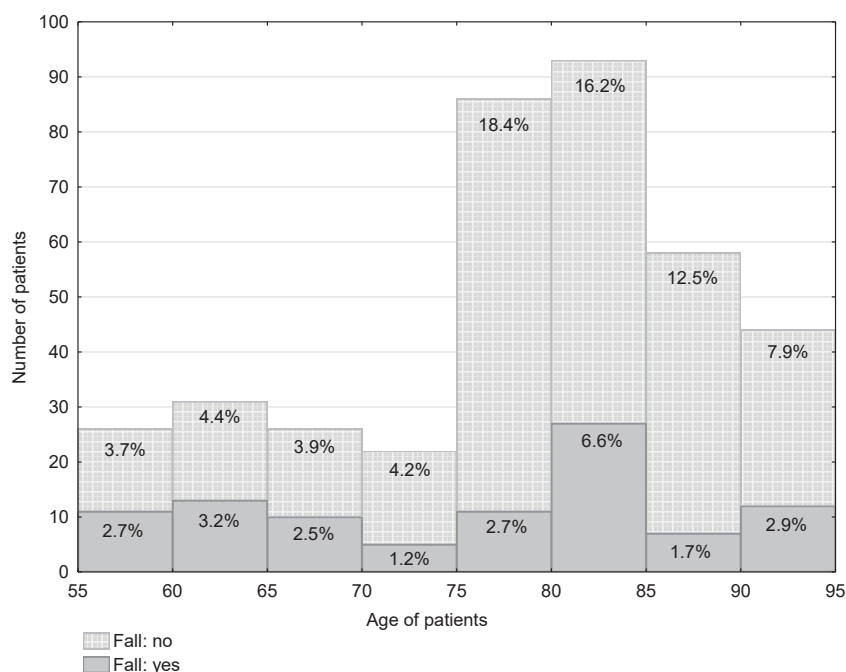


Figure 1. Patients hospitalized for injuries sustained in falls and patients hospitalized for other reasons, divided into age groups (between 55 and 95). Numbers at the top of each bar represent percentages of all patients admitted to the geriatric department over the researched period. N = 411 (100%)

The consequences of falling can be quite serious, from contusions and bruises to complex fractures of the humeral bone, fractures of the femoral bone, spinal fractures, pelvic fractures, head injuries, and other injuries, some of which result in death. The average age of patients admitted to the geriatric department for treatment of fall injuries was 74.47 ($s = 5.82$), the oldest one being a 97-year old woman diagnosed with rib fractures, the youngest one a man of 49 who had fallen down at his home and suffered a broken thigh bone. He was referred to the geriatric department by specialists from the orthopedic department. Out of 105 patients admitted to the geriatric department at the time, 24 had fractures of the femoral neck (18 women and 6 men), 18 sustained a broken femoral bone (15 women and 3 men), 6 suffered broken ribs (3 men and 3 women), and 21 experienced multiple contusions (9 women and 12 men) that required further hospital observation. Table 2 shows the number of patients, their age, main statistical data, and injuries sustained.

Table 2. Injuries sustained by the patients of the geriatric department as a result of falls

Gender*	Injury	Number of patients N	Mean patient age	Age std. deviation	Max patient age	Min patient age
M	Multiple contusions	15	73.75	14.73	90	58
M	Fractured humeral bone	6	63.83	9.78	74	55
M	Fractured lumbar spine	0	—	—	—	—
M	Fractured femoral bone	3	50.00	1.00	51	49
M	Fractured femoral neck	6	69.5	8.29	77	60
M	Fractured radial bone	0	—	—	—	—
M	Fractured ribs	6	55.50	0.55	56	55
M	Fractured pelvis	0	—	—	—	—
M	Fractured thoracic spine	0	—	—	—	—
F	Multiple contusions	9	81.89	10.94	93	68
F	Fractured humeral bone	9	70.78	7.63	81	63
F	Fractured lumbar spine	6	85.50	6.02	91	80
F	Fractured femoral bone	15	82.20	6.36	93	74
F	Fractured femoral neck	18	77.33	9.76	87	62
F	Fractured radial bone	3	86.67	2.30	88	84
F	Fractured ribs	3	95.33	1.52	97	94
F	Fractured pelvis	3	84.67	0.57	85	84
F	Fractured thoracic spine	3	65.67	2.08	68	64
Injuries suffered as a result of falling		N = 105	$\bar{x} = 74.47$	S = 5.82	Max = 97	Min = 49

* M (males) N = 36, F (females) N = 69.

Most female patients were found to have suffered fractures of the femoral neck, femoral bone, and humeral bone, which made up over 60% of all injuries recorded in this group. In male patients these injuries constituted 42% of all cases. Approximately 41.6% of men sustained multiple contusions which were serious enough to justify hospitalization. In women, contusions were diagnosed in about 13% of all instances. Figure 2 shows numbers of injuries in each patient age group.

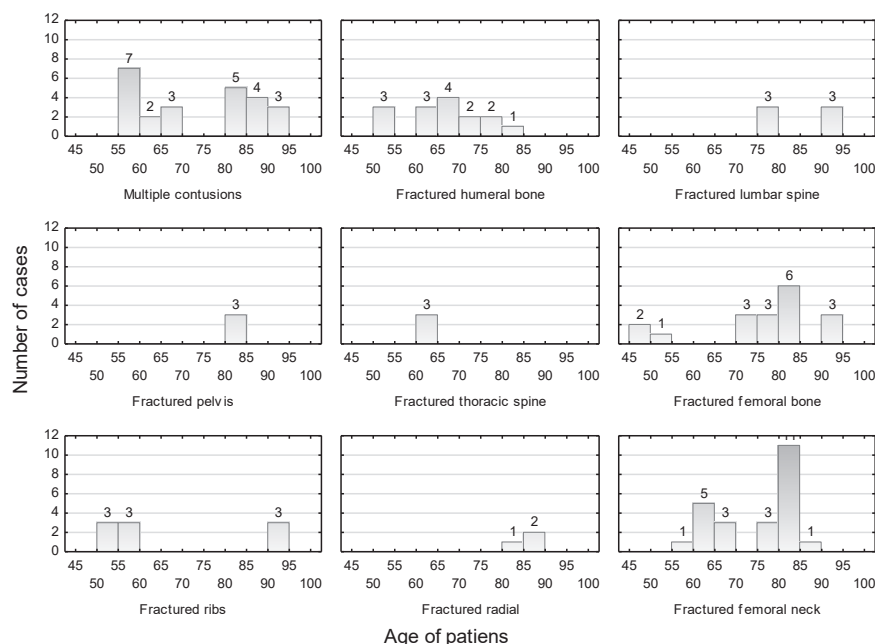


Figure 2. Numbers of fall-related injuries sustained by female and male patients combined, divided into age group

As can be seen, senior patients relatively rarely sustained a fractured pelvis (3 cases), fractured humeral bone (3 cases), or fractured thoracic spine (3 cases). All patients however experienced a great deal of suffering, stress, and discomfort during treatment and required rehabilitation once discharged from hospital. Admittedly, data presented in this paper should be treated as a case study of a specified period at one geriatric department in one of Berlin hospitals. It should also be noted that although a mild winter with very little snowfall and a relatively warm spring were factors encouraging Berliners to move about their city, the outbreak of the Covid-19 pandemic did not invite seniors to venture outdoors, hence so many injuries that occurred at home.

Discussion

Health is becoming an asset that, to a large degree, determines the quality of life of every individual (Rudawska, 2009). But, from a broader perspective, longer lives in good health of larger groups of people put a growing strain on modern health care systems, calling for rationalization of treatment costs, availability of medical services, and implementation of advanced medical procedures.

In their twilight years many people must cope with chronic diseases that adversely influence the comfort and quality of their lives. According to the WHO, about 30% of individuals over 65 years of age suffer from at least one chronic condition. Costs of their treatment constitute approximately 70% of all budget expenses allocated to health care (Juszczak, Lubliński, 2013). Falls can happen at any stage of one's life but the risk of a person falling and suffering an injury increases with age. Seniors 65+ tend to fall quite often and quite often sustain injuries that are very expensive to treat. This, on a national scale, is becoming a growing social problem, all the more so because populations in many countries are aging and the trend is on the rise. The consequences of falls are many – apart

from physical pain and mental discomfort that the patients must often endure, there are also substantial financial outlays that have to be paid. It is therefore of utmost importance that measures are taken in order to minimize the risk of senior citizens falling. A prerequisite for effective injury prevention is identification of why these injuries occur in the first place because falling, next to car accidents, is a frequent cause of unintentional death. Moreover, elderly patients must cope with several coexisting risk factors.

In fall prevention, physical activity of senior citizens and their awareness of potential fall hazards around them play a critical role. In order to be effective exercise must develop four primary parameters of physical fitness: circulatory-and-respiratory efficiency, muscular strength and endurance, flexibility, and balance. Fall prophylaxis should be a multi-level process, with correct rehabilitation being the foundation of all preventive endeavors (Bartoszek et al., 2016).

Regular physical activity of elderly people should therefore include the following:

- (1) aerobic (endurance) exercises that improve aerobic capacity, for example walking, dance, swimming, jogging, cycling;
- (2) strength-building (resistance) exercises that strengthen muscles, for example: workouts with dumbbells or with other similar equipment; an alternative option can be climbing the stairs or digging the garden;
- (3) stretching exercises that improve blood flow in the locomotor system and flexibility;
- (4) balance and coordination exercises that help develop overall fitness and mobility, for example: walking backwards, walking on tiptoes or heels, and standing up from the sitting position (Gębka, Kędziora-Kornatowska, 2012).

The World Health Organization recommends that physical activity classes for senior citizens should meet the following criteria: (1) be held individually and in groups, (2) offer a diversity of (3) regular exercises that (4) are enjoyable and relaxing for them (WHO, 2020).

Efforts to prevent elderly people from falling should also take into account possible home rearrangements, for example redesigning their living areas to better fit age-related limitations of the residents. Stairs, steps, and thresholds, for example, are typical spatial hazards. Rugs, especially soft ones that tend to roll up, need to be removed, just as electric cables stretched across the floor or any other objects lying there and posing a tripping hazard. It may sometimes be necessary to install automatic front door openers and appropriate indoor lighting, the latter both in areas that are used by all residents of a building, such as staircases, and inside individual apartments. Kitchens usually need additional illumination of surfaces on which seniors prepare their meals and ceiling lamps in bedrooms should be checked to make sure they do not emit a dangerously dazzling light. Finally, bathtubs should be replaced with showers fitted with a seat and a handle that a senior can always hold on to for balance. The bathroom floor cannot be slippery.

Other measures that can prove effective in helping to minimize the risk of seniors falling and getting hurt can take the form of local authorities, supported by state authorities, organizing comprehensive home aid for senior and lonely citizens, such as bath assistance, dressing assistance, bringing meals home, etc. Municipalities could also dedicate selected public transport services (minibuses) to elderly passengers and locate bus stops near their homes, or organize classes to teach people suffering from impaired vision to move about with a walking stick safely, or distribute walkers to people with limited locomotion, or hire and pay fitness assistants, i.e. trainers who would supervise senior citizens exercising for minimum 30 minutes a day. Local authorities should also make sure that roads and pavements are free of mud and snow in the autumn and winter seasons.

The aging process can be slowed down by lifestyle (exercise included), nutrition, and human-friendly environment (Zabielska et al., 2019). This is why physical activity of senior citizens, if based on natural and moderately strenuous movement allowing them to remain in optimal physical condition through the correct choice of exercise, should be seen as a prophylactic and therapeutic anti-aging factor (Kawa, Kowza-Dzwonkowska, Schenk, 2016). Education of elderly people who are particularly vulnerable to falls and injuries is critical. Awareness of risk factors and ways to eliminate them coupled with promotion of healthy lifestyles and physical activity is bound to reduce the number of patients with injuries that make it difficult for them to recover to a good quality of life. Additional investments in the surroundings and the environment where senior citizens live and spend their time is another necessary measure that will help diminish the frequency of falls.

A detailed risk analysis and an assessment of all accompanying factors and individual limitations of the patient, full medical records, and well-planned preventive actions based on information about the patient and their family will reduce the number of elderly people suffering from fall-related injuries and diminish costs of geriatric patients medical care. Measures undertaken for that to happen though must integrate health care (emergency health care, basic health care, and specialist health care) with welfare aid (long-term care, home care, education) in order to improve the effectiveness of the health care (Leutz, 1999). Fall- and injury-prevention programs and healthy lifestyle promotion campaigns should be interdisciplinary and multi-level in character (Tinetti et al., 1994). Once prepared, individual care plans should always remain open to modification because patients' needs may evolve over time and so the manner in which care is provided should change as well (Goodwin, Senola, Thiel, 2013).

Conclusions

Patients are often expected to change their lifestyles, from the simplest to the more complex daily routines, as a token of cooperation with their doctors and an important contribution supporting the therapeutic process (Krot, Rudawska, 2019). Prophylaxis and promotion of healthy behaviors of the citizens are becoming increasingly important factors that allow changing people's lifestyles into less risky ones. This in turn has a positive impact on the finances and functioning of the entire medical care system. Research referred to in this article indicates that there is an area within the system in which potential savings can be sought. Over 34% of patients hospitalized at the geriatric department were treated for injuries sustained in falls. The most frequent consequences of these accidents were: fractures (humeral bone, forearm, spine, pelvis, femoral bone), intracranial hematomas, soft tissue injuries and burns (Coutinho, Fletcher, Bloch, Rodrigues, 2008; Nowicki, Rzońca, Rudnicka-Drożak, Młynarska, Chemperek, 2015). Treatment of patients with such diseases is long and expensive and does not guarantee a return to full physical fitness. Also, patients who need to be immobilized can develop complications which ultimately lead to deep vein thrombosis, bed sores, lung inflammation, urinary tract inflammation, hypothermia, dehydration and joint contractures, reduced bone mineral density, and other conditions (Mazur, Pisany-Syska, 2017) that, in order to be treated, need substantial resources in the form of medical staff and funds. Fall-related injuries influence everyday life of members of the family and caretakers of the patients as well (Kamińska, 2013). Additionally, there would be direct savings that could be obtained from the reduction of numbers of patients, who need treatment of fall-related injuries (Figure 2). The research should be expanded to include further potential savings from there being no post-injury complications.

Diverse, often innovative, health care models, including elements of coordination of information flow between health care providers can be another method of improving the quality of life of seniors. This coordination

of activities by many health care providers reduces numbers of seniors that require hospitalization. Patients can stay at home longer and the numbers of individuals admitted to geriatric department drop in a visible way (Kodner, Spreeuwenberg, 2002). All of the above-mentioned elements and factors that come together to create a broadly understood concept of senior citizens fall prophylactics can also help the labor market to grow by creating a demand for certain professions (Karkowski, 2015). It is desirable that an integrated medical care system be set up, one in which prophylactics, diagnostics, treatment, rehabilitation and care are seen as a single, intertwined collection of measures geared towards health maintenance of patients and betterment of their quality of life (Rudawska, 2014). The consequences of falls can be very serious, ranging from general contusions to complicated fractures of the humerus, femur, spine, pelvis, head injuries and others. If the prophylaxis of falls could eliminate or at least reduce the number of geriatric ward patients, this would be a significant step towards improving the quality of life of a significant number of seniors.

References

- Bartoszek, A., Kocka, K., Bartoszek, A., Ślusarska B., Nowicki G., Jamrozik, K. (2016). Selected risk factors of fall among elderly people living in rural environment. *Journal of Education, Health and Sport*, 6 (8), 625–636. DOI: 10.5281/zenodo.61044.
- Bonner, F.J. Jr., Sinaki, M., Grabis, M., Shipp, K.M., Lane, J.M., Lindsay, R., Gold, D.T., Cosman, F., Bouxsein, M.L., Weinstein, J.N., Gallagher, R.M., Melton, L.J. 3rd, Salcido, R.S., Gordon, S.L. (2003). Health professional's guide to rehabilitation of the patient with osteoporosis. *Osteoporos Int.*, 14, Suppl 2, 1–22. DOI: 10.1007/s00198-002-1308-9.
- Coutinho, E.S., Fletcher, A., Bloch, K.V., Rodrigues, L.C. (2008). Risk factors for falls with severe fracture in elderly people living in a middle-income country: a case control study. *BMC Geriatr*, 8, 21. DOI: 10.1186/1471-2318-8-21.
- Delnoij, D.M.J., Klazinga, N.S., van der Velden, K. (2003). Building integrated health systems in central and eastern Europe. *European Journal of Public Health*, 13, 240–245.
- Edbom-Kolarz, A., Marcinkowski, J.T. (2011). Falls of elderly people – causes, consequences, prevention. *Hygeia. Public Health*, 46 (3), 313–318.
- Ferrari, S., Reginster, J., Brandi, M.L., Kanis, J.A., Devogelaer, J.P., Kaufman, J.M., Féron, J.M., Kurth, A., Rizzoli, R. (2016). Unmet needs and current and future approaches for osteoporotic patients at high risk of hip fracture. *Arch Osteoporos*, 11 (1), 37. DOI: 10.1007/s11657-016-0292-1.
- Gębka, D., Kędziora-Kornatowska, K. (2012). Benefits of health training in elderly people. *Probl. Hig. Epidemiol.*, 93 (2), 256–259.
- Goodwin, N., Senola, L., Thiel, V. (2013). *Co-ordinated Care for People with Complex Chronic Conditions: Key Lessons and Markers for Success*. London: The King's Fund.
- Guła, Z., Korkosz, M. (2010). Osteoporosis in the elderly — the pathogenesis, risk of fractures and anti-fracture efficacy of current therapies. *Gerontologia Polska*, 18, (3), 107–113.
- Jaworzyńska, M. (2010). Germany's health care system. Rynek finansowy – nowe perspektywy. *Annales UMCS, Sectio H, XLIV* (2), 995–1010.
- Juszczak, G., Lubliński, R. (2013). *Scenariusze w ochronie zdrowia w Europie w latach 2012–2030. Zdrowie i medycyna – wyzwania przyszłości. Medycyna Praktyczna*. Kraków: Oficyna Wydawnicza AFM.Kamińska, M. (2013). The role of family nurse in prevention of falls in elderly people. *Family Medicine & Primary Care Review*, 15 (1), 21–26.
- Karkowski, T. (2015). Dostosowywanie zasobów kadry medycznej do potrzeb starzejącego się społeczeństwa. *Zdrowie Publiczne i Zarządzanie*; 13 (1), 82–94. DOI: 10.4467/20842627OZ.15.008.412.
- Kawa, M., Kowza-Dzwonkowska, M., Schenk, A. (2016). The role of physical activity in supporting treatment of coxarthrosis symptoms in elderly patients. *Baltic Journal of Health and Physical Activity*, 4 (8), 41–48. DOI: 10.29359/BJHPA.08.4.05.
- Kodner, D.L., Spreeuwenberg, C. (2002). Integrated care: meaning, logic, applications, and implications – a discussion paper. *International Journal of Integrated Care*, 2 (4). DOI: 10.5334/ijic.67.
- Krot, K., Rudawska, I. (2019). Is patient satisfaction the key to promote compliance in health care sector?. *Economics and Sociology*, 12 (3), 291–300. DOI: 10.14254/2071-789X.2019/12-3/19.

- Leutz, W.N. (1999). Five laws for integrating medical and social services: Lessons from the United States and the United Kingdom. *The Milbank Quarterly*, 77 (1), 77–110. DOI: 10.1111/1468-0009.00125.
- Mazur, K., Pisany-Syska, A. (2017). Risk factors for inpatients falls in the geriatric ward. *Polish Nursing*, 2 (64), 260–267. DOI: 10.20883/pielpol.2017.34.
- Nowicki, G., Rzońca, P., Rudnicka-Drożak, E., Młynarska, M., Chemperek, E. (2015). Injuries of elderly people dealt with by the Emergency Department. *Gerontologia Polska*, 2, 47–54.
- OECD, Healthcare 2017 at a Glance: Statistics and Indicators (2017). Retrieved from: <http://www.medicosypacientes.com/sites/default/files/Health-at-a-Glance-2017-Chartset.pdf> (20.07.2020).
- Przywara, B. (2010). Projecting future health care expenditure at European level: drivers, methodology and main results. *European Economy. Economic Papers*, 417. DOI: 10.2765/42844.
- Radecka, A., Karakiewicz, A., Bryczkowska, I., Lubkowska, A. (2015). Body composition analysis in the context of the functional state of the inhabitants of Social Welfare Homes. *Journal of Education, Health and Sport*, 5 (7), 343–352. DOI: 10.5281/zenodo.20152.
- Rigler, S.K. (1999). Preventing falls in older adults. *Hospit Pract.*, 34, 8–12.
- Rudawska, I. (2009). Mechanism of Competition in Healthcare Sector. *Economics & Sociology*, 2 (1), 131–137. DOI: 10.14254/2071-789x.2009/2-1/13.
- Rudawska, I. (2014). *Zintegrowana opieka zdrowotna. Podejście relacyjne do obsługi pacjenta jako klienta*. Kraków: ABC a Wolters Kluwer Business.
- Skalska, A. (2003). Upadki w wieku podeszłym – przypadek czy objaw. *Medycyna Specjalistyczna*, 3, 45–51.
- Synak, B., Bień, B. (2003). *Stan zdrowia i sprawność ludzi starszych. Polska starość*. Gdańsk: Wydawnictwo Uniwersytetu Gdańskiego.
- Thornby, M.A. (1995). Balance and falls in the frail older person: a review of the literature. *Top GerRehab*, 11, 35–43.
- Timsina, L.R., Willetts, J.L., Brennan, M.J., Wellman, H., Lombardi, D.A., Courtney, T.K., Verma, S.K. (2017). Circumstances of fall-related injuries by age and gender among community-dwelling adults in the United States. *PLoS one*, 12 (5), e0176561. DOI: 10.1371/journal.pone.0176561.
- Tinetti, M.E., Baker, D.I., McAvay, G., Claus, E.B., Garrett, P., Gottschalk, M., Koch, M.L., Trainor, K., Horwitz, R.I. (1994). A multifactorial intervention to reduce the risk of falling among elderly people living in the community. *N Engl J Med.*, 331 (13), 821–827. DOI: 10.1056/NEJM199409293311301.
- UN, Department of Economic and Social Affairs Population Division, World Population Ageing (2019). United Nations, New York. Retrieved from: <https://www.un.org/en/development/desa/population/publications/pdf/ageing/WorldPopulationAgeing2019-Highlights.pdf> (20.07.2020).
- WHO Guideliness series for health ageing. (2015). Retrieved from: https://apps.who.int/iris/bitstream/handle/10665/186463/9789240694811_eng.pdf?sequence=1 (20.07.2020).
- WHO, Quality health services (2020). Retrieved from: <https://www.who.int/news-room/fact-sheets/detail/quality-health-services> (20.07.2020).
- Zabielska, P., Wieder-Huszl, S., Gutowska, I., Lubkowska, A., Knyszyńska, A., Jurczak, A. (2019). Gender-Specific Dierences in Concentrations of Biochemical Parameters in Persons over the Age of 90. *Int J Environ Res Public Health.*, 16 (11). DOI: 10.3390/ijerph16111915.
- Żołędowski, C. (2012). Starzenie się ludności – Polska na tle Unii Europejskiej. *Problemy Polityki Społecznej. Studia i Dyskusje*, 17, 29–43.

Cite this article as: Nadobnik, F. (2021). The Role of Fall Prophylaxis in the Quality of Life of the Geriatric Patients. *Central European Journal of Sport Sciences and Medicine*, 1 (33), 43–52. DOI: 10.18276/cej.2021.1-04.

EFFECT OF EDUCATIONAL TRAINING ON NUTRITION AND WEIGHT MANAGEMENT IN ELITE SPANISH GYMNASTS

Andrea Visiedo,^{1, A, B, C, D} Jillian E. Frideres,^{2, A, D} Jose M. Palao^{3, A, B, C, D}

¹ Physical Activity and Sport, University of Murcia, Murcia (Spain)

² University of Wisconsin-Madison Division of Extension (USA)

³ Department of Health, Exercise Science and Sport Management, University of Wisconsin-Parkside (USA).

^A Study Design; ^B Data Collection; ^C Statistical Analysis; ^D Manuscript Preparation; ^E Funding

Address for correspondence:

Andrea Visiedo
Facultad de Ciencias del Deporte
Universidad de Murcia
Calle Argentina, 19, 30720 San Javier, Murcia (Spain)
E-mail: andreavismero@gmail.com

Abstract The aim was to study the effect of a formative program about nutrition as well as weight management and its risks in elite gymnasts. The sample was 37 under-18 Spanish athletes from rhythmic and aesthetic gymnastics (national level). The sample was divided into a control group (n = 21) and an intervention group (n = 16). A quasi-experimental design with a pre-test and post-test was used. The dependent variable was the knowledge of nutrition, weight management, and its risks. The independent variable was the educational program. The program had three 30-minute sessions which combined talks, videos, and tasks to complete. Descriptive and inferential analyses were done. The educational program was ineffective with regard to increasing the gymnasts' knowledge about nutrition, weight management, and its risks. The gymnasts' knowledge of nutrition and weight management was high before beginning the intervention. Gymnasts and the coach expressed the need for individualized training adapted to each gymnast's needs and for incorporating a follow-up that provides feedback that is applicable in the gymnast's daily life.

Key words aesthetic sport, performance, prevention, knowledge

Introduction

Performance in aesthetic sports, such as rhythmic gymnastics, is evaluated by the physical appearance of the athlete's executions (Douda, Toubekis, Avloniti, Tokmakidis, 2008; Lazarevic, Petrovic, Ramnjanovic, 2012). This results in athletes and coaches placing great importance on the physical appearance and shape of the athletes (Gomez-Campos, Camargo, Arruda, Cossio Bolaños, 2013; Hergenroeder, Broun, Klish, 1997; Klentrou, Plyley, 2003; Tan, Calitri, Bloodworth, McNamee, 2016). The importance placed on the athletes' physical appearance, the search for perfection in this type of sport, and the physical and psychological changes in adolescence mean that young gymnasts are at risk for health problems related to weight management and disordered eating (Bonci

et al., 2008; Cupisti, D'Alessandro, Castrogiovanni, Barale, Morelli, 2000; Evans, Rich Holroyd, 2004; Halmi, 2009; Sundgot-Borgen, 1994; Sundgot-Borgen, 1996). The reference image that media and elite athletes provide to young gymnasts is a distortion of the reality in the way that they focus on peak-performance athletes. Therefore, young gymnasts have several models as a reference: from society, models stylized with the help of Photoshop, and from sport, the body that peak-performance athletes have at the pinnacle of their sport life, after years of dedication and training. Among the possible ways of reducing the risks involved in this situation is providing young athletes with information and skills through education (Coppola, Vastola, Scatigna, Fabiani, 2014; Sundgot-Borgen, 1994).

In gymnastics, although athletes' knowledge of nutrition is good, they have been found to have an energy deficit due to the intensity and duration of their training (D'Alessandro et al., 2007; Deutz, Benardot, Martin, Cody, 2000). Some studies have found that elite gymnasts have high carbohydrate intakes and low intakes of lipids, calcium, and proteins (Michopoulou, Avloniti, Kambas, Leontsini, Michalopoulou, 2011; Gomez-Campos et al., 2013; Nordin et al., 2003). Despite insufficiencies, gymnasts have perceived that they had adequate dietary habits (Jonnalagadda, Benardot and Nelson, 1993) and that they had a good dietary distribution throughout the day (Nordin, Harris, Cumming, 2003). During the competitive season, gymnasts change their dietary habits, reaching caloric levels considered inadequate (Michopoulou et al., 2011). In the bibliography, no specific studies have been found about educational training regarding nutrition or weight management. However, several studies have reported their need as well as the higher incidence of disordered eating and eating disorders in gymnastics (Anderson, Petrie, 2012; Sundgot-Borgen, Torstveit, 2004).

There are many aspects that can contribute to the development of unhealthy behaviors related to nutrition and weight management in young athletes. The different stakeholders in these sports must be actively involved in creating environments and resources that promote the athletes' wellbeing. Ideally, the coaches and parents will also be involved in this process. Further, the interventions must provide and reinforce the importance and role of nutrition, healthy reference models, and how athletes should manage their weight and the risks involved in weight management. The aim of this study was to assess the effect of a formative program about nutrition, weight management, and its risks in elite gymnasts.

Material and Methods

The sample was composed of 37 under-18 gymnasts that participated at least once in a Spanish national Championship of rhythmic gymnastics. The sample was divided into a control group ($n = 21$) and an intervention group ($n = 16$), and convenience sampling based on the training location of the gymnasts was utilized. The characteristics of the sample are described in table 1. The study was approved by the Ethics Committee of the first researcher. Parents and guardians of all participants signed an informed consent before the study began. Participation in the study was voluntary, and all participants were informed about the study.

Table 1. The sample's characteristics (Gymnastics)

	Age (yr)		Height (m)		Weight (kg)	
	M	SD	M	SD	M	SD
Intervention group ($n = 16$)	14.25	2.05	1.59	0.08	44.6	8.8
Control group ($n = 21$)	16.61	1.22	1.65	0.04	52.3	3.8

A pre-test and a post-test were utilized in this quasi-experimental design. The knowledge of nutrition, weight management, and its risks was the dependent variable, and the educational program was the independent variable. An ad-hoc questionnaire was utilized to measure the athletes' knowledge. Questionnaires and interviews were used to register the coach's and gymnasts' perception. The program consisted of three 30-minute sessions, which combined talks, videos, and tasks to complete.

Manuals about the topic were utilized to design the questionnaire and the training (Bean, 2011; Bonci et al., 2009). The questionnaire evaluated basic nutrition knowledge as well as knowledge of weight management and its risks. The questionnaire consisted of 41 true-false questions (18 about weight management and its risks and 23 about nutrition knowledge). Both the questionnaire and the training were validated by experts (content validity). Experts were asked to evaluate quantitative (on a scale from 1 to 10) and qualitative (open) questions from the questionnaire and the training with regard to: degree of understanding, degree of adequacy, and the need to reduce or include more questions or information. In accordance with Bulger and Housner (2007), questions with values <7.0 were eliminated, questions with values >7.0 and <8.0 were modified, and questions with values >8.0 were accepted or accepted with modifications. A test-retest protocol with 11 international-level gymnasts (16 ± 1.16 years of age) was used to establish the reliability of the questionnaire. The reliability of each item was calculated using the Kappa Index in the SPSS software. The lowest value for any question was 0.609 (Visiedo, Frideres, Palao, 2017).

The goal of the program was to provide the gymnasts with knowledge about nutrition, weight management, and its risks. The sessions were incorporated into the gymnasts' training schedule. Each session consisted of two 15-minute blocks, the first of which was theoretical and the second of which was practical (tasks to complete). The content distribution for the three sessions included basic nutrition knowledge, weight management and eating habits, and weight management risks. One of the researchers directed the sessions. At the start of the intervention, a document with the information provided during the sessions was given to the gymnasts. The questionnaire was completed before the start and four weeks after the intervention program, and the interviews were completed four weeks after the program. Descriptive (average, standard deviation, percentages) and inferential analyses of the results were done using SPSS software. Differences between the pre-test and the post-test were calculated using T-tests for categorical questions and ANOVAs for independent variables for continuous questions. Significance was set at $p < 0.05$.

Results

The educational training was ineffective with regard to increasing the nutrition and weight management knowledge of the intervention group (Tables 2 and 3). Both groups had scores that were higher than 75% for nutrition knowledge as well as weight management. No significant differences were found between the intervention and control groups in the pre-test or the post-test.

Table 2. Effect of the educational training on nutrition knowledge in gymnasts

	Pre-test				Post-test			
	scale (0 to 23)		percentage		scale (0 to 23)		percentage	
	M	SD	M	SD	M	SD	M	SD
Intervention group	19.56	1.88	78.22	7.51	19.33	2.4	77.33	9.5
Control group	17.87	1.80	77.60	9.00	19.30	2.1	75.80	11.1

Table 3. Effect of the educational training on weight management knowledge in gymnasts

	Pre-test				Post-test			
	scale (0 to 18)		percentage		scale (0 to 18)		percentage	
	M	SD	M	SD	M	SD	M	SD
Intervention group	15.67	1.41	87.05	7.86	16.22	1.20	90.12	6.68
Control group	14.10	5.83	78.30	6.30	14.85	5.47	82.55	8.30

Three ideas were collected about the effect of the educational intervention from the opinions and perceptions of the gymnasts and coach, which were collected from the questionnaires and the interviews: 1) retention and effect of the educational program; 2) level of engagement in the program, and 3) evaluation of the program.

1. Retention and effect of the educational program. Seventy percent of the gymnasts highlight that the educational program helped them to make some changes in their dietary habits or to remind them of information that they already knew. These ideas were expressed in the following way:

It was helpful, a reminder of how to manage the meal schedule and learn more about quantity and proportions" [Gymnast #8]

It will help me to pay more attention and eat better... [Gymnasts #5, #6]

I already had information about this. It was a reminder [Gymnast #1]

2. Level of engagement of the gymnast. There were differences between the engagement mentioned by the gymnasts and that mentioned by the coach. Sixty percent of the gymnasts said that they were interested in the topic and need to pay more attention to what and how much they eat. The coach commented that the gymnasts were not completely committed or engaged in the process.

I pay attention to my meals and to food proportions [Gymnasts #1-6]

It was interesting [Gymnasts #7, #10, #12]

[There was] moderate engagement, but we must review the topic often. It was interesting [Coach]

3. Evaluation of the program. Eighty percent of the gymnasts liked the educational intervention. Most of the gymnasts and the coach expressed the need to incorporate more specific, individualized information that is applicable to the gymnasts and their diets in their daily life.

...We should plan each athlete's diet, because we are not the same [Gymnast #8]

It is necessary to combine the educational training with follow-up in their day-to-day... the information must be individualized for each one [Coach]

Discussion

The intervention, based on theoretical and practical classes and providing the gymnast with educational material, did not increase the gymnasts' knowledge of nutrition or weight management. There are possible explanations for these results. The gymnasts' knowledge was high to begin with, which is in accordance with other

studies in the literature, as elite gymnasts have been found to have good knowledge about nutrition (Cupisti et al., 2000; D'Alessandro et al., 2007; Karabudak, Köksal, Ertaş, Küçükerdönmez, 2016). Another possible reason is that the intervention was not long enough and/or specific enough. Most of the gymnasts considered the intervention to be interesting but a reminder of information they already knew. The gymnasts emphasized the information regarding using a plate as a reference to monitor food proportions as well as using your hand to determine the portion sizes of specific foods. Regarding the specificity of the information, the fact that the educational training used data that were not specific to gymnasts could have resulted in having a lower impact on the gymnasts. The recommendations made by some of the gymnasts and the coach may be helpful in this regard. They mentioned the need to individualize the educational program using data from the same athletes to engage each subject more. Also, they mentioned the need for a follow-up of their diet and for incorporating feedback that is applicable in the daily life of the gymnast. This approach will allow the gymnasts to combine theoretical knowledge with their ability to apply that knowledge.

A previous study carried out with volleyball players has shown the effectiveness of the combination of educational training and a follow-up with a dietician (Valliant, Pittman Emplaincourt, Kieckhaefer Wenzel, Garner, 2012). Several aspects must be considered. The volleyball sample's knowledge was not as high at the beginning of the process. Therefore, it is possible that the educational program must be adapted and involve more individualization. If possible, the involvement of a dietician is recommended. However, oftentimes, gymnastics clubs do not have the possibility to collaborate with a dietician. Another possibility for implementing this type of educational program in this population would be the use of online educational training or educational software that allows gymnasts to automatically receive feedback from a dietician. However, it is not known whether this approach will help to increase the gymnasts' knowledge and improve their habits. Some studies have shown that gymnasts are knowledgeable about nutrition and they use this knowledge to modify their diets and to try to achieve and maintain the physical standards of the sport (Boros, 2009; Cupisti et al., 2000; Karabudak et al., 2016). More studies are needed to assess the effect of other intervention approaches in elite gymnasts.

Conclusions

The educational intervention that combines theoretical and practical classes and provides the athletes with educational material did not change the gymnasts' knowledge about nutrition or weight management. The gymnasts' knowledge of nutrition and weight management before the intervention was high, given that they scored higher than 75% on a knowledge test. Future studies are needed to determine what approach must be followed to effectively provide educational training to elite gymnasts. The gymnasts and the coach expressed the need for individualized training adapted to each gymnast's needs and for incorporating a follow-up that provides feedback that is applicable in the gymnast's daily life.

References

- Anderson, C., Petrie, T.A. (2012). Prevalence of disordered eating and pathogenic weight control behaviors among NCAA division I female collegiate gymnasts and swimmers. *Research Quarterly for Exercise and Sport*, 83 (1), 120–124.
- Bean's, A. (2010). *Sports nutrition for young athletes*. London: A & C Black Publishers Ltd.
- Bonci, A., Bonci, L.J., Granger, L.R., Johnson, C.L., Malina, R.M., Milne, L.W., Ryann, R.R., Vanderbunt, E.M. (2008). National athletic trainers' association position statement: Preventing, detecting, and managing disordered eating in athletes. *Journal of Athletic Training*, 43, 80–108.
- Boros, K. (2009). Dietary habits and physical self-concept of elite rhythmic gymnasts. *Biomedical Human Kinetics*, 1, 1–2.

- Bulger, S.M., Housner, L.D. (2007). Modified Delphi investigation of exercise science in physical education teacher education. *Journal of Teaching in Physical Education*, 26 (1), 57–80.
- Burke, L.M., Slater, G., Broad, E.M., Haukka, J., Modulon, S., Hopkins, W.G. (2003). Eating patterns and meal frequency of elite Australian athletes. *International Journal of Sport Nutrition and Exercise Metabolism*, 13 (4), 521–538.
- Coelho-Bortoleto, M.A., Bello, M.L., Almeida, C. (2007). Sport nutrition applied to artistic gymnastics: A systematization of the scientific production. *O mundo da saude Sao Paulo*, 31 (4), 521–529.
- Coppola, S., Vastola, R., Scatigna, M., Fabiani, L. (2014). Training and health in gymnastics. 9th INSHS International Christmas Sport Scientific Conference, 4–6 December 2014. *International Network of Sport and Health Science*. Szombathely, Hungary.
- Cupisti, A., D'Alessandro, C., Castrogiovanni, S., Barale, A., Morelli, E. (2000). Nutrition survey in elite rhythmic gymnasts. *Journal Sports Medicine and Physical Fitness*, 40 (4), 350–355.
- D'Alessandro, C., Morelli, E., Evangelisti, I., Galetta, F., Franzoni, F., Lazzeri, D., Piazza, M., Cupisti, A. (2007). Profiling the diet and body composition of subelite adolescent rhythmic gymnasts. *Pediatric Exercise Science*, 19 (2), 215–227.
- Deutz, R.C., Benardot, D., Martin, D.E., Cody, M.M. (2000). Relationship between energy deficits and body composition in elite female gymnasts and runners. *Medicine and Science in Sports and Exercise*, 32 (3), 659–668.
- Djordjevic-Nikic, M., Moskovljevic, L. (2009). Uticaj sportskog treninga na rast i polni razvoj takmičarki u ritmičkoj gimnastici (The influence of sports training on the growth and pubertal development in female rhythmic gymnasts). *Fizička kultura*, 63 (1), 3–9.
- Douda, H., Lapidaris, K., Tokmakidis, S.P. (2010). Long-Term Training Induces Specific Adaptations on the Physique of Rhythmic Sports and Female Artistic Gymnasts. *European Journal of Sport Science*, 2 (3).
- Douda, H.T., Toubekis, A.G., Avloniti, A.A., Tokmakidis, S.P. (2008). Physiological and anthropometric determinants of rhythmic gymnastics performance. *International Journal of Sports Physiology and Performance*, 3 (1), 41–54.
- Elendu, I.C., Umeakuka, O.A. (2010). An exploratory study of weight-loss practices of gymnasts in Rivers State, Nigeria. *Pakistan Journal of Nutrition*, 9, 352–357.
- Evans, J., Rich, E., Holroyd, R. (2004). Disordered eating and disordered schooling: What schools do to middle class girls. *British Journal of Sociology of Education*, 25 (2), 123–142.
- Filaire, E., Lac, G. (2002). Nutritional status and the body composition of juvenile elite female gymnasts. *Journal of Sports Medicine and Physical Fitness*, 42 (1), 65–70.
- Gomez-Campos, R., Camargo, C., Arruda, M., Cossio Bolaños, M.A. (2013). Crecimiento físico y estado nutricional de gimnastas rítmicas de élite. *Nutrición Clínica y Dietética Hospitalaria*, 33 (1), 31–37.
- Halmi, K. (2009). Anorexia nervosa: An increasing problem in children and adolescents. *Dialogues in Clinical Neuroscience*, 11, 100–103.
- Hergenroeder, A., Broun, B., Klish, W. (1997). Anthropometric measurements and estimating body compositions in ballet dancers. *Medicine and Science in Sports and Exercise*, 25, 145–150.
- Jonnalagadda, S.S., Bernadot, D., Nelson, M. (1998). Energy and nutrient intakes of the United States national women's artistic gymnastics team. *International Journal of Sport Nutrition*, 8, 331–344.
- Karabudak, E., Köksal, E., Ertaş, Y., Küçükerdönmez, Ö. (2016). Dietary intake of Turkish gymnast and non-gymnast children. *Nutrition and Dietetics*, 73 (2), 184–189.
- Klentrou, P., Plyley, M. (2003). Onset of puberty, menstrual frequency, and body fat in elite rhythmic gymnasts compared with normal controls. *British Journal of Sports Medicine*, 37, 490–494.
- Lazarević, L.V., Petrović, B., Damnjanović, K. (2012). Personality traits of young gifted rhythmic gymnasts. *Physical Education and Sport*, 10 (2), 115–126.
- Michopoulou, E., Avloniti, A., Kambas, A., Leontsini, D., Michalopoulou, M. (2011). Elite premenarcheal rhythmic gymnasts demonstrate energy and dietary intake deficiencies during periods of intense training. *Pediatric Exercise Science*, 23, 560–572.
- Nordin, S., Harris, G., Cumming, J. (2003). Disturbed eating in young, competitive gymnasts: Differences between three gymnastics disciplines. *European Journal of Sport Science*, 3 (5), 1–14.
- Soric, M., Misigoj-Durakovic, M., Pedisic, Z. (2008). Dietary intake and body composition of prepubescent female aesthetic athletes. *International Journal of Sport Nutrition and Exercise Metabolism*, 18, 343–354.
- Stewart, C., Schiavon, L.M., Bellotto, M.L. (2015) Knowledge, nutrition and coaching pedagogy: A perspective from female Brazilian Olympic gymnasts. *Sport, Education and Society*.

- Sundgot-Borgen, J. (1994). Risk and trigger factors for the development of eating disorders in female elite athletes. *Medicine and Science in Sports and Exercise*, 26 (4), 414–419.
- Sundgot-Borgen, J. (1996). Eating disorders, energy intake, training volume, and menstrual function in high-level modern rhythmic gymnasts. *International Journal of Sport Nutrition*, 6, 100–109.
- Sundgot-Borgen, J., Torstveit, M.K. (2004). Prevalence of eating disorders in elite athletes is higher than in the general population. *Clinical Journal of Sport Medicine*, 14 (1), 25–32.
- Tan, J.O., Calitri, R., Bloodworth, A., McNamee, M.J. (2016). Understanding eating disorders in elite gymnastics: Ethical and conceptual challenges. *Clinical Journal of Sport Medicine*, 35 (2), 275–92.
- Valliant, M.W., Pittman Emplainscourt, H., Kieckhafer Wenzel, R., Garner, B.H. (2012). Nutrition education by a registered dietitian improves dietary intake and nutrition knowledge of a NCAA female volleyball team. *Nutrients*, 4 (6), 506–516.
- Visiedo, A., Frideres, J.E., Palao, J.M. (2017). Design, validation and reliability of survey to measure the knowledge in nutrition, weight control and its risk. *Central European Journal of Sport Sciences and Medicine*, 19 (4), 39–51.

Cite this article as: Visiedo, A., Frideres, J.E., Palao, J.M. (2021). Effect of Educational Training on Nutrition and Weight Management in Elite Spanish Gymnasts. *Central European Journal of Sport Sciences and Medicine*, 1 (33), 53–59. DOI: 10.18276/cej.2021.1-05.

COMPARATIVE CHARACTERISTICS AND ASSESSMENT OF THE RELATIONS OF ANTHROPOMETRIC INDICATORS AND MOTOR ABILITIES OF GIRLS' BASKETBALL PLAYERS 12–14 YEARS OLD

Natalia Chukhlantseva,^{A, C, D} Inna Cherednichenko,^{A, B} Eduard Bruhno^{A, B}

Department of Physical Culture and Sport Management, National University «Zaporizhzhia Polytechnic», Ukraine

^A Study Design; ^B Data Collection; ^C Statistical Analysis; ^D Manuscript Preparation

Address for correspondence:

Natalia Chukhlantseva

National University «Zaporizhzhia Polytechnic», Department of Physical Culture and Sport Management

64 Zykovskogo Street, 69063 Zaporizhzhya, Ukraine

E-mail: chuhnv@i.ua

Abstract Anthropometric indicators and motor abilities are significant components of the successful implementation of the physical potential of young basketball players. The aim of the study was to describe and compare anthropometric characteristics, indicators of physical and special preparedness for basketball players under the age of 12 and up to 14 years, to identify the presence and degree of relationship between these indicators in each group of athletes. Athletes ($n = 50$) were grouped in groups under 12 years (U12, 10.97 ± 0.48 years; $n = 24$), and under 14 (U14; 12.96 ± 0.49 years; $n = 26$), body height and body weight were measured, dexterity and indicators of special preparedness were tested and compared ("Throws into the basket from different positions", "Free Throws", "Ten eights"). U12 players showed lower performance than the U14 group in all tests except the "Free Throws" test. All athletes showed a strong correlation between jumping and dexterity ($p < 0.01$). The U14 athletes showed a strong ($p < 0.01$) and moderate ($p < 0.05$) relationship between the indicators of special preparedness. Assessment of indicators of physical development, physical and special preparedness of athletes, the study of the relationship of these indicators at different periods of ontogenesis will help rationally differentiate training loads, emphasize pedagogical influences and optimize the training process.

Key words basketballers, anthropometry, motor abilities, agility, variables

Introduction

The effectiveness of the training process for high-profile basketball players depends on a properly organized basic stage of training aimed at ensuring the physical and technical fitness of young athletes (Cieslicka et al., 2019; Erčulj, Blas, Bračič, 2010). The study of morphological features, in accordance with the requirements of the sport, the determination of sensitive periods of development of basic physical qualities, the diagnosis of the ability to learn various exercises, allow trainers to select, optimally combine and, if necessary, adjust training tools and

methods in accordance with specific conditions (Erčulj et al., 2010; Jakovljević, Karalejić, Pajić, Gardašević, Mandić, 2011; Chukhlantseva, 2019). The stage of basic preparation coincides with the period of active, but uneven development of the motor analyzer, which is manifested in the heterochronism of the formation of individual elements and structures of motility (Matulaitis, Skarbalius, Abrantes, Gonçalves, Sampaio, 2019). In certain periods of ontogenesis, the accelerated development of certain physical qualities and the more successful formation of motor skills are observed (Leonardi et al., 2018, Matulaitis et al., 2019; Nikolaidis et al., 2015). The process of mastering technical and tactical actions and developing special motor abilities is more effective if the tasks of physical and special training are solved comprehensively, and the emphasis of training influences coincides with the natural accelerations of the development of physical qualities and the formation of technical parameters (Guimarães et al., 2019; Ramos et al., 2020).

Functional, morphometric, and motor indicators are the most significant factors affecting the success of the implementation of the basic components of the physical potential of young basketball players (Leonardi et al., 2018; Matulaitis et al., 2019; Šišić, Sekulić, 2014). The most important morphological characteristics of basketball players are body height and body weight, which significantly affect athletic performance, allow you to determine how young athletes meet the selection criteria for training groups, are taken into account when predicting prospects and choosing the optimal one for the player, his role, as well as the formation of teams (Bilali, Bellova, Spahi, 2017; Guimarães et al., 2019; Jakovljević et al., 2011; Ramos et al. 2020; Shahdadi, Alisoufi, 2017). Leonardi et al. (2018) reported that basketball players of 13–15 years old are characterized by a high level of biological maturity, and high rates of special preparedness in athletes can be explained by the relationship of age and accumulated training experience. Karalejic, Jakovljevic, Macura (2011) revealed that the technical skills of young basketball players aged 12–14 depend on the anthropometric characteristics and the level of development of basic physical abilities, as well as changes in the relationship between them as sports qualifications improve.

Pedagogical control tests make it possible to judge the individual's abilities for successful specialization in basketball, where important characteristics of elite athletes are a high level of development of jumping ability, speed, strength, coordination of movements in combination with excellent technique, high accuracy of throwing the ball into the basket (Assefa, Kumar, 2018; Mitova, 2019; Sabin, Marcel, 2016). The importance of a player's ability to jump as high as possible is due to the fact that players must jump as high as possible, performing jump throws, free throws, when mastering the ball when bouncing off a shield or ring, and the specific components of jumping are explosive strength, speed and rhythm of movements (Cieślicka et al., 2019; Erčulj et al., 2010; Kozina et al., 2018). A high level of coordination abilities, as the main component of dexterity, is due to the need for players to repeatedly perform sudden abrupt stops, changes in direction and acceleration. Agility indicators are determined by the rate of change of direction of movement and depend on explosive strength, muscle coordination and flexibility (Kozina et al., 2018; Sabin, Marcel, 2016; Šišić, Sekulić, 2014). Some studies have revealed a moderate or very large relationship between vertical jump height and various dexterity indices, which indicates that the greater the explosive strength, the higher the dexterity indices (Alemdaroğlu, 2012; Asadi, 2016). Moreover, different values of the relationship vary depending on the age, gender, and qualifications of the players.

The most important for catching the ball are coordination abilities, for leading and passing the ball – varieties of speed, agility, and the effective implementation of throwing the ball into the basket is associated with a sufficient level of development of coordination abilities and speed-power qualities. The speed, agility, and jumping ability of basketball players have common physiological and biomechanical determinants (Asadi, 2016; Erčulj et al., 2010).

However, only a few studies examined the relationships between physical and special fitness in groups of young athletes (Cieślicka et al., 2019; El-Shafee, Kapouh, 2016; Kozina et al., 2018). In the context of our study, the data of El-Shafee, Kapouh (2016) are important, which reported a significant positive correlation between the indices of coordination abilities and basic basketball skills in 12-year-old athletes. Analyzing the motor abilities and potential of high-class European basketball players aged 13–15, Erčulj, Blas, Bračič (2010) found that athletes with a long training experience show a higher level of development of motor qualities, especially when performing special (basketball) motor tasks with a ball. Garcia-Gil et al. (2018) revealed a positive correlation ($p < 0.05$ – 0.005) between anthropometric characteristics and competitive performance indicators, except for the number of transfers for women from 18 to 32 years old Spanish women's league players. Regarding the relationship between physical training and the special performance of basketball players, relationships between the time of the dexterity test and the time of the dribbling test with the effectiveness of playing activity have been identified (Garcia-Gil et al., 2018).

In the literature available to us, there is an insufficient number of studies that have been conducted for young basketball players in order to study the nature of the relationship of anthropometric characteristics and indicators of physical and special fitness of athletes. This contradiction determines the relevance of our study.

The objectives of this study were, firstly, to describe and compare anthropometric characteristics, indicators of physical and special fitness for basketball players under the age of 12 and up to 14 years, and secondly, to identify the presence and degree of relationship between indicators of physical and special fitness indicators in each group of athletes.

Materials and methods

Participants

Of the girls – basketball players training in the Children's Sports School in Zaporizhia and taking part in the study ($n = 50$), two groups were formed, U12 (10.30–11.93 years; $n = 24$; 2 year of study), and U14 (12.05–13.80 years; $n = 26$; 3–4 year of study). Basketball players of both groups trained in accordance with the basketball curriculum for children and youth sports schools 3 times a week. Before the study began, participants and their parents received detailed written and verbal information about the possible risks and inconveniences of testing.

Written informed consent was obtained from parents or legal representatives, consent was obtained from participants. The experiments described by us were performed in accordance with the principles of the Declaration of Helsinki and approved by the Research Ethics Committee (No. 27439-067.015, protocol 2019/002 dated 3.09.2019) of the National University «Zaporizhzhia Polytechnic», Zaporizhzhya, Ukraine.

Organization of the study

To assess the physical development of basketball players, anthropometric measurements of the body mass (BM) and body height (BH) of the athletes were used, based on these measurements, the body mass index (BMI) (kg/m^2) was calculated. BM was measured to the nearest 0.01 kg using an electronic balance; BH was measured to the nearest 0.5 cm using a stadiometer.

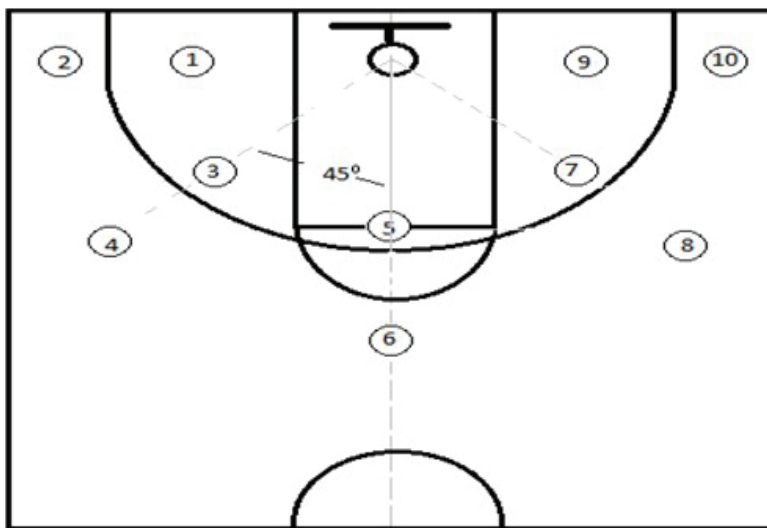
The physical fitness testing program included well-known and reliable tests (Miller, 2012). To evaluate explosive strength, the Vertical Jump Test (cm) was used; a detailed description of the test procedure is widely presented in the literature (Miller, 2012). To assess the ability to rebuild motor actions and speed, the Edgren Side Step Test (m)

was used (McCormick, 2014; Miller, 2012). To determine the level of development of the ability to regulate steps during acceleration and deceleration, the rate of change of direction and control of the body when moving forward, backward and in the transverse direction, we used the Agility T-Test (s) (Alemdaroğlu, 2012; Jakovljević et al., 2011; Miller, 2012; Šišić, 2014). The selected tests are real indicators of dexterity and objectively evaluate movement in different planes, providing a comprehensive assessment of mobility (Asadi, 2016; McCormick, 2014).

To assess the level of special preparedness, we used the tests proposed and described in detail in the basketball curriculum for sports schools (Mitova, 2019; Republican Scientific and Methodological Cabinet of the Ministry of Ukraine of Family, Sports and Youth [RSMCMUFSY], 2019).

Free Throws (percent of hits). The player performed 7 episodes of 3 throws (21 free-throw shoots). After the 1st and 2nd throw, a partner gave them the ball. After the 3rd throw, the player herself took possession of the ball and dribbled back to its original position. Take into account the percent of hits of the ball in the basket.

"Throws of the ball into the basket from different positions" the ball throwing test (40 throws) (Figure 1). The player performed 4 series of 10 throws from positions different in distance and location, which were marked on the court as follows: 1–2 positions – to the left of the shield, parallel to the front line passing through the projection of the ring; 3–4 positions – to the left of the shield at 45° from the center of the ring; 5–6 positions – on a line passing through the projection of the center of the ring at an angle of 90° (opposite the shield); 7–8 positions – symmetrically to positions 3–4 to the right of the shield; 9–10 positions – symmetrically to positions 1–2 to the right of the shield.



1, 2, 3, 4, 5, 6, 7, 8, 9, 10 – throwing positions.

Figure 1. Test "Throws of the ball into the basket from different positions"

For positions 1, 3, 5, 7, 9 the distance from the projection of the ring is 4 m, for positions 2, 4, 6, 8, 10 the distance from the projection of the ring is 5.5 m. The player performed throws from positions in a strict sequence:

1st series of throws (from a position –1, 2, 3, 4, 5, 6, 7, 8, 9, 10); 2nd series of throws (from the position –1, 2, 3, 4, 5, 6, 7, 8, 9, 10), etc. After each throw, the player independently picked up the ball and dribbled out to the position for the next throw. The attempt was counted on condition that 40 throws were completed in 5.5 minutes. Only one attempt was granted (RSMCMUFSY, 2019).

To determine the speed of the hands, the “Ten eights” test (s) was used. The athlete took the starting position (with a slight slope forward, a basketball in one hand between the legs at the knees). On a signal, she completed the “eight” as quickly as possible, while the ball was passed from hand to hand – thus 10 “eights”, when passing the ball was controlled with one hand. Only one attempt was granted.

Testing was carried out in a standard-sized basketball gym by two experienced professionals to ensure reliable measurements. A familiarization session was conducted before each test.

Statistical analysis

All statistical analyzes were carried out with SPSS version 22.00 software (IBM, Armonk, NY, USA). All data were presented as mean \pm standard deviation of the Mean (SD). Statistical significance was set at $p < 0.05$. All variables had a normal distribution and satisfied the equality of variances according to the tests of Shapiro-Wilk and Leuven, respectively. The unpaired student test was used to determine if there are significant differences between U12 and U14. Pearson's correlation coefficients (r) were calculated to determine the relationships between anthropometric parameters, indicators of physical and special fitness. The value of r was classified as moderate ($0.3 < r \leq 0.5$), strong ($0.5 < r \leq 0.7$), very strong ($0.7 < r \leq 0.9$), almost ideal ($r > 0.9$) (Cohen, 1988).

Results

Table 1 presents the results of measurements of anthropometric indicators of both groups. The average BMI of the players was within the age limits and amounted to $16.896 \pm 1.72 \text{ kg/m}^2$ in U12, $22.07 \pm 11.94 \text{ kg/m}^2$ in the group of players U14. The results of independent t-tests show that the groups U12 and U14 differed in all studied parameters.

Table 1. Anthropometric parameters of the U12 and U14 basketballers

Parameters	U12 (n = 24)				U 14 (n = 26)				t-test for Equality of Means		
	\bar{x}	SD	min	max	\bar{x}	SD	min	max	mean difference	t	p
Age (years)	10.97	0.48	10.30	11.93	12.96	0.49	12.05	13.80	1.99	–12.18	0.000
Body height (cm)	156.18	4.61	145.60	162.22	167.85	4.81	159.60	175.30	11.66	–8.74	0.000
Body mass (kg)	41.27	3.64	34.80	49.00	54.16	5.71	44.75	62.84	12.88	–9.43	0.000
BMI (kg/m^2)	16.94	1.65	14.60	21.16	19.21	1.73	16.48	22.99	2.26	–4.72	0.000

Table 2 presents the results of testing the indicators of physical and special fitness of players in both groups. The results of independent t-tests show that the groups U12 and U14 differed in all the studied parameters except the “Free Throws” test (FT), with older athletes showing better results than younger ones (Table 2).

Table 2. Results of testing physical and special fitness of U12 and U14 basketball players

Tests	U12 (n = 24)				U 14 (n = 26)				t-test for Equality of Means		
	\bar{x}	SD	min	max	\bar{x}	SD	min	max	mean difference	t	p
Vertical Jump (cm)	29.46	7.30	8.00	41.00	39.69	6.55	28.00	57.00	10.23	-5.22	0.000
Edgren Side Step Test (m)	24.00	1.98	20.00	28.00	25.27	2.05	21.00	28.00	1.27	-2.23	0.031
Agility T-Test (s)	13.82	0.858	12.62	15.44	12.547	1.02	11.10	14.47	1.28	4.75	0.000
Throws the ball into the basket from different positions (number of hits)	11.25	3.25	7.00	18.00	14.19	3.97	8.00	23.00	2.94	-2.85	0.006
Free Throws (% of hits)	11.17	3.63	6.00	19.00	12.19	3.86	4.00	19.00	1.03	-0.97	0.034
"Ten eights" (s)	16.01	3.33	11.75	23.78	13.21	2.36	9.97	19.65	2.80	3.45	0.001

The results of the Pearson correlation analysis for group U12 showed a strong ($r = 0.617$, $p = 0.001$) correlation between BM athletes and the height of the jump, a strong correlation ($r = 0.594$, $p = 0.002$) between BM athletes and the test results Throws of the ball into the basket from different positions (TBBDP). A moderate positive relationship was found between the results of the Vertical Jump Test and the Edgren Side Step Test (ESST) ($r = 0.406$, $p = 0.049$), between the ESST and the Agility T test ($r = -0.463$, $p = 0.023$) (Table 3).

Table 3. Correlation matrix (coefficients "r"), characterizing the relationship between anthropometric indicators, indicators of physical and special fitness of basketball players of the U12 group (n = 24)

	BH	BM	VJ	ESST	AT-Test	TBBDP	FT	TE
BH	1							
BM	0.214	1						
VJ	0.255	0.617**	1					
ESST	0.261	0.389	0.406*	1				
AT-Test	0.063	-0.140	-0.341	-0.463*	1			
TBBDP	-0.045	0.594**	0.247	0.298	-0.324	1		
FT	0.260	0.186	-0.022	-0.012	0.050	0.350	1	
TE	0.063	-0.219	-0.262	-0.287	0.326	-0.245	-0.241	1

Note. BH = body height; BM = body weight; VJ = Vertical Jump; Edgren Side Step Test = ESST; Agility T-Test = AT-Test; Throws of the ball into the basket from different positions = TBBDP; Free Throws = FT; Ten Eights = TE.

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

The results of the Pearson correlation analysis for group U14 showed a strong correlation of BH and BM athletes ($r = 0.568$, $p = 0.002$). Strong correlations were found between the performance in the Vertical Jump Test (VJ) and Agility T test ($r = 0.545$, $p = 0.004$) and the VJ and the results in the FT ($r = 0.561$, $p = 0.003$). The ESST and Agility T test showed a strong relationship ($r = -0.762$, $p = 0.000$). There is also a strong correlation between the results in the tests "Throws of the ball into the basket from different positions" (TBBDP) and FT ($r = 0.632$, $p = 0.001$) and in the tests TBBDP and the indicators "Ten Eights" ($r = -0.542$, $p = 0.004$). A moderate negative relationship ($r = -0.479$, $p = 0.013$) was revealed between the indicators in the FT and Ten Eights tests (Table 4).

Table 4. Correlation matrix (coefficients “r”), characterizing the relationship between anthropometric indicators, indicators of physical and special fitness of basketball players of group U14 (n = 26)

	BH	BM	VJ	ESST	AT-Test	TBBDP	FT	TE
BH	1							
BM	0.568**	1						
VJ	0.190	0.087	1					
ESST	-0.142	-0.190	0.361	1				
AT-Test	0.175	0.154	-0.545**	-0.762**	1			
TBBDP	0.305	0.103	0.324	0.219	-0.275	1		
FT	0.372	0.083	0.561**	0.125	-0.267	0.632**	1	
TE	-0.207	-0.071	-0.357	-0.305	0.371	-0.542**	-0.479*	1

Note. BH = body height; BW = body weight; VJ = Vertical Jump; Edgren Side Step Test = ESST; Agility T-Test = AT-Test; Throws of the ball into the basket from different positions = TBBDP; Free Throws = FT; Ten Eights = TE.

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Discussion

Studying and describing anthropometric indicators, indicators of physical and special fitness, identifying the nature and degree of relationship between them among young basketball players at the basic stage of training constitute an important area of sports science (Jakovljević et al., 2011; Matulaitis et al., 2019). The main result of our study was the identification of the nature and degree of correlation between the indicators of body height and body weight with some indicators of physical and special fitness, which means that our data can be used both to assess and predict the potential of athletes, and to improve the training of beginner basketball players according to the principle of compliance focus of pedagogical influences on age-specific characteristics of athletes, with an emphasis on the leading parameters of technology and with special physical qualities in the most favorable age periods.

The body height of athletes is an important factor in game performance in basketball, respectively, tall athletes with a high level of motor abilities can become better players (Erčulj et al., 2010; Šišić, Sekulić, 2014). Basketball players of the U14 group are significantly higher than U12 athletes by an average of 6.95%. The body weight of athletes of the U12 group is 23.8% less than the basketball players of the U14 group. BMI in the U14 group is 11.81% higher than in the U12 group. Our data are consistent with the results of other researchers (El-Shafee, Kapouh, 2016; Leonardi et al., 2018; Ramos et al. 2020).

The results of a comparative analysis of the indicators of physical and special fitness of athletes of two different age groups confirms the data that an active increase in motor qualities occurs in the age of 10–12 to 12–14 years. Thus, the performance in the “Vertical Jump” test for girls of the U14 group is higher by 34.73%, “Edgren Side Step Test” – by 13.54%, “Agility T test” – by 9.26%, respectively, among older athletes explosive power and the ability to rebuild motor actions are better developed. A similar difference is also recorded in the results of tests of special readiness. The accuracy during the test TBBDP for senior athletes is higher by 26.13%, the speed of hand movements in the test “Ten Eights” is higher by 17.49%. The efficiency of free throws in girls of the U14 group was higher by 9.13%, however, there was no significant difference in this test between the two age groups ($p > 0.05$).

In general, older basketball players in this sample were taller, heavier and showed better physical and special fitness. This trend is consistent with observations of the development of these indicators in young basketball

players (Jakovljević et al., 2011; Nikolaidis et al., 2015; Sabin, Marcel, 2016). It was previously reported that the age and length of training, differences in the volume and orientation of training loads have a significant impact on the level of training of young athletes (Guimarães et al., 2019; Matulaitis et al., 2019). Comparison of the obtained data on testing physical development and physical fitness with the proper standards for selection in educational groups, in accordance with the curriculum for sports schools, confirms their compliance with the training standard (RSMCMUFSY, 2019).

The results of the correlation analysis showed a smaller number of reliable relationships in the preparedness structure of basketball players of the U12 group compared to U14, since seven reliable relationships were revealed between the studied indicators in the U14 group, while four reliable relationships were found in the U12 group. Comparison of the results obtained by us with the results of other studies of young athletes-basketball players is limited by the small number of studies with the identical design and contingent of participants. Therefore, the results of this study were also compared with the results of studies of young basketball players and data for adult female basketball players (Clemente et al., 2019; Shahdadi, Alisoufi, 2017; Šišić, Sekulić, 2014). However, this fact does not exclude the use of the tests we have chosen, since these tests are successfully practiced in basketball.

The strength of the lower extremities, measured by a vertical jump, is an important factor in determining competitive success in basketball (Clemente et al., 2019; McCormick, 2014). The revealed strong positive correlation between body weight and the height of the vertical jump of the youngest female athletes, apparently means that at the age of 10–12 years, for beginner athletes, a large body mass causes a tendency to increase the height of the jump. This can probably be explained by the presence of mass in those muscles that are the main generators of effort in a vertical jump (extensors of the body and pelvis, knee and ankle joint). Our data are consistent with data from Nikolaidis et al. (2015), which note the importance of body weight for interpreting the variability of physical abilities in the puberty period. Thus, body weight moderately correlates with the height of the vertical jump of basketball players aged 11–13 years (Nikolaidis et al., 2015). The presence of a statistically significant correlation between body weight and the results in the test TBBDP by basketball players of the U12 group, which we identified is consistent with the previously obtained data (Bilali et al., 2017; Clemente et al., 2019). No statistically significant correlation between body height, physical and special fitness indicators of basketball players of both groups was revealed, which is indirectly confirmed by other studies, which reported that the body height of 14–18-year-old male players does not affect the results in dexterity tests (Jakovljević et al., 2011; Šišić, Sekulić, 2014).

In this study, Pearson's correlation analysis showed a significant association for athletes of the U12 group between VJ and ESST, and for athletes of U14 between the VJ and Agility T test, VJ and FT. This significant relationship between special preparedness indicators is supported by other studies (Clemente et al., 2019; Garcia-Gil et al., 2018; McCormick, 2014; Shahdadi, Alisoufi, 2017) and allows them to be interpreted as evidence of the interdependence of the parameters of the motor function. Indirectly, this may indicate sufficient elasticity of muscle fibers, which in turn is an important component of the ability of muscles to develop working effort, for example, in jumping, for accelerations, sudden movements in order to change direction. Note that the relationship between VJ and the result of FT in the group of athletes U14 confirms the opinion that the jerky movement (jump), that is, the work of the legs, in a functional sense determines the kinematic background of the actions of the hands of basketball players with a free throw (Clemente et al., 2019; McCormick, 2014). Together they constitute a component of the system, where each represents a unity of variability and stability of the individual elements of its components. The best results of a vertical jump affect the improvement of dexterity, speed, and coordination of movements

and, consequently, the improvement of intermuscular coordination associated with the improvement of the activity of agonist muscles, synergist muscles and antagonist muscles (Asadi, 2016; Spiteri et al., 2016). Their coordinated work leads to high speed, accuracy of movement and cost-effectiveness. This information complements the data of other researchers and means that the explosive power of the lower extremities is associated with a wide range of indicators of physical and special fitness among young basketball players (McCormick, 2014; Nikolaidis et al., 2015).

In support of our results, previous studies have shown that speed and dexterity depend on muscle strength (Karalejic et al., 2011; Sabin, Marcel, 2016) and that the effects of training muscle strength can be transferred to actions that include rapid changes in direction (McCormick, 2014). In addition, data on the relationship between dexterity and lower limb power in athletes of the U12 group will help optimize training programs. We believe that the determination of the relationship between the components of technical readiness, including jump and throwing movement, is a promising direction in the study of sports equipment.

In the literature available to us, various variants of instructions, implementation and interpretation of the ESST results have been discovered, which are informative and reliable for assessing the ability to change direction. The relationship between the ESST and Agility T-Test indicators in girls of both groups revealed in our study may indicate that, at the age of 12–14 years, the effectiveness of the motor functional system is largely determined by the age maturity of the motor and vestibular analyzers, which leads to an improvement in coordination abilities. Thanks to this, athletes make maximum use of the speed-power potential, can quickly move in different directions, change movements at high speed. Our data are indirectly confirmed by the data of other researchers who reported a strong relationship between the results of the Agility T-test and ESST in adult athletes (Alemdaroğlu, 2012; McCormick, 2014; Spiteri et al., 2015).

Note that in the U14 group, in contrast to U12, significant correlations between the indicators of tests of special preparedness were revealed, which allows them to be interpreted as a positive effect of the effects of the training process. Perhaps this significant influence is explained by the fact that the level of dexterity largely determines the success of a basketball player working with the ball and, in particular, affects the efficiency of throwing the ball into the basket (Asadi, 2016; Assefa, Kumar, 2018).

The main component of technical and tactical preparedness is the effectiveness of the shots. In the testing process, the U14 group of basketball players more efficiently threw the ball into the basket from different points, and the percentage of hits is moderately correlated with the results in the “ten eights” test, respectively, more maneuverable basketball players are better at owning the ball.

A limitation of this study is that the relatively small number of participants in the experiment, in particular the formation of two different age groups from among them, does not allow making unambiguous statistical conclusions. The next limitation to be recognized is that the body composition of the beginning athletes was not assessed and playing positions were not taken into account. Although the testing procedures are suitable for evaluating basketball-specific actions, the level of training and experience of athletes may affect the selected indicators. Future research is supposed to be directed to the study of the relationship between a large number of variables, such as muscle strength and power, flexibility, balance, speed, body composition, and the athlete's playing role.

Conclusions

In the light of this study, data on jumping ability, dexterity, and speed of movement are considered as the most important characteristics of the preparedness of young basketball players. A significant difference was revealed by age groups in relation to body size. Older basketball players (U14) showed better performance than younger athletes (U12) in all tests except the free-throw test. The results of this study indicate a significant correlation between jumping and agility in both groups of athletes. A significant correlation was found between the characteristics of the special preparedness of the athletes of the older group. Thus, comprehensive monitoring of the state of young athletes, the study of the relationship of changes associated with growing up with the experience of training in basketball are important for assessing the individual dynamics of the growth rate of the most significant indicators for a sport, determining the prospects of athletes and optimizing the training process of basketball players.

Acknowledgments

The authors would like to extend his thanks to the coaches and athletes for their willingness to participate in this study.

References

- Alמדaroğlu, U. (2012). The relationship between muscle strength, anaerobic performance, agility, sprint ability and vertical jump performance in professional basketball players. *Journal of Human Kinetics*, 31 (1), 149–158. DOI: 10.2478/v10078-012-0016-6.
- Asadi, A. (2016). Relationship between jumping ability, agility and sprint performance of elite young basketball players: a field-test approach. *Brazilian Journal of Kinanthropometry and Human Performance*, 18 (2), 177. DOI: 10.5007/1980-0037.
- Assefa, T., Kumar, A. (2018). Relationship among anthropometric, body composition and physical fitness of basketball skill performance: a study of ethiopian university players. *Journal of Exercise Science & Physiotherapy*, 14 (1). DOI: 10.18376/jesp/2018/v14/i1/111293.
- Bilali, A., Bellova, E., Spahi, A. (2017). A the correlation between body mass and height with motor abilities in youth basketball players. *European Journal of Health & Science in Sports*, 4 (2), 22–25.
- Chukhlantseva, N. (2019). A high level of coordination among handball players is necessary for optimal, successful competitive activity. *Scientific Journal National Pedagogical Dragomanov University*, 9 (117), 7–10.
- Cieślicka, M., Kozina, Z., Muszkieta, R., Korobeinik, V., Safronov, D., Bugayets, N., Shepelenko, T., Tanko, A. (2019). Integral development of jumping and of throw accuracy of young basketball players 12–13 years. *Journal of Physical Education and Sport*, 3 (19), 992–1002. DOI: 10.7752/jpes.2019.s3143.
- Clemente, F.M., Conte, D., Sanches, R., Moleiro, C.F., Gomes, M., Lima, R. (2019). *Anthropometry and fitness profile, and their relationships with technical performance and perceived effort during small-sided basketball games. Research in Sports Medicine*, 27 (4), 452–466. DOI: 10.1080/15438627.2018.1546704.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Hillsdale, NJ: L. Erlbaum Associates.
- El-Shafee, A., Kapouh, N. (2016). The relationship of developing coordination abilities with the level of performance of some basic skills of young female basketball. *International Journal of Sports Science and Arts*, 301, 253–276.
- Erčulj, F., Blas, M., Bračić, M. (2010). Physical demands on young elite european female basketball players with special reference to speed, agility, explosive strength, and take-off power. *Journal of Strength and Conditioning Research*, 24 (11), 2970–2978. DOI: 10.1519/jsc.0b013e3181e38107.
- Garcia-Gil, M., Torres-Unda, J., Esain, I., Duñabeitia, I., Gil, S.M., Gil, J., Irazusta, J. (2018). Anthropometric parameters, age, and agility as performance predictors in elite female basketball players. *J Strength Cond Res*, 32 (6), 1723–1730. DOI: 10.1519 / JSC.0000000000002043.
- Guimarães, E., Baxter-Jones, A., Maia, J., Fonseca, P., Santos, A., Santos, E., Tavares, F., Janeira, M. A. (2019). The roles of growth, maturation, physical fitness, and technical skills on selection for a portuguese under-14 years basketball team. *Sports (Basel, Switzerland)*, 7 (3), 61. DOI: 10.3390/sports7030061.

- Jakovljević, S., Karalejić, M., Pajić, Z., Gardašević, B., Mandić, R. (2011). The influence of anthropometric characteristics on the agility abilities of 14 year-old elite male basketball players. *Facta universitatis – series: Physical Education and Sport*, 9 (2), 141–149.
- Karalejić, M., Jakovljević, S., Macura, M. (2011). Anthropometric characteristics and technical skills of 12 and 14 year old basketball players. *The Journal of sports medicine and physical fitness*, 51, 103–10.
- Kozina, Z., Sobko, I., Vilvitskii, V., Xiaofei, W., S.V., B., Tymko, Y., Glyadya, S., Minak, A. (2018). Method of integral development of speed-power qualities and accuracy of throws at young basketball players 12–13 years. *Health, Sport, Rehabilitation*, 4 (2), 39–51. DOI: 10.5281/zenodo.1342457.
- Leonardi, T.J., Paes, R.R., Breder, L., Foster, C., Gonçalves, C.E., Carvalho, H.M. (2018). Biological maturation, training experience, body size and functional capacity of adolescent female basketball players: A Bayesian analysis. *International Journal of Sports Science & Coaching*, 13 (5), 713–722. DOI: 10.1177/1747954118772489.
- Matulaitis, K., Skarbalius, A., Abrantes, C., Gonçalves, B., Sampaio, J. (2019). Fitness, technical, and kinanthropometrical profile of youth lithuanian basketball players aged 7–17 years old. *Frontiers in Psychology*, 10. DOI: 10.3389/fpsyg.2019.01677.
- McCormick, B. (2014). The reliability and validity of various lateral side-step tests. *International journal of applied sports sciences*, 26, 67–75. DOI: 10.24985/ijass.2014.26.2.67.
- Miller, T. (2012). *National Strength and Conditioning Associations guide to tests and assessments*. Champaign, IL: Human Kinetics.
- Mitova, O. (2019). Unified algorithm of complex control for athletes' fitness in team sports games. *Science in Olympic Sport*, 2, 16–28. DOI:10.32652/olympic2019.2_2.
- Nikolaidis, P.T., Asadi, A., Santos, E.J., Calleja-González, J., Padulo, J., Chtourou, H., Zemkova, E. (2015). Relationship of body mass status with running and jumping performances in young basketball players. *Muscles, Ligaments and Tendons Journal*, 5 (3), 187–194. DOI: 10.11138/mltj/2015.5.3.187.
- Ramos, S., Volossovitch, A., Ferreira, A.P., Barrigas, C., Fragoso, I., Massuça, L. (2020). Differences in maturity, morphological, and fitness attributes between the better- and lower-ranked male and female u-14 portuguese elite regional basketball teams. *Journal of Strength and Conditioning Research*, 34 (3), 878–887. DOI: 10.1519/jsc.0000000000002691.
- Republican Scientific and Methodological Cabinet of the Ministry of Ukraine of Family, Sports and Youth. (2019). *Basketball. Program for CYSS, SYSSOR AND SHSM. Educational-training groups and groups of sports improvement*. Kyiv, Ukraine.
- Sabin, S.I., Marcel, P. (2016). Testing agility skill at a basketball team (10-12 years old). *Ovidius University Annals, Series Physical Education and Sport/Science, Movement and Health*, 16 (1), 103–109.
- Shahdadi, A., Alisoufi, N. (2017). Relationship between anthropometric characteristics and jump throw skill in female basketball players. *European Journal of Physical Education and Sport Science*, 0. Retrieved from: <https://oapub.org/edu/index.php/ejep/article/view/431>.
- Šišić, N., Sekulić, D. (2014). Morphological-anthropometric measures are not significant predictors of agility performance for high-level junior basketball players. *Anthropological Aspects of Sports Physical Education and Recreation*, 5 (1), 42–49. DOI: 10.5550/sp.5.2013.05.
- Spiteri, T., Newton, R.U., Binetti, M., Hart, N.H., Sheppard, J.M., Nimphius, S. (2015). Mechanical .eterminants of faster change of direction and agility performance in female basketball athletes. *Journal of strength and conditioning research*, 29 (8), 2205–2214. DOI: 10.1519/jsc.0000000000000876.

Cite this article as: Chukhlantseva, N., Cherednichenko, I., Bruhno, E. (2021). Comparative Characteristics and Assessment of the Relations of Anthropometric Indicators and Motor Abilities of Girls' Basketball Players 12–14 Years Old. *Central European Journal of Sport Sciences and Medicine*, 1 (33), 61–71. DOI: 10.18276/cej.2021.1-06.

INJURIES AND CONTUSIONS IN RECREATIONAL AND SPORTS HORSE RIDING

Rena Majchrowicz,^{A, B} Karolina Karaś,^{C, D} Piotr Matłosz,^D Jarosław Herbert^{A, D}

Institute of Physical Culture Sciences, Medical College of Rzeszów University, Rzeszów, Poland

^A Study Design; ^B Data Collection; ^C Statistical Analysis; ^D Manuscript Preparation

Address for correspondence:

Jarosław Herbert

Towarnickiego 3c, 35-959 Rzeszów, Poland

E-mail: jherbert@ur.edu.pl

Abstract Horse riding is a satisfying and exciting sport and recreation activity. However, it is not without risk. A large percentage of riders experience accidents of varying degrees of severity during their professional and recreational careers. Any injury, even one that appears to be harmless, may turn out to be serious and exclude a competitor from sport for a long period of time. The purpose of the following research was to analyse the presence and incidence of contusions and injuries among novice and professional riders. The material for this study was collected using a research questionnaire conducted on a group of 1,973 people. Participants were chosen at random and belonged to an equestrian community from different age groups. The research was carried out all over Poland. Equestrianism is definitely an injurious physical activity, which is confirmed by the answer of 75% of respondents who consider this sport to have been harmful and have suffered an injury related to horse riding. Most respondents suffered hand contusions (45.5%), concussion (25.4%) and hand fractures (16.4%). The strength of the study was the number of respondents (1,973) and feedback on, among others, various types of injuries. These injuries can be easily avoided due to increased knowledge, practice, and education.

Key words horse riding, injury, contusion

Introduction

People have ridden horses since ancient times. In the beginning, the horse played a primarily utilitarian role, helping the rider travel over long distances or transport goods (Urban, 2018).

Horse riding is a form of sport, recreation, tourism and therapy with exceptional attributes and specificity (Sieńko-Awierianów, Łubkowska, Sitna, 2013; Wyżnikiewicz-Nawracała, 2002, p. 7). Riding is divided into seven disciplines: dressage, show jumping, eventing, combined driving, western riding, equestrian vaulting and endurance riding. The first three are included in the Olympic disciplines. There is also horse racing and polo (a team game played on a pitch consisting in getting the ball into the opponent's goal), which is more and more popular in Poland (Garnuszek, 2019).

Horse riding is one of the most popular recreational activities in Europe (Weber, 2017). In Sweden, almost 200,000 people are associated with this sport, which means that it takes eighth place in the ranking of "Most

Popular Sport in the Country” (Altgarde, Redeen, Hilding, Drott, 2014). In New South Wales, 43,000 people under the age of 55 were involved in horse riding during a year (Roe et al., 2003; Angoules, Christakou, Tsididakis, Angoules, Kapetanakis, 2019).

Many reports have shown the benefits of horse riding in terms of overall health, circulatory function (Kim, Lee, 2015) normal balance development and body movement (Whalen, Case-Smith, 2015). What's more, horse riding also has a positive effect on mental health, i.e., it relieves anxiety (Alfonso, Alfonso, Llabre, Fernandez, 2015), reduces hyperactivity (Hyun et al., 2016) or increases self-esteem (Hauge, Kvalem, Berget, Enders-Slegers, Braastad, 2014; Ohtani et al., 2017).

And what is very important, it is a form of physical activity that can be practiced from childhood to old age (Urban, 2013).

Horses are just animals whose behaviour and reactions we cannot be sure. Thus, if one wants to ride a horse, they have to take into account that injuries, cuts and accidents are part of the risk of this sport (Lisik, Napierała, Pezala, Zukow, 2014).

Despite the great interest in this form of activity, horse riding is considered one of the more injurious sports, and yet this sport is becoming increasingly popular in Europe. Injuries in horse riding can be divided into two types: systematic and random. Random injuries are caused by all kinds of falls. Systematic injuries arise as a result of prolonged action on the rider's body of powerful forces from the horse's back and the unnatural position of the rider's body during training. However, it is possible to help the rider by adjusting the saddle and riding equipment (Szypielewicz, Andryszczyk, Siemianowski, Topoliński, 2017). Injuries caused by horses have the highest likelihood of hospitalization based on patients using the US emergency services with injuries sustained by one of 250 monitored recreational activities. The hospital admission rate is 16.6% higher than for the next activity – off-road vehicles and motorcycle riding at 12.0% (United States Consumer Product Safety Commission, 2014). According to the sports injury register, a sports injury is one that prevents a player from participating in training or a tournament for at least one day after the event that caused it. A sports injury must take place during training or sporting events. Injuries may be the result of an excessive range of organ movement or maladjusted loading, and often occur during sports competitions where the competitor is forced to make more effort (Kraszewski, Kraszewska, 2013). Any injury, even one that appears to be harmless, may turn out to be serious and exclude a competitor from sport for a long period of time. The most serious injuries are head and spine injuries (Dobrzański, 1989).

A horse's strength can expose riders to potential injuries (Havlik, 2010). In the case of horse riding, it is estimated that one in five people who ride professionally and one in four who ride recreationally report back pain. It was also noticed that these ailments correlate with limited mobility of the spine (Dąbek, Koczy, Piotrkowicz, 2015). The duration of the load is inversely proportional to the resistance of the spine. Constant loading on the spine causes its resistance to injury to decrease and its hardness to increase. The same happens with vibrations where at the moment when loads occur suddenly and the spine is exposed to rapid vibrations, the resistance to injuries will be much lower. The spine has too little time for natural adaptation to sudden vibrations (Dziak, Tayara, 1999).

To sum up, horse riders are exposed to an increased risk of injury (Eckert, Lockemann, Puschel, Meenen, Hessler, 2011; Smartt, Chalmers, 2009, Loder, 2008).

On the other hand, the overall incidence of injuries compared to other sports is described as rather low (Altgarde, Redeen, Hilding, Drott, 2014; Craven, 2008; Ghosh, Di Scala, Drew, Lessin, Feins, 2000).

Foundation and purpose of the research

The purpose of the following research was to analyse the presence and incidence of contusions and injuries in novice and professional riders. The basic research questions relate to riding injuries and contusions and read as follows:

Is horse riding an injurious sport? Who suffers injuries and contusions most often? What factors contribute to injuries and contusions in this sport? Does the frequency of horse riding training matter?

The authors hypothesized that: Less frequent riders are more likely to get injured.

In order to obtain answers to the basic research questions and hypothesis, a diagnostic survey method based on the classic survey technique was used. As a research tool, allowing the collection of relevant data, a proprietary research questionnaire developed for the purposes of this study was sent to people who expressed a willingness to participate in the study and complete it.

The questionnaire consists of 11 questions. The questions, due to their diverse nature and detailed scope, allow us to build up a full picture of the causes of injuries in horse riding. In addition, the survey determines the profile of the respondent, obtaining information on their gender, age, education, and socio-professional status, which allows us to present a more complete profile of the respondents.

The results obtained during the study were analysed and presented using graphs, summarizing the collected materials and confirming or refuting the hypothesis, as well as answering the research questions.

The material for this study was collected using a research questionnaire conducted on a group of 1,973 people. Participants were chosen at random and belonged to an equestrian community from different age groups. The condition for participation in the research was horse riding, regardless of the discipline. The vast majority of the participants were women – 96.8%. Men accounted for only 3.2% of all the respondents. The research was carried out all over Poland among people who agreed to take part in the study. Survey sheets were placed in thematic groups and equestrian-related social networks. The period in which the study was conducted was 3 months (29.10.2018–29.01.2019). Information on completing the survey was included in the survey sheet. All people participating in the study were informed about the purpose of the study and the total anonymity of the answers given.

Results

The conduction of research, in which the main research tool was a questionnaire, resulted in obtaining results that allowed the examination of the hypothesis and research questions.

The sheet was completed by 1,973 study participants. The largest age group, i.e., 660 respondents (33.5%) were people aged 16–18. A very similar number are the people up to 15 years old, who constituted 640 of the respondents (32.5%). The next group are people aged 19–24, who constitute 431 respondents (21.8%). There were 88 people over 35 years old, which constituted 4.5% of the respondents.

The gender structure of the people who decided to answer the questions in the survey is arranged in a way that shows a clear advantage of the group of women, which constituted 96.8%, i.e., 1909 of the total number of respondents. 64 men participated in the survey, which constitutes 3.2% of respondents.

Of all the respondents, the largest group were people declaring school pupil status – 1,334 (67.6%). The second group was made up of employed persons – 339 (17.2%). The next group were students – 280 (14.2%). The least numerous group were unemployed people, who numbered 15, which is 0.8% of respondents.

The first question in the questionnaire about horse riding injuries and contusions concerned how long the respondent has been riding. Most respondents, as many as 928, have been riding for 7 years or more, which is 47% of the total. The next group is people who have been riding for 4 to 6 years, they constitute 32.9%, i.e., 649 respondents, and persons riding from 1 to 3 years constitute 17.3%, i.e., 342 respondents. The smallest group is the group of respondents who have been riding for less than a year – 54 (2.7%).

The second question concerned the frequency of horse riding training. Most respondents – 589 (29.9%) ride only once a week, 2 times a week – 491 respondents (24.9%), 3–4 times a week – 454 respondents (23%), 5–6 times a week – 328 people (16.6%), and the smallest group of respondents ride 7 times a week – 111 (5.6%).

The third question concerns the amount of time that the respondent devotes to riding per day. Most of the respondents spend 1 to 2 hours a day (1,207 people, 61.2%). Another large group are people who devote up to 1 hour a day – 418 people (21.2%). 211 people (10.7%) spend between 2 and 3 hours on horseback, 77 people (3.9%) 3 to 4 hours, and 60 people (3%) 4 or more hours.

In the fourth question, the respondents who additionally indicated other physical activity were asked about the type of activity they practiced. Many of the people also ride a bicycle: 579 (39.3%), the next popular activity is running: 518 respondents (35.2%), volleyball: 479 people (32.5%), roller skating: 370 people (25.1%), swimming: 348 (23.6%), gymnastics: 301 (20.4%), basketball: 185 (12.6%), handball: 121 (8.2%), football: 95 (6.5%), gym training: 57 (3.9%), dance: 28 (1.9%), aerobics 11 (0.7%), yoga 11 (0.7%), others 165 (11.2%).

The fifth question concerned what form of horse riding the respondent did. A total of 1,973 people responded, of which 824 respondents (41.8%) ride recreationally around a square, 715 (36.2%) ride for sport, 672 (34.1%) ride recreationally in the fields, 641 (32.5%) ride for sport and compete in equestrian competitions, other answers: 60 (3.0%).

The sixth question was about equestrian injuries. 1,415 people (71.7%) responded that they had suffered an equestrian injury, 558 people (28.3%) had never suffered an injury.

The seventh question was optional and concerned the type of contusion or injury suffered. 1,388 people answered them. Most respondents suffered: hand contusions: 632 (45.5%), concussion: 352 (25.4%), hand fractures: 227 (16.4%), ligament ruptures: 189 (13.6%), dislocations and contusion of the shoulder joint: 172 (12.4%), knee damage: 107 (7.7%), ankle injuries: 82 (5.9%), spinal injuries other than fractures and bruises: 65 (4.7%), finger dislocations or fractures: 60 (4.3%), spine fractures: 52 (3.7%), rib injuries: 51 (3.7%). Other injuries are leg injuries other than fractures: 47 (3.4%), leg fractures: 39 (2.8%), metatarsal bone injuries: 33 (2.4%), spinal contusions: 30 (2.2) %, vertebral and cervical muscle injuries: 27 (1.9%), collarbone fracture: 24 (1.7%) and other than those mentioned: 265 (19.1%).

The eighth question required respondents to answer a question about a recovery break in training caused by an injury. The answer to this question was obligatory only for those who have suffered an injury. A total of 1,661 responses were obtained, of which 1,140 (68.6%) replied that a break was required after the injury. 521 (31.4%) of the subjects could return to sports training immediately after the injury.

The next question was about the feeling and recurrence of the effects of injury. The question was optional and was answered in total by 1,568 people. 858 respondents (54.7%) answered that the effects of the injury returned. 710 people (45.3%) did not feel any effects of their injuries.

The penultimate question concerned the symptoms felt after the injury. 1,130 people answered them. Most respondents indicated that they felt pain – 957 people (84.7%). In addition, many riders felt a tearing sensation –

301 people (26.6%) and twinging: 260 people (23%). Only 62 respondents (5.5%) indicated feeling different symptoms than those listed in the questionnaire.

The final question concerns the self-assessment of the respondent's physical fitness. The question was obligatory. 974 people (49.4%) assess their physical fitness at a good level. 611 respondents (31%) at a very good level. 357 people assess their physical fitness at an average level (18.1%), and 26 (1.3%) at a poor level. None of the survey participants rated their fitness at a very poor level.

In addition, the work compares data on the occurrence of injuries depending on the age of the respondents. In the group of the youngest and oldest riders, injuries occurred less frequently than in other groups (20 ±5% difference) (Figure 1).

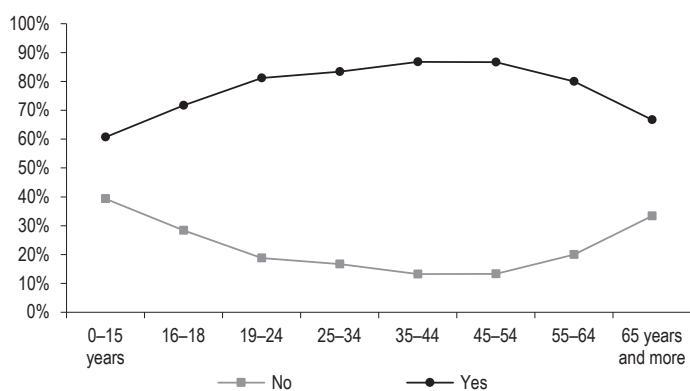


Figure 1. Occurrence of injuries depending on the age of the respondents

Source: based on own research.

The work also summarizes the occurrence of injury depending on training experience (Figure 2).

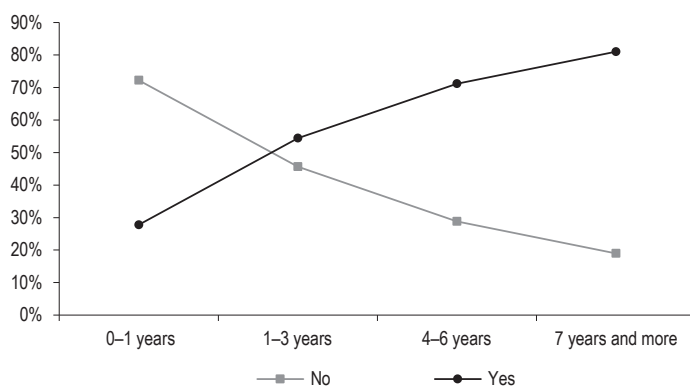


Figure 2. Occurrence of injury depending on training experience

Source: based on own research.

Discussion

Horse riding is widespread worldwide as a sport and recreational physical activity. It is associated with a significant risk of accidents and injuries of the musculoskeletal system (Lang et al., 2014; Boran, Lenehan, Street, McCormack, Poynton, 2011).

Frequent troubles and problems arise from the fact that the horse may not understand what is expected from it. Therefore, the horse may be upset and stressed, which may result in, for example, throwing the rider off (Mickunas, 2006, 263).

It is also important not to overestimate your own abilities, to be able to anticipate certain situations and possible behaviour of the horse (Gobelny, Jasiński, 1997).

Initial observations and analysis of the literature devoted to horse riding leads to the conclusion that horse riding is an injurious sport, both at the beginner level and at the level of advanced people who ride more often and with greater risk.

The research on a group of people associated with horse riding carried out using a questionnaire survey allowed us to achieve the assumed goal in this work. On its basis, we can answer the research questions posed earlier.

Equestrianism is definitely an injurious physical activity, which is confirmed by the answer of 75% of respondents who consider this sport to have been harmful and have suffered an injury related to horse riding. Based on experience one can agree with the respondents. It is not an easy sport, and yet, people who have not tried riding consider it a low-risk sport. These results confirm the research (Carmichael, Davenport, Kearney, Bernard, 2014; Hasler et al. 2011; Wolińska, Łuczyńska, Jaworski, 2012).

Most injuries happen by falling from the horse, which is more likely among people who are not accustomed to the specific behaviour and movement of the horse, and often panic, acting in an irrational way. Most often they are people riding recreationally, once a week, for about an hour.

Age is not significant in the occurrence of injuries; they happen both in the elderly and younger people. Although older people would appear more prone to injury, unlike young people, they have a more developed ability to predict.

In the research of Srinivasan, Pierre, Plog, Srinivasan, Petraglia, Huang (2014) the percentage of women who suffered neurological injury associated with equestrian sport is higher and equal to 54%, with younger women being more at risk.

One of the many ways to avoid injuries is to increase the frequency of riding, which will allow a person to better master horse riding and get used to the specific movement and behaviour of the horse. Injuries in this sport are very diverse, from head to toe. Very often they require a longer break after suffering an injury due to long-term effects. Several studies have shown that more experienced riders are safer and suffer fewer injuries (Loder, 2008; Mayberry, Pearson, Wiger, Diggs, Mullins, 2007; Guyton, Houchen-Wise, Peck, Mayberry, 2013).

At the start of the study, the following hypothesis was made: Less frequent riders experience injuries more often. As a result of applying the survey questionnaire tool and analysing the obtained test results, the hypothesis was not confirmed. People who ride less often experience decidedly fewer injuries. Injuries are caused by simple mistakes, such as a rider leaving their leg in a stirrup when they fall, girth failure when getting on or while riding, incorrect fitting of equipment, inadequate response to horse behaviour, screaming or sudden movements when the rider begins to feel fear. The research results show that as the training period increases, the likelihood of injuries increases (Figure 2).

Often the primary reason for falling from a horse is that the horse was afraid or was surprised and reacted in a way that caused injury to the rider (Srinivasan, Pierre, Plog, Srinivasan, Petraglia, Huang, 2014). Riders must always remain aware of the animal's unpredictable nature.

In summary, this study outlined the presence and incidence of contusions and injuries for beginner and professional riders. Equestrianism can lead to many injuries from very small to serious and even fatal. Research results emphasize that horse riding as well as horse handling carries the risk of serious injuries, and the most common injuries are hand contusions: 632 (45.5%) and concussions: 352 (25.4%).

A strength of the study was the number of respondents (1973) and feedback on, among others, various types of injuries. These injuries can be easily avoided due to increased knowledge, practice, and education. The authors believe that if the number of injuries can be reduced more people will be able to enjoy riding.

It is imperative that riders learn equine behaviour and safety practices around horses to prevent the majority of accidents while on the ground. A significant reduction in the injuries and contusions of equestrians could be obtained with the use of safety equipment (helmets, vests).

References

- Alfonso, S.V., Alfonso, L.A., Llabre, M.M., Fernandez, M.I. (2015). Roject stride: an equine-assisted intervention to reduce symptoms of social anxiety in young women. *Explore (NY)*, 11, 461–467. DOI: 10.1016/j.explore.2015.08.003.
- Altgarde, J., Redeen, S., Hilding, N., Drott, P. (2014). Horse-related trauma in children and adults during a two year period. *Scand J Trauma Resusc Emerg Med*, 22, 40.
- Angoules, A., Christakou, A., Tsibidakis, H., Angoules, G.A., Kapetanakis, S. (2019). Horse-related spine and spinal cord injuries in horse riding: The New South Wales experience 1976–1996. *ANZ J Surg*. DOI: 10.15761/CSRR.1000122
- Boran, S., Lenahan, B., Street, J., McCormack, D., Poynton, A. (2011). A 10-year review of sports-related spinal injuries. *Ir J Med Sci*, 180, 859–863.
- Carmichael, S.P., Davenport, D.L., Kearney, P.A., Bernard, A.C. (2014). On and off the horse: Mechanisms and patterns of injury in mounted and unmounted equestrians. *Injury*, 45, 1479–1483.
- Craven, J.A. (2008). Paediatric and adolescent horse-related injuries: does the mechanism of injury justify a trauma response? *Emerg Med Australas*, 20, 357–362.
- Dąbek, J., Koczy, B., Piotrkowicz, J. (2015). Horse riding as a form of recreation and professional sport taking into account the spine mobility of riders – a preliminary results. *Polski Merkuriusz Lekarski*, 39, 297–304.
- Dobrzański, T. (1989). *Medycyna wychowania fizycznego i sportu*. Warszawa: Sport i Turystyka.
- Dziak, A., Tayara, S. (1999). *Urazy i uszkodzenia w sporcie*. Kraków: Kasper.
- Eckert, V., Lockemann, U., Puschel, K., Meenen, N.M., Hessler, C. (2011). Equestrian injuries caused by horse kicks: first results of a prospective multicenter study. *Clin J Sport Med*, 21, 353–355.
- Garnuszek, J. (2019). *Wprowadzenie Skoki*. Retrieved from: <http://www.pzj.pl/sport/wprowadzenie>.
- Ghosh, A., Di Scala, C., Drew, C., Lessin, M., Feins, N. (2000). Horse-related injuries in pediatric patients. *J Pediatr Surg*, 35, 1766–1770.
- Grobelny, J., Jasiński, J. (1997). Formy rekreacji konnej w zależności od wieku i poziomu umiejętności jeździeckich. In: D. Umiastowska (red.), *Aktywność ruchowa ludzi w różnym wieku* (pp. 15–18). Szczecin: Uniwersytet Szczeciński.
- Guyton, K., Houchen-Wise, E., Peck, E., Mayberry, J. (2013). Equestrian injury is costly, disabling, and frequently preventable: the imperative for improved safety awareness. *Am Surg*, 79, 76–83.
- Hasler, R.M., Gyssler, L., Benneker, L., Martinoli, L., Schötzau, A., Zimmermann, H., Exadaktylos, A.K. (2011). Protective and risk factors in amateur equestrians and description of injury patterns: A retrospective data analysis and a case – Control survey. *J Trauma Manag Outcomes*, 5, 4.
- Hauge, H., Kvalem, I.L., Berget, B., Enders-Slegers, M.J., Braastad, B.O. (2014). Equine assisted activities and the impact on perceived social support, self-esteem and self-efficacy among adolescents – an intervention study. *Int J Adolesc Youth*, 19, 1–21. DOI: 10.1080/02673843.2013.779587.

- Havlik, H.S. (2010). Equestrian sport-related injuries: a review of current literature. *Curr Sports Med Rep*, 9, 299–302.
- Hyun, G.J., Jung, T.W., Park, J.H., Kang, K.D., Kim, S.M., Son, Y.D., Cheong, J.H., Kim, B.N., Han, D.H. (2016). Changes in gait balance and brain connectivity in response to equine-assisted activity and training in children with attention deficit hyperactivity disorder. *J Altern Complement Med*, 22 (4), 286–293. DOI: 10.1089/acm.2015.0299.
- Kim, Y., Lee, D. (2015). Effects of horse-riding exercise on balance, gait, and activities of daily living in stroke patients. *J Phys Ther Sci*, 27, 607–609. DOI: 10.1589/jpts.27.607.
- Kraszewski, K., Kraszewska, A. (2013). Drogi życiowe sportowców po urazach uniemożliwiających dalszą karierę- aspekty psychologiczne, „Фізичне виховання, спорт і здоров'я людини” (pp. 284–288). Kamieniec Podolski: Narodowy Uniwersytet im. Iwana Ogiienki w Kamieńcu Podolskim.
- Lang, J., Sathivelu, M., Tetsworth, K., Pollard, C., Harvey, K., Bellamy, N. (2014). The epidemiology of horse-related injuries for different horse exposures, activities, and age groups in Queensland, Australia. *J Trauma Acute Care Surg*, 76, 205–212.
- Lisik, M., Napierała, M., Pezala, M., Zukow, W. (2014). Urazy i kontuzje w jeździectwie w opinii osób uprawiających sporty konne. *Journal of Health Sciences*, 4 (15), 29–41.
- Loder, R.T. (2008). The demographics of equestrian-related injuries in the United States: injury patterns, orthopedic specific injuries, and avenues for injury prevention. *J Trauma*, 65, 447–460.
- Mayberry, J.C., Pearson, T.E., Wiger, K.J., Diggs, B.S., Mullins, R.J. (2007). Equestrian injury prevention efforts need more attention to novice riders. *J Trauma*, 62, 735–793.
- Mickunas, W. (2006). *Trener radzi. Jak lepiej poznać konie, lepiej je zrozumieć i lepiej na nich jeździć*. Łódź: Galaktyka.
- Ohtani, N., Kitagawa, K., Mikami, K., Kitawaki, K., Akiyama, J., Fuchikami, M., Uchiyama, H., Ohta, M. (2017). Horseback Riding Improves the Ability to Cause the Appropriate Action (Go Reaction) and the Appropriate Self-control (No-Go Reaction) in Children. *Front. Public Health*, 5, 8.
- Roe, J.P., Taylor, T.K., Edmunds, I.A., Cumming, R.G., Ruff, S.J., Plunkett-Cole, M.D., Mikk, M., Jones, R.F. (2003). Spinal and spinal cord injuries in horse riding: the New South Wales experience 1976–1996. *ANZ J Surg.*, 73 (5), 331–334.
- Sieńko-Awierianów, E., Łubkowska, W., Sitna, A. (2013). Czynniki warunkujące uczestnictwo w rekreacji jeździeckiej. *Ekonomiczne Problemy Turystyki*, 4 (24), 85–101.
- Smartt, P., Chalmers, D. (2009). A new look at horse-related sport and recreational injury in New Zealand. *J Sci Med Sport*, 12, 376–382.
- Srinivasan, V., Pierre, C., Plog, B., Srinivasan, K., Petraglia, A.L., Huang, J.H. (2014). Straight from the horse's mouth: neurological injury in equestrian sports. *Neurol Res*, 36, 873–877.
- Szypielewicz, S., Andryszczyk, M., Siemianowski, P., Topoliński, T. (2017). Analiza biomechaniki kręgosłupa w jeździectwie. *Aktualne Problemy Biomechaniki*, 13, 57–62.
- United States Consumer Product Safety Commission (2014). 2014 calendar year national electronic injury surveillance system. Retrieved from: www.cpsc.gov/en/research-statistics/NEISS-Injury-Data.
- Urban R. (2013). Turystyka jeździecka w Polsce – tradycje i terażniejszość. Zarys problematyki. In: R. Pawlusiński (ed.), *Współczesne uwarunkowania i problem rozwoju turystyki*. Kraków: IGiGP Uniwersytet Jagielloński.
- Urban, R. (2018). Polish Contribution to the Development of Views on Horse Riding as a Form of Therapy – a Brief Historical Retrospection. *Central European Journal of Sport Sciences and Medicine*, 3 (23), 17–24. DOI: 10.18276/cej.2018.3-02.
- Weber, C.D., Nguyen, A.R., Lefering, R., Hofman, M., Hildebrand, F., Pape, H-C.H. (2017). Blunt injuries related to equestrian sports: results from an international prospective trauma database analysis. *Int Orthop*, 41, 2105–2112.
- Whalen, C.N., Case-Smith, J. (2012). Therapeutic effects of horseback riding therapy on gross motor function in children with cerebral palsy: a systematic review. *Phys Occup Ther Pediatr*, 32, 229–242. DOI: 10.3109/01942638.2011.619251.
- Wolińska, K., Łuczyńska, M., Jaworski, Z. (2012). Analiza zaburzeń behawioralnych u koni rekreacyjnych w wybranych ośrodkach jeździeckich województwa pomorskiego i warmińsko-mazurskiego. *Roczniki Naukowe Polskiego Towarzystwa Zootechnicznego*, 8 (1).
- Wyżnikiewicz-Nawracała, A. (2002). Jeździectwo w rozwoju motorycznym i psychospołecznym osób niepełnosprawnych. Gdańsk: Akademia Wychowania Fizycznego i Sportu, Gdańsk.

Cite this article as: Majchrowicz, R., Karaś, K., Matłosz, P., Herbert, J. (2021). Injuries and Contusions in Recreational and Sports Horse Riding. *Central European Journal of Sport Sciences and Medicine*, 1 (33), 73–80. DOI: 10.18276/cej.2021.1-07.

THE EMERGENCE OF ESPORTS NUTRITION: A REVIEW

Fernando J. Ribeiro,^{1, 2, A, B, D} Victor M. Viana,^{1, 3, 4, D} Nuno P. Borges,^{1, 4, D}
Vitor H. Teixeira^{1, 5, A, D}

¹ Faculty of Nutrition and Food Science of the University of Porto (FCNAUP), Porto, Portugal

² Faculty of Sciences of the University of Porto (FCUP), Porto, Portugal

³ Centro Hospitalar Universitário S. João, Porto, Portugal

⁴ CINTESIS, Porto, Portugal

⁵ Research Centre in Physical Activity, Health and Leisure (CIAFEL), Porto, Portugal

^A Study Design; ^B Data Collection; ^D Manuscript Preparation

Address for correspondence:

Fernando J. Ribeiro

Rua da Certão, n.º 143, 4630-247 Marco de Canaveses, Portugal

E-mail: fernandoribeiro1393@gmail.com

Abstract Peak cognitive performance is of paramount importance for the sports and competitive activities that depend on a high level of cognitive performance, such as eSports. The popularity of eSports has increased rapidly in recent years and will probably continue to rise in the forthcoming years. Above all, eSports practitioners require higher levels of cognitive abilities and motor skills for optimal performance and may benefit from adequate body composition and proper nutrition, as happens with more traditional athletes. However, there is a noticeable shortage of scientific knowledge in this area, including in nutritional-related aspects. Therefore, the objective of this non-systematic review is to summarize the nutritional strategies that may enhance health, cognitive performance, decrease reaction time and minimize fatigue. This information may be relevant for eSports competitors and set a base for further investigations, which could ultimately lead to the establishment of nutritional recommendations specific for this competitive population.

Key words eSports, nutrition, eSports nutrition, video games, cognitive performance

Introduction

Traditionally, sports nutrition has focused on promoting an optimum level of physical fitness particularly for athletes of more physically intense sports, such as the marathon, football, weightlifting, etc. (Kerksick et al., 2018). However, sport is not limited to these modalities. There are other sports and competitive activities that depend mainly on another type of skills, like a high level of cognitive capacity, high-speed response, accuracy and resistance to mental fatigue, such as billiards, darts, motorsports, drone racing, chess, and eSports (Campbell, Toth, Moran, Kowal, Exton, 2018).

eSports involve video game competitions with other players. Some examples of eSports games include League of Legends, Dota 2, Starcraft II, Counter-Strike: Global Offensive, and the FIFA series (Hamari, Sjöblom, 2017).

While it is debatable if eSports are considered a true sport or not, its popularity has been growing tremendously, and it is estimated that by the end of the year 2018, it may have reached a total of 380 million fans and \$906 million in incomes (Hallmann, Giel, 2018).

The practice of eSports may provide benefits in various cognitive domains, including refined attention, memory, plasticity, spatial reasoning and problem-solving, among others (Taylor, Elam, 2018). It may also motivate students to reduce school absenteeism and improve their grades, and, as it is practiced in teams, it could also improve soft skills that are desired by universities and employers, such as teamwork, communication skills and problem-solving in high-pressure contexts (Rothwell, Shaffer, 2019).

The average age of eSports professional players maybe around 21–25 years (ESPN, 2017, accessed: 22.01.2020) and their careers are usually very brief, lasting until their mid-twenties, an age from which their speed of responsive action starts decreasing and younger competitors may be in advantage (Hallmann, Giel, 2018). The scientific literature mentions various cognitive domains that seem to be of the utmost importance in the competitive practice of video games, namely: fine cognitive motor skills, including aiming and manual dexterity (Reeves, Brown, Laurier, 2009), cognitive motor speed, including reaction time, speed of action and actions per-minute (Huang, Yan, Cheung, Nagappan, Zimmermann, 2017; Reeves et al., 2009), fluid intelligence, memory (Kokkinakis, Cowling, Drachen, Wade, 2017), visuospatial attention (Han, Lyoo, Renshaw, 2012), concentration (Cottrell, McMillen, Harris, 2019), resistance to mental fatigue (Thomas, Rothschild, Earnest, Blaisdell, 2019), multitasking, management and organization (Huang et al., 2017).

Nonetheless, it seems that most competitors do not recognize the cognitive and physiological demands of competitive eSports, and fail to adhere to healthy dietary patterns, not preparing themselves for competition in a professional manner (Schütz, 2016). As in most sports, and as the level of demand rises, a progressive increase in demand for strategies to improve performance is expected, and there are already companies dedicated to providing personalized programs, including nutritional plans (Himmelstein, Liu, Shapiro, 2017). However, there is a noticeable shortage of scientific knowledge in this area, including in the field of nutritional science.

The objective of this review is to summarize how nutritional status and dietary strategies can influence health, cognitive performance, decrease reaction time and minimize fatigue. While the information here summarized may be relevant for eSports competitors, it may have a higher favorable influence for typical adolescents and young adults, as high-level eSports players may already be operating close to the limit of human cognitive ability, leaving little room for performance improvement (Bernard, Louise, Louise, 2018).

Methods

This article is a non-systematic review and the information here resumed was collected through research on Google Scholar, PubMed, and Web of Science. The searches included the following keywords: “esports”, “cognition”, “nutrition”, “diet”, “breakfast”, “lunch”, “snack”, “evening meal”, “protein”, “carbohydrates”, “glucose”, “fat”, “saturated fats”, “polyunsaturated fats”, “vitamins”, “minerals”, “hydration”, “alcohol”, “coffee”, “caffeine”, “BMI”, “overweight”, “obesity”, and “weight loss”. The information considered relevant was included in this review. In addition, published books on nutrition and cognition were also consulted for retrieval of additional information and references.

Diet-related aspects influence on cognition

Diet quality

Diet quality may impact cognitive capacities, including learning and memory of the immature and adult brain (Reichelt, Westbrook, Morris, 2017). Poor eating habits are associated with decreased performance in various cognitive domains (Wright, Gerassimakis, Bygrave, Waldstein, 2017), which may be partially explained by ethanol neurotoxicity (Brust, 2010), increased brain inflammation promoted by high fat (Pistell et al., 2010) and high sugar diets (Yeomans, 2017). The western pattern diet, which is typically high in refined sugars and cereals, sodium, saturated fats and alcohol (Statovci, Aguilera, MacSharry, Melgar, 2017), may predispose to obesity, is linked to an overall decrease in cognitive function, and may have a negative influence in the hippocampus, which is implicated in memorization and learning (Morris, Beilharz, Maniam, Reichelt, Westbrook, 2015).

On the other hand, a healthier diet correlates with optimum mental performance (Kim, Kang, 2017). The Mediterranean diet, which is composed mainly by significant amounts of whole grains, legumes, vegetables, fruit and a modest amount of fish, dairy and olive oil, may decrease the risk of cognitive impairments (Radd-Vagenas Duffy, Naismith, Brew, Flood, Fiatarone Singh, 2018).

Meal patterns

Meal timing, size, and composition also have the potential to affect cognitive performance (Dye, Lluch, Blundell, 2000; Leigh Gibson, Green, 2002; Prasad, Lieberman, Kanarek, 2005).

Moreover, the ingestion of a meal with a nutritional composition different to the one that is usually eaten seems to worsen the mood and energy ratings (Cunliffe, Obeid, Powell-Tuck, 1997).

The frequent omission of meals, especially breakfast, in young adults, is correlated with inferior diet quality, reduced intake of micronutrients, greater BMI and risk of abdominal adiposity, increased insulin resistance (Pendergast, Livingstone, Worsley, McNaughton, 2016), poorer sleep (Tanaka et al., 2002), fatigue, decreased attention, and inferior academic performance (Ackuaku-Dogbe, Abaidoo, 2014).

Breakfast intake enhances cognitive aspects linked to attention, executive function, memory (Adolphus, Lawton, Champ, Dye, 2016), test scores (Rampersaud, Pereira, Girard, Adams, Metzl, 2005), and improves the capacity to cope with cognitive workload (Sihvola et al., 2013).

There is some evidence that lunch is a major contributor for the post-prandial dip in performance, and leads to a decline in some aspects of cognitive performance, including in discrimination efficiency, sustained attention (Smith, Miles, 1986), and increased response time (Lloyd, Green, Rogers, 1994). These detrimental effects may be modulated by personality type (Craig, Baer, Diekmann, 1981) and meal size, with biggest decrements being observed after the ingestion of a big (922–1,380 Kcal) versus a light lunch (260–305 Kcal) (Craig, Richardson, 1989; Reyner, Wells, Mortlock, Horne, 2012). The ingestion of a lunch containing high amounts of fat or carbohydrates decreases alertness and cognitive efficiency (Lloyd et al., 1994).

In a study involving university students as volunteers, those who had an evening meal felt more energetic, more attentive, more competent and achieved a better performance in a logical reasoning test than those who didn't (Smith, Maben, Brockman, 1994). On the other hand, the ingestion of a big supper (30% of daily total energy intake) at late night increased sleepiness (Gupta et al., 2019), decreased driving performance and vigilant attention

(Gupta et al., 2019; Gupta et al., 2017), while the ingestion of a light meal (10% of 24 h energy intake) led to improved performance in those parameters (Gupta et al., 2019).

Hydration

It is estimated that 54.5% of the USA children and adolescents (Kenney, Long, Craddock, Gortmaker, 2015) and 15,8% of the adults (20–29 years) are dehydrated and 40% have borderline blood plasma hypertonicity (295 to 300 mmol/L) (Stookey, 2005).

Water accounts for 75% of brain mass (Zhang, Du, Zhang, Ma, 2019) and hydration status may be one of the main variables that affect the performance of eSports practitioners since there is reasonably consistent evidence that a dehydration level greater than 2% of body mass decreases cognitive performance (Adan, 2012; Riebl, Davy, 2013) decreases alertness, mood and increases fatigue (Benton, Young, 2015). Seemingly, a greater level of dehydration correlates with greater decreases in cognitive performance and mood (Pross et al., 2013), while water consumption can improve these parameters (Masento, Golightly, Field, Butler, van Reekum, 2014).

Moreover, some studies suggest that a dehydration level of 1–2% is enough to diminish cognitive performance (Riebl, Davy, 2013), and a more recent study found that a dehydration level of only 0.22% had a negative influence on memory and attention (Benton, Jenkins, Watkins, Young, 2016).

Indeed, the mere sensation of thirst may negatively affect memory and attention (Benton et al., 2016; Benton, Young, 2015) possibly by diverting some attention from cognitive performance (Benton, Young, 2015), and it was observed that the consumption of water favors mental performance in thirsty young adults, although it impaired it in those who were not thirsty (Rogers, Kainth, Smit, 2001).

Even if a moderate level of dehydration doesn't decrease cognitive test performance in adolescents and healthy adults, it may require more brainwork to reach a similar cognitive output as in a hydrated condition (Barulli, Stern, 2013; Kempton et al., 2011; Stern, 2017), and these individuals also exhibit lower mental clarity, well-being and greater fatigue (Kempton et al., 2011).

The daily amount of water necessary to maintain euhydration varies between individuals and must be adjusted to environmental conditions. The European Food Safety Agency (EFSA) has set an adequate total water intake value of 2,5L/day for males and 2,0L/day for females (EFSA, 2017).

Nutrients

Glucose. Notwithstanding constituting just ~2% of an adult individual's body mass, the energy expenditure of the brain represents ~20% of the body total expenditure (Herculano-Houzel, 2011). Because its energy reserves are limited, brain depends on continued delivery of glucose, its main fuel substrate (Murray, Rosenbloom, 2018) except during long periods of fasting, in which it oxidizes ketone bodies (Morris, 2005). In fasting and resting conditions, approximately 60% of blood glucose is metabolized by the brain (Wasserman, 2009), totalizing around 130 g about glucose/day (Lupton, Brooks, Butte, Caballero, Flatt, Fried, 2005).

In cognitively demanding scenarios, brain glucose consumption can increase by up to 12% (Madsen et al., 1995), and blood glucose levels may drop by as much as 10% (Fairclough, Houston, 2004; Gailliot et al., 2007; Scholey, Harper, Kennedy, 2001; Scholey, Laing, Kennedy, 2006). It has been shown that playing Tetris consumes a significant quantity of glucose (Haier, Siegel, Tang, Abel, Buchsbaum, 1992) and decreases blood glucose levels (Lange, Seer, Rapior, Rose, Eggert, 2014). In this context, the consumption of glucose may increase the availability

of this nutrient and support the brain areas involved in the heightened workload and ultimately increase cognitive performance (Smith, Riby, Eekelen, Foster, 2011).

The potential mechanisms behind glucose cognitive enhancement effects through a) increased acetylcholine production, whose synthesis depends upon glucose (Messier, 2004); b) raised insulin levels, which may promote hippocampus glucose utilization (Craft, Murphy, Wemstrom, 1994); c) rewarding pathways upon activation of glucose-sensitive receptors present in the mouth (Hagger, Chatzisarantis, 2013); d) interplay with dopamine, serotonin, and opiates (Riby, 2004).

The positive effects of glucose administration on cognitive performance have been supported by the results of a meta-analysis (Riby, 2004), with larger effects on episodic memory, and possible benefits on sustained attention and vigilance (Bernard et al., 2018). The cognitive enhancements may be visible up to 20 min after its ingestion (Jones, Sunram-Lea, Wesnes, 2012) and glucose blood levels may start to decline after around 30 min, dropping to basal levels in approximately 2 hours (Benton, Parker, Donohoe, 1996). The nootropics effects of glucose seem more noticeable on prolonged and cognitively demanding tasks and in fasting conditions (Riby, 2004). This may explain why most interventions were performed at breakfast time (Hoyland, Lawton, Dye, 2008). These nootropic effects may be short-lived, as impairments in working memory have been detected 60 min after the administration of 25 g of glucose, possible due to a subsequent decrease in plasma glucose levels, secondary to increased insulin levels (Jones et al., 2012).

It may not be necessary to ingest carbohydrates through a pure glucose solution to potentiate cognition. The ingestion of a dietary source of carbohydrates (breakfast cereals) at early morning also improves spatial memory (Smith, Clark, Gallagher, 1999). Moreover, the regular ingestion of sugary drinks, including energy drinks and sports drinks, should be discouraged due to its association with increased inflammation, weight gain and oral health problems (Aeberli et al., 2011; Malik, Pan, Willett, Hu, 2013; Hardy, Bell, Bauman, Mhrshahi, 2018).

It should be noted that practicing eSports for many hours a day and during various months may lower or block the cognitive benefits associated with glucose intake. Playing Tetris daily for 4–8 weeks result in a decrease in cerebral glucose expenditure, despite a concomitant >7-fold increase in performance (Haier et al., 1992).

Lipids. Lipids account for 50–60% of adult brain's dry weight (Sastry, 1985) and it was found that alterations in the lipid constituents of neurons membrane may affect neurotransmission by modulating the activity of ion channels, receptors, enzymes and ion channels wrapped or involved with the membrane phospholipids (Prasad et al., 2005). In humans, high-fat diets have been documented to modify the brain metabolism of glucose, causing the electroconvulsive threshold to rise (Appleton, DeVivo, 1974), and the consumption of fatty foods has been robustly correlated with an increase in reaction time (Phillimore, 1988).

The type of fat may also influence cognition. The ingestion of higher amounts of unsaturated fatty acids has been correlated with optimized cognitive health in comparison with saturated fatty acids (Cao et al., 2019), while the ingestion of trans fatty acids is strongly linked with the worsening of word recall ability (Golomb, Bui, 2015). Trans fatty acids, which are produced in industrial installations (Stender, Astrup, Dyerberg, 2008), are associated to increased oxidative stress (Tomey et al., 2007), negative repercussions on blood lipids, metabolic processes, decreased glucose tolerance, general body inflammation, disrupted endothelial function, visceral adiposity, increased BMI, worsening of cardiac and general health (Mozaffarian, Aro, Willett, 2009), which may impair cognition (Atzmon et al., 2002; Eggermont et al., 2012; Geroldi et al., 2005; Isaac et al., 2011; Messerotti, Benvenuti, Zanatta, Valfre, Polesel, Palomba, 2012; van Exel et al., 2003).

Additionally, dietary trans fats decrease the availability of the long chain omega-3 fatty acids EPA and DHA, which are anti-inflammatory (Kaur, Chugh, Gupta, 2014), important to brain health and have been associated with a more favorable cognitive function (Lim, Gammack, Van Niekerk, Dangour, 2006; Robinson, Ijioma, Harris, 2010).

According to EFSA, for adults, the ingestion of total fat should represent 20–35% of total energy intake, the adequate intake of EPA + DHA is 250 mg/day, and the intake of saturated fat and trans fats should be as low as possible (EFSA, 2017).

Unlike glucose, the effects of acute consumption of pure fat and protein on cognition have been scarcely studied, with contradictory results. These inconsistencies may have been due to different methodologies applied in these studies. Additional investigations must be conducted before any conclusions can be drawn (Bachlechner et al., 2017; Jones et al., 2012).

Protein. The ingestion of adequate amounts of protein is also necessary for optimum brain development and functioning. With a protein content of approximately 10% (Banay-Schwartz, Kenessey, DeGuzman, Lajtha, Palkovits, 1992), the brain has a daily turnover rate of 3–4%, superior to that of skeletal muscle mass (1–2%) (Smeets et al., 2018). The central nervous systems also uses amino acids as neurotransmitters or as substrates for the synthesis of neurotransmitters and neuromodulators (Chertoff, 2015). The production of the neurotransmitters serotonin and catecholamines requires tryptophan and tyrosine as substrates, respectively, and its synthesis rate is influenced by the blood availability of these amino acids and, consequently, by the ingestion of protein (Fernstrom, Fernstrom, 2007).

It has been observed that the ingestion of a larger proportion of carbohydrates relative to protein raises tryptophan levels by elevating insulin levels, which promotes the uptake of the large neutral amino acids (LNAA) valine, leucine, and isoleucine by muscle tissues, thus dropping their blood levels, while tryptophan levels remain relatively unaltered. As tryptophan competes with these branched chain amino acids for the same transporter through the blood-brain barrier (BBB), the rate of transport of tryptophan through the BBB increases, as well as the brain availability of this amino acid, thus increasing serotonin production, a neurotransmitter that exerts sedating effects and consequently slows motor performance (Lieberman, 1999; van de Rest, van der Zwaluw, de Groot, 2013).

In general, dietary protein sources contains higher proportions of tyrosine in comparison with tryptophan. Being a LNAA, tyrosine competes for transport through the BBB with tryptophan and other LNAAs. As the proportion of protein to carbohydrates of a given meal increases, greater decreases in tryptophan levels are observed and, consequently, the brain synthesis of serotonin also decreases (Lieberman, 1999; van de Rest et al., 2013).

Acute high-stress conditions may decrease brain tyrosine levels due to heightened catecholamines synthesis triggered by an increased fire rate of central catecholaminergic neurons. In these cases, the ingestion of a protein-rich food increases blood tyrosine levels, favors its transport through the BBB, and boosts brain catecholamines synthesis, which may increase alertness and enhance cognition (Lieberman, 1999; van de Rest et al., 2013). Arguably, the lifestyle of eSports professional players may be considered stressful, especially in periods congested with important competitions (Pereira, Brito, Figueiredo, Verhagen, 2019).

In 2010 Jakobsen et al. applied a high protein diet (3.0 g kg/body weight) to a group of healthy young male college students (19–31 years), for 3 weeks, while another group followed a usual protein diet (1.5 g kg). These authors observed a significantly reduction in the reaction time in the high protein group, in comparison with the usual protein diet group, and attributed these effects mainly to increased levels of tyrosine, but also to raised

phenylalanine and BCAA concentration in the high protein group (Jakobsen, Kondrup, Zellner, Tetens, Roth, 2011). However, there is clearly a need for further investigations on this topic. Moreover, the amount ingested by the high protein diet largely surpassed the population reference intake value of 0.83 g/kg proposed by EFSA (EFSA, 2017).

Micronutrients. The brain energy metabolism is also dependent on an adequate supply of vitamins and minerals (Kennedy et al., 2016). Low brain magnesium levels appear to decrease serotonin levels and promote depressive states (Eby, Eby, 2010), which may decrease performance in cognitive tasks, possibly due to a reduced capacity to allocate cognitive resources to challenging tasks (Jones, Siegle, Muelly, Haggerty, Ghinassi, 2010). Due to its key role in myoglobin, cytochromes, and many other cellular proteins and enzymes (DeLoughery, 2017), iron deficiency has been strongly associated with fatigue (Brunner, Willemin, 2010) and decreased mental performance in children (Lozoff, Beard, Connor, Barbara, Georgieff, Schallert, 2006) and young adults (Scott, Murray-Kolb, 2016). Iodine is necessary for the endogenous production of two hormones in the thyroid (triiodothyronine and thyroxine), which influence human development and growth, including the central nervous system (Zimmermann, 2009). Iodine deficiency may cause a number of negative health consequences, including impaired cognition capacity (Zimmermann, 2009). Zinc plays a key role in controlling the expression of genes and in normal synaptic signaling processes (Trumbo, Yates, Schlicker, Poos, 2001). Vitamin D deficiency might have negative effects on the brain because it also has vitamin D receptors (Garcion, Wion-Barbot, Montero-Menei, Berger, Wion, 2002) and some studies suggest that hypovitaminosis D is associated with a lower cognition performance in adults (Goodwill, Szoek, 2017).

Caffeine. Caffeine is considered the main constituent of coffee that provides cognitive facilitation effects (Haskell-Ramsay, Jackson, Forster, Dodd, Bowerbank, Kennedy, 2018). A dosage of 100 ml of coffee, extracted by the drip method, contains 60–100 mg of caffeine, an amount found sufficient to improve reaction time, alertness, vigilance, and attention (0.5 to 4 mg/kg) (McLellan, Caldwell, Lieberman, 2016). This value is below the EFSA established safe upper limit for acute caffeine ingestion (3 mg/kg) (EFSA Panel on Dietetic Products & Allergies, 2015). Nonetheless, coffee contains other components, such as chlorogenic acids, that may also exert positive mood and cognitive effects (Camfield et al., 2013). One study found that the ingestion of decaffeinated coffee improved alertness in young healthy adults (Haskell-Ramsay et al., 2018). In another investigation, the mere act of smelling coffee improved performance on an analytical reasoning task, an effect that may be attributed to the placebo effect (Madzharov, Ye, Morrin, Block, 2018).

Alcohol. Binge and heavy alcohol drinking during adolescence, a time when the brain is still maturing, is associated with significant negative brain and behavioral changes, inferior academic performance, retardation of white matter maturation, and volume reductions of specific brain areas, such as the cerebellar region and the frontal lobe (Cservénka, Brumback, 2017).

Cognition and weight status

Obesity may induce insulin resistance, promote inflammation, increase oxidative stress, and lead to endothelial dysfunction (Montero, Walther, Perez-Martin, Roche, Vinet, 2012), which can be harmful to the brain, and correlates with cortical thinning of specific brain regions, diminished integrity of white matter and reduced nerve conduction velocity in adolescents (Medic et al., 2016; Sweat, Yates, Migliaccio, Convit, 2017; Yau, Kang, Javier, Convit, 2014) and adults (Majumdar, Chaudhuri, Ghar, Rahaman, Hai, 2017; Stanek et al., 2011; Xu, Li, Lin, Sinha, Potenza, 2013). Compared with their lean counterparts, obese adolescents perform worst in various domains of cognition, such as

arithmetic, working memory, spelling, mental flexibility, attention, executive functioning, cognitive processing speed, visuospatial performance, and motor skills (Liang, Matheson, Kaye, Boutelle, 2014; Sweat et al., 2017; Yau et al., 2014).

A significant percentage of esports practitioners may be overweight. In a survey conducted in Germany, involving 1,066 esports players from 18 to 38 years old, the average BMI was 24.6 (± 4.8) and that only 51.9% of the sample had a normal weight, while the mean value for the population of Germany with the same age is 59.9–72.3%. Moreover, time spent playing video games was positively associated to BMI and self-reported health status (Rudolf, Bickmann, Froböse, Tholl, Wechsler, Grieben, 2020).

If obesity is linked to decreased cognitive performance, it is reasonable to theorize that weight loss could improve cognitive performance in obese. Indeed, intentional weight loss seems to enhance several aspects of cognition in overweight and obese adults, such as executive function, attention, memory, and language (Veronese et al., 2017), although some works only found cognitive benefits in obese and not in overweight individuals (Siervo et al., 2011).

Weight loss requires a negative energy balance, which has been associated with functional cognitive deficits in self-reported dieters (Green, Rogers, 1995, 1998; Kems, Tiggemann, 2005; Kems, Tiggemann, Marshall, 2005; Vreugdenburg, Bryan, Kems, 2003), that seems to be more concerned with esthetics (Green, Elliman, Rogers, 1997; Green Rogers, 1998; Kems Tiggemann, 2005; Kems et al., 2005; Shaw, Tiggemann, 2004; Vreugdenburg et al., 2003). Such concerns can deviate cognitive resources for trivial cognitive tasks, thus diminishing the total cognitive resources available to other mental tasks (Green et al., 1997; Green, Rogers, Elliman, Gatenby, 1994; Sebastian, Williamson, Blouin, 1996). However, such association is missing or minimized when weight loss is reported or energy restriction is applied through clinical intervention (Bryan, Tiggemann, 2001; Green, Elliman, Rogers, 1995; Kretsch, Green, Fong, Elliman, Johnson, 1997; Landers, Arent, Lutz, 2001; Martin et al., 2007).

On the other hand, a too low BMI (i.e. *anorexia nervosa*) may impair cognitive flexibility and working memory. Weight recovery seems to restore these cognitive domains (Olivo, Gaudio, Schiöth, 2019). Chronic malnutrition undoubtedly hinders cognitive development and performance (Dauncey Bicknell, 1999; Kretchmer, Beard, Carlson, 1996).

Conclusions

To our knowledge, to date, no studies have evaluated the effects of dietary strategies on the cognitive performance of eSports competitors. However, there is a relatively great amount of evidence regarding nutritional strategies that may simultaneously benefit health and cognition, which may also be useful to eSports players:

1. Maintain an adequate weight for height.
2. Follow a low GI, high quality, and nutritious diet.
3. Limit the intake of fat to (20–25 total energy) and avoid saturated and trans fat.
4. Avoid and correct possible vitamin and mineral deficits.
5. Maintain a regular dietary pattern and do not skip breakfast.
6. A light meal at lunch may minimize the detrimental effects of post-lunch dip on cognition.
7. Avoid drinking alcoholic beverages.
8. Maintain an adequate hydration state, especially before competitions.
9. Consider the sensible ingestion of coffee before competitions.

Considering the currently available literature, it is not yet possible to establish specific recommendations for eSports competitors, but the information here presented may help to set a basis and identify the most viable topics which warrant further investigation. As this new world of eSports involves an increasing number of individuals over time, it is urgent to carry out further research in this area, which may ultimately lead to the establishment of nutritional and supplementation recommendations that may promote health and optimize cognitive performance.

References

- Ackuaku-Dogbe, E.M., Abaidoo, B. (2014). Breakfast eating habits among medical students. *Ghana medical journal*, 48 (2), 66–70.
- Adan, A. (2012). Cognitive performance and dehydration. *J Am Coll Nutr*, 31 (2), 71–78. DOI: 10.1080/07315724.2012.10720011.
- Adolphus, K., Lawton, C.L., Champ, C.L., Dye, L. (2016). The Effects of Breakfast and Breakfast Composition on Cognition in Children and Adolescents: A Systematic Review. *Adv Nutr*, 7 (3), 590s–612s. DOI: 10.3945/an.115.010256.
- Aeberli, I., Gerber, P.A., Hochuli, M., Kohler, S., Haile, S.R., Gouni-Berthold, I., Berthold, H.K., Spinass, G.A., Berneis, K. (2011). How to moderate sugar-sweetened beverage consumption impairs glucose and lipid metabolism and promotes inflammation in healthy young men: a randomized controlled trial. *Am J Clin Nutr*, 94 (2), 479–485. DOI: 10.3945/ajcn.111.013540.
- Appleton, D.B., DeVivo, D.C. (1974). An animal model for the ketogenic diet. *Epilepsia*, 15 (2), 211–227. DOI: 10.1111/j.1528-1157.1974.tb04943.x.
- Atzmon, G., Gabrieli, I., Greiner, W., Davidson, D., Schechter, C., Barzilai, N. (2002). Plasma HDL levels highly correlate with cognitive function in exceptional longevity. *J Gerontol A Biol Sci Med Sci*, 57 (11), M712–715. DOI: 10.1093/gerona/57.11.m712.
- Bachlechner, S., Denzer-Lippmann, M.Y., Wielopolski, J., Fischer, M., Buettner, A., Doerfler, A., Schöfl, C., Münch, G., Kornhuber, J., Thürauf, N. (2017). The Effects of Different Isocaloric Oral Nutrient Solutions on Psychophysical, Metabolic, Cognitive, and Olfactory Function in Young Male Subjects. *Front Psychol*, 8, 1988. DOI: 10.3389/fpsyg.2017.01988.
- Banay-Schwartz, M., Kenessey, A., DeGuzman, T., Lajtha, A., Palkovits, M. (1992). Protein content of various regions of rat brain and adult and aging human brain. *AGE*, 15 (2), 51–54. DOI: 10.1007/BF02435024.
- Barulli, D., Stern, Y. (2013). Efficiency, capacity, compensation, maintenance, plasticity: emerging concepts in cognitive reserve. *Trends Cogn Sci*, 17 (10), 502–509. DOI: 10.1016/j.tics.2013.08.012.
- Benton, D., Jenkins, K.T., Watkins, H.T., Young, H.A. (2016). Minor degree of hypohydration adversely influences cognition: a mediator analysis. *Am J Clin Nutr*, 104 (3), 603–612. DOI: 10.3945/ajcn.116.132605.
- Benton, D., Parker, P.Y., Donohoe, R.T. (1996). The supply of glucose to the brain and cognitive functioning. *J Biosoc Sci*, 28 (4), 463–479. DOI: 10.1017/s0021932000022537.
- Benton, D., Young, H.A. (2015). Do small differences in hydration status affect mood and mental performance? *Nutr Rev*, 73 Suppl 2, 83–96. DOI: 10.1093/nutrit/nuv045.
- Bernard, B.N., Louise, L.C., Louise, D. (2018). The Effects of Carbohydrates, in Isolation and Combined with Caffeine, on Cognitive Performance and Mood-Current Evidence and Future Directions. *Nutrients*, 10 (2), 192. DOI: 10.3390/nu10020192.
- Brunner, C., Willemin, W.A. (2010). Iron deficiency and iron deficiency anemia - symptoms and therapy. *Ther Umsch*, 67 (5), 219–223. DOI: 10.1024/0040-5930/a000040.
- Brust, J.C.M. (2010). Ethanol and cognition: indirect effects, neurotoxicity and neuroprotection: a review. *International journal of environmental research and public health*, 7 (4), 1540–1557. DOI: 10.3390/ijerph7041540.
- Bryan, J., Tiggemann, M. (2001). The effect of weight-loss dieting on cognitive performance and psychological well-being in overweight women. *Appetite*, 36 (2), 147–156. DOI: 10.1006/appe.2000.0389.
- Camfield, D.A., Silber, B.Y., Scholey, A.B., Nolidin, K., Goh, A., Stough, C. (2013). A randomised placebo-controlled trial to differentiate the acute cognitive and mood effects of chlorogenic acid from decaffeinated coffee. *PLoS One*, 8 (12), e82897. DOI: 10.1371/journal.pone.0082897.
- Campbell, M.J., Toth, A.J., Moran, A.P., Kowal, M., Exton, C. (2018). eSports: A new window on neurocognitive expertise? *Prog Brain Res*, 240, 161–174. DOI: 10.1016/bs.pbr.2018.09.006.
- Cao, G.Y., Li, M., Han, L., Tayie, F., Yao, S. S., Huang, Z., ..., Xu, B. (2019). Dietary Fat Intake and Cognitive Function among Older Populations: A Systematic Review and Meta-Analysis. *J Prev Alzheimers Dis*, 6 (3), 204–211. DOI: 10.14283/jpad.2019.9.
- Chertoff, M. (2015). Protein malnutrition and brain development. *Brain Disord. Ther*, 4 (3).

- Cottrell, C., McMillen, N., Harris, B. S. (2019). Sport psychology in a virtual world: Considerations for practitioners working in eSports. *Journal of Sport Psychology in Action*, 10 (2), 73–81. DOI: 10.1080/21520704.2018.1518280.
- Craft, S., Murphy, C., Wemstrom, J. (1994). Glucose effects on complex memory and nonmemory tasks: The influence of age, sex, and glucoregulatory response. *Psychobiology*, 22 (2), 95–105. DOI: 10.3758/BF03327086.
- Craig, A., Baer, K., Diekmann, A. (1981). The effects of lunch on sensory-perceptual functioning in man. *International Archives of Occupational and Environmental Health*, 49 (2), 105–114.
- Craig, A., Richardson, E. (1989). Effects of experimental and habitual lunch-size on performance, arousal, hunger and mood. *Int Arch Occup Environ Health*, 61 (5), 313–319. DOI: 10.1007/bf00409386.
- Cservenka, A., Brumback, T. (2017). The Burden of Binge and Heavy Drinking on the Brain: Effects on Adolescent and Young Adult Neural Structure and Function. *Front Psychol*, 8, 1111. DOI: 10.3389/fpsyg.2017.01111.
- Cunliffe, A., Obeid, O.A., Powell-Tuck, J. (1997). Post-prandial changes in measures of fatigue: effect of a mixed or a pure carbohydrate or pure fat meal. *Eur J Clin Nutr*, 51 (12), 831–838. DOI: 10.1038/sj.ejcn.1600496.
- Dauncey, M.J., Bicknell, R.J. (1999). Nutrition and neurodevelopment: mechanisms of developmental dysfunction and disease in later life. *Nutr Res Rev*, 12 (2), 231–253. DOI: 10.1079/095442299108728947.
- DeLoughery, T.G. (2017). Iron Deficiency Anemia. *Med Clin North Am*, 101 (2), 319–332. DOI: 10.1016/j.mcna.2016.09.004.
- Dye, L., Lluch, A., Blundell, J.E. (2000). Macronutrients and mental performance. *Nutrition*, 16 (10), 1021–1034. DOI: 10.1016/S0899-9007(00)00450-0.
- Eby, G.A., Eby, K.L. (2010). Magnesium for treatment-resistant depression: a review and hypothesis. *Med Hypotheses*, 74 (4), 649–660. DOI: 10.1016/j.mehy.2009.10.051.
- EFSA (2017). *Dietary reference values for nutrients summary report* (2397-8325). Retrieved from
- EFSA Panel on Dietetic Products & Allergies. (2015). Scientific Opinion on the safety of caffeine. *EFSA Journal*, 13 (5), 4102.
- Eggermont, L.H., de Boer, K., Muller, M., Jaszke, A.C., Kamp, O., Scherder, E.J. (2012). Cardiac disease and cognitive impairment: a systematic review. *Heart*, 98 (18), 1334–1340. DOI: 10.1136/heartjnl-2012-301682.
- ESPN (2017). Average age in esports vs. major sports. Retrieved from: https://www.espn.com/esports/story/_/id/20733853/the-average-age-esports-versus-nfl-nba-mlb-nhl (22.01.2020).
- Fairclough, S.H., Houston, K. (2004). A metabolic measure of mental effort. *Biol Psychol*, 66 (2), 177–190. DOI: 10.1016/j.biopsycho.2003.10.001.
- Fernstrom, J.D., Fernstrom, M.H. (2007). Tyrosine, phenylalanine, and catecholamine synthesis and function in the brain. *J Nutr*, 137 (6 Suppl 1), 1539S-1547S; discussion 1548S. DOI: 10.1093/jn/137.6.1539S.
- Gailliot, M.T., Baumeister, R.F., DeWall, C.N., Maner, J.K., Plant, E.A., Tice, D.M., Brewer, L.E., Schmeichel, B.J. (2007). Self-control relies on glucose as a limited energy source: willpower is more than a metaphor. *J Pers Soc Psychol*, 92 (2), 325–336. DOI: 10.1037/0022-3514.92.2.325.
- Garcion, E., Wion-Barbot, N., Montero-Menei, C.N., Berger, F., Wion, D. (2002). New clues about vitamin D functions in the nervous system. *Trends Endocrinol Metab*, 13 (3), 100–105.
- Geroldi, C., Frisoni, G.B., Paolisso, G., Bandinelli, S., Lamponi, M., Abbatecola, A.M., Zanetti, O., Guralnik, J.M., Ferrucci, L. (2005). Insulin resistance in cognitive impairment: the InCHIANTI study. *Arch Neurol*, 62 (7), 1067–1072. DOI: 10.1001/archneur.62.7.1067.
- Golomb, B.A., Bui, A.K. (2015). A Fat to Forget: Trans Fat Consumption and Memory. *PLoS One*, 10 (6), e0128129–e0128129. DOI: 10.1371/journal.pone.0128129.
- Goodwill, A.M., Szoek, C. (2017). A Systematic Review and Meta-Analysis of The Effect of Low Vitamin D on Cognition. *J Am Geriatr Soc*, 65 (10), 2161–2168. DOI: 10.1111/jgs.15012.
- Green, M.W., Elliman, N.A., Rogers, P.J. (1995). Lack of effect of short-term fasting on cognitive function. *Journal of psychiatric research*, 29 (3), 245–253. DOI: 10.1016/0022-3956(95)00009-t.
- Green, M.W., Elliman, N.A., Rogers, P.J. (1997). Impaired cognitive processing in dieters: Failure of attention focus or resource capacity limitation? *British Journal of Health Psychology*, (3), 259–267.
- Green, M.W., Rogers, P.J. (1995). Impaired cognitive functioning during spontaneous dieting. *Psychol Med*, 25 (5), 1003–1010. DOI: 10.1017/s0033291700037491.
- Green, M.W., Rogers, P.J. (1998). Impairments in working memory associated with spontaneous dieting behaviour. *Psychol Med*, 2 (5), 1063–1070. DOI: 10.1017/s0033291798007016.

- Green, M.W., Rogers, P.J., Elliman, N.A., Gatenby, S.J. (1994). Impairment of cognitive performance associated with dieting and high levels of dietary restraint. *Physiol Behav*, 55 (3), 447–452. DOI: 10.1016/0031-9384(94)90099-x.
- Gupta, C.C., Centofanti, S., Dorrian, J., Coates, A., Stepien, J.M., Kennaway, D., Wittert, G., Heilbronn, L., Catcheside, P., Noakes, M., Coro, D., Chandrakumar, D., Banks, S. (2019). Altering meal timing to improve cognitive performance during simulated nightshifts. *Chronobiol Int*, 36 (12), 1691–1713. DOI: 10.1080/07420528.2019.1676256.
- Gupta, C.C., Dorrian, J., Grant, C.L., Pajcin, M., Coates, A.M., Kennaway, D.J., Wittert, G.A., Heilbronn, L.K., Della Vedova, C.B., Banks, S. (2017). It's not just what you eat but when: The impact of eating a meal during simulated shift work on driving performance. *Chronobiol Int*, 34 (1), 66–77. DOI: 10.1080/07420528.2016.1237520.
- Hagger, M.S., Chatzisarantis, N.L. (2013). The sweet taste of success: the presence of glucose in the oral cavity moderates the depletion of self-control resources. *Pers Soc Psychol Bull*, 39 (1), 28–42. DOI: 10.1177/0146167212459912.
- Haier, R.J., Siegel, B., Tang, C., Abel, L., Buchsbaum, M.S. (1992). Intelligence and changes in regional cerebral glucose metabolic rate following learning. *Intelligence*, 16 (3), 415–426. DOI: 10.1016/0160-2896(92)90018-M.
- Haier, R.J., Siegel, B.V., Jr., MacLachlan, A., Soderling, E., Lottenberg, S., Buchsbaum, M.S. (1992). Regional glucose metabolic changes after learning a complex visuospatial/motor task: a positron emission tomographic study. *Brain Res*, 570 (1–2), 134–143. DOI: 10.1016/0006-8993(92)90573-r.
- Hallmann, K., Giel, T. (2018). eSports – Competitive sports or recreational activity? *Sport Management Review*, 21 (1), 14–20. DOI: 10.1016/j.smr.2017.07.011.
- Hamari, J., Sjöblom, M. (2017). What is eSports and why do people watch it? *Internet research*, 27 (2), 211–232.
- Han, D.H., Lyoo, I.K., Renshaw, P.F. (2012). Differential regional gray matter volumes in patients with on-line game addiction and professional gamers. *Journal of psychiatric research*, 46 (4), 507–515. DOI: 10.1016/j.jpsychires.2012.01.004.
- Hardy, L.L., Bell, J., Bauman, A., Mihrshahi, S. (2018). Association between adolescents' consumption of total and different types of sugar-sweetened beverages with oral health impacts and weight status. *Aust N Z J Public Health*, 42 (1), 22–26. DOI: 10.1111/1753-6405.12749.
- Haskell-Ramsay, C.F., Jackson, P.A., Forster, J.S., Dodd, F.L., Bowerbank, S.L., Kennedy, D.O. (2018). The Acute Effects of Caffeinated Black Coffee on Cognition and Mood in Healthy Young and Older Adults. *Nutrients*, 10 (10). DOI: 10.3390/nu10101386.
- Herculano-Houzel, S. (2011). Scaling of brain metabolism with a fixed energy budget per neuron: implications for neuronal activity, plasticity and evolution. *PLoS One*, 6 (3), e17514–e17514. DOI: 10.1371/journal.pone.0017514.
- Himmelstein, D., Liu, Y., Shapiro, J. L. (2017). An exploration of mental skills among competitive league of legend players. *International Journal of Gaming and Computer-Mediated Simulations (IJGCMS)*, 9 (2), 1–21.
- Hoyland, A., Lawton, C.L., Dye, L. (2008). Acute effects of macronutrient manipulations on cognitive test performance in healthy young adults: a systematic research review. *Neurosci Biobehav Rev*, 32 (1), 72–85. DOI: 10.1016/j.neubiorev.2007.05.006.
- Huang, J., Yan, E., Cheung, G., Nagappan, N., Zimmermann, T. (2017). Master Maker: Understanding Gaming Skill Through Practice and Habit From Gameplay Behavior. *Topics in Cognitive Science*, 9 (2), 437–466. DOI: 10.1111/tops.12251.
- Isaac, V., Sim, S., Zheng, H., Zagorodnov, V., Tai, E.S., Chee, M. (2011). Adverse Associations between Visceral Adiposity, Brain Structure, and Cognitive Performance in Healthy Elderly. *Frontiers in aging neuroscience*, 3, 12–12. DOI: 10.3389/fnagi.2011.00012.
- Jakobsen, L.H., Kondrup, J., Zellner, M., Tetens, I., Roth, E. (2011). Effect of a high protein meat diet on muscle and cognitive functions: a randomised controlled dietary intervention trial in healthy men. *Clin Nutr*, 30 (3), 303–311. DOI: 10.1016/j.clnu.2010.12.010.
- Jones, E.K., Sunram-Lea, S.I., Wesnes, K.A. (2012). Acute ingestion of different macronutrients differentially enhances aspects of memory and attention in healthy young adults. *Biol Psychol*, 89 (2), 477–486. DOI: 10.1016/j.biopsycho.2011.12.017.
- Jones, N.P., Siegle, G.J., Muelly, E.R., Haggerty, A., Ghinassi, F. (2010). Poor performance on cognitive tasks in depression: Doing too much or not enough? *Cognitive, affective & behavioral neuroscience*, 10 (1), 129–140. DOI: 10.3758/CABN.10.1.129.
- Kaur, N., Chugh, V., Gupta, A.K. (2014). Essential fatty acids as functional components of foods- a review. *Journal of food science and technology*, 51 (10), 2289–2303. DOI: 10.1007/s13197-012-0677-0.
- Kemps, E., Tigge mann, M. (2005). Working memory performance and preoccupying thoughts in female dieters: evidence for a selective central executive impairment. *Br J Clin Psychol*, 44 (Pt 3), 357–366. DOI: 10.1348/014466505x35272.
- Kemps, E., Tigge mann, M., Marshall, K. (2005). Relationship between dieting to lose weight and the functioning of the central executive. *Appetite*, 45 (3), 287–294. DOI: 10.1016/j.appet.2005.07.002.
- Kempton, M.J., Ettinger, U., Foster, R., Williams, S.C., Calvert, G.A., Hampshire, A., Zelaya, F.O., O'Gorman, R.L., McMorris, T., Owen AMSmith, M.S. (2011). Dehydration affects brain structure and function in healthy adolescents. *Hum Brain Mapp*, 32 (1), 71–79. DOI: 10.1002/hbm.20999.

- Kennedy, D.O., Stevenson, E.J., Jackson, P.A., Dunn, S., Wishart, K., Bieri, G., Barella, L., Carne, A., Dodd, F.L., Robertson, B.C., Forster, J., Haskell-Ramsay, C.F. (2016). Multivitamins and minerals modulate whole-body energy metabolism and cerebral blood-flow during cognitive task performance: a double-blind, randomised, placebo-controlled trial. *Nutrition & metabolism*, 13, 11–11. DOI: 10.1186/s12986-016-0071-4.
- Kenney, E.L., Long, M.W., Craddock, A.L., Gortmaker, S.L. (2015). Prevalence of Inadequate Hydration Among US Children and Disparities by Gender and Race/Ethnicity: National Health and Nutrition Examination Survey, 2009–2012. *Am J Public Health*, 105 (8), e113–118. DOI: 10.2105/ajph.2015.302572.
- Kerksick, C.M., Wilborn, C.D., Roberts, M. D., Smith-Ryan, A., Kleiner, S. M., Jager, R., ..., Kreider, R.B. (2018). ISSN exercise & sports nutrition review update: research & recommendations. *J Int Soc Sports Nutr*, 15 (1), 38. DOI: 10.1186/s12970-018-0242-y.
- Kim, J.Y., Kang, S.W. (2017). Relationships between Dietary Intake and Cognitive Function in Healthy Korean Children and Adolescents. *Journal of lifestyle medicine*, 7 (1), 10–17. DOI: 10.15280/jlm.2017.7.1.10.
- Kokkinakis, A.V., Cowling, P.I., Drachen, A., Wade, A.R. (2017). Exploring the relationship between video game expertise and fluid intelligence. *PLoS One*, 12 (11), e0186621. DOI: 10.1371/journal.pone.0186621.
- Kretchmer, N., Beard, J.L., Carlson, S. (1996). The role of nutrition in the development of normal cognition. *Am J Clin Nutr*, 63 (6), 997s–1001s. DOI: 10.1093/ajcn/63.6.997.
- Kretsch, M.J., Green, M.W., Fong, A.K., Elliman, N.A., Johnson, H.L. (1997). Cognitive effects of a long-term weight reducing diet. *Int J Obes Relat Metab Disord*, 21 (1), 14–21. DOI: 10.1038/sj.jco.0800353.
- Landers, D.M., Arent, S.M., Lutz, R.S. (2001). Affect and Cognitive Performance in High School Wrestlers Undergoing Rapid Weight Loss. *J Sport Exerc Psychol*, 23 (4), 307–316. DOI: 10.1123/jsep.23.4.307.
- Lange, F., Seer, C., Rapior, M., Rose, J., Eggert, F. (2014). Turn it all you want: Still no effect of sugar consumption on ego depletion. *Journal of European Psychology Students*, 5 (3).
- Leigh Gibson, E., Green, M.W. (2002). Nutritional influences on cognitive function: mechanisms of susceptibility. *Nutr Res Rev*, 15 (1), 169–206. DOI: 10.1079/nrr200131.
- Liang, J., Matheson, B.E., Kaye, W.H., Boutelle, K.N. (2014). Neurocognitive correlates of obesity and obesity-related behaviors in children and adolescents. *Int J Obes (Lond)*, 38 (4), 494–506. DOI: 10.1038/ijo.2013.142.
- Lieberman, H. (1999). The Role of Protein and Amino Acids in Sustaining and Enhancing Performance. *Institute of Medicine: Washington, DC, USA*.
- Lim, W.S., Gammack, J.K., Van Niekerk, J., Dangour, A.D. (2006). Omega 3 fatty acid for the prevention of dementia. *Cochrane Database Syst Rev* (1), Cd005379. DOI: 10.1002/14651858.CD005379.pub2.
- Lloyd, H.M., Green, M.W., Rogers, P.J. (1994). Mood and cognitive performance effects of isocaloric lunches differing in fat and carbohydrate content. *Physiol Behav*, 56 (1), 51–57. DOI: 10.1016/0031-9384(94)90260-7.
- Lozoff, B., Beard, J., Connor, J., Barbara, F., Georgieff, M., Schallert, T. (2006). Long-lasting neural and behavioral effects of iron deficiency in infancy. *Nutrition reviews*, 64 (5 Pt 2), S34–S91. DOI: 10.1301/nr.2006.may.s34-s43.
- Lupton, J.R., Brooks, J., Butte, N., Caballero, B., Flatt, J., Fried, S. (2005). Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein, and amino acids. *National Academy Press: Washington, DC, USA*, 265–337. DOI: 10.17226/10490.
- Madsen, P.L., Hasselbalch, S.G., Hagemann, L.P., Olsen, K.S., Bulow, J., Holm, S., Wildschmidt G., Paulson, O.B., Lassen, N.A. (1995). Persistent resetting of the cerebral oxygen/glucose uptake ratio by brain activation: evidence obtained with the Kety-Schmidt technique. *J Cereb Blood Flow Metab*, 15 (3), 485–491. DOI: 10.1038/jcbfm.1995.60.
- Madzharov, A., Ye, N., Morrin, M., Block, L. (2018). The impact of coffee-like scent on expectations and performance. *Journal of Environmental Psychology*, 57, 83–86. DOI: 10.1016/j.jenvp.2018.04.001.
- Majumdar, S., Chaudhuri, A., Ghar, M., Rahaman, W., Hai, A. (2017). Effect of obesity on nerve conduction study in an urban population of a developing country. *Saudi Journal of Sports Medicine*, 17 (3), 162–167. DOI: 10.4103/sjsm.sjsm_8_17.
- Malik, V.S., Pan, A., Willett, W.C., Hu, F.B. (2013). Sugar-sweetened beverages and weight gain in children and adults: a systematic review and meta-analysis. *The American journal of clinical nutrition*, 98 (4), 1084–1102. DOI: 10.3945/ajcn.113.058362.
- Martin, C.K., Anton, S.D., Han, H., York-Crowe, E., Redman, L.M., Ravussin, E., Williamson, D.A. (2007). Examination of cognitive function during six months of calorie restriction: results of a randomized controlled trial. *Rejuvenation research*, 10 (2), 179–190. DOI: 10.1089/rej.2006.0502.
- Masento, N.A., Golightly, M., Field, D.T., Butler, L.T., van Reekum, C.M. (2014). Effects of hydration status on cognitive performance and mood. *Br J Nutr*, 111 (10), 1841–1852. DOI: 10.1017/s0007114513004455.

- McLellan, T.M., Caldwell, J.A., Lieberman, H.R. (2016). A review of caffeine's effects on cognitive, physical and occupational performance. *Neurosci Biobehav Rev*, 71, 294–312. DOI: 10.1016/j.neubiorev.2016.09.001.
- Medic, N., Ziauddeen, H., Ersche, K.D., Farooqi, I.S., Bullmore, E.T., Nathan, P.J., Ronan L., Fletcher, P.C. (2016). Increased body mass index is associated with specific regional alterations in brain structure. *Int J Obes (Lond)*, 40 (7), 1177–1182. DOI: 10.1038/ijo.2016.42.
- Messerotti Benvenuti, S., Zanatta, P., Valfre, C., Polesel, E., Palomba, D. (2012). Preliminary evidence for reduced preoperative cerebral blood flow velocity as a risk factor for cognitive decline three months after cardiac surgery: an extension study. *Perfusion*, 27 (6), 486–492. DOI: 10.1177/0267659112453475.
- Messier, C. (2004). Glucose improvement of memory: a review. *Eur J Pharmacol*, 490 (1–3), 33–57. DOI: 10.1016/j.ejphar.2004.02.043.
- Montero, D., Walther, G., Perez-Martin, A., Roche, E., Vinet, A. (2012). Endothelial dysfunction, inflammation, and oxidative stress in obese children and adolescents: markers and effect of lifestyle intervention. *Obes Rev*, 13 (5), 441–455. DOI: 10.1111/j.1467-789X.2011.00956.x.
- Morris, A.A. (2005). Cerebral ketone body metabolism. *J Inherit Metab Dis*, 28 (2), 109–121. DOI: 10.1007/s10545-005-5518-0.
- Morris, M.J., Beilharz, J.E., Maniam, J., Reichelt, A.C., Westbrook, R.F. (2015). Why is obesity such a problem in the 21st century? The intersection of palatable food, cues and reward pathways, stress, and cognition. *Neurosci Biobehav Rev*, 58, 36–45. DOI: 10.1016/j.neubiorev.2014.12.002.
- Mozaffarian, D., Aro, A., Willett, W.C. (2009). Health effects of trans-fatty acids: experimental and observational evidence. *European Journal of Clinical Nutrition*, 63 (2), S5–S21. DOI: 10.1038/sj.ejcn.1602973.
- Murray, B., Rosenbloom, C. (2018). Fundamentals of glycogen metabolism for coaches and athletes. *Nutr Rev*, 76 (4), 243–259. DOI: 10.1093/nutrit/nuy001.
- Olivo, G., Gaudio, S., Schiöth, H.B. (2019). Brain and Cognitive Development in Adolescents with Anorexia Nervosa: A Systematic Review of fMRI Studies. *Nutrients*, 11 (8), 1907. DOI: 10.3390/nu11081907.
- Pendergast, F.J., Livingstone, K.M., Worsley, A., McNaughton, S.A. (2016). Correlates of meal skipping in young adults: a systematic review. *The international journal of behavioral nutrition and physical activity*, 13 (1), 125–125. DOI: 10.1186/s12966-016-0451-1.
- Pereira, A.M., Brito, J., Figueiredo, P., Verhagen, E. (2019). Virtual sports deserve real sports medical attention. *BMJ Open Sport & Exercise Medicine*, 5 (1), e000606–e000606. DOI: 10.1136/bmjsem-2019-000606.
- Phillimore, P., Cox, B.D., Blaxter, M., Buckle, A.J.L. (1988). The Health and Lifestyle Survey, Health Promotion Research Trust, London, 1987. 212 pp. paper £15.00. *Journal of Social Policy*, 17 (4), 562–564. DOI: 10.1017/S0047279400017141.
- Pistell, P.J., Morrison, C.D., Gupta, S., Knight, A.G., Keller, J.N., Ingram, D.K., Bruce-Keller, A.J. (2010). Cognitive impairment following high fat diet consumption is associated with brain inflammation. *J Neuroimmunol*, 219 (1–2), 25–32. DOI: 10.1016/j.jneuroim.2009.11.010.
- Prasad, C., Lieberman, H.R., Kanarek, R.B. (2005). *Nutritional neuroscience*: CRC Press.
- Pross, N., Demazieres, A., Girard, N., Barnouin, R., Santoro, F., Chevillotte, Klein, A., Le Bellego, L. (2013). Influence of progressive fluid restriction on mood and physiological markers of dehydration in women. *Br J Nutr*, 109 (2), 313–321. DOI: 10.1017/s0007114512001080.
- Radd-Vagenas, S., Duffy, S.L., Naismith, S.L., Brew, B.J., Flood, V.M., Fiatarone Singh, M.A. (2018). Effect of the Mediterranean diet on cognition and brain morphology and function: a systematic review of randomized controlled trials. *Am J Clin Nutr*, 107 (3), 389–404. DOI: 10.1093/ajcn/nqx070.
- Rampersaud, G.C., Pereira, M.A., Girard, B.L., Adams, J., Metz, J.D. (2005). Breakfast habits, nutritional status, body weight, and academic performance in children and adolescents. *J Am Diet Assoc*, 105 (5), 743–760; quiz 761–742. DOI: 10.1016/j.jada.2005.02.007.
- Reeves, S., Brown, B., Laurier, E. (2009). Experts at Play: Understanding Skilled Expertise. *Games and Culture*, 4 (3), 205–227. DOI: 10.1177/1555412009339730.
- Reichelt, A.C., Westbrook, R.F., Morris, M.J. (2017). Editorial: Impact of Diet on Learning, Memory and Cognition. *Frontiers in behavioral neuroscience*, 11, 96–96. DOI: 10.3389/fnbeh.2017.00096.
- Reyner, L.A., Wells, S.J., Mortlock, V. Horne, J.A. (2012). 'Post-lunch' sleepiness during prolonged, monotonous driving – effects of meal size. *Physiol Behav*, 105 (4), 1088–1091. DOI: 10.1016/j.physbeh.2011.11.025.
- Riby, L.M. (2004). The Impact of Age and Task Domain on Cognitive Performance: A Meta-Analytic Review of the Glucose Facilitation Effect. *Brain Impairment*, 5 (2), 145–165. DOI: 10.1375/brim.5.2.145.58253.

- Riebl, S.K., Davy, B.M. (2013). The Hydration Equation: Update on Water Balance and Cognitive Performance. *ACSM's health & fitness journal*, 17 (6), 21–28. DOI: 10.1249/FIT.0b013e3182a9570f.
- Robinson, J.G., Ijioma, N., Harris, W. (2010). Omega-3 fatty acids and cognitive function in women. *Womens Health (Lond)*, 6 (1), 119–134. DOI: 10.2217/whe.09.75.
- Rogers, P.J., Kainth, A., Smit, H.J. (2001). A drink of water can improve or impair mental performance depending on small differences in thirst. *Appetite*, 36 (1), 57–58. DOI: 10.1006/appe.2000.0374.
- Rothwell, G., Shaffer, M. (2019). eSports in K-12 and Post-Secondary Schools. *Education Sciences*, 9 (2), 105. Retrieved from <https://www.mdpi.com/2227-7102/9/2/105>.
- Rudolf, K., Bickmann, P., Froböse, I., Tholl, C., Wechsler, K. Grieben, C. (2020). Demographics and Health Behavior of Video Game and eSports Players in Germany: The eSports Study 2019. *International journal of environmental research and public health*, 17 (6), 1870. DOI: 10.3390/ijerph17061870.
- Sastry, P.S. (1985). Lipids of nervous tissue: composition and metabolism. *Prog Lipid Res*, 24 (2), 69–176. DOI: 10.1016/0163-7827(85)90011-6.
- Scholey, A.B., Harper, S., Kennedy, D.O. (2001). Cognitive demand and blood glucose. *Physiol Behav*, 73 (4), 585–592. DOI: 10.1016/S0031-9384(01)00476-0.
- Scholey, A.B., Laing, S., Kennedy, D.O. (2006). Blood glucose changes and memory: effects of manipulating emotionality and mental effort. *Biol Psychol*, 71 (1), 12–19. DOI: 10.1016/j.biopsycho.2005.02.003.
- Schütz, M. (2016). Science shows that eSports professionals are real athletes. Retrieved from: <https://www.dw.com/en/science-shows-that-esports-professionals-are-real-athletes/a-19084993> (22/01/2020).
- Scott, S.P., Murray-Kolb, L.E. (2016). Iron Status Is Associated with Performance on Executive Functioning Tasks in Nonanemic Young Women. *J Nutr*, 146 (1), 30–37. DOI: 10.3945/jn.115.223586.
- Sebastian, S.B., Williamson, D.A., Blouin, D.C. (1996). Memory bias for fatness stimuli in the eating disorders. *Cognitive Therapy and Research*, 20 (3), 275–286.
- Shaw, J., Tiggemann, M. (2004). Dieting and working memory: preoccupying cognitions and the role of the articulatory control process. *Br J Health Psychol*, 9 (Pt 2), 175–185. DOI: 10.1348/135910704773891032.
- Siervo, M., Arnold, R., Wells, J.C.K., Tagliabue, A., Colantuoni, A., Albanese, E., ..., Stephan, B.C.M. (2011). Intentional weight loss in overweight and obese individuals and cognitive function: a systematic review and meta-analysis. *Obesity Reviews*, 12 (11), 968–983. DOI: 10.1111/j.1467-789X.2011.00903.x.
- Sihvola, N., Korpela, R., Henelius, A., Holm, A., Huotilainen, M., Muller, K., ..., Peuhkuri, K. (2013). Breakfast high in whey protein or carbohydrates improves coping with workload in healthy subjects. *Br J Nutr*, 11 (9), 1712–1721. DOI: 10.1017/S0007114513000779
- Smeets, J.S.J., Horstman, A.M.H., Schijns, O.E.M.G., Dings, J.T.A., Hoogland, G., Gijzen, A.P., ..., van Loon, L.J.C. (2018). Brain tissue plasticity: protein synthesis rates of the human brain. *Brain*, 141 (4), 1122–1129. DOI: 10.1093/brain/awy015.
- Smith, A., Maben, A., Brockman, P. (1994). Effects of evening meals and caffeine on cognitive performance, mood and cardiovascular functioning. *Appetite*, 22 (1), 57–65. DOI: 10.1006/appe.1994.1005.
- Smith, A.P., Clark, R., Gallagher, J. (1999). Breakfast cereal and caffeinated coffee: effects on working memory, attention, mood, and cardiovascular function. *Physiol Behav*, 67 (1), 9–17. DOI: 10.1016/S0031-9384(99)00025-6.
- Smith, A.P., Miles, C. (1986). The effects of lunch on cognitive vigilance tasks. *Ergonomics*, 29 (10), 1251–1261. DOI: 10.1080/00140138608967238.
- Smith, M.A., Riby, L.M., Eekelen, J.A., Foster, J.K. (2011). Glucose enhancement of human memory: a comprehensive research review of the glucose memory facilitation effect. *Neurosci Biobehav Rev*, 35 (3), 770–783. DOI: 10.1016/j.neubiorev.2010.09.008.
- Stanek, K.M., Grieve, S.M., Brickman, A.M., Korgaonkar, M.S., Paul, R.H., Cohen, R.A., Gunstad, J.J. (2011). Obesity is associated with reduced white matter integrity in otherwise healthy adults. *Obesity (Silver Spring)*, 19 (3), 500–504. DOI: 10.1038/oby.2010.312.
- Statovci, D., Aguilera, M., MacSharry, J., Melgar, S. (2017). The Impact of Western Diet and Nutrients on the Microbiota and Immune Response at Mucosal Interfaces. *Frontiers in immunology*, 8, 838–838. DOI: 10.3389/fimmu.2017.00838.
- Stender, S., Astrup, A., Dyerberg, J. (2008). Ruminant and industrially produced trans fatty acids: health aspects. *Food Nutr Res*, 52. DOI: 10.3402/fnr.v52i0.1651.
- Stern, Y. (2017). An approach to studying the neural correlates of reserve. *Brain Imaging Behav*, 11 (2), 410–416. DOI: 10.1007/s11682-016-9566-x.
- Stookey, J.D. (2005). High prevalence of plasma hypertonicity among community-dwelling older adults: results from NHANES III. *J Am Diet Assoc*, 105 (8), 1231–1239. DOI: 10.1016/j.jada.2005.05.003.

- Sweat, V., Yates, K.F., Migliaccio, R., Convit, A. (2017). Obese Adolescents Show Reduced Cognitive Processing Speed Compared with Healthy Weight Peers. *Child Obes*, 13 (3), 190–196. DOI: 10.1089/chi.2016.0255.
- Tanaka, H., Taira, K., Arakawa, M., Masuda, A., Yamamoto, Y., Komoda, Y., ..., Shirakawa, S. (2002). An examination of sleep health, lifestyle and mental health in junior high school students. *Psychiatry Clin Neurosci*, 56 (3), 235–236. DOI: 10.1046/j.1440-1819.2002.00997.x.
- Taylor, N., Elam, J. (2018). 'People are robots, too': Expert gaming as autoplay. *Journal of Gaming and Virtual Worlds*, 10 (3), 243–260. DOI: 10.1386/jgvw.10.3.243_1
- Thomas, C.J., Rothschild, J., Earnest, C.P., Blaisdell, A. (2019). The Effects of Energy Drink Consumption on Cognitive and Physical Performance in Elite League of Legends Players. *Sports (Basel)*, 7 (9). DOI: 10.3390/sports7090196.
- Tomey, K.M., Sowers, M.R., Li, X., McConnell, D.S., Crawford, S., Gold, E.B., ..., Randolph, J.F., Jr. (2007). Dietary fat subgroups, zinc, and vegetable components are related to urine F2a-isoprostane concentration, a measure of oxidative stress, in midlife women. *J Nutr*, 137 (11), 2412–2419. DOI: 10.1093/jn/137.11.2412.
- Trumbo, P., Yates, A.A., Schlicker, S., Poos, M. (2001). Dietary reference intakes: vitamin A, vitamin K, arsenic, boron, chromium, copper, iodine, iron, manganese, molybdenum, nickel, silicon, vanadium, and zinc. *Journal of the Academy of Nutrition and Dietetics*, 101 (3), 294.
- van de Rest, O., van der Zwaluw, N.L., de Groot, L.C. (2013). Literature review on the role of dietary protein and amino acids in cognitive functioning and cognitive decline. *Amino Acids*, 45 (5), 1035–1045. DOI: 10.1007/s00726-013-1583-0.
- van Exel, E., de Craen, A.J., Remarque, E.J., Gussekloo, J., Houx, P., Bootsma-van der Wiel, A., ..., Westendorp, R.G. (2003). Interaction of atherosclerosis and inflammation in elderly subjects with poor cognitive function. *Neurology*, 61 (12), 1695–1701. DOI: 10.1212/01.wnl.0000098877.07653.7c.
- Veronese, N., Facchini, S., Stubbs, B., Luchini, C., Solmi, M., Manzato, E., ..., Fontana, L. (2017). Weight loss is associated with improvements in cognitive function among overweight and obese people: A systematic review and meta-analysis. *Neurosci Biobehav Rev*, 72, 87–94. DOI: 10.1016/j.neubiorev.2016.11.017.
- Vreugdenburg, L., Bryan, J., Kemps, E. (2003). The effect of self-initiated weight-loss dieting on working memory: the role of preoccupying cognitions. *Appetite*, 41 (3), 291–300. DOI: 10.1016/s0195-6663(03)00107-7.
- Wasserman, D.H. (2009). Four grams of glucose. *Am J Physiol Endocrinol Metab*, 296 (1), E11–21. DOI: 10.1152/ajpendo.90563.2008.
- Wright, R.S., Gerassimakis, C., Bygrave, D., Waldstein, S.R. (2017). Dietary Factors and Cognitive Function in Poor Urban Settings. *Current nutrition reports*, 6 (1), 32–40. DOI: 10.1007/s13668-017-0186-x.
- Xu, J., Li, Y., Lin, H., Sinha, R., Potenza, M.N. (2013). Body mass index correlates negatively with white matter integrity in the fornix and corpus callosum: a diffusion tensor imaging study. *Hum Brain Mapp*, 34 (5), 1044–1052. DOI: 10.1002/hbm.21491.
- Yau, P.L., Kang, E.H., Javier, D.C., Convit, A. (2014). Preliminary evidence of cognitive and brain abnormalities in uncomplicated adolescent obesity. *Obesity (Silver Spring, Md.)*, 22 (8), 1865–1871. DOI: 10.1002/oby.20801.
- Yeomans, M.R. (2017). Adverse effects of consuming high fat-sugar diets on cognition: implications for understanding obesity. *Proc Nutr Soc*, 76 (4), 455–465. DOI: 10.1017/s0029665117000805.
- Zhang, N., Du, S.M., Zhang, J.F., Ma, G.S. (2019). Effects of Dehydration and Rehydration on Cognitive Performance and Mood among Male College Students in Cangzhou, China: A Self-Controlled Trial. *International journal of environmental research and public health*, 16 (11). DOI: 10.3390/ijerph16111891.
- Zimmermann, M.B. (2009). Iodine deficiency. *Endocr Rev*, 30 (4), 376–408. DOI: 10.1210/er.2009-0011.

Cite this article as: Ribeiro, F.J., Viana, V.M., Borges, N.P., Teixeira, V.H. (2021). The Emergence of eSports Nutrition: A Review. *Central European Journal of Sport Sciences and Medicine*, 1 (33), 81–95. DOI: 10.18276/cej.2021.1-08.

PHYSICAL ACTIVITY OF SENIOR CITIZENS: QUANTITATIVE ANALYSIS OF LITERATURE DERIVED FROM SCOPUS BASE

Dorota Ortenburger,^{A, B, C, D, E} Anatolii Tsos^{D, E}

Jan Długosz University of Częstochowa, Poland

^A Study Design; ^B Data Collection; ^C Statistical Analysis; ^D Manuscript Preparation; ^E Funds Collection

Address for correspondence:

Dorota Ortenburger

Armii Krajowej 13/15; 42-200 Częstochowa, Poland

E-mail: d.ortenburger@gmail.com

Abstract Introduction. The aim of this paper is to evaluate the development of scientific output, while also to define the scope of the subject matter of research in the sphere of the physical activity of senior citizens. The research process concentrates on the following research questions: In what way has the research output developed in the field of research on the physical activity of senior citizens? Who is the principal participant (countries, universities, authors, source titles in terms of accumulating the research subject matter in a particular field? What are the prominent subject areas that attract the greatest attention among the academic environment?

Research material. Scopus data was availed in the process of selecting a research sample as the source of bibliometric data. The research data (N = 415) consisted of publications which included such phrases in their contents as: "Physically Active Elderly, Physically Active Seniors, Physically Active Older Adults" in their titles or key words. The process of analysis and visualization of the findings was supported by the use of MS Excel software.

Results. The research illustrated that the physical activity of the elderly is a field of science that has a long tradition. In 2011, it gained increasingly high levels of interest among the academic environment, which in turn bore fruit in terms of the breakthrough growth in the number of publications in 2014 that are indexed in Scopus data. This scientific output encompasses 20 research areas.

Conclusions. The principal areas of the greatest number of publications relate to the activity of the elderly are to be found in the areas of medical science and health science. The main authors and co-authors in this field of research are as follows: the representatives of the USA, whereas the most productive research institute is The University of British Columbia. The author of the largest number of publications is Rodríguez-Artalejo from Spain. The main sponsors of research activities in the sphere of the physical activity of the elderly are the National Institutes of Health.

Key words physical activity, bibliometric data, research profiling, senior citizens, elderly adults

Introduction

Regular physical activity is the guarantee of the health of an individual, while also the feeling of happiness and social confidence among senior citizens. Literature on the subject and clinical practice indicate that the physical

activity and improvement of an individual's psychophysical functioning encourages multiplying and strengthening positive therapeutic effects elderly people. (Krejci, Bendikova, Jandova, 2020; Ortenburger, Rodziewicz-Gruhn, Wąsik, Marfina, Polina, 2017; Szerla, Wąsik, Ortenburger, Gwara, Trybulec, 2016; Wąsik, Wójcik, 2017). Contemporary research shows that physical activity may prolong a fit and independent life, as well as improve the quality of life of senior citizens (Ammitzbøll et al., 2015; Wen et al., 2011). Furthermore, it helps to reduce the burden of health care by means of facilitating healthy aging (Davis, Fox, 2007).

The aging of the population almost worldwide has brought new requirements in the sphere of the improvement in the health of elderly people by means of adding "quality" to their prolonged lives (Bowling, 2009). The lack of physical activity is an increasing burden on health worldwide (Lee et al., 2012), while the supervision of physical activity is becoming one of the priorities of global public health in the sphere of preparing effective programs to prevent non-infectious diseases (Hallal et al., 2012).

Depending on the physical activity conducted, there is a beneficial change in the body composition, which counteracts the trend that involves the fact that age usually reduces the fat-free body mass, while increasing the amount of fat (Krejci et al., 2020). The body mass and the body mass index (BMI) usually increase together with the aging process. Subsequently, there is a tendency to decrease. It would seem that at an old age this rises to 27.0. A significant impact on the ratio of muscle mass to adipose tissues is created by the lifestyle, particularly food consumption, energy expenditure and training. From an anthropometric viewpoint, both in the case of men and women, there are changes in the shape of the chest. The comprehensive European research of SENECA conducted in the period of 1988–1999 on people aged between 70–75 years of age indicated that the average height of senior citizens was reduced by between 1.5 cm and 2 cm, while the waist measurement increased by between 3 cm and 4 cm (Krejci, Hill, Hosek, Jandova, Kajzar, 2019).

One of the main causes of the negative impact on the level of physical activity is the low level of balance (Krejci, 2018) and the fear of falling (Ní Chróinín, Ní Chróinín, Beveridge, 2015). Likewise, the fear of certain illnesses associated with the aging process (i.e. Type 2 Diabetes) causes unease which is associated with the loss of balance and risk of falls (De Pew, Karpman, Novotny, Benzo, 2013).

With relation to this fact, in terms of planning physical exercises for senior citizens, it is necessary to take account of the ability to maintain balance, the anthropometric parameters and the psycho-social indicators with regard to sex type, age and individuals. In the case of senior citizens, the most important aspect is that of "safety", thus, professional knowledge that is based on scientific elements is an extraordinarily important aspect in the process of planning physical activities for senior citizens.

It would seem to be necessary to conduct further meticulous research that would involve representative random sampling and consistent use of tried and trusted measurement instruments (Sun, Norman, While, 2013). For this purpose, more data is required on the subject matter of physical activity among elderly people who may prolong health and quality of life in old age.

The question arises here in terms of what the access to specialized literature is here and whether there are many sources that may be recommended on this subject matter. Hence, the aim of this paper is to acquire knowledge on the development of scientific output, while also to define the scope of the subject matter of research in the field of physical activity for senior citizens. The scientific process concentrates on the following research questions:

1. In what way has the research output in the field of research physical activity for senior citizens developed?
2. Who is the principal participant (countries, universities, authors, source titles) in terms of accumulating the research subject matter in a particular field?
3. What are the prominent subject areas that attract the greatest attention among the academic environment?

Material and methods

Scopus data was availed in the process of selecting a research sample as the source of bibliometric data. The research data consisted of publications which included such phrases in their contents as: Physically Active Elderly, Physically Active Seniors, Physically Active Older Adults in their titles or key words.

The following algorithm was used: (TITLE-ABS-KEY (Physical Activity Elderly) AND TITLE-ABS-KEY (Physical activity seniors) AND TITLE-ABS-KEY (Physical activity Older Adults). A general search for results depending on the factors of interest to the researcher of the publications was conducted in order to evaluate the trends in the scientific output and acknowledgement among the leading co-workers in the field of research.

The process of analysis and visualization of the findings was supported by the use of MS Excel software.

Results

The research findings in accordance with the assumed algorithm illustrate 415 entries in Scopus data. According to Figure 1, it is evident that the number of articles on the subject of physical activity for senior citizens is rising. In Figure 2, we can see the number with regard to the country of origin of the authors. The greatest level of interest in this subject matter is shown by the authors from the USA (163 articles), followed by Canada (63 articles) and Spain (23 articles). In Table 1, the chosen bibliometric data has been displayed in order to specify the greatest number of publications divided up into the following.

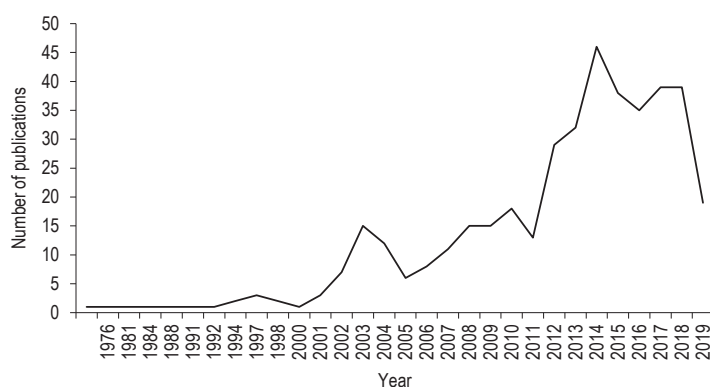


Figure 1. The number of scientific papers with regard to the country of origin of the authors

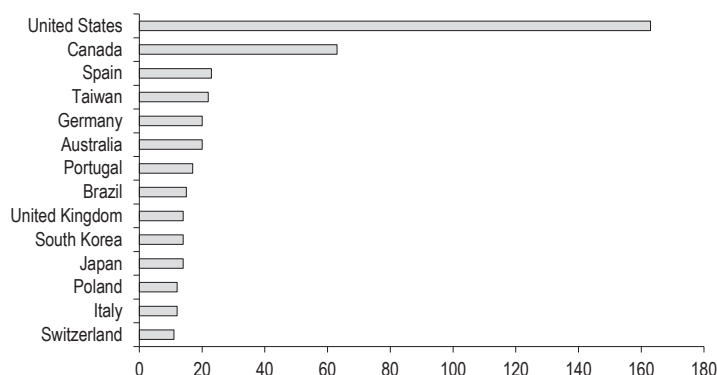


Figure 2. The number of scientific papers relating to the activity of senior citizens in subsequent years

Table 1. Chosen bibliometric data from the analysed sample

Category	Number of publications
Document Type	Article (367), Review (28), Conference Paper (12), Book Chapter (4), Book (2), Conference Review (1), Short Survey (1)
Subject Area	Medicine (325), Nursing (109), Health Professions (58), Biochemistry, Genetics and Molecular Biology (56), Social Sciences (56), Environmental Science (24), Psychology (23), Computer Science (14), Neuroscience (12), Agricultural and Biological Sciences (11), Multidisciplinary (6), Arts and Humanities (5), Engineering (5), Business, Management and Accounting (3), Economics, Econometrics and Finance (2), Mathematics (2), Dentistry (1), Energy (1), Immunology and Microbiology (1), Physics and Astronomy (1)
Documents by funding sponsor (top 13 items)	National Institutes of Health (14), National Institute on Aging (10), Canadian Institutes of Health Research (8), Instituto de Salud Carlos III (5), Japan Society for the Promotion of Science (5), European Commission (4), Fundação para a Ciência e a Tecnologia (4), Horizon 2020 Framework Programme (4), National Research Foundation of Korea (4), European Regional Development Fund (3), Fonds de recherche du Québec – Santé (3), John A. Hartford Foundation (3), Robert Wood Johnson Foundation (3)
Affiliation (top 10 items)	The University of British Columbia (11), University of Toronto (10), Université de Sherbrooke (7), University of Saskatchewan (7), University of Washington, Seattle (7), Universidad Autónoma de Madrid (7), Universidade de Lisboa (7), VA Medical Center (6), Simon Fraser University (6), University of California, San Diego (6)
Author Name (top 8 items)	F. Rodríguez-Artalejo (5), Y. Aoyagi (4), E. García-Esquinas (4), U. Granacher (4), A.C. King (4), J.F. Sallis (4), D.A. Santos (4), R.J. Shephard (4)
Journals (top 20 items)	International Journal of Environmental Research And Public Health (20), Journal of Aging And Physical Activity (15), Journal of The American Geriatrics Society (12), Journal of Nutrition Health And Aging (9), BMC Geriatrics (8), American Journal of Health Promotion (7), Archives of Gerontology And Geriatrics (7), Aging Clinical And Experimental Research (6), Clinical Interventions In Aging (6), Gerontologist (6), Plos One (6), Preventive Medicine (6), Gerontology (5), Journal Of Applied Gerontology (5), Age And Ageing (4), Canadian Journal On Aging (4), Experimental Gerontology (4), International Journal of Behavioral Nutrition And Physical Activity (4), Journal of Geriatric Physical Therapy (4), Medicine And Science In Sports And Exercise (4)

Discussion

On the basis of the analysis conducted, it is evident that the number of scientific papers on the subject matter of the physical activity of senior citizens is increasing (Figure 1). Initially, in the period of 1976–2000 this was not

a very popular subject matter. Only after 2001 did we observe an upward trend. The breakthrough growth in terms of publications was noted between 2011 and 2014, in which there was peak growth.

It is possible to observe that the greatest level of interest in this subject matter is among authors from the USA (31 %), who are unquestionably the leaders. The authors from Canada (12%) publish two and a half times less, while the scientists from Spain (4%) almost eight times less, albeit in spite of this they hold second and third places respectively in this ranking (Figure 2). However, what is interesting is the fact that the author with the greatest number of publications is a citizen of Spain, namely Prof. Rodríguez-Artalejo (Table 1).

Most papers are original works, which constitute 88% of all publications on this subject matter. The principal areas that are the focus of the greatest number of publications are to be found in medical science (subject area: Medicine – 325 items) and health science (subject area: Nursing and Health Professions – 167 items), which constitute a combined total of as much as 68% of all fields of science. The total scientific output encompasses 20 research areas.

The following universities and research institutions are listed as being the prominent lights in this field: The University of British Columbia, University of Toronto, Université de Sherbrooke, University of Saskatchewan, University of Washington, Seattle, Universidad Autónoma de Madrid, Universidade de Lisboa. The main sponsors of such research include the National Institutes of Health, National Institute on Aging, Canadian Institutes of Health Research. The key magazines on the subject matter of the physical activity of senior citizens are the following, according to Scopus data: the International Journal of Environmental Research And Public Health, Journal of Aging And Physical Activity, Journal of The American Geriatrics Society.

A bibliometric literary review ensures added value in the management of information on the subject matter of the scientific output in a particular field of research by means of discovering the most productive countries and research institutions. Such an analysis presents the research system and illustrates the patterns of management of the scientific output. This facilitates the identification of the main authors, while also providing opportunities for scientists to find potential co-workers among the most prolific authors and making a choice of the magazines with the highest level of quality and source titles of their publications.

The limitation of this research is the analysis of only one bibliometric database and its restriction to the English languages. Unfortunately, among the bibliometric databases there is a lack of the uniformity of the possibilities and criteria of the accumulation and indexation of data (Urban, 2019). It would be interesting to repeat the research with bibliometric data taken from other databases, or even more so in terms of the records in other national languages than English. Perhaps in some Asian countries there are works associated with the activity of senior citizens. In almost every country the proportion of older people in the population is increasing. We know that a multitude of people (including senior citizens) in China practice Tai Chi. This is an area where it is well established that being active is essential for improving movement performance elderly (Milert, Klich, Ridan, Morgas, 2017). This is an area of the science physical activity review where more research is urgently needed. From a broader perspective generally, martial arts and sports is an area of the science physical activity review where more research is urgently needed (Buková, Zusková, Szeridová, Küchelová, 2017; Wąsik, Shan 2014; Liu, Kong, Wang, Shan, 2020). The majority of studies reported positive effects resulting from hard martial arts practice, showing some improvement and maintenance of balance, cognitive function and psychological health. Benefits may be obtained regardless of the age of practice commencement (Origua, Marks, Estevan, Barnett, 2017). The results and considerations presented in this work may contain material for comparisons for other researchers and may indicate the path for further

research of an interdisciplinary character. This research provides examples of striving towards the optimization of the psycho-physical functioning which will have a positive impact on the later stages of the life of an individual (including the elderly stage), which in turn may take multiple routes (Góra, Wąsik, 2014; Kmiecik, Bakota, Plomiński, 2020; Pivovarnik, 2016; Wąsik, 2010; Wąsik, Shan, 2015).

In the future, together with the development of “search engines and artificial intelligence” as a translator, it shall be possible to conduct such analysis with the aid of a very sophisticated method of calculation on the basis of all the available data from all the Internet databases (Golomb, Garg, Saha, Azzouz, Williams, 2008).

References

- Ammitzbøll, G., Søgaard, K., Karlsen, R., Frederiksen, K., Tjønneland, A., Johansen, K., Envold Bidstrup, P. (2015). Physical activity and survival in patients with breast cancer. *Physiotherapy*. DOI: 10.1016/j.physio.2015.03.197.
- Bowling, A. (2009). The Psychometric Properties of the Older People's Quality of Life Questionnaire, Compared with the CASP-19 and the WHOQOL-OLD. *Current Gerontology and Geriatrics Research*, 298950. DOI: 10.1155/2009/298950.
- Buková, A., Zusková, K., Szerdiová, L., Küchelová, Z. (2017). Demographic factors and physical activity of female undergraduates. *Physical Activity Review*, 5, 202–211.
- Davis, M.G., Fox, K.R. (2007). Physical activity patterns assessed by accelerometry in older people. *European Journal of Applied Physiology*, 100, 581–589. DOI: 10.1007/s00421-006-0320-8.
- De Pew, Z.S., Karpman, C., Novotny, P.J., Benzo, R.P. (2013). Correlations between gait speed, 6-minute walk distance, physical activity, and self-efficacy in patients with severe chronic lung disease. *Respiratory Care*, 58 (12), 2113–2119. DOI: 10.4187/respcare.02471.
- Golomb, M.R., Garg, B.P., Saha, C., Azzouz, F., Williams, L.S. (2008). Cerebral palsy after perinatal arterial ischemic stroke. *Journal of Child Neurology*, 23 (3), 279–286. DOI: 10.1177/0883073807309246.
- Góra, T., Wąsik J. (2014). 3rd World Congress of Martial Arts and Sports. *Physical Activity Review*, 2, 77–78.
- Hallal, P.C., Andersen, L.B., Bull, F.C., Guthold, R., Haskell, W., Ekelund, U., ..., Wells, J.C. (2012). Global physical activity levels: Surveillance progress, pitfalls, and prospects. *The Lancet*. DOI: 10.1016/S0140-6736(12)60646-1.
- Kmiecik, A., Bakota, D., Plomiński, A. (2020). The level of mood regulation in practicing hatha yoga in the background of people who do not practice this physical activity. *Physical Activity Review*, 8 (1), 95–103. DOI: 10.16926/par.2020.08.11.
- Krejci, M., Hill, M., Bendikova, E., Jandova D., Kajzar, J. (2020). Interplay among physical balance ability, physical activities realization, anthropometric parameters and psychosocial indices in relation to gender and age of seniors 65+. *Physical Activity Review*, 8 (1), 121–132. DOI: 10.16926/par.2020.08.14.
- Krejci, M., Hill, M., Hosek, V., Jandova, D., Kajzar, J. B.P. (2019). Bio-Psycho-Social Consequences and Effects in Fall-Efficacy Scale in Seniors Using Exercise Intervention of Motor Learning According to Yoga Techniques. *International Journal of Sport and Health Sciences*, 13 (10), 435–440.
- Krejci, M.H.V. (2018). Identification characteristics of the intervention method “Life in Balance” focused on seniors 65+. *Acta Salus Vitae*, 6 (2), 45–54.
- Lee, I.M., Shiroma, E.J., Lobelo, F., Puska, P., Blair, S. N., Katzmarzyk, P. T., ..., Wells, J.C. (2012). Effect of physical inactivity on major non-communicable diseases worldwide: An analysis of burden of disease and life expectancy. *The Lancet*, 380, 219–229. DOI: 10.1016/S0140-6736(12)61031-9.
- Liu, Y., Kong, J., Wang, X., Shan, G. (2020) Biomechanical analysis of Yang's spear turning-stab technique in Chinese martial arts. *Physical Activity Review*, 8 (2), 16–22. DOI: 10.16926/par.2020.08.17.
- Milert, A., Klich, W., Ridan, T., Morgas, J. (2017). The influence of 1-year Tai Chi practice on health behavior in adults. *Physical Activity Review*, 5, 29–36. DOI: 10.16926/par.2017.05.05.
- Ní Chróinín, D., Ní Chróinín, C., Beveridge, A. (2015). Factors influencing deprescribing habits among geriatricians. *Age and Ageing*, 44 (4), 704–708. DOI: 10.1093/ageing/afv028.
- Origua, S., Marks, I., Estevan I., Barnett L.M. (2017) Health benefits of hard martial arts in adults: a systematic review. *Journal of Sports Sciences* 36 (1), 1–9. DOI: 10.1080/02640414.2017.1406297.

- Ortenburger, D., Rodziewicz-Gruhn, J., Wąsik, J., Marfina, O., Polina, N. (2017). Selected problems of the relation between pain-immunity and depression. *Physical Activity Review*, 5, 74–77.
- Pivovarnik, J. (2016). Dual concentration in karate and its use in diagnosis of sport. *Physical Activity Review*, 4, 81–88.
- Sun, F., Norman, I.J., While, A.E. (2013). Physical activity in older people: A systematic review. *BMC Public Health*, 13, 449. DOI: 10.1186/1471-2458-13-449.
- Szerla, M.K., Wąsik, J., Ortenburger, D.E., Gwara, M., Trybulec, B. (2016). Optimization of quality of functional improvement – aspects of psychomedical treatment. *Medical Studies*, 2 (2), 150–156. DOI: 10.5114/ms.2016.61105.
- Urban, R. (2019). Degree of interest in horse-back riding therapy interventions for patients with neurocognitive disorders: a quantitative analysis of literature in online scientific databases. *Physical Activity Review*, 7, 240–248. DOI: 10.16926/par.2019.07.28.
- Wąsik, J., Wójcik, A. (2017). Health in the context of martial arts practice. *Physical Activity Review*, 5, 91–94.
- Wąsik, J., Shan, G. (2014). Factors influencing the effectiveness of axe kick in taekwon-do. *Archives of Budo*, 10 (1), 29–36.
- Wąsik, J. (2010). The structure of the roundhouse kick on the example of a European Champion of taekwon-do. *Archives of Budo*, 6 (4), 211–216.
- Wąsik, J., Shan, G. (2015). Kinematics of the turning kick – Measurements obtained in testing well-trained taekwon-do athletes. *Archives of Budo*, 11, 61–67.
- Wen, C.P., Wai, J.P.M., Tsai, M.K., Yang, Y.C., Cheng, T.Y. D., Lee, M.C., ..., Wu, X. (2011). Minimum amount of physical activity for reduced mortality and extended life expectancy: A prospective cohort study. *The Lancet*, 378, 1244–1253. DOI: 10.1016/S0140-6736(11)60749-6.

Cite this article as: Ortenburger, D., Tsos, A. (2021). Physical Activity of Senior Citizens: Quantitative Analysis of Literature Derived from Scopus Base. *Central European Journal of Sport Sciences and Medicine*, 1 (33), 97–103. DOI: 10.18276/cej.2021.1-09.

SPORTS IN THE PROVINCE OF VOLHYNIA AS PRESENTED IN THE “ZIEMIA WOŁYŃSKA” MAGAZINE (1928–1932)

Teresa Drozdek-Małołepsza

Uniwersytet Humanistyczno-Przyrodniczy im. Jana Długosza w Częstochowie, Poland

Address for correspondence:

Teresa Drozdek-Małołepsza

Uniwersytet Humanistyczno-Przyrodniczy im. Jana Długosza w Częstochowie

Jerzego Waszyngtona 4/8, 42-200 Częstochowa, Poland

E-mail: t.drozdek-malolepsza@ujd.edu.pl

Abstract The purpose of this paper is to present sports in the province of Volhynia as presented in the “Ziemia Wołyńska” [The Land of Volhynia] magazine. The magazine, published in the years 1928–1932 dealt with the economic, social, cultural and educational issues of the province of Volhynia. The magazine also published articles, materials and reports on sports in Volhynia. The published articles dealt with conditions of sports activities. In this regard, the training of sports instructors was organized, as well as the condition of the sports infrastructure was improved. An important factor in the development of sports was the establishment of regional sports associations at the turn of the 1920s and 1930s. There were the following sports disciplines practised in sports societies and clubs: motorsports, boxing, horse riding, cycling, athletics, motorcycling, football, shooting, water sports, winter sports. The Volhynian sportsmen did not achieve any spectacular sports successes in the national arena in the discussed period.

Key words sports, the province of Volhynia, “Ziemia Wołyńska” magazine

Introduction

The purpose of this paper is to present sports in the province of Volhynia as described by the “Ziemia Wołyńska” [The Land of Volhynia] magazine. The magazine was published in the years 1928–1932. The seat of the editorial office of the magazine was in Lutsk. There was also a branch of the editorial office in Rivne. The magazine was published as a weekly, “devoted to the affairs of Volhynia”. The Province of Volhynia was located in the central-eastern part of the Second Republic of Poland. From the north, it bordered with the Province of Polesie, on the west with the Province of Lublin, in the south-west with the Province of Lviv, and on the south with the Province of Tarnopol. The eastern border of the province was the state border between the Republic of Poland and the Soviet Union. The province was inhabited by many nationalities, incl. Polish, Ukrainian, Jewish, German, Czech, Russian. City dwellers constituted only 13% of the population of the province.

As for the state of research, there are not any publications devoted to sports activities in the province of Volhynia as presented in the "Ziemia Wołyńska" magazine. As for the historiography of sports in the province of Volhynia in the years 1921–1939, the most important cognitive publications are those of Eligiusz Małołepszy and Teresa Drozdek-Małołepsza (Małołepszy, Drozdek-Małołepsza 2019, 2020). The basic research method used in the preparation of this paper was the analysis of historical sources. The methods of synthesis, induction, deduction and the comparative method were also used. The following research problems are also discussed:

1. Was there an increase in the level of individual sports in the province of Volhynia at the turn of the 1920s and 1930s?
2. What conditions influenced the activities of the Volhynia community in the field of sports?

Conditions for the development of sports in the province of Volhynia

The establishment of the Regional Physical Education Centre – WF [PE] in Lutsk at the end of the first half of 1931 played an enormous role in the development of the physical activity, including sports activities (Ziemia Wołyńska, 1932, 15, p. 3). The head of the Centre was Lt. Waclaw Dziewulak. Significant achievements should be noted already in the first 10 months of the existence of the Regional Physical Education Centre. 153 leaders (instructors) were trained on two-week courses in the following sports: boxing, sports games, athletics, swimming; 363 people attended the "external" (evening) courses. 73 members of the Army Sports Club (WKS) of the 24 Infantry Regiment [I.R.], completed a course in freestyle swimming (crawl); 12 members of the WKS and 79 non-commissioned officers [NCOs] of the 24 I.E. as well as 32 members of the Jewish Sports Club (ŻKS) "Hasmonea" Lutsk completed courses in athletics; 2-week boxing courses were attended by 22 high school students, 15 members of the Lutsk Rifle Club (ŁKS) "Strzelec", 14 members of WKS 24 I.R. club, 20 members of the "Hasmoena" and 22 non-local people "from all cities of Volhynia". 14 women from the Army Family, 18 officers from 24 I.R., 17 NCOs, 21 officers and NCOs from the 13 pap. [Field Artillery Regiment] as well as 27 unaffiliated participants (including 10 women) completed the sets of gymnastic exercises (gymnastic sets) as preparation for winning the National Sports Badge (POS). 133 people completed the ski courses organized in the winter (1931/1932). The Regional Physical Education Centre developed sport (by organizing courses in various areas of physical activity) in towns outside of Lutsk, namely in Dubno, Horokhiv, Kyslyn, Rokitno, Rozhyshche, Sarny and Zaturce. A total of 417 people completed these courses. The Centre organised attempts to get a POS, attended by 277 participants.

On June 14, 1931, a weekly gymnastics course, organized by the Regional Board of Education of the Volhynian District for primary school teachers from the counties of Kovel, Liuboml and Vladimir (Ziemia Wołyńska, 1931, 25, p. 7), ended in Kovel. The gymnastics course was run by the school inspector Tyszek from Rivne. Ski courses were organized in Rivne, e.g. in the winter season of 1931/1932, with the help of the Polish Ski Association (PZN). The courses were conducted for the needs of the newly created ski section of the Riflemen's Association (ZS) of Rivne, as well as for school students (Ziemia Wołyńska, 1932, 10, p. 5).

Physical activities, such as drills, sports games – volleyball, shooting training, gymnastics were included in the program of firefighting courses for chiefs of volunteer firefighters. From May 24 to June 3, 1930, a 10-day firefighting course was held in Kovel for a group of 40 chiefs of volunteer fire brigades from the districts of Kovel, Lutsk and Vladimir (Ziemia Wołyńska, 1930, 26, p. 3). The manager and main organizer of the course was a fire instructor for the district of Lutsk – Bolesław Gronowski.

An important role in the development of physical activity was played by district and sub-district sports associations operating in the province of Volhynia. At the turn of April and May 1930, the General Meeting of the Volhynian Football Sub-District (WPPN) was held, chaired by Major Jacheć – a representative of the Polish Football Association (Ziemia Wołyńska, 1930, 19, p. 8). During the WPPN meeting, a new Board was elected. Gurwicz became the president of WPPN. The start of the A-league matches in 1930 was set for May 18; and the B-league matches on May 28 (Ziemia Wołyńska, 1930, 19, p. 8; 1930, 21, p. 7).

The Lublin Regional Athletics Association (Lublin OZLA) was active in the structures of the Polish Athletics Association. Within its structures, on March 31, 1928, the Rivno Sub-District of the Lublin OZLA was established (Ziemia Wołyńska, 1928, 3, pp. 2–3). The sub-district management board was formed and included: major Andrzejewski (president, District Commander of the 13th Infantry Division), major Rusiecki (1st vice-president), Hofmann (2nd vice-president), Borowicz, Eisler, Koźmiński, Kulawik, Nowosielski (members of the board). On the initiative of the sub-district, competitions were held on the National Day of May 3. Very good results were achieved by the WKS Rivne athlete -Srokowski.

The first General Assembly of the Volhynia OZLA was held in Lutsk on March 29, 1931, with the participation of representatives of physical education organizations and sports clubs (Ziemia Wołyńska, 1931, 15, pp. 6–7). The board of the Volhynia OZLA was elected, including: Marian Szpak – president, Gustaw Menke – first vice-president, Tadeusz Lesiak – second vice-president, Władysław Sulewski – secretary, Hipolit Szalawa-Szałacki – treasurer, Józef Baczkowski, Izrael Dosik, Bronisław Kondratowicz, second-lieutenant Waclaw Sosiński – members of the board.

In the Volhynian press, the establishment of a regional association dedicated to water sports had already been postulated. The following information was published in the pages of "Ziemia Wołyńska", in one of its November editions of 1931: *Establishment of the Volhynia Regional Water Sports Association with such sections as rowing, swimming and sailing, which will be the branches of the affiliated national associations in Volhynia. All Rowing Societies and sports clubs in Volhynia should be summoned to participate in the work to the benefit of the Association* (Ziemia Wołyńska, 1931, 48, p. 6). Establishing the structures of a district association in Volhynia concerning water sports would result in the more intensive development of these areas concerning qualified activities as well as water tourism. It is also worth noting that in the landscape of Volhynia, there was a significant number of natural water reservoirs.

Societies and organizations conducting sports activities

Sports activities were conducted by organizations and associations, including Gymnastic Society TG "Sokół" [Falcon], Polish Scouting Association (ZHP), ZS. On April 25, 1931, the annual General Meeting of the members of TG "Sokół" was held in Łuck (Ziemia Wołyńska, 1931, 18, p. 6). In 1930, the nest had 150 members. During the General Assembly elections of the board of the nest were held. The following members were elected to this body: H. Szalawa-Szawodki – president, Narzyst Wiśniewski – vice-president, Fr chaplain Spisacki, W. Dobrzyński, Kleszno, L. Pruszyński, Rachmankowska, M. Sebastianowiczówna and Szczepanowski – members of the board.

On March 3, 1929, the annual General Meeting of TG "Sokół" members was held in Rivne, attended by 47 girl guides and scouts bridesmaids and friends (Ziemia Wołyńska, 1929, 10, p. 5). During the meeting, Rychter (president), Fiala (chief) and Graff presented a report on the activities of the Board of the Nest for 1928. The issue of purchasing a plot of land for the construction of a Falcon's nest was presented. Members of the branch of the

Union of Volhynia Landowners provided significant material contribution in this endeavour. The budget of the nest for 1929, amounting to 16,950 zlotys, was approved. During the meeting, a new management board in Rivne Nest was elected. The first meeting of the board was held on March 7, 1929, in the room of the branch of the Union of Volhynian Landed Gentry (Ziemia Wołyńska, 1929, 11, p. 6). The function of the chairman of the nest was entrusted to Wacław Wilczkowski, the first vice-president was Henryk Lasocki, the second vice-president was Franciszek Lis, the secretary – Jan Zub, the host – Aleksander Rychter, the chaplain of the nest – Reverend Ludwik Syrewicz, V.F. while the board members were: W. Babicki, Ignacy Hirszel, Korusiewicz, S. Załęski. A year later (May–June 1930) W. Wilczkowski was still the chairman of the nest, the vice-chairman was H. Lasocki, secretary – Zaremba, treasurer – Graf, and the nest administrator – Fiala (Ziemia Wołyńska, 1930, 22, p. 6). In 1931, 16 ZS departments operated in the Sarne district, 6 of which had day-rooms (Ziemia Wołyńska, 1931, 40, p. 7). The Border Protection Corps (KOP) provided significant assistance in the work of the PE and CC ZS in the Sarne district.

The beginnings of scouting and guiding in Volhynia date back to 1914 (Ziemia Wołyńska, 1928, 13, p. 11). Scouts from Volhynia took part in the ZHP rally in Warsaw in 1924. In 1928, the Żeńska Chorągiew Wołyńska [Women's Volhynian Banner] consisted of 20 teams, 595 members and 14 Friends of Scouting and Guiding Circles. The Men's Volhynian Banner consisted of 28 teams, 686 scouts and 10 Friends of Scouting and Guiding Circles. The Volhynian Scouting Rally was held from August 31 to September 3, 1928. The program of the rally included a celebration, elements of "guiding and scouting drills" and sports competitions.

In Rivne, there were Guiding and Scouting [ZHP] units with 200 members in 1930 (Ziemia Wołyńska, 1930, 22, pp. 6–7). Guiding and Scouting organizations existed, among other places, at the Commercial School of the Polish Educational Society and the Russian Junior High School. The activity was carried out by the Friends of Scouting and Guiding Circle which organized trips and camps. In 1929, scouts from Rivne took part in a rally in Poznań, as well as camps in Czarna Wieś in the Pieniny Mountains, and in Hrushvitsa near Rivne (a camp for younger scouts). The budget of the Friends of Scouting and Guiding Circles in 1930 was 7100 zlotys.

On March 22, 1930, a Congress of the Guiding and Scouting Association [ZHP] of the province of Volhynia took place in Lutsk (Ziemia Wołyńska, 1931, 13, p. 5). According to the reports of the ZHP in Volhynia, there were 850 girl guides, 1,020 boy scouts and 65 teams. 50 per cent of the teams were active in elementary schools and arts and crafts schools, whereas the other half operated in secondary education. Scout teams were set up in new centres, such as Horokhiv, Kivertsi, Kostopil and Liuboml. During the Congress, attention was drawn to the difficult situation of the instructors; a low number of scouts among teachers and office workers. In 1930, the Volhynian Banners (men's and women's) organized 1 instructor course and 3 summer camps for troops in Kovel, Rivne and Volhynian Vladimir. In 1931, 10 camps for girl guides and scouts were planned, as well as the organization of scout work among Ukrainian and Russian youth. Stanisława Sanojcówna was the Commander of the Women's Banner, and W. Nekrasz was the Commander of the Men's Banner. In July 1931, there was a group of young girl guides from the Kovel Troop in the camp (in the forest area) between the villages of Zielona and Zadybie (8 km from Kovel) (Ziemia Wołyńska, 1931, 28, p. 8).

The 11th day of May 1929 is an important date in the history of motorization in Volhynia (Ziemia Wołyńska, 1929, 18, pp. 3–4). On this day, on the initiative of the Organizational Committee of the Volyn Automobile Club, the first congress of motor racing sportsmen – motorists took place. During the congress, the delegates were addressed by the deputy governor of Volhynia, Kazimierz Dziewałtowski-Gintowt and M. Grygoriew, Eng., who presented the state and development of motor racing in Volhynia. The participants of the congress adopted

the statute of the Volhynian Automobile Club (Automobilklub Wołyński) and the regulations of the car rally from Lutsk via Dubno to Kremenec and back to Lutsk (Ziemia Wołyńska, 1929, 20, p. 6). At the congress, the club's management board was elected and included: K. Dziwiałowski-Gintowt, Ledóchowski, engineers Księżopolski, M. Grygoriew, A. Zapolski, A. Jackiewicz, Jerzy Bonkiewicz-Sittauer (the Starost of Lutsk), Z. Załęski, S. Korkowicz and W. Zachradnik. The editors of the magazine "Ziemia Wołyńska", reported in issue 23 of June 9, 1929, that the governor of Volhynia legalized the Volhynian Automobile Club based in Lutsk (Ziemia Wołyńska, 1929, 23, p. 7). It is worth mentioning that the beginnings of motor racing in Volhynia, go back to 1928. In that year, the Automobile Circle (Ziemia Wołyńska, 1929, 18, p. 3) was established in Vladimir. The Automobile Circle of Vladimir became a part of the Volhynian Automobile Club. The meeting of the board of the Volhynian Automobile Club was held on October 30, 1930 (Ziemia Wołyńska, 1930, 48, p. 6). During the meeting, the need for an appropriate building for the club and the program of activities for the nearest period were discussed.

Every year, the board of the Lutsk Rowing Association (ŁTW) organized the ceremonial opening of the marina and the opening of the "rowing season". The opening of the ŁTW marina took place quite late, as late as June 1, 1930 (Ziemia Wołyńska, 1930, 21, p. 7; 1930, 23, p. 7). The delay was due to the construction of a dyke on the Styr River (the area close to the ŁTW rowing harbour). The ceremony included, a blessing of the boat funded by the officials of the Bank of Poland; a speech by the vice-president of ŁTW – Szubert; boy scouts' show (setting up and folding tents); a gymnastic show by members of the local "Falcon" nest (Ziemia Wołyńska, 1930, 23, p. 7).

Sports competitions

Boxing was becoming more and more popular in Volhynia. Friendly competitions were very popular. At the beginning of 1932, a boxing section was established in ŁKS "Strzelec" [Rifleman] (Ziemia Wołyńska, 1932, 10, p. 4). Apart from "Strzelec", other clubs in Łuck developed: "Hasmonea", Police Sports Club (PKS), WKS 24 pp. On February 27, 1932, a boxing competition was held in the City Cinema-Theatre. The winners in each weight category were: flyweight – Gurfinkel ("Hasmonea"); in bantamweight scales – Biziuk (WKS 24 pp.); in the semi-light scale – "Dąbrowa"; in lightweight – Żyłajtis (ŁKS "Strzelec"); in welterweight – Szczepański (ŁKS "Strzelec"); in middleweight – Górski (ŁKS "Strzelec"); in light heavyweight – Leśniak (WKS 24 pp.) tied in the fight with Leszczyński I (PKS). The competition enjoyed enormous popularity among the audience of about 800 people. That sporting event played a very important role in promoting the sport of boxing.

A series of equestrian competitions were held in military units stationed in Volhynia. An indoor riding school was opened at the 21st Vistula Lancer Regiment in Rivne. The first official competition at the arena – a show jumping competition – took place on January 31, 1932 (Ziemia Wołyńska, 1932, 9, p. 3) with the participation of 16 riders. The first place in the competition was taken by Lt. Znamierowski (on the mare Prima), ahead of Lt. Szelażek (on the gelding Postument) and Captain Boczkowski (on the mare Ognista). 24 riders participated in the NCO competition, which consisted of 10 obstacles 1 m high and 2 m wide. The winner was the senior sergeant Grządka (on the gelding Pikantny), the second place was taken by the captain Iwkiewicz (on the gelding Klin), and the third – by sergeant Wrona (on the mare Pretty).

On the initiative of the Volhynian Association of Cyclists and Motorcyclists (WTCiM) in Lutsk, on September 23, 1928, the Lutsk championship was organized on a route of 50 km length. (Ziemia Wołyńska, 1928, 18, p. 5). 25 cyclists took part in the race, but only 10 of them reached the finish line. Samuel Gertner won the race, Andrzej

Zwerykin took the 2nd place, and Aleksander Kuzikowski was 3rd. The competition was popular with the local community and about 500 fans watched it.

The organization of the race "Bieg Wołyńia" [Volhynia Cycling Run] (Ziemia Wołyńska, 1929, 35, p. 7) played a significant role in popularizing cycling in Volhynia. On August 25, 1929, a cycling race was held on the route Lutsk-Rivne-Dubno-Lutsk. The route of the race was 169 km. The winner was the cyclist of the Lviv KS "Pogoń" – Franciszek Babiarz. He completed the route in a very good time – 6 hours 42 min. 20 s. By profession, F. Babiarz was a constable of the Civil Police in Lviv. The cyclists from Volhynia took the next places. The second place was taken by Leon Awerbuch, and the third – by Gustaw Warnke (WTCiM). The race was completed by 10 cyclists, out of 27 who joined it. The winner of the race received a gold token and a new bicycle, funded by the editors of Przegląd Wołyński.

One of the most important cycling races in the province of Volhynia was the cycling competition for the championship of the province of Volhynia organised in Łuck on June 24, 1928. The competition was organized, on the Kovel route, over a distance of 100 km (Ziemia Wołyńska, 1928, 5, p. 5). The event, in which 16 cyclists participated, was organized by WTCiM. Samuel Gertner became the champion of the Volhynia Province. He covered a distance of 100 km in 3 hours 56 min. 17 s.

A year later (1929), on June 30, the road race was also held over a distance of 100 km on the Kovel route (Ziemia Wołyńska, 1929, 28, p. 7). The competition attracted 12 cyclists, 7 of whom finished the race. The title of the champion of the Volhynia province was won by Leon Awerbuch (he covered the distance in 3 hours 36 minutes 36 seconds), Gustaw Warnke won the silver medal, and the bronze medal went to Jerzy Księżopolski. It is worth noting that the winner of the competition achieved an almost 20 minutes better result than the provincial champion in 1928. There was also a women's cycling competition on the 10 km route. Maria Szpaczkówna became the champion of the province (she covered the distance in 24 minutes 17 seconds).

The cyclists of the Volhynian Association of Cyclists and Motorcyclists dominated the championships of the Volhynia Province in 1930, conducted over a distance of 100 km on the Kovel-Lutsk route (Ziemia Wołyńska, 1930, 27, p. 6). Eugeniusz Rybak won the competition on June 22 (3 hours 29 minutes 55 seconds), beating Gustaw Warnke and Michał Dżaczuk. In terms of the time score obtained by the Volhynia Province champions of cycling, the former champions were outperformed again.

The first competition organized by Volhynian OZLA on April 26, 1931 in Lutsk was a cross-country race, over a distance of about 3,500 m (Ziemia Wołyńska, 1931, 18, p. 6). The start and finish lines were marked on the WKS 24 I.R. sports field. 42 athletes were registered for the competition. Stanisław Borowiecki (PKS Lutsk) won the competition. The next places were taken by: Żelechowski (ZS Kovel), Sobolewski (ZS Lutsk), Fridrich (WKS 24 I.R. Lutsk), and Jewdokimow (ZS Kovel).

The next athletics competition organised by the Volhynian OZLA was held on May 17, 1931 at the city stadium in Lutsk (Ziemia Wołyńska, 1931, 22, p. 2). 26 athletes, mainly from Lutsk and Rozhyshche participated in the competition. In individual competitions the best ones turned out to be: in the 100 m and 400 m run dash – S. Borowiecki (PKS Lutsk); in the 3,000 m run – Edward Kaczyński (ZS Lutsk); in the long jump and in the high jump – Jerzy Suchodolski (Harcerski KS Lutsk); in shot put, in javelin and in discus – Mikołaj Srokowski (TG "Sokół" Lutsk). The Referee Commission consisted of: Lieutenant W. Dzięwulak, B. Kondratowicz, R. Lewandowski – MSgt., L. Menke, Lt. Sosiński, W. Sulewski, H. Szalawa-Szarański, M. Szpak.

On June 6–7, 1931, the Volhynian OZLA Championships in athletics took place (Ziemia Wołyńska, 1931, 25, pp. 6–7). 87 athletes, mainly from Kovel, Lutsk and Rivne, took part in the competition. On the second day of the competition, heavy rainfall prevented the athletes from achieving good sports results. The champions of the Volhynian OZLA were: in the 100 m race – Tokarzewski (Przysposobienie Wojskowe [Civil Defence] – PW Kovel); on the following distances: 200 m dash, 400 m dash and 1,500 m run – S. Borowiecki (PKS Lutsk); in the 4 × 400 m relay – PW Kovel; in discus and javelin throw – Leon Gorin (PW Kovel); in the long jump the best result was achieved by Jan Kabzinski (PW Kovel); in the shot put – Ilarjon Dublański (TG "Sokół" Lutsk); in the 800 m run – S. Borowiecki; in the 5,000 m run – Pasieczuk (ZS Rivne); in the 4 × 100 m relay – PW Kovel. The team classification was won by the athletes of PW Kovel (51 points), ahead of PKS Lutsk (21 points) and ZS Rivne (6 points). The competition gathered quite a large audience. During the first day of the competition, 300 spectators were present in the stands.

Cross-country running has gained great popularity in the field of athletics. In 1930, on the occasion of the Independence Day, the Volhynian Sub-District Headquarters of the ZS organized in Lutsk competitions in individual and team cross-country runs (distance over 3 km), in which the following teams participated ZS, WKS 24 str., Civil Police (PKS) and WTCiM (Ziemia Wołyńska, 1930, 52, p. 6). The individual run was won by Borowiecki (PKS Lutsk), the second place was taken by Żelichowski (ZS Kovel), and the third – by Sobolewski (ZS Lutsk). The team run was won by ZS Lutsk (Karpowicz, Niewiarowski, Sobolewski), before PKS Lutsk, WKS 24 I.R., ZS Kovel, ZS Lutsk II, WKS 24 I.R. II, ZS Zdobuniv and ZS Dubno. The commander of the Volhynian Sub-district of the ZS, Lieutenant Zarębski, was present at the competition.

On October 12, 1930, the championship of the Volhynian province in the cross-country race took place (Ziemia Wołyńska, 1930, 42, p. 4). 21 runners from the following clubs and associations entered the competition: PKS (Kremenets and Lutsk), WKS 24 I.R. Lutsk, Riflemen's Association (Kovel and Lutsk). The organizer of the cross-country run was PKS Lutsk. The ZS Kovel runner – Władysław Żelichowski became the champion of Volhynia, ahead of Mieczysław Sobolewski (ZS Lutsk) and B. Polikowski (WKS 24 I.R.).

In the years 1928–1930, clubs from the province of Volhynia participated in the soccer games of the Lviv OZPN, as part of the WPPN. The following teams played in the WPPN division A matches in the 1930 season: TG "Sokół" Rivne, WKS Dubno, WKS Kovel, WKS Rivne, ŻKS "Hasmonea Kovel, ŻKS "Hasmonea" Rivne; The reserve teams of the clubs playing in the division A matches were qualified for the division B soccer games (Ziemia Wołyńska, 1930, 19, p. 8). As a result of their victory in the division A games of the WPPN, the players of TG "Sokół" took part in interregional games for promotion to the national league. The Falcons turned out to be a weaker team than the teams of Lechia Lviv and WKS Unia Lublin. As the editorial office of "Ziemia Wołyńska" wrote: *The champion of the Volhynian sub-district, "Sokół" from Rivne, in their matches against Lechia (Lviv) and Unia (Lublin) lost all of the matches, not scoring a single point. (...) The Sokół turned out to be a completely primitive team, with no idea of tactics and minimal technical values* (Ziemia Wołyńska, 1930, 43, p. 8). This opinion probably reflects the level of Volhynian football against the national background at the turn of the 1920s and 1930s.

Football competitions for the championship of the city and county were held in other parts of the Volhynian province. On the initiative of the County Committee of Physical Education and Civil Defence (PKWFiPW) in Kostopol, at the turn of October and November 1930, a football tournament for the championship of the city of Kostopol was held (Ziemia Wołyńska, 1930, 52, p. 6). Three local teams took part in the competition: PTG "Czarni", ŻKS "Trumpeldoria" and "Zaporożec". In the first match, "Trumpeldoria" defeated the team "Zaporożec" (5 : 1). The match between the teams of PTG "Czarni" and ŻKS "Trumpeldoria" was held at the stadium of PE and CD in Kostopol

(Ziemia Wołyńska, 1930, 48, p. 7). The team of "Czarni" won the match (5 : 2). PTG "Czarni" became Kostopol champions. The award of the starost of Kostopol – M. Galusiński – the PKWFiPW Cup was presented to Capt. Nadobnik (president of the PTG "Czarni" Kostopol team). In the following year (1931), the organizers intended to organize games for all football teams of the Kostopol district.

The regional shooting competition organized by the PW organization was held in Rivne in November 1929 (Ziemia Wołyńska, 1929, 46, p. 9). The following counties joined the competition: Kostopol, Rivne, Zdolbuniv and the city of Rivne. The team representing Zdolbuniv was the winner in the team classification, ahead of the teams of Rivne (city), Kostopol and Rivne (district). The best in the individual competition was Hermaszewska before Dąbrowska (both Kostopol), Jadwiga Romanówna, Maria Romanówna (both Zdolbuniv). 10 shooters participated in the women's competition. The manager of the competition was Lieutenant H. Niemiec (45 p.). The competition attracted quite a large number of viewers. Another shooting competition (with military weapons and small arms) with the participation of the PW representations of the following counties: Kostopol, Rivne, Zdolbuniv, was held on October 5, 1930 (Ziemia Wołyńska, 1930, 42, pp. 4–5).

On the initiative of the Commander of the Regional PE Centre in Lutsk, Lt. Waclaw Dziewulak, a swimming competition was held on August 27–28, 1932. (Ziemia Wołyńska, 1932, 36, p. 3). The competition attracted a fairly large number of players (82). They competed in the categories of women and men. In the competition of women, Irena Zapolska – Rozhyshche won the 5 km race; in the 400 m race – Alina Nadolska took the 1st place; Jadwiga Kaczyńska won the 100 m race. The winners of the men's competitions were: in the 5 km race – Stefan Lisowski (KW "Temida"); in the 1,000 m race – Zbigniew Siekierzyński (TG "Sokół"); in the 400 m race – Włodzimierz Porochnik; in the 100 m freestyle race – Tadeusz Jąłowy (WKS Rivne); in the 100 m breaststroke race and the 100 m backstroke race – Ksawery Sulik (WKS Rivne).

On September 1, 1929, the "LTW Autumn Regatta" was held (Ziemia Wołyńska, 1929, 36, p. 9). The program of the event consisted of women's and men's competitions. A. Dowgird was the winner in the race of single scullers over a distance of 400 m. Among men, M. Srokowski took the first place in the 600 m race, and the best in the 1000 m race of coxed pairs were A. Lutostański, W. Kropotkin and Marcinowicz (cox). In 1931, three clubs and societies in Lutsk had a rowing section. In addition to LTW, the rowing section was owned by the "Temida" Rowing Club (KW) (established in 1930) and the WKS Lutsk (Ziemia Wołyńska, 1931, 37, p. 7).

On September 6, 1931, an inter-club rowing regatta was held. The following settlements were victorious in the competition: in the 1000 m race of men's coxed pairs – S. Lipień (cox), M. Srokowski and W. Krapotkin (LTW); in a race of women's coxed pairs a distance of 500 m – M. Piotrowska (cox), E. Żukowska and A. Dowgird (LTW); in canoe races – S. Kędziora (KW "Temida"); in the fishing boat run – M. Kowalczyk. The judges were: A. Donau-Szpindler (president of LTW), Lieutenant Janczewski, Karpiński, Menke, W. Nekrasz, and Alfred Surmański.

The ceremonial beginning of the regatta season of the rowing clubs in Lutsk took place on May 15, 1932 (Ziemia Wołyńska, 1932, 21, p. 3). The ceremony began at the new WKS marina, where the flag was raised. Then the participants went to the KW "Temidy" harbour and the LTW. President A. Donau-Szpindler gave a ceremonial speech at the LTW marina.

On the initiative of the head of the school workshops of the Crafts and Industry School in Wiśniowiec (a commune in the district of Kremenets) – Litwin, a ski competition "For the Ski Badge" was held (Ziemia Wołyńska, 1931, 11, p. 8). As a result of the competition – held on February 15, 1931, the "Ski Badge" was awarded to the following

contestants: Benedykt, Józef Górski, Wiktor Pinrut, Srot. The competition was watched by Cpt. Styczyński – the commander of the PW (in the Kremenets district) and teachers from local schools.

Local ski competitions were held in Lutsk. In February 1932, a 12 km ski run was organized by the local Physical Education Center (*Ziemia Wołyńska*, 1932, 10, p. 4). The skiers of PKS Lutsk stood out in the competition. Sawicki won before Prystupa, who was second. Another cross-country skiing competition was held by PKS, on March 5, 1932, on an 18 km route (*Ziemia Wołyńska*, 1932, 11, p. 5). The start and finish of the run were in Krasne (next to the Civil Police Headquarters). More than 20 skiers took part, 17 of whom finished the competition. The winner was Wojciech Muszyński, a skier of LKS "Strzelec". He covered the route of the run in 1 hour. 49 min. 3 s. The second place went to Sawicki (PKS Lutsk), and the third to Konakov I (PKS Lutsk).

At the beginning of the 1930s, sports clubs from the Volhynia province played mainly friendly matches in ice hockey, in among other places, in Kovel and Rivne. At the turn of February and March 1932, friendly matches were played in Kovel, in which PKS Rivne defeated the local gymnasium team and lost to PKS Kovel (*Ziemia Wołyńska*, 1932, 10, p. 5). The sport of ice hockey developed in Lutsk. The first ice hockey match took place in Lutsk on February 27, 1932, between the local PKS and PKS Rivne (*Ziemia Wołyńska*, 1932, 10, p. 4). The game ended with a victory for the PKS Rivne hockey players (3 : 0).

The first event prepared by the Automobile Club of Volhynia was the car rally to Kremenets on May 12, 1929. The commander of the rally, attended by about 100 participants, was Aleksander Zapolski (*Ziemia Wołyńska*, 1929, 20, p. 6). The column of cars (each at a distance of 200 to 300 m) moved at 50 km per hour. In Kremenets, the participants of the rally visited the Jesuit church and the Kremenets Secondary School. Already in the first period, the activists of the Automobile Club of Volhynia planned to organize several events, mainly sports tourism, including the one-day trip for members and supporters of the club from Lutsk through Dubno, Ostroh to Rivno that took place on July 28, 1929 (*Ziemia Wołyńska*, 1929, 29, p. 8).

In 1930, the activists of the Automobile Club of Volhynia organized the Automobile Rally, consisting of 3 stages – the route of the rally was about 980 km long (*Ziemia Wołyńska*, 1930, 22, pp. 2–3; 1930, 24, pp. 3–4). Hulewicz was the commander of the rally, Lecewicz was the vice-commander, and M. Grygoriew, was the general secretary. There were 9 motorists at the starting line. The winners of the individual competitions of the rally were: the braking test – Kulikowski; the speed test – Romerow (Citroen); The first prize was won by Marynowicz (Tatra) (for driving without penalty points); Kulikowski won the second prize, and the 3rd prize was won by Josipowa (Chevrolet). The rally was completed by 7 motorists.

On the initiative of the Automobile Club of Volhynia, a motorcycle competition was organized in Lutsk on May 22, 1932 (*Ziemia Wołyńska*, 1932, 22, p. 4). The competition was played in 3 categories: 14 km (for 250 cm³ motorcycles); 8 km (for motorcycles with a capacity of 350 cm³); and 22 km (for motorcycles with a capacity over 350 cm³). There were 7 motorcyclists taking part in the competition: J. Radyszyński, Chodkiewicz (both from Lviv); Barzuk, Nowacki (Lutsk); Lieutenant Rzelski, Kwiatkowski, Michałowski (Kovel). The best bikers of the competition were: Chodkiewicz and Barzuk. The route of the competition ran along the streets of Lutsk.

Conclusion

In the years 1928–1932, the editors of the magazine *Ziemia Wołyńska* published materials related to the subject of sport in the province of Volhynia. The information concerned the conditions, as well as activities in particular fields of sport. The training of instructors as well as the improvement of the condition of the sports

infrastructure played an important role in the development of sports. An important element in the development of sports, such as athletics and football, was the establishment of the regional structures of sports associations at the turn of the 1920s and 1930s. Associations and clubs with sports sections operated in the area of the Volhynia province, including the "Sokół" Gymnastic Society, the Polish Scouting and Guiding Association and the Shooting Association. The following disciplines were practised in sports associations and clubs: motoring, boxing, ice hockey, horse riding, cycling, athletics, motorcycling, skiing, football, swimming, shooting, and rowing. In the discussed period, the sportsmen of the Volhynia province did not achieve any sports successes in the national arena.

References

- Małołepszy, E., Drozdek-Małołepsza, T. (2020). *Kultura fizyczna i turystyka w województwie wołyńskim w latach 1921–1939*. [Physical culture and tourism in the province of Volhynia in the years 1921–1939]. Poznań: Wydawnictwo Nauka i Innowacje w Poznaniu.
- Małołepszy, E., Drozdek-Małołepsza, T. (2019). Sports in the county of Kremenets in the light of „Życie Krzemienieckie” magazine (1932–1939), *Sport i Turystyka. Środkowoeuropejskie Czasopismo Naukowe*, 2 (3), 39–58. DOI: 10.16926/sit.2019.02.22.
- Ziemia Wołyńska* (1928), 3, 2–3.
- Ziemia Wołyńska* (1928), 5, 5.
- Ziemia Wołyńska* (1928), 13, 11.
- Ziemia Wołyńska* (1928), 18, 5.
- Ziemia Wołyńska* (1929), 10, 5.
- Ziemia Wołyńska* (1929), 11, 6.
- Ziemia Wołyńska* (1929), 18, 3–4.
- Ziemia Wołyńska* (1929), 20, 6.
- Ziemia Wołyńska* (1929), 23, 7.
- Ziemia Wołyńska* (1929), 28, 7.
- Ziemia Wołyńska* (1929), 29, 8.
- Ziemia Wołyńska* (1929), 35, 7.
- Ziemia Wołyńska* (1929), 36, 9.
- Ziemia Wołyńska* (1929), 46, 9.
- Ziemia Wołyńska* (1930), 19, 8.
- Ziemia Wołyńska* (1930), 21, 7.
- Ziemia Wołyńska* (1930), 22, 2–3, 6–7.
- Ziemia Wołyńska* (1930), 23, 7.
- Ziemia Wołyńska* (1930), 24, 3–4.
- Ziemia Wołyńska* (1930), 26, 3.
- Ziemia Wołyńska* (1930), 27, 6.
- Ziemia Wołyńska* (1930), 42, 4–5.
- Ziemia Wołyńska* (1930), 43, 8.
- Ziemia Wołyńska* (1930), 48, 6–7.
- Ziemia Wołyńska* (1930), 52, 6.
- Ziemia Wołyńska* (1931), 11, 8.
- Ziemia Wołyńska* (1931), 13, 5.
- Ziemia Wołyńska* (1931), 15, 6–7.
- Ziemia Wołyńska* (1931), 18, 6.
- Ziemia Wołyńska* (1931), 22, 2.

- Ziemia Wołyńska* (1931), 25, 6–7.
Ziemia Wołyńska (1931), 28, 8.
Ziemia Wołyńska (1931), 37, 7.
Ziemia Wołyńska (1931), 40, 7.
Ziemia Wołyńska (1931), 48, 6.
Ziemia Wołyńska (1932), 9, 3.
Ziemia Wołyńska (1932), 10, 4–5.
Ziemia Wołyńska (1932), 11, 5.
Ziemia Wołyńska (1932), 15, 3.
Ziemia Wołyńska (1932), 21, 3.
Ziemia Wołyńska (1932), 22, 4.
Ziemia Wołyńska (1932), 36, 3.

Cite this article as: Drozdek-Małołepsza, T. (2021). Sports in the Province of Volhynia as Presented in the "Ziemia Wołyńska" Magazine (1928–1932). *Central European Journal of Sport Sciences and Medicine*, 1 (33), 105–115. DOI: 10.18276/cej.2021.1-10.

ANALYSIS OF TRAINING LOADS AMONG SWIMMERS WITH DISABILITIES DURING SPECIFIC PREPARATION PERIOD

Zuzanna Karpieł,^{B, E} Katarzyna Kozikowska,^{B, D} Dominika Sasin^{A, B, C}

University School of Physical Education in Wrocław, Poland

^A Study Design; ^B Data Collection; ^C Statistical Analysis; ^D Manuscript Preparation; ^E Funds Collection

Address for correspondence:

Katarzyna Kozikowska

Szkoła Doktorska

Akademia Wychowania Fizycznego we Wrocławiu

Aleja Ignacego Jana Paderewskiego 35, 51-612 Wrocław, Poland

E-mail: katarzyna.kozikowska13@gmail.com

Abstract The research goal was to analyse training loads during specific preparation period among swimmers with disabilities. Double examination of 20 athletes with disabilities of motion and sight organs, at the beginning and at the end of the period was conducted. Garmin Forerunner 735XT device was used as a measuring tool, which registered heartbeat rate during training sessions. Records of the heartbeat rate were sent up to Garmin Connect programme, where percentage share of each energy zone in the whole training volume was calculated. Taking into consideration the achieved results, during specific preparation period, swimmers were training mostly with moderate and high intensity and the biggest training volume was registered in zones EN2, EN3 and SP1. Additionally, between the first and the second measurement, the biggest decrease in training volume took place in EN, whereas the biggest increase in training volume took place in zone SP1 what indicates increase of work in the field of specific endurance.

Key words sport of disabled people, swimming, energy zones

Introduction

Swimming is one of the sport disciplines which became more inclusive for people with disabilities in the last decade of XX century. It means that majority of people with disabilities can achieve success in this sport, through division for groups and starting classes which is helpful. Athletes classification is essential to assure fairness of competition. It is a result of disability differences in types and degrees, as well as functional abilities of the athletes.

System of functional classification was introduced in 1992 at the Paralympic Games in Barcelona with the division for groups and starting classes (Molik, Kosmol, 2003; Oh, Burkett, Osborough, Formosa, Payton, 2013). The aim of creating such a system was to equalize chances for all athletes during the sport rivalry, in all swimming competitions. Since that time, it has been continuously modified, however it does not seem to be completely

adequate (Seidel, Bolach, Kachnikiewicz, Walowska, 2012). Based on actually valid laws and regulations of World Para Swimming (WPS) in the starting group “S” in freestyle swimming, there are 10 classes in motion organs disabilities and 3 classes in sight organ disabilities (Tweedy, Vanlandewijck, 2009). Training loads of disabled athletes are usually lower than able body swimmers, they are also dependent on the type and degree of disability. The more severe disability, the lower number of kilometres per training.

During the specific preparation period the biggest emphasis is put on tasks and exercises which improve particular elements of specific athleticism – distance and style, in training load in which the athlete is specializing. The energy supply comes mainly from the anaerobic and mixed, aerobic and anaerobic, energy systems. Technique improvement and optimization are priorities here as well as movement patterns which are the base of swimmers speed abilities development (Bolach, Bolach, Doliński, Seidel, 2004; Bolach, Seidel, Fic, Adamczak, 2013; Seidel, Bolach, Szafraniec, Machuła, Bolach, 2017; Bolach, Seidel, Sobczak, Stępień-Słodkowska, Bolach, 2019; Bomp, 2011).

In training loads we should focus on determining energy zones during given training unit. We can distinguish following zones: REC – refers to warm up (slow swimming); EN1 – base training; EN2 – anaerobic threshold level; EN3 – overload endurance level (VO2max); SP1 – lactate threshold tolerance training; SP2 – threshold similar to the previous zone (the distance is shorter; the breaks are longer); SP3 – creating the high power phosphagen system.

When it comes to the specific preparation training, EN1, EN2, EN3 and SP1 are dominant zones. Each energy zone causes specific adaptation changes in the body of an athlete, so properly planned participation of each zone in the training unit allows to optimize the whole training process.

Research goal

Analysing training loads in specific preparation period among the swimmers with disabilities was the ultimate goal of this research.

Research questions:

1. Is there any difference in training loads between the beginning and the end of the specific training period among the athletes with disabilities?
2. Which energy zones determine the biggest training load of the whole period?
3. What are the differences between the level of each energy zone on the beginning and at the end of specific preparation period?

Material and Methods

20 athletes, 8 women and 12 men with disabilities of motion and sight organs participated in this research. All of them were professional swimmers of Voivodeship Sport Association of Disabled “START” in Wrocław. In order to standardize the research group, criteria of practice experience and performance level were introduced. Age of the examined athletes differed between 14 and 28 years, with the average of 19.4 years. Practice experience differed between 5.5 and 14 years, with the average of 9.3 years. All research subjects were medallist of Polish Championships or international championship competitions. Both swimmers and their coach agreed to conduct the research during their training sessions at the swimming pool of the Academy of Physical Education in Wrocław in April and May 2019. Research was conducted twice, at the beginning and at the end of the specific preparation period.

Research was conducted using heart beat rate monitor Garmin Forerunner 735XT (monitoring system consisted of heart beat rate sensor placed on the wrist and the electrode belt on the chest of athlete). It was a non-invasive research method.

Before the beginning of the research all athletes participated in blood count examination. In order to determine concentration of La in plasma photometr LP – 400 was used. The research has begun from the step test (lactate) and consisted of 8 reps 100 meters freestyle swim intervals.

Speed and intensity of each consecutive interval were determined individually for each swimmer. First three 100 meters intervals were performed at 77% of the best result in actual training period. Next two intervals at 83%. Sixth and seventh interval at 88% and 93%. The last one with the maximum intensity 100%.

During the research, heart beat rate and concentration of lactic acid in blood were measured. Heart beat rate was checked at the beginning, during rest and then after performing each interval. Lactic acid concentration was tested after performing third interval; during the first minute after 5 interval; during third minute after 6 interval; during first and third minute after 7 interval; during third, sixth and ninth minute – among women; during fourth, sixth and ninth minute – among men after performing the last 100 m interval. During the research resting periods were applied in appropriate time spans. After 3 and 5 interval rest lasted three minutes; after 6 interval – five minutes; after 7 interval – twenty minutes; in other cases rest lasted one minute.

Second examination consisted of measuring heart beat rate during 1.5-hour training session. It was conducted at the beginning and at the end of the specific training period. Garmin Forerunner 735XT was used to measure desired data. Garmin Connect (Foster, 2001) software was used to save and process the data.

Statistical analysis method

Based on W. Shapiro-Wilka's test, it was stated that empirical distribution of analysed data, did not differ significantly from the normal distribution. It allowed to use parametric test t-Student for dependent samples during size volume change evaluations of each energy zone. For statistical significance evaluation criterion $p < 0.05$ was introduced. Calculations were performed by using Dell (Fergusson, Takane, 2007) company's programme STATISTICA 13.1

Results

Analysis of training loads at the beginning of examined period

Beginning of specific training period consists above all of swimming at the level of anaerobic transformation, which is marked with the high production of lactic acid. Athletes were training also, during this period, with aim to increase aerobic capacity and adaptation for heavy loads and they were progressing despite swimming only 3–7% above the level of anaerobic transformation. The biggest training load was observed in zones EN1 and EN2 (each 25%), when the base training in aerobic transformation zone made 19%. According to this fact basic aerobic endurance was being built and the biggest training loads were stabile under the 5% level. The smallest percentage of volume was observed in the anaerobic non-lactic acid zone SP3 – 5% (Figure 1).

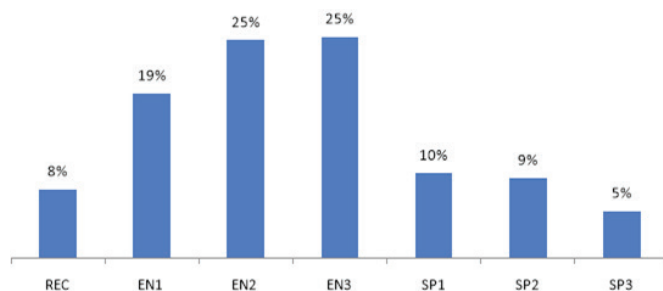


Figure 1. Volume of energy zones at the beginning of specific training period

Analysis of training loads at the end of examined period

The biggest training volume was recorded in zone SP1 – 25%, whereas zones EN2 – 18% and EN3 – 17% represented lower percentage. Trainings in zone SP1 were characterized by high intensity, creating specific endurance and lactic acid tolerance. Participation of aerobic and aerobic-anaerobic transformations was smaller and trainings in these zones were building aerobic capacity (VO₂max). The smallest were training loads in zone SP3 – 7%, which were based on creating phosphagen power and speed (Figure 2).

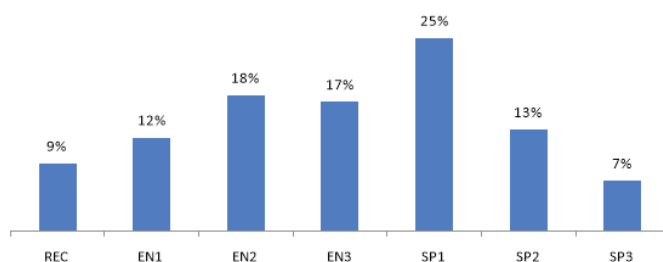


Figure 2. Volume of energy zones at the end of specific training period

Comparison of training loads at the beginning and at the end of the training period

Comparing training loads at the beginning and at the end of the specific training period it can be observed that, at the beginning, athletes were training mostly in aerobic and aerobic-anaerobic transformation zones (EN1, EN2 and EN3) and working with medium intensity. It was aimed to adapt athletes to desired loads. At the end of the period, zones EN2 and EN3 were still representing high percentage of total training amount. The biggest difference in volume occurred in zone SP1 – 15%, and the lowest in zones: REC, SP2, SP3. In both cases athletes have worked for the shortest amount of time in zone SP3 in the area of phosphagen capacity and power (Figure 3).

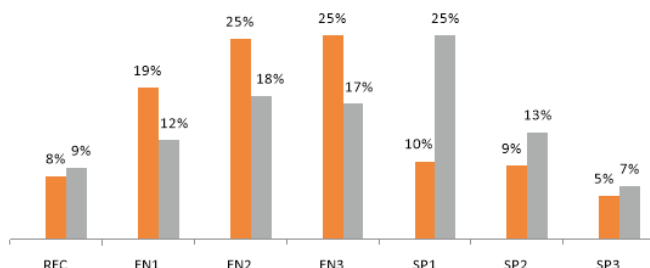


Figure 3. Comparison of volume in each energy zones at the beginning and at the end of the specific training period

Changes of energy zones volume at the beginning and at the end of the period

The biggest, possible to notice, changes occurred in the anaerobic zone SP1 with the sharp increasing tendency. It means that at the end of the period athletes have spent much more time creating specific endurance by training with high intensity. Decreasing tendency was noticed in zones EN1, EN2 and EN3. Similar training volume at the beginning and at the end of competing period was noticed in zones REC, SP2 and SP3 with increasing tendency (Figure 4).

Changes of average volume in zones EN1, EN2, EN3 and SP1, SP2 were statistically significant ($p < 0.05$) (Table 1).

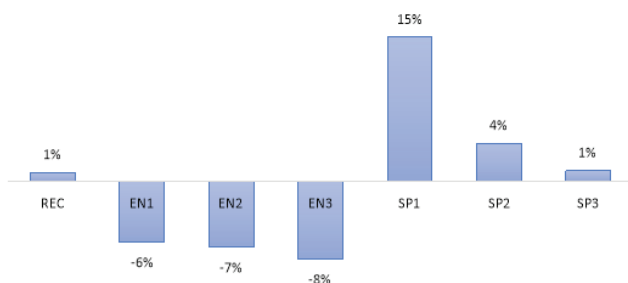


Figure. 4 Changes of energy zones volume at the beginning and at the end of specific training period

Table 1. Volume comparison of each energy zone at the beginning and at the end of specific training period. Statistically significant values p in Student's test were marked with red colour ($p < 0.05$).

Energy zone	Specific training period				Average change (%)	Student's test	
	at the beginning		at the end			T (%)	p
	average (%)	standard deviation	average (%)	standard deviation			
1	2	3	4	5	6	7	8
REC	8	0.008920	9	0.014120	1	-1.26	0.221665
EN1	19	0.017280	12	0.034055	-6	5.03	0.000074
EN2	25	0.040280	18	0.057280	-7	5.16	0.000055

1	2	3	4	5	6	7	8
EN3	25	0.037400	17	0.079775	-8	4.87	0.001070
SP1	10	0.008280	25	0.068000	15	-11.14	0.000000
SP2	9	0.016095	13	0.042055	4	3.27	0.003989
SP3	5	0.011055	7	0.018295	1	-1.41	0.174672

Discussion

Training concept of disabled swimmers is still not researched enough. This process requires more time and coaching practice before being as conceptualized and analysed as able-body swimmers. However, differences in training are not as significant, what enables to be based on able-body athletes systems, alongside learning correct modifications for disabled swimmers. It is only a matter of time when the training knowledge will simplify creating training plans for disabled athletes and guarantee the highest sport achievements. Right choice of training loads is the determining part of a training.

Only a few authors have handled the subject of training loads in annual training cycle of disabled swimmers. If so, they were concerned about heart rate and blood pressure during periods of annual training cycle. That is how Bolach (et al., 2004) were analysing blood pressure (RR) and heart rate (HR) during 5 training sessions of specific training period. Measurement was done during six 90 minutes sessions: before physical effort; after warm-up; during the peak; at the end of main part; after the main part and after 15 minutes of restitution. Research group consisted of 19 swimmers divided into two groups (advanced and intermediate) aged between 19–43 with the average of 25.7 years. Advanced athletes' experience was between 5–28 years with the average of 11.1 years. Whereas in the intermediate group it was between 2–4 years with the average of 2.7 years. Research findings indicated that heart rate in group I was lower than in group II, whereas the blood pressure was similar but in different time spans of training session. For group I at the end of main part and for group II at the peak of main part. Heart beat analysis demonstrated significant statistical differences however in case of blood pressure significant statistical differences were not observed.

Similar research was conducted among swimmers from sport classes S4 and S10 during the specific training period (Bolach et al., 2013). They applied the Cooper Test, where results were registered by Polar RS 800 CX sport tester. Differences only in energy zone EN3 were observed. In other energy zones differences were small and insignificant.

Bolach and others (Seidel et al., 2017) analysed also energy zones in disabled swimmers training during the specific training period in classes S4 and S10. Researched athletes were medallists of Polish Championships with the average age of 18.7 years and average experience of 4.9 years. Individual energy zones were determined based on modified Cooper Test, which was chosen due to the ease of application, regardless of disability level. It relied on swimming the longest possible distance during 12 minutes. Score of this test was registered by sport tester RS 800 CX. Athletes of both starting classes trained the smallest amount of time in energy zones REC and SP1 and the biggest amount of time in EN1, EN2 and EN3. Athletes from class S4, during training session, were training mostly in zone EN2 and at the very last in zone REC. Slightly different scores were among swimmers in class S10, who were training mostly in zone EN3. Variations of average time effort in energy zones REC, EN1, EN2 and SP1 were slight. It was observed only that athletes from class S4 have spent more time in energy zones REC, EN1 and EN2 than swimmers from class S10, whereas in energy zone EN3 and SP1 athletes from class S10 have been for

a longer period of time. Nevertheless, observed differences were slight and statistically insignificant. Slightly bigger differences between classes S4 and S10 were noted in the average time spent in energy zone EN3. In this case training time of athletes from class S10 was 4.25% longer, which is statistically significant.

Size of training volume during the pre-start preparations period was researched by Bolach (et al., 2019). Research was conducted among 11 disabled swimmers during I microcycle (10 training units) and III microcycle (10 training units) of pre-start preparation period. Experiment related to athletes from 4 classes: "S7", "S9", "S10" and "S12" from sport club "Start" Wrocław. Swimmers were aged between 16–25 years with the average of 19.4 years. Their experience was between 5–13 years of training, with the average of 8.2 years. Heart rate values were analysed during 10 training units at six chosen moments of training (0', 10', 45', 80', 90' and 105'). Sport tester Polar RS 800 CX was used. Results showed that in I microcycle intensity was higher than in III microcycle (pre-start preparation period). Additionally, it was stated that volume of training loads had no impact on correlation of age and experience. It was also concluded that the amount of training volumes among disabled swimmers was similar despite the differences in level and kind of dysfunction in both microcycles (pre-start preparation period).

Sport is influencing people with disabilities in a very positive manner, taking into consideration both cultural and social aspect. In professional sport, long lasting and systematic training is required. It may though lead to many additional injuries and overloads of motion organs. For people with disabilities it is very important to properly adapt trainings in order to prevent undesirable outcomes like loss of fitness and aggravation of general health condition. Comparing both able-bodied and disabled athletes it appears that body reserves of disabled ones are smaller. Proper selection of training loads its volume and intensity is crucial (Costill et al., 1991). Implications of those components are internal burdens with the heart rate (HR) as the best indicator to measure it. In swimming athletes are required to have high physical capacity, which is acquired by performing properly prescribed trainings. Properly matched training load is a determining factor of high physical adaptation. Trainer should individually adapt training loads in order to achieve high sport results of swimmer (Bompa, 2011; Collette, Kellmann, Ferrauti, Meyer, Pfeiffer, 2018). Analysing up to date knowledge concerning training loads we can conclude that we have to be aware of athletes physical capacity which is changing alongside consecutive training units and based on that proper training loads should be matched (Costill et al., 1991; Halson, 2014; Szafraniec, Seidel, Kruszyna, Żurowska, 2012). Energy profile and biological predispositions are crucial for every athlete, because thanks to them, right training loads can be prescribed in order to shape his optimal metabolism. Being aware of athlete's individual predispositions, trainer is able to prepare him to appropriate distance. Application of step testing and knowledge of heart rate value, enabled to determine anaerobic threshold and intensity level of each disabled athlete. Distance performed during training lead to creating individual training programme.

Analysis of disabled swimmers training load during specific training period was the research question of this work. As a result, training load of specific energy zones was determined. Analysis was performed at the beginning and at the end of specific training period, where swimming speed and number of performed kilometres enabled to determine differences. According to performed research, the biggest volume was present in zones EN2, EN3 and SP1. Due to this fact we can conclude that athletes performed anaerobic effort as well as aerobic with increased intensity equally when the period was ending. It can be stated based on decrease of zones EN2 and EN3, whereas increasing tendency was observed in zones SP1 and SP2. Finally, it means that volume of swimming in the specific endurance increased at the end of analysed period and volume of aerobic endurance decreased. Alongside decreasing volume, training intensity was increasing. Initially long distances in zones EN1, EN2 and EN3 aimed

at preparing athletes for anaerobic training, which are characterized with much higher intensity (Fulton, Payne, Hopkins, Burkett, 2009).

Analysing training loads among swimmers with disabilities it is extremally important to take into account physical capabilities of an athlete and continuously observe changes by performing control testing. Significant amount of trainers do not take these aspect into consideration which prevent quick and forecasted athlete's development. Change of attitude may lead to facilitating perfection pursuit aimed on achieving desired sport results.

Researches performed in this field enrich specific knowledge and may be used in creating more adequate conditions which are optimizing training process of swimmers with disabilities on different levels of sport advancement.

Conclusions

1. Among athletes, a significant difference in performed training loads of zones EN3 and EN2 occurred with respect to the final assumptions of the specific training period.
2. The biggest training volume of analysed period consists of energy zones EN2, EN3 and SP1.
3. The biggest decrease in training volume, between the beginning and the end of analysed period, occurred in energy zone EN3 and the biggest increase in zone SP1.
4. During the specific training period athletes with disabilities were swimming with moderate and high intensity. It is indicated by values of energy zones which were obtained based on heart rate (HR) of each examined athlete, counted up to date by Garmin Connect programme.

References

- Bolach, E., Bolach, B., Doliński, A., Seidel, W. (2004). Obciążenia fizyczne stosowane u pływaków niepełnosprawnych w podokresie przygotowania specjalnego. In: J. Migasiewicz, E. Bolach (eds.), *Aktywność ruchowa osób niepełnosprawnych: monografia w zakresie rekreacji, turystyki i sportu osób niepełnosprawnych* (pp. 145–154). Wrocław: Studio Wydawniczo-Typograficzne „Typoskript”.
- Bolach, B., Seidel, W., Fic, M., Adamczak, M. (2013). Charakterystyka obciążeń treningowych w podokresie przygotowania specjalnego u niepełnosprawnych pływaków z klas S4 i S10. In: M. Wilski, J. Gabryelski (eds.), *Idee olimpijskie a kierunki rozwoju sportu osób niepełnosprawnych* (159–169). Poznań: Akademia Wychowania Fizycznego w Poznaniu.
- Bolach, B., Seidel, W., Sobczak, K., Stępień-Słodkowska, M., Bolach, E. (2019). Wielkość obciążeń treningowych niepełnosprawnych pływaków w bezpośrednim przygotowaniu sportowym. In: E. Bolach, A. Kawczyński (eds), *Adaptacyjna aktywność fizyczna: monografia* (pp. 185–193). Wrocław: Agencja Usługowo-Handlowa „AGIW”.
- Bompa, T.O. (2011). *Periodyzacja teoria i metodyka treningu*. Warszawa: Centralny Ośrodek Sportu.
- Collette, R., Kellmann, M., Ferrauti, A., Meyer, T., Pfeiffer, M. (2018). Relation Between Training Load and Recovery-Stress State in High-Performance Swimming. *Frontiers in Physiology*, 9, (845).
- Costill, D.L., Thomas, R., Robergs, R.A., Pascoe, D., Lambert, C., Barr, S., Fink, W.J. (1991). Adaptations to swimming training: influence of training volume. *Medicine and Science in Sports and Exercise*, 23, (3), 371–377.
- Fergusson, G.A., Takane, Y. (2007). *Analiza statystyczna w psychologii i pedagogice*. Warszawa: Wydawnictwo Naukowe PWN.
- Foster, C., Florhaug, J.A., Franklin, J., Gottschall, L., Hrovatin, L., Parker, S., Doleshall, P., Dodge, C. (2001). A new approach to monitoring exercise testing. *Journal of Strength and Conditioning Research*, 15, 109–115.
- Fulton, S., Payne, D., Hopkins, G., Burkett, B. (2009). Variability and progression in competitive performance of paralympic swimmers. *Journal of Sports Sciences*, 1, 1–5.
- Halson, S.L. (2014). Monitoring Training Load to Understand Fatigue in Athletes. *Sports Medicine, Australia*, 44 (2), 139–147.
- Molik, B., Kosmol, A. (2003). Klasyfikacja zawodów w sporcie niepełnosprawnych – drogi wyrównania szans. *Postępy Rehabilitacji*, 3, 55–61.

- Oh, Y., Burkett, B., Osborough, C., Formosa, D., Payton, C. (2013). London 2012 Paralympic swimming: passive drag and the classification system. *Sports Medicine*, 47, 838–843.
- Seidel, W., Bolach, B., Kachnikiewicz, J., Walowska, J. (2012). Analiza wyników sportowych uzyskiwanych przez niepełnosprawnych pływaków na Igrzyskach Paraolimpijskich w latach 1992–2008. *Zeszyty Naukowe*, 39, 84–89.
- Seidel, W., Bolach, B., Szafraniec, R., Machuła, Ż., Bolach, E. (2017). Obciążenia treningowe niepełnosprawnych pływaków w bezpośrednim przygotowaniu startowym. In: E. Bolach, A. Kawczyński (eds.), *Adaptacyjna aktywność fizyczna: monografia* (pp. 127–140). Wrocław: Agencja Usługowo-Handlowa „AGIW”.
- Szafraniec, R., Seidel, W., Kruszyna, D., Żurowska, A. (2012). Aerobic and anaerobic endurance of disabled swimmers in special preparation sub-period. *Baltic Journal of Health and Physical Activity*, 4 (4), 231–237.
- Tweedy, S.M., Vanlandewijck, Y.C. (2009). *International Paralympic Committee Position Stand-Background and scientific principles of Classification in Paralympic Sport*. The University of Queensland, School of Human Movement Studies. Brisbane, Australia.

Cite this article as: Karpiel, Z., Kozikowska, K., Sasin, D. (2021). Analysis of Training Loads among Swimmers with Disabilities during Specific Preparation Period. *Central European Journal of Sport Sciences and Medicine*, 1 (33), 117–125. DOI: 10.18276/cej.2021.1-11.

DETERMINANTS OF ASSAULT ON FOOTBALL LEAGUE REFEREES DURING COMPETITIONS IN NIGERIA

Danjuma Moudu Momoh,^{A, B, C, D, E} Toyosi Olaseyo^{A, B, C, D, E}

Department of Human Kinetics and Health Education, Faculty of Education, Adekunle Ajasin University, Akungba-Akoko, Ondo State, Nigeria

^A Study Design; ^B Data Collection; ^C Statistical Analysis; ^D Manuscript Preparation; ^E Funds Collection

Address for correspondence:

Danjuma Moudu Momoh
Department of Human Kinetics and Health Education
Faculty of Education, Adekunle Ajasin University, Akungba-Akoko
Ondo State, Nigeria
E-mail: danjuma.momoh@aaua.edu.ng

Abstract The assault on referees is an act committed by an individual involved in a match such as players, substitutes, coaches, team officials or spectators against a referee that is of a violent or intimidating nature. This study, therefore, investigated the level of assault of referees in Nigeria's Premier Football League. The participants for the study consisted of two hundred and fifty (250) Nigerian Premier League elite referees, footballers, coaches, and spectators. The purposive sampling technique was used for the study to select the respondents. A structured questionnaire with validated and reliability value of 0.75 was used for data collection. The data was analyzed using the inferential statistics of Chi-square (χ^2) to test the research questions and hypotheses at 0.05 alpha levels. The three hypotheses of officiating, organization of the league and win at all cost tested, were all rejected. Consequently, some recommendations were made based on the findings of the study.

Key words assault, competition, football, professionalism, violence

Introduction

Football has become a social phenomenon which brings people together attracting the attention of millions all over the world. Apart from being simply watched as a game, football is currently a vast commercial concern, global competition is intense, and the production and marketing sectors work in close conjunction on the sport (Collina, 2003).

The referee and match officials make up a crucial element in the game of football. Like them or not, it is through the diligence, professionalism and often hard work of these men and women, that football matches across the globe can take place. However, the individuals who are match officials are often the target of unnecessary and unruly taunts and abuse, because of the job that they have offered to do (Rainey, Hardy, 1999). Today, Football is

the most popular sport in the world. It is the least expensive but the richest sport. It is the sport that people travel far-off distance to witness. It is the sport that caused wars between nations and bitter enemies very close friends. It is the sport in which passions can easily rise, fight can erupt, and a whole place can be destabilized (Smith, 2003). People often go to witness this sport with preconceived outcome of the match. When the result of the match is not as expected, the consequences would be extremely unpleasant. Thus, the pressure on referees to produce flawless performance is increasing and with media pundit attempting to create controversy, the spotlight is often cast upon the match referee (Morrison, 2002).

The vast financial dimension of football makes the effective conduct of the matches an important issue that moves way beyond being a simple event influencing only the football players, the managers, and the crowd (Wolfson, Neave, 2007). Developments in these huge markets determine the achievements or failures of the clubs and, at this point the performances of referees, who control the matches, are subject to much critical discussion.

Referees and match officials are special populations, and as such, it takes a special kind of individual to become a referee. Not only do they need to be physically fit and be able to keep up with play (Reilly, Gregson, 2006), they need to be able to cope with threats that are targeted towards them.

The responsibility of the football referee on the ground, in a sport that is sometimes watched by millions, even hundreds of millions, is huge. Additionally, the facts that proportion of people income going on sports increases, and sports share in the economy rises, and the incomes of referees have risen proportionately resisting in the perception that being a referee is an occupation in which people can earn a professional salary (Evans, Rowe, 2002)

Baldwin (2005) said refereeing in a sport like football requires not only knowledge, skills, and perseverance but also the ability to understand and predict people's behavior and courage. It is in this context that a football referee on the field has to behave like a psychologist to avoid being assaulted or battered. The sole job of the referee is to make sure that a game is played fairly and that all the players, coaches and associated personnel adhere to the rules of the game. The toughest job for referee is keeping players and coaches calm after a close call (Weinstein, 2003).

Refereeing is one of the hobbies that require the ability to make many decisions in a short period of time. Quick decisions must be at frequent intervals. Therefore, attention and concentration are vital and must be at a maximum level. The decisions made rapidly and in quick succession, are made under great pressure (Akanji, 2009). Accordingly, the effects of psychological and psychological states of referees, who have a great influence at every point in the game, must be taken into consideration at the present time. Referees should be capable of making the right decisions by keeping under control psychological elements such as anxiety, fear, and stress (Balch, Scott, 2007).

Collina (2003) posited that refereeing in sports competitions requires not only the possession of physical ability and knowledge about the rules of the game, but also the need for a display of physiological efficiency for the conduct of a successful performance during the game. In this sense, people who have a high previous experience of the same atmosphere, who have a high educational status, and who have played football before should be encouraged to conduct matches.

Football is a universal game which has a wide audience, and which is meant to be enjoyed by spectators, teams and match officials. Studies have shown that in Nigeria, violence and irresponsible behavior at match venues are regular occurrences. There are reports of match officials, especially referees, match commissioners even both the secret and open match assessors being manhandled by fans of the teams.

The dangerous challenges posed by violence to the development of football in Nigeria should be the worry of lovers of the game because, football in Nigeria has lost its glorious reputation and fellowship due to violence, thuggery, assault on match officials and unfriendly atmosphere which have taken the center stage at venues of both professional and premiership league matches across the country.

Top-flight football referees in Nigeria are contending with a critical crisis. Two major incidents that concern them have threatened the 2018/2019 Nigeria Professional Football League season, which got underway on January 1, 2019. On the opening weekend, ill-tempered fans went haywire in Jos, Plateau State and attacked match officials. A week later, the gory attacks by fans occurred again in Sagamu, Ogun State. For a sport that is trying to rediscover its halcyon days, these acts of violence are inimical to its growth. Not that violence had been totally absent from club football, but to witness bloody incidents on two consecutive match-days at the beginning of a season portends grave danger ahead. First, fans went berserk shortly after the match between the host team, Plateau United, and Ifeanyi Ubah FC ended goalless at the Rwang Pam Stadium in Jos. Alleging that the referees, led by Sam Agba, disallowed a goal, they stormed the pitch to attack the officials. Agba, who bore the brunt of the violence, oscillated between life and death after the barbaric attacks (Nigeria Punch, 2019)

Another ugly incident took occurred on 19th January 2019 in another NPFL game in Sagamu. This time, it was at the Gateway Stadium where newly promoted Remo Stars drew 1–1 with visiting Insurance of Benin. Claiming that the referee, Bethel Nwanesi, and his assistants, A Nalado and B Salihu, disallowed their team's goal, they descended on them. Viral photos of the attacks in the social media were shocking: the officials' heads and back were covered in blood. This is criminality, not a show of support to a team. These fans should face the law (Nigeria Punch, 2019).

Lack of knowledge about what the rules say leads to absolute misunderstanding and misinterpretation of a referee's decision especially if the signals are against the home team what follows is pandemonium and crowd violence which will lead to assault of referees. Besides the fact that majority of Nigeria league fans are ignorant of the laws of the game, we witness bias officiating on the part of some referees.

This explains why it is very difficult for away teams to secure draws not to talk of a win. In most cases, officials of home teams either by intimidation or pre-match negotiation, illegally force referees to officiate in their favor not minding how their team plays, if a courageous or professionally minded referee refuses to follow the home team's line of action, he will eventually be descended upon especially when visiting teams escape with vital point(s).

Therefore, it can be said that the win at all cost mentality of some home teams is a major cause of referees' assault at some league centers. Most Nigerian football fans prefer to stay at home rather than go to league venues to watch local matches for the fear of insecurity. For instance, in the western world, people go to match venues to enjoy themselves and catch fun, but in Nigeria the reverse is the case, perhaps that is the main reason why the Nigerian league is unattractive and unexciting.

There was serious violence on Monday evening, June 10, at the Agege stadium in Lagos as fans of NPFL club Kano Pillars stormed the pitch at the ongoing Super Six playoff. The fans invaded the pitch in the encounter between Kano Pillars and Enugu Rangers which ended 1–1 as the Flying Antelopes kept their Champions League hopes alive. Kano Pillars' captain Rabi'u Ali scored the first goal for his side via a superb free kick in the 58th minute, but Rangers came back into the game via a penalty ten minutes to final whistle. And before referee Adebimpe blew the final whistle, Kano Pillars had a free kick which was not scored and the match official ended the match afterwards. Rabi'u Ali was then annoyed with how the referee ended the match claiming that the official did not allow them to

play the full minutes. He was engaging in serious vituperation on the pitch against the referee before Kano Pillars fans got livid and decided to storm the pitch. They were seen holding all sort of harmful objects with the intention of harming the center referee, but the securities on ground were of help to the match official (Ibitoye, 2019)

The Nigeria premier league is the highest level of domestic football in Nigeria. The league was founded in 1972 with six teams. On Saturday 12th May 1990 at the Onikan Stadium Lagos, the league was re-christened the professional league with the goal to modernize the game and make clubs self-sufficient. Decrees 10 and 11 were used to codify the introduction of professional clubs which should be run as limited liability companies and each governed by a regularly constituted body.

The body is required to hold annual general meetings, present independently audited accounts, create youth or feeder teams, and own their own stadium within five years of registration with the league department (NFA, 1995). From 1999–2007, there was an end of season championship called the super four. The four teams from the groups would play a round robin mini league at a neutral ground to determine the league champion. After the 2006 competition, the league changed its calendar to more closely match the European regular season structure starting around August and ending around the month of May.

Material and Methods

Study Area

The study area covered five sport councils of southwest states of Nigeria (Lagos, Ogun, Oyo, Ondo, and Osun) The population of the study comprises of male and female referees, coaches, footballers, and spectators in the Nigeria football league in the South West of Nigeria.

Sample and Sampling Techniques

The random sampling technique was used to select 5 states out of the 6 states in the Southwest of Nigeria while purposive sampling technique was used to select 100 referees, 20 coaches, 100 footballers and 30 spectators making two hundred and fifty (250) participants who were the respondents for the study.

Analysis and Discussion

Research Hypotheses

Hypothesis 1

Table 1. Officiating of Football Referees will not be a significant determinant of Assault on Football referees in Nigeria Premier League

Variable	Respondent	X ² Cal	X ² Crit.	Df	Sig. Level	Remark
Officiating	250	666.97	16.919	9	0.05	Rejected

P < 0.05.

The result on Table 1 showed that the calculated value was higher than the X² table value, the null hypothesis was therefore rejected because of the revealing significance of officiating of football referees to assault on referees

in the Nigeria Premier League. The way a game is handled by a referee can make or mar such match and also determine the outcome of the game. The result is in line with Inoyo (2011) who posited that good refereeing speeds up the flow of the game of football and inefficient refereeing spoils the enjoyment of the game for players, tacticians, and spectators. This also agreed with Arun (2004) who explained that a good referee should be consistent with his behavior in situations to remove any doubt about taking sides.

Hypothesis 2

Table 2. Organization of the league will not be a significant determinant of assault on football referees in Nigeria Premier League

Variable	Respondent	X ² Cal	X ² Crit.	Df	Sig. Level	Remark
Officiating	250	114.91	16.919	9	0.05	Rejected

P < 0.05.

Table 2 showed that the X² calculated value was higher than the table value, therefore the null hypothesis was rejected, and organization of the league was found to be a significant determinant of assault on football referees in Nigeria Premier League.

Assault on football referees is equally galvanized through lack of organization on the team's part. This result is in line with Idowu (2009) who posited that most teams are not well organized structurally and they tend to put pressure on match officials. The result also agreed with Olaniyan (2011) that supporters clubs are not properly constituted and well organized with the football body thereby allowing hooligans to take laws into their own hands by assaulting match officials.

Hypothesis 3

Table 3. Win at all cost syndrome will not be a significant determinant of assault on football referees in Nigeria Premier League

Variable	Respondent	X ² Cal	X ² Crit.	Df	Sig. Level	Remark
Officiating	250	400.38	16.919	9	0.05	Rejected

P < 0.05.

Table 3 showed that X² calculated value was higher than the X² table value, therefore the null hypothesis was rejected because win at all cost syndrome was found to be significant in determining assault on football referees in Nigeria Premier League.

The result is in line with Ishola (2009) assertion that win at all cost syndrome is not a new development in the football league, and that home clubs in desperate attempts to win intimidate and harass football referees. The finding is also in line with Akanji (2009) position that clubs have been known to intimidate referees, rival teams and even supporters to win home matches at all cost. Generally, it was observed that the results of findings in this study was that officiating of football referees, knowledge of the laws of the game, security at match venues, organization of the league and win at all cost syndrome are all determinants of assault on football referees in Nigeria Premier League.

Conclusion

The results of the data collected from the respondents showed that all the 3 null hypotheses tested were rejected, which implied that all the 3 variables tested were significant to the determinants of assault on football referees in Nigeria Premier League at 0.05 alpha level.

It was therefore concluded based on the findings of this study that:

1. Officiating of football referees will be a significant determinant of assault on football referees in Nigeria Premier League.
2. Organization of the league will be a significant determinant of assault on football referees in Nigeria Premier League.
3. Win at all cost syndrome will be a significant determinant of assault on football referees in Nigeria Premier League.

Recommendations

Based on the findings of this study and the conclusion drawn thereof the researchers therefore offer the following recommendations in anticipation that if implemented, will help to reduce if not eradicate football referee's assault in Nigeria Premier League.

1. Refresher courses for match officials and team administrators on laws of the game must be conducted regularly to update them on the laws governing football globally.
2. Football referees should be tested and found mentally and physically stable before allowing them to handle Premier League matches.
3. Football referees should be given matches to handle based on their competence and knowledge.
4. Football referees should be encouraged to make refereeing a hobby and not a full-time profession so as to curb any form of inducement from teams or administrators of clubs.
5. Supporters clubs of teams should be properly registered and accredited for proper monitoring and also curb the act of hooligans pretending to be supporters of league clubs thereby causing assault on referees at match venues.
6. The Nigeria Premier league should not encourage home teams to pay referees allowances.
7. The Nigeria Premier League should schedule matches before the start of the season and strictly adhere to the fixtures as planned.

References

- Akanji, J.J. (2009). The League for the highest bidder. *Weekend Soccer Star*, 14.03.09.
- Arun, S. (2004). Game, Set and Client Match. *Media Asia*, May 9, 28–29.
- Balch, M.C., Scott, D. (2007). Contrary to popular belief refs are people too. Personality and perceptions of officials. *Journal of Sport Behaviour*, 30 (1), 3–20.
- Baldwin, C. (2005). *Field Research Notes*. Sydney.
- Collina, P. (2003). *The rules of the game*. London: Macmillan.
- Evans, R., Rowe, M. (2002). For club and country: Taking Football Disorder Abroad. *Journal of Soccer and Society*, 3 (1), 37–53.
- Ibitoye, S. (2019). Violence erupts in Lagos as Kano Pillars fans invade the pitch, attack referee. *Genesis Media online* (10.04.2020).
- Idowu, N. (2009). *Problem of Sport Federations*. Retrieved from: www.playthegame.org.

- Inoyo, J. (2011). Laws of the game. *Nigeria Football Referees Magazine*, June, 16–17.
- Inoyo, J. (2011). The Role of Psychology in Refereeing. *Nigeria Football Referees Magazine*, 24–28.
- Ishola, W. (2009). Corruption bane of sport development in Nigeria. Retrieved from: www.nigeriamuse.com (10.10.2017).
- Morrison, E. (2002) *Football union elite referee development manager*. Paper presented at inaugural elite referee union conference, Huddersfield, UK.
- Nigeria Football Association (1995). *Annual general meeting year guide*. Lagos.
- Nigeria Punch (2019). Attacks on football referees, inimical. *Nigeria Punch* online (accessed on 20.03.2020).
- Olaniyan, O. (2011). Communication in refereeing before, during and after the match. *Nigeria Football Referees Magazine*, 14–15.
- Rainey, D., Hardy, L. (1999). Sources of Stress, burnout and intention to terminate among referees. *Journal of Sports Sciences*, 17, 797–806.
- Reilly, T., Gregson, W. (2005). Special populations: The referee and assistant referee. *Journal of Sports Sciences*, 24 (7), 795–801.
- Smith, R. (2003). Towards a cognitive - affective model of athletic burnout. *Journal of sport psychology*, 8, 36–50.
- Weinstein, M. (2003). Physiological load imposed on elite soccer referees during actual match play. *Journal of Sports Medicine and Physical Fitness*, 41 (1), 27–32.
- Wolfson, S., Neave, N. (2007). Coping under pressure. cognitive strategies for maintaining confidence among soccer referees. *Journal of Sports Behaviour*, 30 (2), 232–247.

Cite this article as: Momoh, D.M., Olaseyo, T. (2021). Determinants of Assault on Football League Referees during Competitions in Nigeria. *Central European Journal of Sport Sciences and Medicine*, 1 (33), 127–133. DOI: 10.18276/cej.2021.1-12.

