GeoSport for Society

Volume 14/ no. 1 / 2021

Oradea-Debrecen-Gdánsk

© GEOSPORT FOR SOCIETY
ISSN 2393-1353
Edited by Oradea University Press
1, University street, 410087 Oradea, Romania
Journal homepage: http://geosport.uoradea.ro/geosport.html

Editorial Board

GeoSport for Society

Volume 14/ no. 1 / 2021

Oradea-Debrecen-Gdánsk

© GEOSPORT FOR SOCIETY,
Scientific Journal founded in 2014 under aegis of University of Oradea
(Romania), University of Debrecen (Hungary), University of Gdánsk (Poland)
and published by Oradea University Press
ISSN 2393-1353
Journal homepage: *http://geosport.uoradea.ro*

GeoSport for Society is a scientific publication, with an international status. The journal appears at the initiative of an international group of specialists, based on an editorial and scientific committee with a wide international coverage, including leading figures in the field. The first number/volume is published since 2014 in English.

The journal aims to publish relevant contributions in Geography, Physical Education, Sport Science, Physical Therapy, Economy, Sociology, Psychology, Leisure, Recreation and Tourism, Environment and other areas whose analysis is related to these fields, standing out through originality and scientific contribution to the knowledge and development of this area with benefices for society. An important objective is to promote academic and applied research based on interdisciplinary with a complex local and global approach.

The content of the publication is intended for a heterogeneous community made of teaching staff, researchers, practitioners and students showing interest in that fields, who can contribute substantially to the understanding, promotion and development of places, regions and the territory in its whole.

The journal meets the international requirements concerning the publication norms and ethics; can be viewed free of charge on the on-line pdf version; publishes *blind reviewed* research articles, promoting research by *open access* policy.

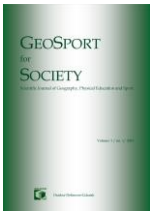
Geosport for Society is indexed in:

- **INDEX COPERNICUS**
- **DOAJ- DIRECTORY OF OPEN ACCES JOURNALS**
- **GENAMICS**
- **ERIH PLUS**
- **J-GATE**
- **SCIPIO**

Editorial Office Address:

GeoSport for Society
University of Oradea
Faculty of Geography, Tourism and Sport
1, University st., Pav. C, Et. II, room 215,
410087- Oradea, Romania
Phone: 00.40.259.408475
e-mail: *geosportforsociety@gmail.com*
Journal homepage: *http://www. geosport.uoradea.ro*

© **GeoSport for Society**, volume 14, no. 1/2021, pp. 1-66



GEOSPORT FOR SOCIETY
Scientific Journal founded in 2014 under aegis of University of Oradea (Romania), University of Debrecen (Hungary), University of Gdánsk (Poland)
ISSN 2393-1353
Edited by Oradea University Press
1, University Street, 410087, Oradea, Romania
Journal homepage *http://geosport.uoradea.ro/geosport.html*

Contents

Volume 14, no. 1/ 2021, pp. 1-66

© **GeoSport for Society**, volume 14, no. 1/2021, pp. 1-11, DOI 10.30892/gss.1401-070

GEOSPORT FOR SOCIETY
Scientific Journal founded in 2014 under aegis of University of Oradea (Romania), University of Debrecen (Hungary), University of Gdánsk (Poland)
ISSN 2393-1353
Edited by Oradea University Press
1, University Street, 410087, Oradea, Romania
Journal homepage: *http://geosport.uoradea.ro*

Aspects Regarding Geographic and Spatial Dispersion Determined by Romanian National Men's Basketball League (2006-2019)

Călin POP[1*], Ioan FEFLEA[2], Marius MARINĂU[2]

1. University of Oradea, PH.D. School in Geography, 1 Universității st., cod 410087, Oradea, Romania, e-mails: pop_calinbaschet@yahoo.com,
2. University of Oradea, Department of Physical Education, Sport and Physical Therapy, 1 Universității st., cod 410087, Oradea, Romania, e-mails: feflea@yahoo.com, marius_marinau@yahoo.com

* *Corresponding author*

Citation: Pop, C., Feflea, I., & Marinău, M. (2021). Aspects Regarding Geographic and Spatial Dispersion Determined by Romanian National Men's Basketball League (2006-2019). *Geosport for Society*, 14(1), 1-11. https://doi.org/10.30892/gss.1401-070

Article history: 18.01.2021; Revised: 15.02.2021; Accepted: 22.03.2021, Available online: 31.03.2021

Abstract: This article intends to analyze the men's basketball phenomenon in Romania, at the level of the Romanian National Basketball League (the elite league in Romanian Men's Basketball). In the first part of this article we will analyze the numeric indicators resulted from the mathematical quantifiers of the participation of men's basketball teams in the National Basketball League. In the second part we will highlight aspects of geographic and spatial dispersion by using mathematical methods (such as the Euclidean distances). Furthermore, we will highlight the advantages and disadvantages of the geographic location of men's basketball teams from Romania.

Keywords: basketball, competitive season, Euclidean distances, geographic and spatial indicators

Introduction

"Space" and "Location" are central concepts in geography and sport. Places, for example, are means of identification of most sports teams, whereas sport impacts and is impacted by the physical environment and landscape where it takes place. Any quick analysis of sports phenomena would show that there are geographic and spatial differences from several perspectives, such as: the performance of sports clubs, the performance of athletes, the popularity of sports clubs or that of athletes, economic efficiency and many others. Naturally, these spatial differences vary according to the sports phenomenon that is being analyzed (Bale, 2003; Herman et al., 2018; Ilieș et al., 2014; Buhaș, 2015a; Ilieș et al., 2017; Buhaș, 2017).

DOI 10.30892/gss.1401-070

The analysis of the geographic dispersion of sports phenomena is a relatively new area of research; this analysis was carried out for the first time for economic activities, in order to study the effects of localization on business performance (using a series of indicators), economic growth, welfare, but also the impact of the location on the economy and the impact of economic activities on the location where these activities are being carried out. Based on this analysis, a lot of indicators which were valid in the analysis of economic activities, especially those that underscore geographic and spatial differences, were used to highlight geographic and spatial differences of sports phenomena.

There is also a geographic side to sport, since it has geographic features, models and movements. The geographic component is used for many aspects, from choosing the locations of sports fields to managing security during sports events.

Therefore, as far as sports events are concerned, there are two approaches used by the specialized literature in order to analyze sports phenomena from a geographic and spatial perspective: the first one focuses on the analysis of the impact determined by the spatial localization of sports clubs, whereas the second approach focuses on the analysis of the impact determined by the effects of sports phenomena on locations (Gratton et al., 2010; Herman et al., 2016, Doran and Declan, 2018; Buhaş, 2015b, c). We will use the first approach, analyzing the spatial localization of the men's basketball phenomenon in Romania. The second approach, regarding effects on locations, will explored in a future article.

METHODOLOGY

We have chosen the Romanian National Men's Basketball League (RNMBL) as basis for our analysis. The existing data that was used and analyzed in this study is taken from the 2006/2007-2018/2019 competitive seasons. This data, regarding participating teams, was provided by the Romanian Basketball Federation (https://www.frbaschet.ro/).

This study is structured in two parts: the first part is an analysis of the teams that took part in the RNMBL during the 2006/2007-2018/2019 competitive seasons, from a numeric and percentage perspective. In the second part, in order to identify spatial variability, Euclidean distances were calculated and analyzed (using the formula $d=\sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$, where x and y were given by the eastern longitudinal values and, respectively, the northern latitude of each city which had at least one participating men's basketball team, for at least one competitive season between 2006-2019, as well as every participating team). In order to highlight the geographic and spatial distribution, the eastern longitudinal values and the northern latitudinal values were converted into Cartesian coordinates (Howard and Rorres, 1994).

AREA OF STUDY, TEAMS, COMPETITIVE SEASONS

During the 2006/2007-2018/2019 competitive seasons of the RNMBL, there were 30 participating professional teams, from 25 cities: Arad, Baia Mare, Braşov, Bucharest (four teams), Chiajna, Cluj-Napoca (three teams), Constanţa, Craiova, Galaţi, Giurgiu, Iaşi, Mediaş, Miercurea Ciuc, Oradea, Otopeni, Piteşti, Ploieşti,

Ploieşti, Rm. Vâlcea, Sibiu, Târgovişte, Tg. Jiu, Tg. Mureş and Timişoara (two teams) (figure 1; table 1).

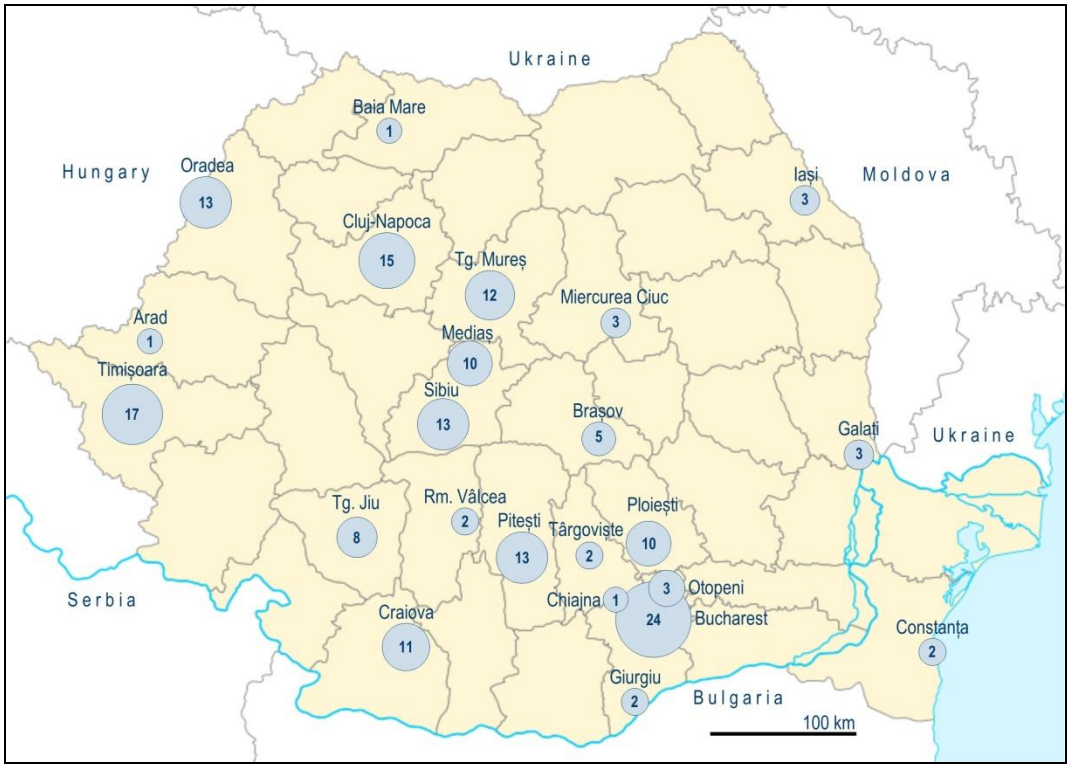


Figure 1. The intensity of the basketball phenomenon in the RNMBL during the 2006/2007-2018/2019 competitive seasons
(Source: The Romanian Basketball Federation and our own calculations)

Based on their attendance, the 30 teams that took part in the 2006/2007-2018/2019 competitive seasons, in the RNMBL, can be classified into four categories (figure 1; table 1):

- Teams with the highest attendance score (with an attendance ranging between 75.1% and 100%): CS Dinamo Ştiinţa Bucharest (76.9%), U BT Cluj-Napoca (100%), SCMU Craiova (84.6%), CS Gaz Metan Mediaş (76.9%), CSM CSU Oradea (100%), BCMU FC Argeş Piteşti (100%), CS CSU Sibiu (100%), BC Mureş Tg. Mureş (92.3%) and SCM Timişoara (100%);

- Teams with a medium attendance score (ranging between 50.1% and 75%): CSM Steaua CSM Eximbank Bucharest (61.5%), CSU Asesoft Ploieşti (69.2%) and CS Energia Rovinari Tg. Jiu (61.5%);

- Teams with a low attendance score (ranging between 25.1% şi 50%): CSU Cuadripol Braşov (38.5%), CS Otopeni (46.2%) and BC Timba Timişoara (30.8%) and

- Teams with a very low attendance score (inferior or equal to 25%): West Petrom Arad (7.7%), BCM Olimpia Baia Mare (7.7%), Rapid Bucharest (23.1%), CSM

DOI 10.30892/gss.1401-070

Bucharest (23.1%), CS Concordia Chiajna (7.7%), Gladiator Cluj-Napoca (7.7%), Universitatea Cluj-Napoca (7.7%), CS BC Farul Constanţa (15.4%), CS Phoenix Galaţi (23.1%), CSŞ Giurgiu (15.4%), CS Politehnica Iaşi (23.1%), BC PH Csikszereda Miercurea Ciuc (23.1%), CSM Ploieşti (7.7%), BC Rm. Vâlcea (15.4%) and BC Gresiloft Târgovişte (15.4%).

Table 1. The value of the Euclidean distances determined by the participating teams in the RNMBL in the 2006/2007-2018/2019 competitive seasons
(Data source: The Romanian Basketball Federation and our own calculations)

Cities	Participating teams in RNMBL			Competitive seasons													
		Number	%	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	Average
Arad	West Petrom	1	7.7%	3.43													**3.43**
Baia Mare	BCM Olimpia	1	7.7%											2.94			**2.94**
Braşov	CSU Cuadripol	5	38.5%	2.01	1.74	1.85	1.91	1.93									**1.89**
Bucharest	CS Dinamo Ştiinţa	10	76.9%	2.39	2.06	2.15	2.18		2.24	2.53			2.68	2.62	2.94	2.77	**2.46**
	CSM Steaua CSM Eximbank	8	61.5%				2.18	2.45			2.74	3.03	2.68	2.62	2.94	2.77	**2.68**
	Rapid	3	23.1%	2.39	2.06	2.15											**2.20**
	CSM	3	23.1%				2.18		2.24	2.53							**2.32**
Chiajna	CS Concordia	1	7.7%								2.65						**2.65**
Cluj-Napoca	U BT	13	100.0%	2.25	2.26	2.27	2.18	2.29	2.46	2.52	2.45	1.90	2.29	2.40	2.65	2.42	**2.33**
	Gladiator	1	7.7%				2.18										**2.18**
	Universitatea	1	7.7%									1.90					**1.90**
Constanţa	CS BC Farul	2	15.4%							4.69	4.94						**4.82**
Craiova	SCMU	11	84.6%			2.13	2.19	2.38	2.37	2.42	2.40	2.21	2.32	2.58	2.77	2.29	**2.37**
Galaţi	CS Phoenix	3	23.1%										4.16	4.02	4.16		**4.11**
Giurgiu	CSŞ	2	15.4%						2.52	2.75							**2.64**
Iaşi	CS Politehnica	3	23.1%					3.77	3.80						4.16		**3.91**
Mediaş	CS Gaz Metan	10	76.9%	1.85	1.72	1.77	1.77	1.82	1.96	2.10	2.09	1.76	1.92				**1.88**
Miercurea Ciuc	BC PH Csikszereda	3	23.1%					2.19	2.29	2.58							**2.35**
Oradea	CSM CSU	13	100.0%	3.24	3.47	3.41	3.35	3.45	3.63	3.51	3.35	2.76	3.33	3.45	3.52	3.23	**3.36**
Otopeni	CS	6	46.2%	2.33	1.99	2.09	2.13	2.37	2.19								**2.18**
Piteşti	BCMU FC Argeş	13	100.0%	1.88	1.63	1.68	1.77	1.92	1.91	2.09	2.16	2.11	2.06	2.17	2.45	2.10	**1.99**
Ploieşti	CSU Asesoft	9	69.2%	2.21	1.88	1.99	2.05	2.21	2.19	2.41	2.58	2.78					**2.26**
Ploieşti	CSM	1	7.7%											2.45			**2.45**
Rm. Vâlcea	BC	2	15.4%	1.83	1.66												**1.75**
Sibiu	BC CSU	13	100.0%	1.79	1.69	1.71	1.72	1.81	1.93	2.04	2.01	1.68	1.85	2.07	2.31	2.01	**1.89**
Târgovişte	BC Gresiloft	2	15.4%		1.65	1.74											**1.70**
Tg. Jiu	CS Energia	8	61.5%			2.10	2.13	2.29	2.36	2.36	2.27	1.92	2.19				**2.20**
Tg. Mureş	BC Mureş	12	92.3%	2.00	1.89	1.96	1.94	1.95	2.11	2.27	2.29	1.96	2.11	2.23	2.49		**2.10**
Timişoara	SCM	13	100.0%	3.48	3.78	3.65	3.63	3.77	3.91	3.64	3.45	2.91	3.58	3.81	3.68	3.40	**3.59**
	BC Timba	4	30.8%							3.64	3.45	2.91			3.68		**3.42**
Total attendance in RNMBL				**14**	**14**	**15**	**16**	**15**	**16**	**16**	**14**	**13**	**12**	**12**	**12**	**8**	
Average			117		**2.11**	**2.18**	**2.22**	**2.44**	**2.51**	**2.76**	**2.77**	**2.29**	**2.60**	**2.78**	**3.15**	**2.62**	**2.60**

During the competitive seasons that are being analyzed, the Romanian National Men's Basketball League held 13 championships, one per every competitive year. Therefore, during this period the maximum number of participating teams, 16, was reached in the following competitive seasons: 2009/2010, 2011/2012 and 2012/2013. If in the first part of the period of time that is being analyzed, the number of participating teams ranged between 14 and 16, in the second part of the same period, there was a decrease with every season; in the 2012-2013 competitive

season there were 16 participating teams, whereas in the 2018/2019 competitive season the number dropped to 8 (figure 2; table 1).

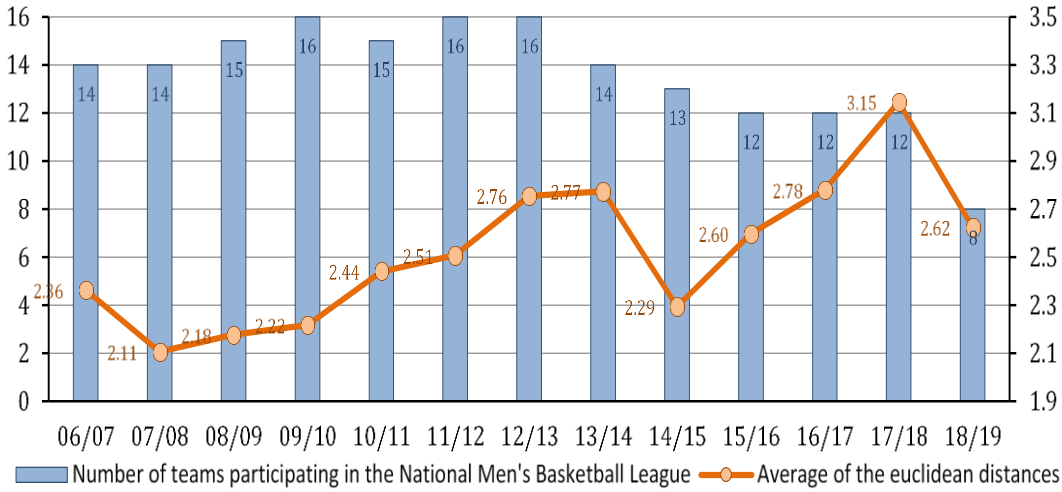


Figure 2. The number of participating teams in the RNMNL and the average of Euclidean distances for the 2006/2007-2018/2019 competitive seasons
(Data source: The Romanian Basketball Federation and our own calculations)

ANALYSIS OF THE GEOGRAPHIC AND SPATIAL DISPERSION

2006/2007 Competitive Season

There were 14 participating teams in the RNMBL, in the 2006/2007 competitive season. The average distance covered by a team during the 2006/2007 season, calculated according to the Euclidean distances, was 2.36; the average minimum distance was 1.79 (covered by BC CSU Sibiu), and the average maximum distance was 3.48 (covered by SCM Timişoara) (figures 2, 3; table 1).

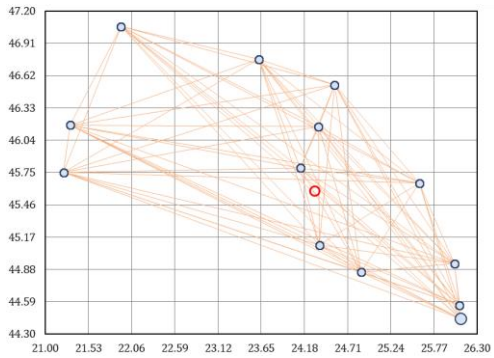


Figure 3. The Euclidean distance system for the 2006/2007 competitive season
(Data source: The Romanian Basketball Federation and our own calculations)

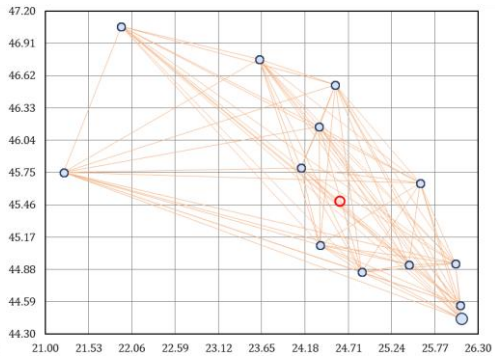


Figure 4. The Euclidean distance system for the 2007/2008 competitive season
(Data source: The Romanian Basketball Federation and our own calculations)

DOI 10.30892/gss.1401-070

2007/2008 Competitive Season

In the 2007/2008 competitive season, there were also 14 teams in RNMBL. The average distance covered by a team during the 2007/2008 season, calculated using the Euclidean distances, was 2.11 (12.2% less than the previous competitive season); the average minimum distance was 1.63 (covered by BCMU FC Argeş Piteşti) and the average maximum distance was 3.78 (covered by SCM Timişoara) (figures 2, 4; table 1).

2008/2009 Competitive Season

There were 15 participating teams in the RNMBL, in the 2008/2009 competitive season (one team more than the previous competitive season) The average distance covered by a team during the 2008/2009 season, calculated according to the Euclidean distances, was 2.18 (3.3% more than the previous competitive season); the average minimum distance was 1.68 (covered by BCMU FC Argeş Piteşti), and the average maximum distance was 3.65 (covered by SCM Timişoara) (figures 2, 5; table 1).

2009/2010 Competitive Season

There were 16 participating teams in the RNMBL, in the 2009/2010 competitive season (one team more than the previous competitive season) The average distance covered by a team during the 2009/2010 season, calculated according to the Euclidean distances, was 2.22 (1.9% more than the previous competitive season); the average minimum distance was 1.72 (covered by BC CSU Sibiu), and the average maximum distance was 3.63 (covered by SCM Timişoara) (figures 2, 6; table 1).

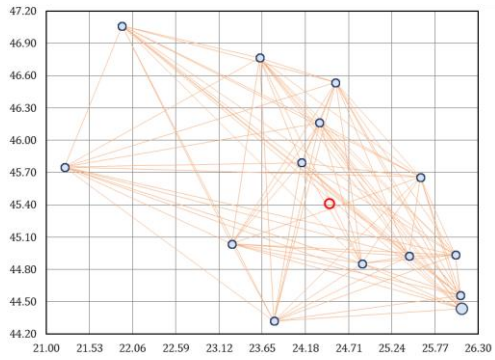


Figure 5. The Euclidean distance system for the 2008/2009 competitive season
(Data source: The Romanian Federation and Basketball our own calculations)

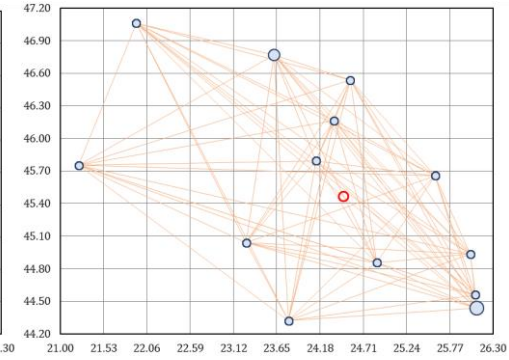


Figure 6. The Euclidean distance system for the 2009/2010 competitive season
(Data source: The Romanian Basketball Federation and our own calculations)

2010/2011 Competitive Season

There were 15 participating teams in the RNMBL, in the 2010/2011 competitive season (one team less than the previous competitive season). The average distance covered by a team during the 2010/2011 season, calculated

according to the Euclidean distances, was 2.44 (9.1% more than the previous competitive season); the average minimum distance was 1.81 (covered by BC CSU Sibiu), and the average maximum distance was 3.77 (covered by SCM Timişoara) (figures 2, 7; table 1).

2011/2012 Competitive Season

There were 16 participating teams in the RNMBL, in the 2011/2012 competitive season (one team more than the previous competitive season). The average distance covered by a team during the 2011/2012 season, calculated according to the Euclidian distances, was 2.51 (2.7% more than the previous competitive season); the average minimum distance was 1.91 (covered by BCMU FC Argeş Piteşti), and the average maximum distance was 3.91 (covered by SCM Timişoara) (figures 2, 8; table 1).

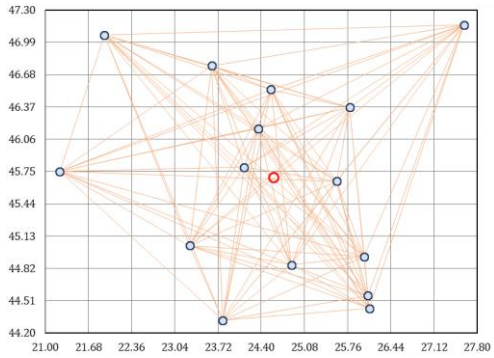


Figure 7. The Euclidean distance system for the 2010/2011 competitive season
(Data source: The Romanian Federation and Basketball our own calculations)

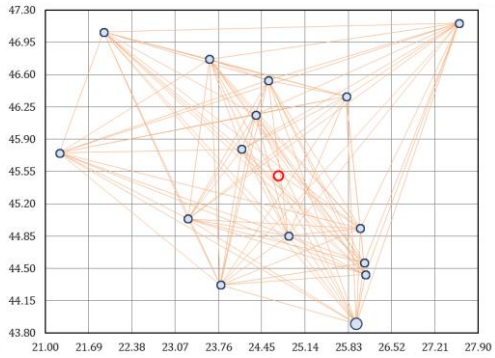


Figure 8. The Euclidean distance system for the 2011/2012 competitive season
(Data source: The Romanian Basketball Federation and our own calculations)

2012/2013 Competitive Season

In the 2007/2008 competitive season, there were also 16 teams in RNMBL. The average distance covered by a team during the 2012/2013 season, calculated according to the Euclidean distances, was 2.76 (9.0% more than the previous competitive season); the average minimum distance was 2.04 (covered by BC CSU Sibiu) and the average maximum distance was 4.69 (covered by CS BC Farul Constanţa) (figures 2, 9; table 1).

2013/2014 Competitive Season

In this season, the number of participating teams dropped to 14 in RNMBL (two teams less than in the previous competitive season). The average distance covered by a team during the 2013/2014 season, calculated according to the Euclidean distances, was 2.77 (0.7% more than the previous competitive season); the average minimum distance was 2.01 (covered by BC CSU Sibiu) and the average maximum distance was 4.94 (covered by CS BC Farul Constanţa) (figures 2, 10; table 1).

DOI 10.30892/gss.1401-070

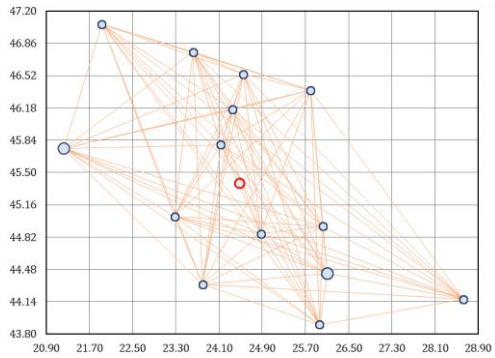


Figure 9. The Euclidean distance system for the 2012/2013 competitive season
(Data source: The Romanian Federation and Basketball our own calculations)

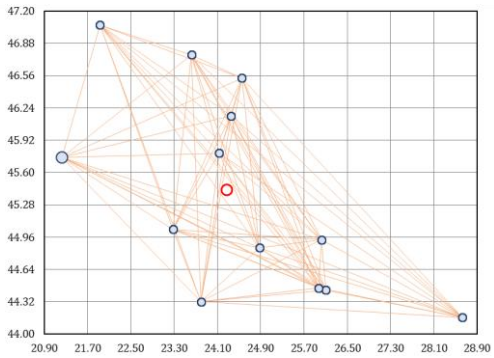


Figure 10. The Euclidean distance system for the 2013/2014 competitive season
(Data source: The Romanian Basketball Federation and our own calculations)

2014/2015 Competitive Season

There were 13 participating teams in the RNMBL, in the 2014/2015 competitive season (one team less than the previous competitive season). The average distance covered by a team during the 2014/2015 season, calculated according to the Euclidean distances, was 2.29 (20.9% less than the previous competitive season); the average minimum distance was 1.68 (covered by BC CSU Sibiu), and the average maximum distance was 3.03 (covered by CSM Steaua CSM Eximbank Bucharest) (figures 2, 11; table 1).

2015/2016 Competitive Season

There were 12 participating teams in the RNMBL, in the 2015/2016 competitive season (one team less than the previous competitive season). The average distance covered by a team during the 2015/2016 season, calculated according to the Euclidean distances, was 2.60 (11.7% more than the previous competitive season); the average minimum distance was 1.85 (covered by BC CSU Sibiu), and the average maximum distance was 4.16 (covered by CS Phoenix Galați) (figures 2, 12; table 1).

2016/2017 Competitive Season

There were also 12 participating teams in the RNMBL, in the 2016/2017 competitive season. The average distance covered by a team during the 2016/2017 season, calculated according to the Euclidean distances, was 2.78 (6.6% more than the previous competitive season); the average minimum distance was 2.07 (covered by BC CSU Sibiu), and the average maximum distance was 4.02 (covered by CS Phoenix Galați) (figures 2, 13; table 1).

2017/2018 Competitive Season

There were also 12 participating teams in the RNMBL, in the 2017/2018 competitive season. The average distance covered by a team during the 2017/2018 season, calculated according to the Euclidean distances, was 3.15 (11.6% more than

the previous competitive season); the average minimum distance was 2.31 (covered by BC CSU Sibiu), and the average maximum distance was 4.16 (covered by CS Politehnica Iaşi) (figures 2, 14; table 1).

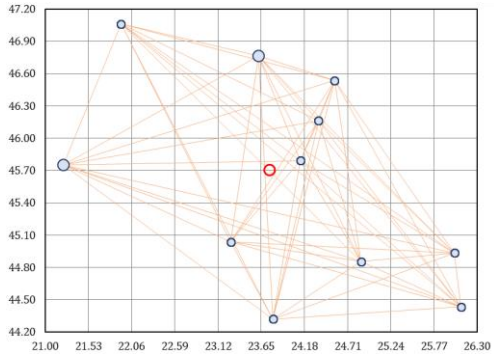


Figure 11. The Euclidean distance system for the 2014/2015 competitive season
(Data source: The Romanian Federation and Basketball our own calculations)

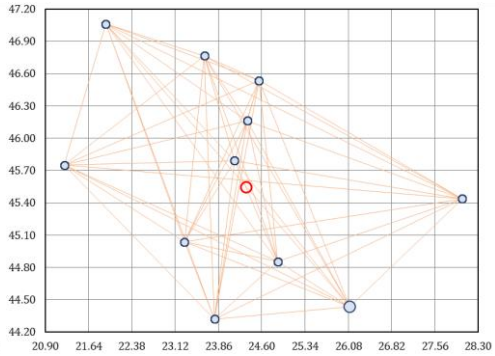


Figure 12. The Euclidean distance system for the 2015/2016 competitive season
(Data source: The Romanian Basketball Federation and our own calculations)

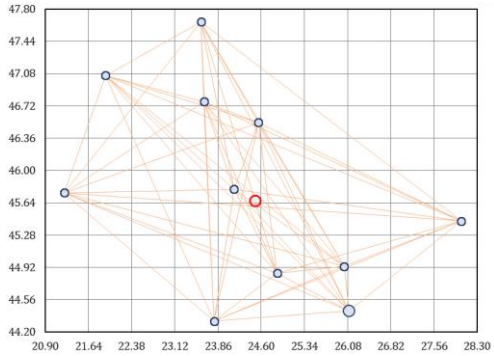


Figure 13. The Euclidean distance system for the 2016/2017 competitive season
(Data source: The Romanian Federation and Basketball our own calculations)

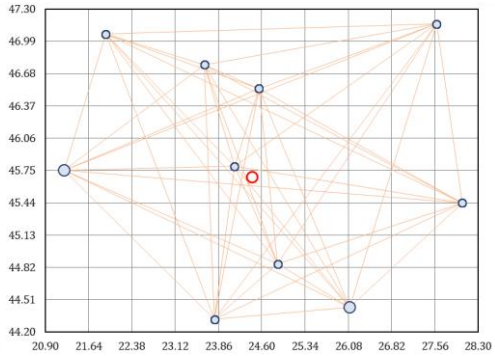


Figure 14. The Euclidean distance system for the 2017/2018 competitive season
(Data source: The Romanian Basketball Federation and our own calculations)

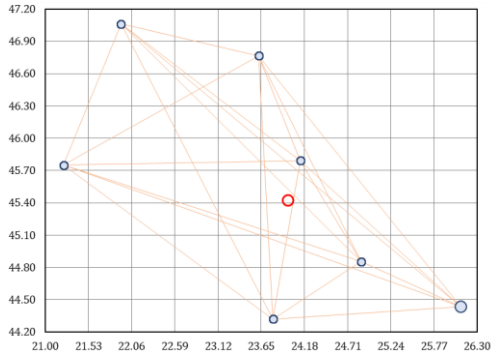


Figure 15. The Euclidean distance system for the 2018/2019 competitive season
(Data source: The Romanian Federation and Basketball our own calculations)

DOI 10.30892/gss.1401-070

2018/2019 Competitive Season

There were 8 participating teams in the RNMBL, in the 2018/2019 competitive season (four teams less than the previous competitive season). The average distance covered by a team during the 2018/2019 season, calculated according to the Euclidean distances, was 2.62 (19.9% less than the previous competitive season); the average minimum distance was 2.01 (covered by BC CSU Sibiu), and the average maximum distance was 3.40 (covered by SCM Timişoara). (figures 2, 15; table 1).

The competitive centre of gravity of the RNMBL is represented by the average between the eastern longitudinal and northern latitudinal values of each city that has had at least a participating men's basketball team, for at least a competitive season, calculated for each season in part. Values that vary from one season to the other are determined by the changes that occurred at a competitive level (figure 16).

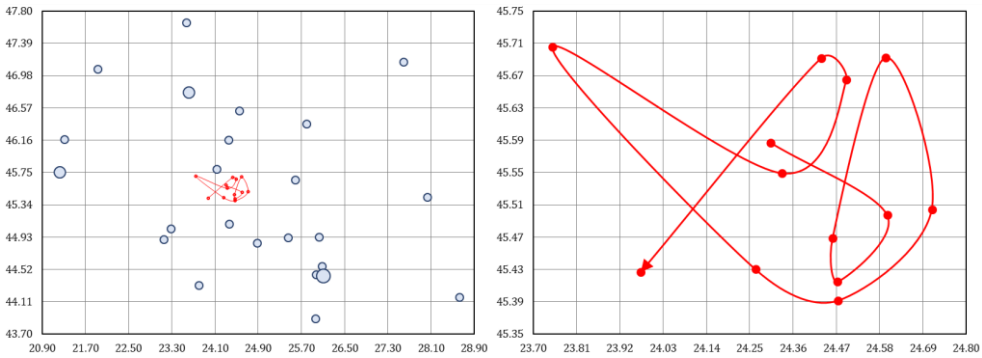


Figure 16. The competitive centre of gravity of the RNMBL for the 2006/2007-2018/2019 competitive seasons
(Data source: The Romanian Federation and Basketball our own calculations)

CONCLUSION

By observing the number of participating teams in the Romanian National Men's Basketball League and the evolution of the average of the Euclidean distances, we can assert that there is no relation of proportionality between these two aspects (figure 2).

Based on the analysis of the Euclidean distances determined by the position of the cities that have men's basketball teams and the competitive centre of gravity, we can set up the following classification (figures 3-15; table 1):

- Close teams, (73.3% out of the total number of teams, with an average distance ranging between 1.70 and 2.73): CSU Cuadripol Braşov (1.89), CS Dinamo Ştiinţa Bucharest (2.46), CSM Steaua CSM Eximbank Bucharest (2.68), Rapid Bucharestt (2.20), CSM Bucharest (2.32), CS Concordia Chiajna (2.65), U BT Cluj-Napoca (2.33), Gladiator Cluj-Napoca (2.18), Universitatea Cluj-Napoca (1.90), SCMU Craiova (2.37), CSŞ Giurgiu (2.64), CS Gaz Metan Mediaş (1.88), BC PH Csikszereda Miercurea Ciuc (2.35), CS Otopeni (2.18), BCMU FC Argeş (1.99), CSU Asesoft Ploieşti (2.26), CSM Ploieşti (2.45), BC Rm. Vâlcea (1.75), BC CSU Sibiu (1.89), BC Gresiloft

Târgovişte (1.70 –the lowest value), CS Energia Rovinari Tg. Jiu (2.20) and BC Mureş Tg. Mureş (2.10);

- Distant teams, (16.7% out of the total number of teams, with an average distance ranging between 2.74 and 3.77): West Petrom Arad (3.43), BCM Olimpia Baia Mare (2.94), CSM CSU Oradea (3.36), SCM Timişoara (3.59) and BC Timba Timişoara (3.42) and

- Very distant teams, (10.0% out of the total number of teams, with an average distance ranging between 3.78 and 4.82): CS BC Farul Constanţa (4.82 – the highest value), CS Phoenix Galaţi (4.11) and CS Politehnica Iaşi (3.91).

In conclusion, observing the distribution hereinbefore, we can assert that, at least from the point of view of the geographic location, the teams situated in peripheral cities in relation to the national territory are considered to be distant or very distant from the competitive centre of gravity determined by the basketball phenomenon in Romania.

References

Bale, J.R. (2003). Sports Geography, *Routledge,* London.

Buhaş, D. S., Herman, G. V., Paul, F. D., & Stance, L. (2017). Football and economy before and after communism in Romania. *GeoSport for Society*, 6(1), 30-39

Buhaş, S. D. (2015a). Sport management. From institutionalism to research. *Geosport for Society*, 2(1), 26-32.

Buhaş, S. D. (2015b). *Managementul organizaţiilor sportive [The management of sports organizations]*, Eikon Publishing House, Cluj Napoca (in Romanian).

Buhaş, S. D. (2015c). *Strategii manageriale, cluburile de fotbal din liga 1 [Management strategies. Football clubs in League I],* Eikon Publishing House, Cluj Napoca (in Romanian).

Doran, J., & Declan, J. (2018). The effect of geographical proximity and rivalry on performance: evidence from the English Football League. *Regional Studies*, 52(11), 1559-1569.

Gratton, C., Bobson, N., & Shibil, S. (2000). The economic importance of major sports events: a case-study of six events. *Managing Leisure*, 5(1), 17-28.

Herman, G.V., Buhaş, S.D., Stance, L., Pop, C.A. (2016). Considerations regarding the evolution, distribution and dynamics of the romanian football (League I) between 1989-2016. *GeoSport for Society*, 5(2), 69-78.

Herman, G.V., Szabo-Alexi, Mariana, Szabo-Alexi, P., Dragoş, F.P., Marinău, M. (2018). The sport, vector of regionalization / globalization Case study: International Volleyball Federation (FIVB). *GeoSport for Society*, 9(2), 88-95.

Howard, A., & Rorres, C. (1994). *Elementary Linear Algebra (11th ed.).* Wiley. pp. 131-182.

Ilieş, A., (coord.), Baias, Ş., Baias, I., Blaga, L., Buhaş, S., Chiriac, A., Ciocan, J., Dăncuş, M., Deac, A., Dragoş, P., Dumitrescu, G., Gaceu, O., Godea, I., Gozner, M., Grama, V., Herman, G. V., Hodor, N., Hurley, P., Ilieş, A., Ilieş, D. C., Ilieş, G., Ilieş M., Josan, I., Leşe, G., Măduţa, F., Mojolic, D., Morar, C., Olaru, M., Staşac, M., Stupariu, M., Sturza, A., Ştefănescu, B., Tătar, C., Vârnav, R., Vlaicu, M., & Wendt, J. (2014). *Crişana - Maramureş, Atlas Geografic al patrimoniului touristic*, Editura Universităţii din Oradea.

Ilieş, D. C., Herman, G., Ilieş, A., Baias, Ş., Dehoorne, O., Buhaş, S., & Ungureanu, M. (2017). Tourism and Biodiversity in Natura 2000 Sites. Case Study: Natura 2000 Valea Roşie (Red Valley) Site, Bihor County, Romania. *Études caribéennes*, (37-38).

Web sources:

https://www.frbaschet.ro/ (accessed at: 20.11.2018).

© **GeoSport for Society**, volume 14, no. 1/2021, pp. 12-20, DOI 10.30892/gss.1402-068

GEOSPORT FOR SOCIETY
Scientific Journal founded in 2014 under aegis of University of Oradea (Romania), University of Debrecen (Hungary), University of Gdánsk (Poland)
ISSN 2393-1353
Edited by Oradea University Press
1, University Street, 410087, Oradea, Romania
Journal homepage: *http://geosport.uoradea.ro*

Understanding the importance of service in the beach volleyball game

Gabriel Alexandru PETROVICI[1*]

1. University *"1 December 1918"* Alba Iulia, Faculty of Law and Social Sciences, Department of Physical Education and Sport, Adress: Str. Gabriel Bethlen, No. 5, Alba Iulia, C.P. 510009, Romania, e-mail: ducu_petrovici@yahoo.com

* *Corresponding author*

Citation: Petrovici, G.A. (2021). Understanding the importance of service in the beach volleyball game. *Geosport for Society*, 14(1), 12-20. https://doi.org/10.30892/gss.1402-068

Article history: 12.01.2021; Revised: 20.03.2021; Accepted: 20.04.2021, Available online: 10.05.2021

Abstract: Beach volleyball is a practical sports game practiced both by the high-performance athlete and the great mass of lovers of movement, for recreational purposes, of lousier. In recent years, an increasing number of participants and tournaments have led to several studies on beach volleyball. Beach volleyball is divided into two phases: defense and counterattack. The sequence of beach volleyball actions is service, taking over, lifting, attacking, blocking, and diving. The defense phase includes: taking over, lifting, and attacking. Counterattack includes: blocking, defending, lifting, and attacking. This research tries to identify beach volleyball's fundamental characteristics and highlights the main ideas regarding this critical skill in beach volleyball. This technical procedure was and will be one of the most important in the volleyball game - both beach and indoor. Beach volleyball service is a specific motor skill commonly described as the first element of defense, essential to prevent a team from getting the side-out.

Keywords: service, beach volleyball, technique, beach volleyball fundamentals

Introduction

Beach volleyball is a practical sports game practiced both by the high-performance athlete and by the great mass of lovers of movement, for recreational purposes, of lousier. The game of beach volleyball is similar to indoor volleyball in terms of the similarity of the execution of technical procedures and some attack or defense actions, but there are some significant differences between the two sports. The game of volleyball is relatively simple, and once, through the training of players and the speed of multilateral actions, it enjoys a broad acceptance of this in a larger audience (Cojocaru and Cojocaru, 2018).

The game of volleyball is a game of acyclic movement like its older brother basketball (Sopa 2019a), in which most of the time the combination of speed-force

motor qualities is present, coordinated by precise movements (Kozina et al., 2018; Sopa & Pomohaci, 2018a). The volleyball game has developed in characteristics of speed and strength, being more and more physical (Sopa, 2019b).

In recent years, an increasing number of participants and tournaments have led to several studies on beach volleyball. In most cases, these studies analyzed the amount of energy used (Zetou et al., 2008), epidemiology, and injury rehabilitation (Pfirrmann et al., 2008; Lajtai et al., 2009), kinematic analyzes of movement models (Tilp et al., 2008), physical performance (Sheppard et al., 2008; Lidor and Ziv, 2010), body composition (Palao et al., 2008) and technical-tactical characteristics of the game (Koch and Tilp, 2009; López-Martínez and Palao, 2009).

Beach volleyball is less harmful to the players' bodily integrity; it does not put so much pressure on the ligaments and joints to be practiced until a considerable age. In a scientific article, Kugler et al., found an incidence of 0.08 injuries per year in beach volleyball, most injuries being in the knee (20%), ankle (17%), fingers (15%), shoulder (13.1%), and pain back (5.7%) (Kugler et al., 2006), compared with indoor volleyball where the most significant injuries appear at the shoulder [1] (Szabo & Sopa, 2018) back pain and knee joint (Szabo et al., 2018).

Given the natural environment in which this activity occurs, it is an excellent advantage for those who manage to adapt to weather conditions (rain, wind, cold, extreme heat, light) and use them to their advantage over volleyball. This aspect develops the senses and the ability to act in the most varied way possible, depending on the moment and the phases of the game. These physiological responses are closely associated with various variables, such as game rules (Giatsis, 2003), area, number of players, and environmental conditions (Palao et al., 2014). Of all the conditions listed so far, the playing surface was the most studied. Sand impedes players' movement (Smith, 2006), but due to this, players have developed specific movement models for beach volleyball (Cortell-Tormo et al., 2011; Perez-Turpin et al., 2009). The playing field forces players to do more work to minimize force absorption by sand (Buscà et al., 2015). This resistance complicates movements such as jumping (Bishop, 2003) because the height of the vertical jump on the sand is lower than that made on rigid surfaces (Giatsis et al., 2004).

Beach volleyball is an intermittent team sport played by two teams of two players on a sandy field divided by a net (Kiraly and Shewman, 1999). It is characterized by frequent high-intensity efforts, interposed by short recovery phases (Palao et al., 2012). The performance involves jumping (e.g., attack, service, blocking), short sprints, direction changes, and dives (Natali et al., 2019). Although in beach volleyball just two components from the team, the importance of cohesion is considerable like in indoor volleyball game where team cohesion is fundamental (Pomohaci and Sopa, 2018; Sopa and Pomohaci, 2018b).

During a single set, Palao et al. (2012) observed that defenders and blocking players performed an average of 27 and 31 jumps, respectively. Also, moving on sand increases energy costs compared to moving on solid ground (Zamparo, 1992).

[1] *https://www.researchgate.net/publication/347691366_CONSERVATIVE_TREATMENT_IN_CALCIFYING_TENDINITIS_OF_SHOULDER*

DOI 10.30892/gss.1402-0368

Beach volleyball is played in demanding environmental conditions: Zetou et al. (2008) reported that during over 50 matches analyzed in an official tournament, the average air temperature was 33.6◦C (max 38ºC), and the average humidity was 56% (max 75%). Although there are no changes in beach volleyball, a player has to cover a much larger area of the field than in indoor volleyball, reaching for the ball more often, almost every time he is on their side of the field.

Fundamental data are obtained in modern volleyball using statistical programs that identify the opponent team's strong points and weaknesses. Coaches use this data to exploit other teams and get the expected results (Szabo and Magdas, 2014, Szabo, 2015a, Szabo 2015b, Szabo and Sopa, 2015, Szabo et al., 2019a; Szabo et al., 2019b; Szabo and Sopa, 2019; Sopa and Szabo, 2020).

In beach volleyball over the years, with improvements to the rules, an athlete should have outstanding physical fitness, such as speed (reaction and movement), agility, explosive power, and maximum strength (Bizzocchi, 2008; Lehnert et al., 2009; Pereira et al., 2015; Pastore et al., 2015).

Essential aspects of service in beach volleyball

This technical procedure was, is, and will be one of the most important in volleyball - both beach and indoor. Beach volleyball service is a specific motor skill commonly described as the first defense element, which is essential to prevent a team from getting the side-out (Wise, 2002).

Service is how the ball is put back into play after winning a point (according to the rules, there is no situation in which a team serves without having won the previous point - except the first service of the set or match, which is chosen according to the draw by a lot). In high-level beach volleyball, the chance of getting a direct point using the service is low.

However, the benefits of serving are not only based on the ability to score but also on influencing the opponent's next attacking game (Quiroga et al., 2010).

A team struggling to effectively defend a good service will drastically reduce its chances of winning the match (Patsiaouras et al., 2011). Thus, the service is the first opportunity for the team to possess the ball to score against opponents.

The first rule that the youngest volleyball players learn is to pass the ball over the net to the opponent's court. Without this aspect fulfilled, the point has no chance of being won, and it is lost before being disputed. It is also imperative that the players on duty do not make the mistake of kicking, that is, touching the field of the field's back boundary before it hits the ball with their hand.

Accepting the high risk of error related to the execution of the service (1 in 5 jumping services reach the net or out of bounds according to Agelonidis, 2004) is part of the defensive strategy of high-level sand volleyball teams. Attack has proved to be one of the best predictors of team performance (Yiannis and Panagiotis, 2005; Zetou et al., 2006; Zetou et al., 2007; Monteiro et al., 2017; Rodríguez-Ruiz et al., 2011) and that blocking efficiency is closely related to service quality (Drikos et al., 2009).

Many high-level beach volleyball players, but not only, have a routine before performing the service just to avoid this mistake. They measure their momentum very well and focus on throwing the ball in the air, the sequence of steps, and the

moment of hitting the ball. In the case of ground service, it is recommended that players position themselves at a distance of approximately one meter from the court's bottom line to avoid the risk of touching the ground (the bottom line is part of the field) before hitting the ball. If we are talking about a right-handed player, he holds the ball in his left hand, his shoulders are pulled back, and the so-called "archery" position is applied. Namely, the left hand stretched in front throws the ball in the air on a straight vertical trajectory, without oscillations, left-right or front-back. We imagine that if we did not hit the ball with our right hand, the perfectly stretched left hand should catch the ball in the same position from which it released it. The right hand is pulled back with the elbow at this moment bent and the hand stiff.

In international volleyball, there are already signs that the serving strategy is now based on the team's blocking and defensive strategy and that one of the goals of the serving strategy is to prevent the opposing team from having an easy build by increasing the difficulty of taking a vital service, and risky (Papageorgiou and Spitzley, 2003). It seems, then, that the team at work has no choice but to gain advantage other than to take the opposing team out of the attack system and, in particular, to prevent first-tempo attacks (Zetou et al., 2007) and rapid attacks outside (Fellingham et al., 2013) risking service. However, there is some evidence that the higher the team level, the lower the likelihood of unforced errors during the game (Palao et al., 2004), and this statement includes the service.

When the ball is at the point of maximum height, about one meter above the head and 20-30 centimeters in front of the performer, the right hand is directed towards the ball, the elbow is stretched, which becomes a rigid joint, as well as the joint palm and all fingers. The contact with the ball will be short and executed precisely in its center to print an oscillating trajectory. At the time of contact with the ball, the bodyweight passed from the back leg supporting until that moment to the front one that takes over the weight after hitting the ball.

As the proposed area of sending the ball relative to the net's upper band, it is important not to set a challenging goal to achieve, namely sending the ball to the other side at a very short distance from the net. Indeed, if the executor succeeds in this frequently, the opponents in the hypostasis of those who execute the takeover from the service will be in difficulty. The distance that we intend the ball to have when passing over the net is about 2 meters.

Service is one of the most important tools that a team can use to win a battle. If a team is very good at the side-out (receiving, lifting, and winning attack of the ball), they need a point on their service to win the set. Otherwise, it is impossible, according to the regulation.

As a strategy, if a team encounters a lower-ranked opponent than its team, they must not make mistakes at work and make one or more points to their opponents. Even if the service is not difficult, the ball needs to reach the opponent's court, who will be forced to build the point and play the ball. The chances of making a wrong attack are much higher than forcing those on duty a direct hit: winner, an ace. In beach volleyball and indoor volleyball, it is considered a service that either puts the ball directly in the opponent's court or is touched by one of the two partners in the takeover position, but it can no longer be played.

DOI 10.30892/gss.1402-0368

In the idea that those in possession of the ball at work master this technical procedure very well, the blows can be varied by resorting to services that give the ball a particular effect (the ball rotates around its axis), the trajectory followed by this is different from that resulting from standard palm contact with the ball. A secret of this type of trajectory is represented by the wind's presence that can significantly influence it. It is also imperative the ball with which this type of service is performed as not all balls react the same under certain conditions. The ones currently used in FIVB and AVP competitions are quite difficult to control in terms of the printed effect, but with training and patience, you can direct the ball in a complicated way for the opponent to take over.

Depending on where the ball is hit, it will follow a particular trajectory trying to be as difficult as possible for opponents. It is especially recommended to apply this strategy when the topspin effect is applied (topspin) when the person at work has the wind in front of him.

The most exciting option to serve is the inside-out variant, the variant in which the ball acquires a strange trajectory, and instead of reaching the player's hand from the opposite corner to the one serving, the ball makes a spectacular turn at the last moment. He reoriented himself towards the middle of the field, creating confusion among those who have to take the ball from the service.

Figure 1. The effect of hitting the volleyball at the service (Mauro, 2012)

The figure above shows how the effect is applied to the ball when it is hit in the place indicated by the blue and red arrows. The more wind it will be, the stronger its effect will impress the ball, and the more pronounced the result. If we hit the ball in the place indicated by the yellow arrow, the ball will pass the net and, benefiting from the printed effect, will fall immediately after the net strip.

The effect is significantly amplified if the wind blows from the front. When we hit the ball next to the green arrow, the desired trajectory works only against the

wind and will make the ball before it reaches the opponents and be taken, get a different trajectory, and make the receiving of service much more difficult. The orange marked place makes the ball follow a direct path to the player on the right and then change direction towards the middle of the field, thus creating great confusion among opponents. The area marked with purple makes the ball, although it seems that it will go out of the field, acquires a sudden downward trajectory, and to the joy of the one who served it, the bottom line of the field will fall.

Conclusions

A vital service can be performed which, although it would leave the impression that it will go far outside the field of play, with the help of the wind interacting with the ball, it will fall just before the bottom line of the field, thus creating the perfect frame to score on the board.

Depending on the opponents we face, we have to adapt our style of service. If the service is easy for the opposing players to take over because they come from indoor volleyball and are used to taking over from a vital jumping service, they should change their strategy and use another type of service, namely the floating service "float". This float service has the advantage over the force service that the ball is straightforward to be influenced by the wind and very difficult to anticipate its trajectory by opponents.

To perform this particular type of service, the ball must be hit precisely in its center, with the palm and arm held rigid and firm, following the movement of hitting the ball, the arm is locked after touching it, do not let go to follow his ordinary course as after the attack. In this case, the ball must not be hit too hard, no rotational movement is desired on it at all, but it is still necessary as an objective that the ball be transmitted to the other side on the bottom of the opponent's court.

References

Agelonidis, Y. (2004). The jump serve in volleyball: From oblivion to domi-nance. *Journal of Human Movement Studies,* 47, 205-213.

Bishop, D. (2003). A comparison between land and sand-based testsfor beach volleyball assessment. *Journal of Sports Medicine and Physical Fitness,* 43(4), 418–423.

Bizzocchi, C. (2008). *O voleibol a alto nível: da iniciação à competição.* 2ed. Barueri, SP: Manole.

Buscà, B., Alique, D., Salas, C., Hileno, R., & Peña, J. (2015). Relationshipbetween agility and jump ability in amateur beach volleyball maleplayers. *Journal of Performance Analysis in Sport,* 15(3), 1102–1113.

Cojocaru, A. M., & Cojocaru, M. (2018). The model of the middle blocker in volleyball. *Conference 10th Lumen International Scientific Conference Rethinking Social Action. Core values in practice RSACVP,* 20-21 April 2018, Suceava. DOI: 10.18662/lumproc.37

Cortell-Tormo, J. M., Perez-Turpin, J. A., Chinchilla-Mira, J. J., Ce-juela, R., & Suarez, C. (2011). Analysis of movement patterns byelite male players of beach volleyball. *Perceptual and Motor Skills,* 112(1), 21–28.

Drikos, S., Kountouris, P., Laios, A., & Laios, Y. (2009). Correlates of team per-formance in volleyball. *International Journal of Performance Analysis in Sport,* 9(2), 149-156.

Fellingham, G., Hinkle, L., & Hunter, I. (2013). Importance of attack speed in volleyball. *Journal of Quantitative Analysis in Sport,* 9(1), 87-96.

Giatsis, G. (2003). The effect of changing the rules on score fluctuationand match duration in the FIVB women's beach volleyball. *International Journal of Performance Analysis in Sport,* 3(1), 57–64.

DOI 10.30892/gss.1402-0368

Giatsis, G., Kollias, I., Panoutsakopoulos, V., & Papaiakovou, G. (2004). Biomechanical Differences in Elite Beach-Volleyball Players in Vertical Squat Jump on Rigid and Sand Surface. *Sports Biomechanics,* 3(1), 145–158.

Kiraly, K., & Shewman, B. (1999). *Beach Volleyball.* Human Kinetics: Champaign, IL, USA.

Koch, C., & Tilp, M. (2009). Beach volleyball techniques and tactics: a comparison of male and female playing characteristics. *Kinesiology,* 41(1), 52-59.

Kozina, Z., Goloborodko, Y., Boichuk, Y., Sobko, I., Repko, O., Bazilyuk, T., & Stsiuk, I. (2018). The influence of a special technique for developing coordination abilities on thelevel of technical preparedness and development of psycho-physiological functions of young volleyball players 14–16 years of age. *Journal of Physical Education and Sport,* 18(3), 1445–1454. doi:10.7752/jpes.2018.03214

Kugler, A., Späth, S., Krüger-Franke, M., Schurk, B., Feichtner, F., & Rosemeyer, B. (2006). Volleyball - Beachvolleyball. *Sport-Orthopadie -Sport-Traumatologie,* 22(4), 241–244.

Lajtai, G., Pfirrmann, C. W., Aitzetmuller, G., Pirkl, C., Gerber, C., & Jost, B. (2009). The Shoulders of Fully Competitive Professional Beach Volleyball Players: High Prevalence of Infraspinatus Atrophy. *The American Journal of Sports Medicine,* 37(7), 1375-1383.

Lehnert, M., Lamrova, I., & Elfmark, M. (2009). Changes in speed and strength in female volleyball players during and after a plyometric training program. *Acta Universitatis Palackianae Olomucensis Gymnica,* 39, 59-66.

Lidor, R., & Ziv, G. (2010). Physical and physiological attributes of female volleyball players-a review. *Journal of Strength and Conditioning Research,* 24(7), 1963-1973.

López-Martinez, A. B., & Palao, J. M. (2009). Effect of serve execution on serve efficacy in men's and women's beach volleyball. *International Journal of Applied Sports Sciences,* 21(1), 1-16.

Mauro, D. (2012). *Beach volleyball secret of the pros.* Smashwords Edition.

Monteiro, R., Mesquita, I., & Marcelino, R. (2017). Relationship between the set outcome and the dig and attack efficacy in elite male Volleyball game. *International Journal of Performance Analysis in Sport,* 9(3), 1-10.

Natali, S., Ferioli, D., La Torre, A., & Bonato, M. (2019). Physical and technical demands of elite beach volleyballaccording to playing position and gender. *Journal of Sports Medicine and Physical Fitness,* 59(1), 6–9.

Palao, J. M., Santos, J. A., & Ureña, A. (2004). Effect of team level on skill per-formance in volleyball. *International Journal of Performance Analysis in Sport,* 4(2), 50-60.

Palao, J. M., Gutierrez, D., & Frideres, J. E. (2008). Height, weight, Body Mass Index, and age in beach volleyball players in relation to level and position. *The Journal of Sports Medicine and Physical Fitness,* 48(4), 466-471.

Palao, J. M., Valades, D., & Ortega, E. (2012). Match Duration and Number of Rallies in Men's and Women's 2000–2010 FIVB World Tour Beach Volleyball. *Journal of Human Kinetics*, 34(1), 99–104.

Palao, J. M., Valadés, D., Manzanares, P., & Ortega, E. (2014). Physicalactions and work-rest time in men's beach volleyball. *Motriz: Re-vista de Educação Física,* 20(3), 257–261.

Papageorgiou, A., & Spitzley, W. (2003). *Handbook for competitive volleyball.* Oxford: Meyer & Meyer Sport.

Pastore, J. C. F., Ferreira, C. A. A., Costa, F. C. H., & Joao, P. V. (2015). Case study: Proposal for training in combined plyometrics and muscular strength in improved vertical jump in beach volley. *International Journal of New Technology and Research (IJNTR)*, 2(5), 30-33.

Patsiaouras, A., Moustakidis, A., Charitonidis, K., & Kokaridas, D. (2011). Technical skills leading in winning or losing volleyball matches during Beijing Olympic Games. Journal of Physical Education and Sport, 11(2), 39-42.

Pereira, A., Costa, A. M., Santos, P., Figueiredo, T., João, P. V. (2015). Training strategy of explosive strength in young female volleyball players. *Revista Medicina,* 51, 26 –131.

Perez-Turpin, J. A., Cortell-Tormo, J. M., Chinchilla-Mira, J. J., Ce-juela-Anta, R., & Suarez-Llorca, C. (2009). Performance analysisthrough the use of temporal activity patterns of elite players inbeach volleyball. *Retos. Nuevas Tendencias En Educación Fisica, Deporte y Recreación,* (16), 67–69.

Pfirrmann, C. W., Jost, B., Pirkl, C., Aitzetmuller, G., & Lajtai, G. (2008). Quadriceps tendinosis and patellar tendinosis in professional beach volleyball players: sonographic findings in correlation with clinical symptoms. *European Radiology,* 18(8), 1703-1709.

Pomohaci, M., & Sopa, I. S. (2018). Discovering the cohesion of a volleyball team and finding the right leader of the group. *Revista Academiei Fortelor Terestre "Nicolae Balcescu" Sibiu,* 23(1), 58-65.

Quiroga, M., García-Manso, J. M., Rodríguez-Ruiz, D., Sarmiento, S., De Saa, Y., & Moreno, M. P. (2010). Relation between in-game role and service characteristics in elite women's volleyball. *Journal of Strength and Conditioning Research,* 29(9), 2316-2321.

Rodríguez-Ruiz, D., Quiroga, M., Miralles, J. A., Sarmiento, S., De Saá, Y., & García-Manso, J. M. (2011). Study of the technical and tactical variables determining set win or loss in top-level European men's volleyball. *International Journal of Per-formance Analysis in Sport,* 7(1).

Sheppard, J. M., Cronin, J. B., Gabbett, T. J., McGuigan, M. R., Etxebarria, N., & Newton, R. U. (2008). Relative importance of strength, power, and anthropometric measures to jump performance of elite volleyball players. *Journal of Strength and Conditioning Research,* 22(3), 758-765.

Smith, R. (2006). Movement in the sand: training implications for beach volleyball. *Strength and Conditioning Journal,* 28(5), 19-21.

Sopa, I. S., & Pomohaci, M. (2018a). Discovering the leader of a volleyball team using the sociometric survey method. *Timisoara Physical Education and Rehabilitation Journal,* 11(20), 27-33.

Sopa, I. S., & Pomohaci, M. (2018b). Evaluation of motor development and skills in mini-volleyball game (10-12 years old), *Bulletin of the Transilvania University of Brasov Series IX: Science of Human Kinetics,* 11(1), 95-104.

Sopa, S. (2019a). The influence of external factors in the efficiency of basketball scoring. Bulletin of the Transilvania University of Brasov. *Series IX, Sciences of Human Kinetics*, 12(1), 137-144.

Sopa, I. S. (2019b). Developing attack point in volleyball game using plyometric exercises at 13-14 years old volleyball players. Bulletin of the Transilvania University of Brasov. *Series IX, Sciences of Human Kinetics*, 12(2), 67-76.

Sopa, I. S., & Szabo, D. A. (2019). Statistical comparison related to service and reception of volleyball team CSM Volei Alba Blaj in the CEV Champions League Final Four 2018. *Timisoara Physical Education and Rehabilitation Journal,* 12(23), 16-25.

Sopa, I. S., & Szabo, D. A. (2020). Comparison between statistical parameters of attack and defense in high volleyball performance (CSM Volei Alba Blaj in the CEV Champions League Final Four 2018). *Bulletin of the Transilvania University of Brașov,* 13.1(62), 93-102

Szabo, D. A., Sopa, I. S., Stoica, R. S., & Ivănescu, A. (2018). The effectiveness of physiotherapeutic treatment in the recovery of the collateral ligament lesion. *Discobolul – Physical Education, Sport and Kinetotherapy Journal*, 14(52.2), 16-24.

Szabo, D. A., & Magdaș, L. (2014). Increasing the defensive efficiency in volleyball using the statistical program "Click&Scout". Conference proceedings of eLearning and Software for Education (eLSE), 1, 223-228.

Szabo, D. A. (2015a). Modalities of Using the Information Provided by the Statistical Program Click and Scout for Improving the Outside Hitters Service Efficiency in Volleyball Game. *The European Proceedings of Social & Behavioral Sciences EpSBS*, XI, 341-347. doi: http://dx.doi.org/10.15405/epsbs.2016.06.47

Szabo, D. A. (2015b). Study on improving the service unforced errors in volleyball game by using a statistical software. *Conference proceedings of eLearning and Software for Education* (eLSE), 3, 320-326.

Szabo, D. A., & Sopa, I. S. (2015). Study on the Interpretation of the Results in a Volleyball Game by Using a Specific Program of Statistics. *Procedia Social and Behavioral Sciences*, Elsevier Publication, Volume 180C, p. 1357-1363.

Szabo, D. A., & Sopa, I. S. (2018). Preventing shoulder injuries using prophylactic programs for volleyball players. *Discobolul - Physical Education, Sport and Kinetotherapy Journal,* 14(53), 49-57.

Szabo, D. A., Neagu, N., Teodorescu, S., Pomohaci, M., & Sopa, I. S. (2019a). Modalities of Exploitation the Information Provided by the Click&Scout Statistical Program in Preparing Volleyball Attack Players. *International Journal of Applied Exercise Physiology,* 8(2.1), 804-811.

Szabo, D. A., Neagu, N., Voidăzan, S., Sopa, I. S., & Gliga, C. A. (2019b). Analyzing the attack players in volleyball through statistical methods. *Health, Sports & Rehabilitation Medicine,* 20(4), 154-158.

Tilp, M., Wagner, H., & Muller, E. (2008). Differences in 3D kinematics between volleyball and beach volleyball spike movements. *Sports Biomechanics,* 7(3), 386-397.

Wise, M. (2002). *Serving. En D. Shondell, & C. Reynaud (Eds.), The volleyball coaching bible*. Champaign, IL, USA: Human Kinetics, pag. 163-175.

Yiannis, L., & Panagiotis, K. (2005). Evolution in men's volleyball skills and tactics as evidenced in the Athens 2004 Olympic Games. *International Journal of Per-formance Analysis in Sport*, 5, 1-8.

DOI 10.30892/gss.1402-0368

Zamparo, P., Perini, R., Orizio, C., Sacher, M., & Ferretti, G. (1992). The energy cost of walking or running on sand. *European Journal of Applied Physiology and Occupational Physiology,* 65(1), 183–187.

Zetou, E., Tsigilis, N., Moustakidis, A., & Komninakidou, A. (2006). Playing characteristics of men's olympic volleyball teams in complex II. *International Journal of Performance Analysis in Sport,* 6(1), 172-177.

Zetou, E., Moustakidis, A., Tsigilis, A., & Komninakidou, A. (2007). Does effectiveness of skill in complex I predict win in men's olympic volleyball games? International Journal of Performance Analysis in Sport, 3(4), 1-11.

Zetou, E., Giatsis, G., Mountaki, F., & Komninakidou, A. (2008). Body weight changes and voluntary fluid intakes of beach volleyball players during an official tournament. *Journal of Science and Medicine Sport,* 11(1), 139–145.

*** (2021). CONSERVATIVE TREATMENT IN CALCIFYING TENDINITIS OF SHOULDER. Available from: https://www.researchgate.net/publication/347691366_CONSERVATIVE_TREATMENT_IN_CALCIFYING_TENDINITIS_OF_SHOULDER [accessed Jan 05 2021].

© **GeoSport for Society**, volume 14, no. 1/2021, pp. 21-27, DOI 10.30892/gss.1403-067

GEOSPORT FOR SOCIETY
Scientific Journal founded in 2014 under aegis of University of Oradea (Romania), University of Debrecen (Hungary), University of Gdánsk (Poland)
ISSN 2393-1353
Edited by Oradea University Press
1, University Street, 410087, Oradea, Romania
Journal homepage: *http://geosport.uoradea.ro*

Sport and tourism facing the covid-19 pandemic

Maia MARGVELASHVILI[1*]

1. Georgian State Teaching University of Physical Education and Sport, Department of Sport Management, 49 I. Chavchavadze Avenue, 0162 Tbilisi, Georgia, e-mail: margvel.m@gmail.com

* *Corresponding author*

Citation: Margvelashvili, M. (2021). Sport and tourism facing the covid-19 pandemic. *Geosport for Society*, 14(1), 21-27. https://doi.org/10.30892/gss.1403-067

Article history: 12.01.2021; Revised: 25.03.2021; Accepted: 10.05.2021, Available online: 21.05.2021

Abstract: The present study focuses on understanding the current research on the sports and tourism facing the COVID-19 pandemic. A review of the contemporary literature is considered to identify and classify research that focuses on the sports and tourism industries in the time of Covid-19. The primary purpose of review was to identify and analyze the findings of relevant studies that are addressing defined research question. Restrictions imposed on the spread of the virus have affected all aspects of human life, including sports and tourism. As a result of the pandemic, we have severely restricted travel, canceled sports events, empty hotels, closed theaters, restaurants, cafes, and bars. That has had devastating consequences for the sports and tourism industries. Above limitations have made two things lucid - the desire of people to get out of the house and have the opportunity to travel beyond their daily movement, and recognition that physical activity and the ability to watch sports event, are a significant factor in supporting and ensuring the wellbeing of the people. These concepts are discussed in detail. Also, the matter of promoting electric scooters as an alternative to vehicles for urban mobility is discussed. The study proposes that at this early stage, while the pandemic is not yet about to recede, as evidenced by the current state of the world, it is too early to draw any far-reaching conclusions. But in this context, some basic concepts formed for further analysis of the issue. Undoubtedly, life after the pandemic will be quite different, and it is time for tourism and sports policymakers and organizers to start preparing for that.

Keywords: Covid-19, sports, tourism, physical activity, sports event, alternative transportation

Introduction

In January 2020, the World Health Organization declared Covid-19 an international threat to public health. And a few weeks later, it was recognized as a pandemic with 118 thousand infected and 4300 dead in 114 countries. In March, Europe became the epicenter of the virus, after which it spread to America and spread around the world. There are currently 88 million infected and 1 million 900 thousand dead worldwide (Worldometer, 2021).

DOI 10.30892/gss.1403-0367

233.879 cases of Covid-19 are confirmed in Georgia at present. 223.276 infected have already fully recovered, while 2,666 have died. [1]

The virus that caused the global pandemic, against which there was neither vaccine nor cure, brought strict isolation measures to deal with it. Restrictions imposed on the spread of the virus have affected all aspects of human life, including sports and tourism. As a result of the pandemic, we have severely restricted travel, canceled sports events, empty hotels, closed theaters, restaurants, cafes, and bars. That has had devastating consequences for the sports and tourism industries. However, due to their nature, it is known that they characterized by rapid recovery (Cooper et al., 2005), and upon the end of the pandemic, both industries will occupy leading positions in the world economy, although with some adjustments, which are quite hard to predict at this stage and require significant observation and analysis.

The present study focuses on understanding the current research on the sports and tourism industries facing the COVID-19 pandemic. A review of the contemporary literature is considered to identify and classify research that focuses on the sports and tourism industries in the time of Covid-19. The primary purpose of review was to identify and analyze the findings of relevant studies that are addressing defined research questions.

For researchers in physical activity, health, wellbeing, sports, and tourism, above limitations have made two things unambiguous: (a) The desire of people to get out of the house and have the opportunity to travel beyond their daily movement, which, of course, was much more limited than in normal circumstances, and (b) Recognition that physical activity and the ability to watch sports, especially sports events, are a significant factor in supporting and ensuring the wellbeing of the people. Taken together, both observations revealed that sport and tourism could play an important role in supporting the response to Covid-19, as well as being an important lesson and example that could influence future response to other public issue policies (Weed, 2020).

Methodology

The literature review conducted using Google Scholar and WHO COVID-19 databases on the impact of Covid-19 on sports and tourism industries. The study selected twenty nine publications with participants from eleven countries. The following research question has guided this review: what impact has Covid-19 on sports and tourism industries.

There has been a lot of discussion and debate among the authors over the years about the exact definition of sports tourism. To move from precise definition to conceptualization and better characterize sports tourism, Weed and Bull (2004) suggested that sports tourism is better understood as arising from the unique interaction of activity, people, and place. An accurate definition of sports tourism is less significant for our analysis than identified concepts. The fact is that the sense of movement and place, the activity, its interdependence with the place, the experience received, and all of the above together contribute to human wellbeing.

[1] https://civil.ge/archives/342486

In all of the above concepts, and given the role of sport and tourism in the Covid-19 response process, these interactions seem to be significant and the key to the sense of wellbeing that people and policymakers strive to achieve during a pandemic.

In this regard, the proposed review discusses two areas: a) sports events and b) physical activities and travel.

Result

As the impact and spread of Covid-19 became clearer in February and March 2020, sports event hosts and administrations began discussing whether to postpone or cancel their events. Perhaps most important among them was the discussion of the Tokyo Olympic and Paralympic Games, which was planned for July 24, 2020.

Initially, the International Olympic Committee and other administrations, such as the World Athletics Council, suggested that it was not necessary to consider canceling the Games until the Covid-19 impact was clarified (McCurry, 2020). Herein, this position has been maintained for quite some time, despite growing evidence of a devastating global impact of the virus. This decision was also strange according to the criteria by which it was made. The reasons given for not canceling included the need to protect the income of elite athletes' and the rescheduling of events in the busy international sports calendar; whilst also commenting that despite increasing lockdown restrictions in many countries, it was necessary to allow athletes to continue training so that their preparation for the Games would not be impaired (BBC Sport, 2020). They did not envisage the international movement of significant masses of people, which posed such an event, nor the obvious threat to the health of athletes, their family members and the encirclement. Finally, the decision to postpone the Tokyo Games was made on March 24, 2020. Thus, if we want major sports events to play a positive role in the economy and society, decisions about their holding must be made with the necessary consideration of the problems of society. The fact that there has been no immediate response to the world's most significant threat to public health was a big accusation and an important lesson for the future.

Strict lockdown measures taken by various countries around the world meant that local leagues and international sports events, which usually attracted both traveling live spectators and large television audiences, were abruptly discontinued. That has left sports fans who suppose that 'being there' is always significant, without favorite sports spectacles, which has caused nostalgia in many countries around the world (Weed, 2010).

The principal theme of nostalgia caused by lockdown is not only the longing for the past but also the hope and expectation that impressions of the past will return in the future. Boym (2008) has termed this restorative nostalgia that linked to the role of hope as a positive and uplifting emotion (Lazarus, 1999).

Given the role of restorative nostalgia in sports events and their reactivation for the wellbeing of the people, the UK Government has supported the launch of elite sports tournaments as lockdown loosened, but behind closed doors, for broadcast (TV) only (HM Government, 2020).

DOI 10.30892/gss.1403-0367

But, for example, watching live football play at empty stadiums at home, as restriction measures still prohibit the gathering of more than a few socially distanced people, has the potential for bizarre isolation. It is probably not essential if the person just wants to watch the game, but if he/she also wants to share his/her experience with someone - he/she will be disappointed.

Department of Economic and Social Affairs of the United Nations on May, 2020, in their Policy Brief №73 on The impact of COVID-19 on sport, physical activity and well-being and its effects on social development, has issued following recommendations to: [2]

1. Sporting federations and organizations. Governments and intergovernmental organizations may provide sports federations, clubs and organizations around the world with guidance related to safety, health, labor and other international standards and protocols that would apply to future sport events and related safe working conditions. This would allow all stakeholders to work cooperatively as a team with the objective to address the current challenges and to facilitate future sports events that are safe and enjoyable for all.

2. Professional sport ecosystem. The sport ecosystem, comprising of producers, broadcasters, fans, businesses, owners and players among others, need to find new and innovative solutions to mitigate the negative effects of COVID-19 on the world of sport. This includes finding ways to engage with fans in order to ensure safe sport events in the future while maintaining the workforce, creating new operating models and venue strategies.

Hopefully, governments and organizations will take timely steps to implement these recommendations completely.

The second direction concerns physical activities and travel.

In most countries of the world, no matter how strict the lockdown measures were, some exceptions were made for some types of physical activity or exercise. In the early stages of lockdown, the UK, like many other countries, has limited such physical exercises (for example, only up to an hour per day, near home, with only one family member) but, were broadly limited to walking, jogging, or cycling.

The reaction turned out to be quite surprising. A survey commissioned by Nuffield Health found that more than three-quarters of people in the UK chose a new form of exercise in addition to walking, jogging, or cycling - activities at home such as yoga, weight loss exercises, and home treadmills (Nuffield Health, 2020). Not surprisingly, walking exercise turned out to be the most popular activity. Herein, almost two-thirds of people reported that physical exercises were significant for their mental health and wellbeing.

In the same UK, in the first weeks after the introduction lockdown, one of the most critical aspects of public debate became the rules of exercise outside and access to green spaces. While those whose homes were close to such green spaces could freely use it, it proved impossible for others who needed transportation to do so. It has given rise to a discussion about the social and health inequalities created (Duncan et al., 2020).

[2] https://www.un.org/development/desa/dpad/publication/un-desa-policy-brief-73-the-impact-of-covid-19-on-sport-physical-activity-and-well-being-and-its-effects-on-social-development/

These debates have illustrated the importance of not only physical exercises but also the places where these exercises were carried out (Atkinson et al., 2016). The impact of exercising on wellbeing in natural green areas greatly outweighs the impact of exercising in urban areas (Barton et al., 2016). So, as it turned out, achieving wellbeing is also linked to moving to the places that are perceived to be different from home.

It suggests that the impact of sports tourism on wellbeing is even broader than previously conceived and maybe an obvious shortcoming in what might be designate as everyday sports tourism.

Strict lockdown restrictions have led to the shortening of all motorized travel types, with air travel experiencing the broadest reduction. However, UK data showed that vehicle use fell by two-thirds in the first month of restrictions. Although restrictions loosened in the summer and people started working, vehicle use at the end of June was only 75% before the lockdown rate (Department of Transport, 2020). The same data also showed that taking advantage of bicycles as a type of transportation increased by an average of 50% to 100%, and in some weeks (mostly in the good weather) by more than 200%. These data have sparked significant debate over whether the experience of severe restrictions will lead to sustained growth in more sustainable forms of travel.

It does not seem to be a coincidence to increase bicycle use by reducing vehicle use by two-thirds due to restrictions. Hopefully, such intensive use of bicycles will continue after the return of vehicles.

Discussion

Alleviating the constraints caused by the pandemic has highlighted the need for individual, low-emission transport that allows for social distance. An electric scooter can be considered as such because it is a fun and eco-friendly way to move for short distances.

Improving pedestrian conditions, arranging bicycle paths, and promoting small electric scooters can reduce dependence on vehicles. The rapid development of digital technologies has made it very easy and convenient for citizens to use electric scooters.

Currently, electric scooter sharing systems are already available in more than 100 cities in 20 countries. Europe and the US are leading by this figure. According to studies, by 2024, there will be 4.6 million electric scooters in operation.

Numerous cities around the world are actively implementing ambitious scooter-sharing schemes. After people avoided public transport due to the pandemic, electric scooters appeared in Tbilisi and Batumi. Electric scooters are actively establishing themselves, becoming more and more popular and increasing their number on city streets and parks.

The scooter-sharing system "Scroll" first appeared in the capital of Georgia on April 27, 2020. It became an alternative to many other means of transport due to public transport restrictions (Kvashilava, 2020).

Electric scooters were promoted as a green alternative to vehicles for short distances. It is noteworthy that after the use of electric scooters, 39% of consumers

DOI 10.30892/gss.1403-0367

travel less by vehicles. In the cities of Georgia, a scooter can be considered as a transport means that can freely replace a vehicle for short distances. For achieving this, it is necessary to make it more affordable and secure.

It should be noted, however, that with the increase in the number of electric scooters, the number of road accidents associated with them has increased. Electric scooters on the sidewalk pose a danger to pedestrians, wheelchair users, especially the weak eyesight persons.

Electric scooter-sharing companies pay close attention to sustainability issues. Some of them are introducing the use of renewable energy in the operation system, improving the durability of scooters through better design, etc.

For example, the company Bird, which has about 2,000 scooters already operating in Georgia, says that its latest models of electric scooters can last up to two years, while the first models are marked by about three or four months of durability. Recently, the company Lime promised that by 2030 its fleet will be 100% powered by an electric motor. The fulfillment of the promise started in Paris, where only eco-friendly transport operates the system. The main challenge of the electric scooter sharing service is its availability to a broad segment of citizens.

During the pandemic, sales of electric scooters increased in Finland, Ireland, and the UK, although their use in the streets of two latter countries is still illegal. The UK is not the only country that makes electric scooters part of its post-pandemic transport strategy. That is what happened in Australia and Colombia. Bogota has eased regulations on electric scooters for service providers. Buenos Aires supports the use of bicycles and scooters when traveling short distances. Rome had its first electric scooters in May. According to one of the mayors, after the changes caused by the pandemic, the ruling circles should encourage new means of mobility.

The Italian government's Covid-19 working group has partnered with Helbiz - the electric scooter company, which supports mobility through social distance, and says the paradigm needs to be changed and the state's priority should be to provide citizens with wellbeing and mobility alternatives that allow them to move around without compromising the sustainability element. The government is offering subsidies to city residents to buy electric scooters. It will be perfect introducing such an approach in other countries as well.

Conclusions

The presented analysis revealed that sport and tourism play a significant role in supporting the response to Covid-19 and become an important lesson and example, which may influence solving other community-wide problems in future.

It is clear that at this early stage, while the pandemic is not yet about to recede, as evidenced by the current state of the world, it is too early to draw any far-reaching conclusions. But in this context, some basic concepts formed for further analysis of the issue. Undoubtedly, life after the pandemic will be quite different, and it is time for tourism and sports policymakers and organizers to start preparing for that.

Recommendations of the UN Department of Economic and Social Affairs, provided in their Policy Brief №73, indicate the significance and necessity of such preparation.

References

Atkinson, S., Fuller, S., & Painter, J. (2016). *Wellbeing and place*. 274 p., London: Routledge.

Barton, J., Bragg, R., Wood, C., & Pretty, J. (2016). *Green exercise: Linking nature, health and wellbeing*. 228 p., London: Routledge.

BBC Sport. (2020). *Tokyo Olympics & coronavirus: Lord Coe says too early to decide on cancellation (March 19).* Available at https://www.bbc.co.uk/sport/olympics/51958640 (Retraived on November 29th, 2020).

Boym, S. (2008). *The Future of Nostalgia*. New York: Basic Books.

Cooper, C. P., Fletcher, J., Wanhill, S., Gilbert, D., & Shepherd, R. (2005). *Tourism: principles and practice* (3rd ed.), 810 p., Pearson Education.

Covid-19: *Georgia Live Blog*. Available at https://civil.ge/archives/342486 (Retrieved on January 7, 2021).

Department of Economic and Social Affairs of the United Nations, May, 2020, Policy Brief №73 on The impact of COVID-19 on sport, physical activity and well-being and its effects on social development, Available at https://www.un.org/development/desa/dpad/publication/un-desa-policy-brief-73-the-impact-of-covid-19-on-sport-physical-activity-and-well-being-and-its-effects-on-social-development/ (Retraived on December 12, 2020).

Department of Transport. (2020). Transport use by mode: Great Britain, since March 1, 2020. Available at https://www.gov.uk/government/statistics/transport-use-during-thecoronavirus-covid-19-pandemic (Retrieved on December 6, 2020).

Duncan, P., McIntyre, N., & Cutler, S. (2020). Coronavirus park closures hit BAME and poor Londoners most (The Guardian, April 10). Available at https://www.theguardian.com/uk-news/2020/apr/10/coronavirus-park-closures-hit-bame-and-poor-londoners-most (Retrieved on December 6, 2020).

HM Government. (2020). Our plan to rebuild: The UK Government's COVID-19 recovery strategy. London: HM Government.

Kvashilava, G. (2020). Future of Electric Scooters in Georgia. Available at https://publika.ge/article/eleqtro-skuterebis-momavali-saqartveloshi/ (Retrieved on December 3, 2020).

Lazarus, R. S. (1999). Hope: An emotion and a vital coping resource against despair. *Social Research*, 66(2), 653–678.

McCurry, J. (2020). *Tokyo 2020 organisers fight false rumours Olympics cancelled over coronavirus crisis*. The Guardian, January 31. Available at https://www.theguardian.com/world/2020/feb/01/tokyo-2020-organisers-fight-false-rumours-olympics-cancelled-over-coronaviruscrisis (Retrieved on June 29, 2020).

Nuffield Health. (2020). *Over half of Brits have taken up a new form of exercise during lockdown, with many vowing to continue with their new regimes (10 May).* Available at https://www.nuffieldhealth.com/article/over-half-of-brits-have-taken-up-a-new-form-of-exercise-during-lockdown-with-many-vowing-to-continue-with-their-new-regimes (Retrieved on December 12, 2020).

Weed, M. E. (2010). Sport fans and travel – is 'being there' always important. *Journal of Sport & Tourism*, 15(2), 103–109.

Weed, M. E., & Bull, C. J. (2004). *Sports tourism: Participants, policy & providers* (1st ed.). 351 p., Oxford: Elsevier.

Weed, M. E., (2020). The role of the interface of sport and tourism in the response to the COVID-19 pandemic. *Journal of Sport & Tourism*, 24 (2), 79-92.

Worldometer. (2021). *COVID-19 Coronavirus Pandemic*. Available at https://www.worldometers.info/coronavirus/ (Retrieved on January 7, 2021).

© **GeoSport for Society**, volume 14, no. 1/2021, pp. 28-46, DOI 10.30892/gss.1404-074

GEOSPORT FOR SOCIETY
Scientific Journal founded in 2014 under aegis of University of Oradea (Romania), University of Debrecen (Hungary), University of Gdánsk (Poland)
ISSN 2393-1353
Edited by Oradea University Press
1, University Street, 410087, Oradea, Romania
Journal homepage: *http://geosport.uoradea.ro*

The Urban Legacy Impacts of Mega-Event Stadia: Selected Case Studies from South Africa

Hilary K. N. BAMA [1*], Tembi M. TICHAAWA[1]

1. University of Johannesburg, School of Tourism and Hospitality, College of Business and Economics, Bunting Rd, Cottesloe, 2092, Johannesburg, South Africa, e-mails: tembit@uj.ac.za, hbamason@gmail.com

* *Corresponding author*

Citation: Bama, H.K.N. , Tichaawa, T.M. (2021). The Urban Legacy Impacts of Mega-Event Stadia: Selected Case Studies from South Africa. *Geosport for Society*, 14(1), 28-46. https://doi.org/10.30892/gss.1404-074

Article history: 21.05.2021; Revised: 30.05.2021; Accepted: 01.06.2021, Available online: 02.06.2021

Abstract: This study considered the urban infrastructure legacy impacts of mega-events in the Global South with a specific focus on South Africa's 2010 stadia. By way of multiple case studies, undertaken in 2010 FIFA World Cup stadia in host cities Cape Town, Durban and Port Elizabeth, and applying a mixed-method approach, n=1120 urban residents living within a 2-km radius were surveyed in addition to interviews with key resource persons. The empirical findings indicate the existence of significant statistical differences in the perceptions of the urban residents and other stakeholder groups regarding the sustainability precepts that accompany the construction of stadia associated with the long-term urban infrastructure legacy implications. While the urban residents and the key resource persons agreed that the stadia had the potential to attract positive urban infrastructure legacy outcomes to their communities, one of the critical observations noted was the agreement that the costs associated with the maintenance and operations of these stadia were currently enormous, posing significant sustainability challenges and contentions. The study provides fresh insights into long-term mega-event urban infrastructure legacy impact assessment from a developing country perspective with innovative planning and strategy implications.

Keywords: Mega-event stadia, FIFA World Cup, tourism, sustainability, infrastructure development, legacy

Introduction

This study considered the urban infrastructure legacy impacts of mega-events in the Global South with a specific focus on South Africa's 2010 stadia. Mega-events have featured prominently on the agendas of countries of the Global South in the last few decades and contemporary discourse indicates robust engagements by these countries in the mega-event complex with prime intention to leverage their catalytic infrastructure development impetus while being increasingly incorporated into their urban planning agendas (Hemmonsbey and Tichaawa, 2018, 2019; Koch and

Valiyev, 2016; Preuss, 2015; Wood, 2017; Stewart and Rayner, 2016; Chen et al., 2013; Steinbrink et al., 2011; Kassens-Noor and Kayal, 2016). There has therefore been an increased significance in mega-events due to their potential to transform entire urban spaces (Preuss, 2015; Philips and Barnes, 2015; Kassens-Noor and Kayal, 2016). In 2010, South Africa hosted the first ever FIFA World Cup to be held on the continent since the inception of the showpiece (Tichaawa and Bama, 2012; Swart and Bob, 2012). In preparations for the hosting of the event, local authorities, urban planning and other event proponents suggested that the hosting of the event stood the chance of fast-tracking developmental projects, often related to stadia, housing, transport and telecommunications, and by implication, that it similarly would transform the image of the cityscape with the resultant effect of attracting increased tourism (Hemmonsbey and Tichaawa, 2018, 2019; Ilieş et al., 2014. Kassens-Noor and Kayal, 2016; Stewart and Rayner, 2016; Chen et al., 2013; Kunzmann, 2016; Steinbrink et al., 2011). Specifically, in the case of stadia, contentions were that enormous resources, both financial and physical, would be committed to ensuring their readiness for the events, an assertion which was true for the case of the 2010 FIFA World Cup hosted by South Africa. In this regard, Bama (2018) notes that South Africa spent in the region of R17 billion in the construction and upgrading of stadia alone, a figure which Molloy and Chetty (2015) highlighted constituted the largest portion of the budget outlay for the entire 2010 FIFA World Cup event preparations.

In mega-event legacy discourse, few studies have looked at the infrastructure legacy constructs that often accompany the hosting of these events as well as the post-event sustainability of these structures. As such, the knowledge regarding legacy planning, delivery, and the barriers associated with realising legacies is fragmented which raises the issue of the need for a holistic approach towards understanding how legacy is delivered (Bocarro et al., 2018; Hemmonsbey and Tichaawa, 2018, 2019; Thomson et al., 2018). Specifically, in the developing context, and owing to the fact that between 2010 and 2022, all mega-events in this category (Olympic Games or FIFA World Cup) have been hosted in emerging destinations, with Africa (FIFA World Cup South Africa 2010), Eastern Europe (FIFA World Cup Russia 2018), the Middle East (FIFA World Cup Qatar 2022), and the first Olympic Games in South America (Rio de Janeiro 2016), integrated strategies are needed in order to maximise the legacy outcomes of such events. The only exception within this period is the upcoming Olympic Games that were granted to Tokyo, Japan to be held in 2021 (Müller and Gaffney, 2018). This apparent dominance by emerging economies in the mega-event complex begs for a concise consideration of their legacy outcomes, specifically around stadium infrastructure legacies, which often form spatial and architectural markers for the host destinations in the aftermath of the events. By adopting selected stadia across South Africa that were constructed for the hosting of the 2010 FIFA World Cup, this paper considers stakeholder views in relation to the debates surrounding the legacy impacts of mega-event stadia in the context of the Global South while paying attention to issues around their sustainability. Furthermore, there seems to be mounting evidence which challenges the ability of mega sport events to produce sustainable, positive legacies, prompting

DOI 10.30892/gss.1404-074

further research on whether legacy is indeed mutable in the context of stadium infrastructure development (Bama, 2018; Brittain et al., 2018). Following calls for mega-event legacy impact research to be conducted over time; this study considers the urban infrastructure legacy dimensions with specific reference to those linked to stadia. In pursuing this objective, the study is structured in the following manner: the literature review puts mega-event legacy in context for the study concerned, while it discusses key concepts around legacy in terms of sustainability within a developing context. The study's mixed (quantitative and qualitative) methodological framework is highlighted in the subsequent section, and, thereafter, a descriptive and thematic presentation of the study's findings is elaborated upon and discussed, based on in-depth analysis of the data. Lastly, the study's implications are outlined, before the study concludes with final remarks and recommendations for future research.

Literature Review

Mega-event legacy in the context of stadium infrastructure

Mega-events are a feature of modern urban life and are an integral component of 20th-century urban development. Kim et al., (2019) and Kassens-Noor et al., (2019) assert that mega-events have been shown to affect the environments within which they are hosted with various transformative changes including the opportunity to develop tourism-related infrastructure and media attention. Clark et al., (2016), highlight that in many ways the essence of mega-events is linked to scale. Increasingly, such events are being hosted by countries in the 'Global South', raising new challenges as to how they are organised, and what impacts they might portend (Byers et al., 2019; Robbins, 2012). These mega-events have often been justified as catalytic in terms of their ability to engender urban transformation and other legacy benefits (Hemmonsbey and Tichaawa, 2018, 2019; Kim et al., 2019; Müller and Gaffney, 2018). According to Philips and Barnes (2015), the planning of urban development in the developing context involves making the urban landscape more livable by addressing challenges around urban poverty, inequality and environmental decay, and as such, urban planners tend to rely on leveraging mega-events as urban planning strategies for their development related impacts, a position which is acknowledged by other scholars in the area (Bama and Tichaawa, 2020; Byers et al., 2019; Ferrari and Guala, 2017; Steinbrink et al., 2011). In addition, urban planners and event proponents have been noted to use the hosting of mega-events along four integral dimensions, in relation to which scale should be considered: visitor attractiveness; mediated reach; cost, and transformative impact (Hemmonsbey and Tichaawa, 2018, 2019; Müller, 2017).

In the process of the hosting of these mega-events, there is a need for investments to be made in the area of infrastructure that will be used for the event (Byers et al., 2019; Groothuis and Rotthoff, 2014). According to Cottle (2010), such investments often attract a high premium to the host community which, as opined by Müller and Gaffney (2018), include capital cost of material interventions in the city such as the upgrading or building of new sports venues, roads, railway lines, airports, conference centres, security systems, and hotels and often runs into billions of dollars, which is several times the operational cost of putting on the event

itself (Humphrey and Fraser, 2016; Gold and Gold, 2016). The escalating costs, and the increasingly substantial sums of taxpayers' resources that are regularly sunk into preparing the stadia for such hosting activities, often are followed by either low keyed legacy outcomes with little or scant policy learning taking place (Bama and Tichaawa, 2020; Girginov, 2011; Grix and Brannagan, 2017; Kim et al., 2019; Leopkey and Parent, 2012; Tomlinson, 2014). Legacy should, therefore, be considered as a high-risk strategy for justifying exorbitant expenditures on sport mega-events with no dedicated focus on research that informs the existence and process through which sport mega-events enhance the attainment of legacies (Byers et al., 2019; Zimbalist, 2017). Extant literature related to sport event legacies suggest that legacy planning should be adopted at the inception stage of the conceptualisation of the events and that an impacts and implementations team be constituted and adequately funded after the event in order to ensure that the legacy plan is executed and monitored in the events' aftermath - especially legacy considerations around infrastructure linked to stadia (Bama and Tichaawa, 2020).

According to Black (2007) and Philips and Barnes (2015), the pursuit of sport mega-events by the developed and the developing countries is linked to the exigencies and the impetus of mega-events acting as developmental strategies. Mega-event boosters have often provided positive projections of their intentions towards the hosting of mega-events. According to Gaffney (2013), the preparations for the hosting of the flagship events are often preceded by massive investments in infrastructure, both in terms of the event-related infrastructure, such as the stadia, and other related infrastructure investments, such as transport infrastructure upgrades, roads, airports and others. Infrastructural development and sustainability contestations are, therefore, gaining prominence among participants seeking to deliver sustainable mega-events (Humphrey and Fraser, 2016; Preuss, 2015; Tichaawa et al., 2015). To this end, opponents have variously indicated that such infrastructure investments sometimes come with huge financial burdens. For example, Hlabane (2012:102) highlights figures presented by Sturgess and Brady (2006:28), who indicate that, for the FIFA World Cup event co-hosted by Japan and Korea in 2002, "a combined sum of US$ 4.5 billion was spent on stadia alone". In the case of Germany, a total of US$ 1.92 billion was invested in developing stadia for the 2006 FIFA World Cup (Sturgess and Brady, 2006). The authors further opined that the trend is suggestive of the fact that the sums allocated for building stadia have been increasing, and that the numbers are expected only to rise further in the future (Sturgess and Brady, 2006). Additionally, a plethora of studies have indicated that the impacts of sport stadia to local economies have not been in alignment with related theory (Alm et al., 2012; Byers et al., 2019; Groothuis and Rotthoff, 2014; Kassens-Noor et al., 2019; Kim et al., 2019). To situate the discussion and debates in context, the urban nature of these mega-event stadia receive some consideration next.

The urban nature of the mega-event stadia

The allure of sport mega-events has been noted as a means by which hitherto dilapidated urban areas can be re-energised and renewed (Coates, 2007; Gaffney, 2013, 2015). Undoubtedly, stadia impact on their locality and on the larger urban

DOI 10.30892/gss.1404-074

environment (Gaffney, 2013). Mega-events are considered as urban spectacles for the most part, with investing in them consequently affecting the urban spaces within which they occur (Blomgren and Valkonen, 2007; Coates, 2007; Gaffney, 2013, 2015; Jaworek et al., 2020; Montgomery, 2008; Moshoeshoe, 2014). According to Rosentraub (2010), the construction of a stadium in a downtown area has been shown to be capable of positively revitalising such an area by encouraging far greater private development in the surrounding areas. The successfulness of stadia has mostly been rated in terms of their ability to spur on economic development in their surrounding areas (Koehler, 2012). A key element in urban discourse that could largely affect the success of sports stadia is their location, with Koehler (2012), in such regard, stating that the only stadia that have successfully revitalised their surrounding areas have been those that are situated in the downtown areas of cities. An argument that was put forward for the construction of the stadium in Cape Town in the run-up to the 2010 FIFA World Cup was that the stadium would help with the urban regeneration of the city, and specifically the Athlone area, where the stadium was initially meant to have been located (Swart and Bob, 2009).

Furthermore, other urban-demography-related characteristics that have been noted to encourage successful stadia relate to the sizes of the stadia, to the distance of the stadia from public transport, and to other socio-demographic indicators, such as the average income and crime statistics in the surrounding areas (Coates, 2007; Koehler, 2012; Mills and Rosentraub, 2013; Rosentraub, 2010). Such outcomes have, however, only been successfully tested in the Global North, and the context and outcomes might be very different in the case of the Global South economies that have, in the recent past, also been involved in the mega-event complex. Examples abound of where the residents have tended to resist the attending of events in the stadia, even though the stadia are situated well within the inner limits of cities, with urban transport networks available, and with almost negligible crime rates (Grix and Brannagan, 2017; Moshoeshoe, 2014; Swart and Bob, 2012). In the case of the 2014 FIFA World Cup and the 2016 Summer Olympics having been hosted by Brazil, the indications have shown that the infrastructure-related investments that were made in the run-up to the events assumed an 'unsustainable status' that was similar to the claims that have been levied on the stadia in South Africa since the end of the 2010 FIFA World Cup (Douglas, 2015; Gaffney, 2015; Kiernan, 2014; Patel, 2016). Thus, stadium-related legacies have become contentious mega-event legacy narratives, owing to their costs relative to their benefits.

Legacy impacts of mega-event stadia within the developing context

Among the multitude of studies that have focused on examining the concept of legacy, the majority concur that mega-event legacies are the outcomes that could be linked not only to the permanent sequel, but also to the adaptations to, changes or readjustments to normality as a function of the outcomes of the event (Bama and Tichaawa, 2015; 2016; Black, 2007; Cashman and Horne, 2013; Chappelet and Junod, 2006; Cornelissen, 2007; Cornelissen et al., 2011; Hemmonsbey and Tichaawa, 2019; Preuss, 2007, 2011, 2013; Smith and Fox, 2007). Mega-event hosting necessitates the investment into the creation of infrastructure such as stadia

(Groothuis and Rotthoff, 2014). These stadia investments usually come at a high premium to the host community (Cottle, 2010; Molloy and Chetty, 2015). Certain factors have rendered the study of the nature of the events more relevant in contemporary times. The factors consist, among others, of the increasingly wide range of states seeking to host them, including those from the Global South, the escalating costs, and the increasingly substantial sums of taxpayers' resources that are regularly sunk into preparing the stadia for such hosting activities. In addition, such factors include the justificatory discourse around the spending on such events, whereby the stadium infrastructure legacies are brandished as the key return on investment. Despite the mounting evidence that many of the stadium-linked legacies have failed to materialise, the perennial sport event cycle has continued, with little policy learning taking place (Girginov, 2011; Grix and Brannagan, 2017; Leopkey and Parent, 2012; Tomlinson, 2014).

However, it has also been noted, variously, that the provision of such sport infrastructure such as stadia, beyond being used for the sporting competition, also portends an array of positive and negative legacy impacts on the host communities of mega-events. For example, mega-sporting events are considered capable of generating positive outcomes and consequences for the host communities, such as image enhancement, urban regeneration and renewal, heightened awareness, leisure resource development, positive socio-economic impacts, and infrastructure development. In contrast, the negative impacts for the host community could include, for example, the high costs for stadium construction, negative socio-economic impacts, traffic problems, increases in the cost of living, gentrification, overcrowding, and societal and cultural problems (Almeida et al., 2014; Girginov, 2011; Grix and Brannagan, 2017; Leopkey and Parent, 2012).

The hosting of the 2010 FIFA World Cup in South Africa was the first of the first-order mega-events to be staged on African soil within the context of the developing economies. Cezne (2014), therefore, highlights the contention that, historically, mega-events have managed to transmit powerful messages, playing a multitude of both explicit and implicit roles. The heightened consideration of such potential is encapsulated by Erten and Özfiliz (2006:525) in their analysis and commentary in relation to the potential of mega-event stadia when they state that "[S]tadia have always been significant urban elements for many reasons like the extent of the area that they occupy in a city, their size, their function, the spatial relations they motivate." Cornelissen et al. (2011) contend that the development of stadia in the mega-event literature is pursued based on the critical component of the legacies that are associated with the hosting of such mega-events. In the case of South Africa and the hosting of the 2010 FIFA World Cup, a plethora of researchers postulate that the stadia were extremely costly to build, with costs rising from the initial estimates of R2.5 billion to R8.4 billion, and then, finally, to over R10 billion by the time of their completion (Desai and Vahed, 2010; Jory and Boojihawon, 2011; Maharaj, 2011; Tichaawa and Bama, 2012). The final figures, according to Hlabane (2012), suggest that the stadium construction and upgrades programme for the 2010 FIFA World Cup cost the South African government R16.16 billion.

DOI 10.30892/gss.1404-074

In the current era of global urbanism, the intricate relationship between capital accumulation and urban spatial transformation in the context of mega-events, often engendered through event-driven strategies remain contested and uncertain (Lin and Xu, 2019). Specifically, impact-related and legacy debates and discourses relating to the stadia that are often constructed for such events are scant. Ren (2017) intimates that most existing enquiry does not venture enough into the complex layers of institutional contexts that underpin the structure of event-driven urbanisation and its outcomes. Meanwhile, Lin and Xu (2019) assert that extant literature on mega-events provides contentious and competing interpretations of such strategy. It is hoped therefore that the current study delves into these conundrums and provides fresh insight into how these stadium-related infrastructure legacies could be comprehensively identified by future host communities, especially within the developing context.

Methodology

In examining the perceptions of urban residents in relation to mega-event stadia development and their urban legacy implications, the study adopted a mixed method approach, applying both quantitative and qualitative techniques for the collection, analysis and the interpretation. The combination of these approaches has engendered the implementation of the pragmatic approach, especially adopted as it is regarded as the philosophic partner of mixed methods research and provides a workable solution to multifaceted research problems in relation to post-positivism (Johnson and Onwuegbuzie, 2004). The study was based on the Cape Town Stadium located in Cape Town, the Moses Mabhida Stadium located in Durban and the Nelson Mandela Bay Stadium located in Port Elizabeth. Figure 1 presents an illustration of the geographic representations of all nine host cities of the 2010 FIFA World Cup, also noting the case study areas under investigation. The justification for choosing the three stadiums was based upon the premise that each is primely located in the urban coastline of South Africa, with communities living close to them. Moreover, these stadiums were newly constructed for the purpose of the event and drew sharp criticism in terms of their choice of location (Swart and Bob, 2009).

The study targeted urban residents, living within a 2-km radius of the three case study areas. This radius is recommended by previous relevant research that has found that such residents are more likely to be impacted by the stadium or hold a strong interest in them (Bassa and Jaggernath, 2010; Swart and Bob, 2009; Tichaawa and Bama, 2012). A total of 1120 (Cape Town n=400, Durban n=320, Port Elizabeth n=400) willing adult members were randomly interviewed. The survey instrument that was used comprised of several questions linked to the sociodemographic profiles of the respondents. In addition, a traditional 5 point Likert type scale where 1= Strongly agree; to 5 = Strongly disagree was used to rate several urban infrastructure related impact based statements that were informed by previous mega-event related studies (see for example Agha, 2013; Allen et al., 2013; Alm et al., 2012; Bob and Kassens-Noor, 2012; Cottle, 2010; Giampiccoli et al., 2015; Gunter, 2014) albeit they were modified to suit the current study objectives. The surveys were undertaken in 2016/17 (about 7 year's post-event)

with the assistance of trained fieldworkers. Consequently, the surveys provide a long-term perspective of the resident' views on the stadia and urban infrastructure related legacy.

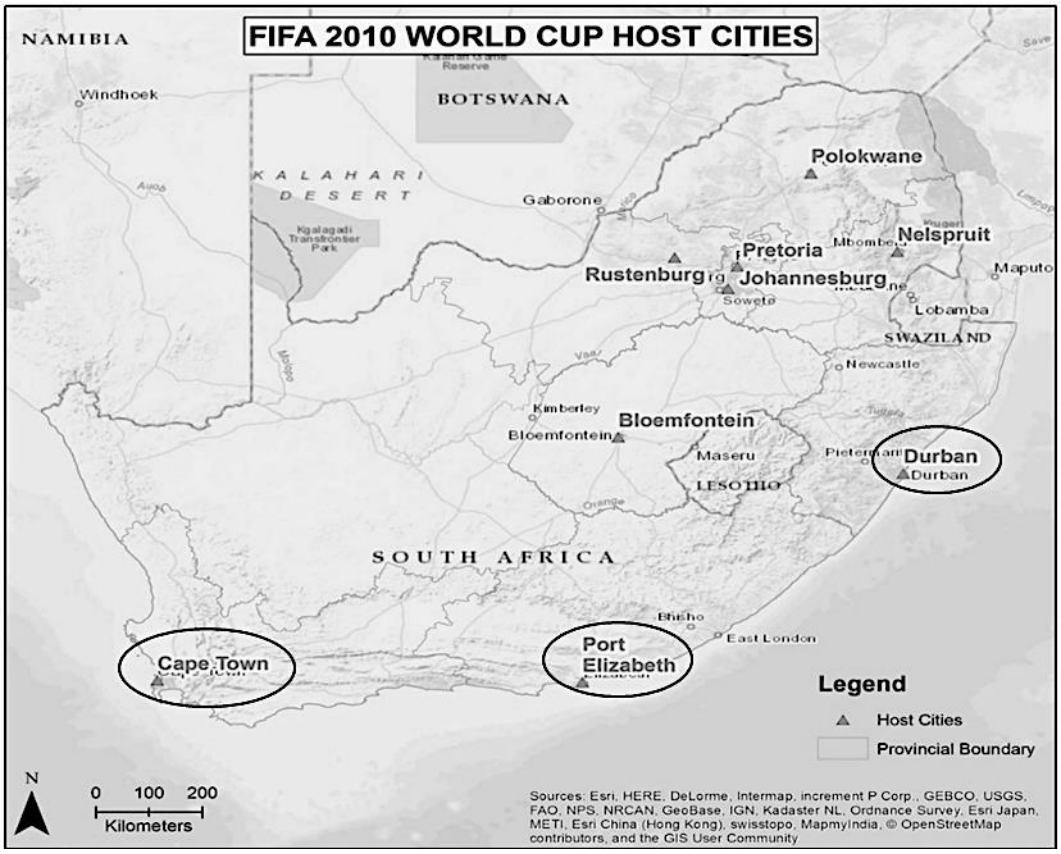


Figure 1. Geographic location of the 2010 FIFA World Cup host cities and case study areas (Source: Authors' based on fieldwork)

In addition to the surveys, the qualitative thrust included the administration of interviews to eight key resource persons including stadium management officials, municipal authorities who are directly linked to the management of the stadia and residents' associations' representatives in order to elicit their in-depth views on aspects related to the current study. The findings as collated will be elaborated upon both in terms of the descriptive presentations and thematic annotations. Discussions will accompany these presentations looking at the potential implications of the responses collated

Results and Discussions

Demographic profiles of respondents

The findings of the study established that the majority of the respondents across all three case study areas were male and mostly young professionals. The

DOI 10.30892/gss.1404-074

demographics further highlighted the cosmopolitan nature of urban populations within developing regions while also establishing their attitudes towards sport consumerism. Though these socio-demographic profiles quite evidently are linked generally to the attitudes of urban residents in terms of their propensity to participate in sport-related discourse and activities, they, however, are specifically based on the sample selection of the respective case study areas as opposed to general sport consumption patterns. The composition of urban residents within the social demography of the study would suggest a young, vibrant, energetic population. Middle-class professionals who earned enough to have disposable leisure time would also be in the category. Such profiles also bode well for a segment with more vested interests in the community, thereby making them more opinionated about the social phenomena within their communities. In the context of the current study, such a concentration of citizens within the urban space, especially within suburbs traditionally considered as upper-middle-class income suburbs, such as Green Point, one would imagine should augur well for their urban infrastructure and tourism consumption and therefore promote sustainable legacy implications of the respective stadia.

Table 1. Summary of sample profile of the respondents (n=1120)

Demographic variable	**Percentage**
Age	
18 – 20 years	19.1
21 – 30 years	37.1
31 – 40 years	22.2
40 years and older	21.6
Gender	
Male	57.3
Female	42.7
Highest level of education	
No formal education	2.4
Primary schooling completed	1.2
Secondary school completed	5.3
High school completed	23
Certificate/ diploma	28.9
Undergraduate	24.2
Postgraduate	14.8
Other	0.2
Employment status	
Unemployed	10.3
Student/ scholar	18.4
Retired	2.3
Unskilled labour	10.7
Skilled labour	45.6
Self- employed	8.9
Home executive	1
Other	2.8
Highest monthly household salary range	**In ZAR**
CPT	30 000 – 40 000
DUB	20 000 – 30 000
PE	20 000 – 30 000

ZAR refers to South African Rand; 1 USD = 13.74 ZAR (31/5/2021).

Infrastructure legacy dimensions linked to stadium construction

Using ten different infrastructure related legacy variables, the current study set out to investigate and holistically present the infrastructure legacy outcomes linked to the construction of stadia for the 2010 FIFA World Cup. According to the results received, stakeholders were consistently positive in relation to the potential tourism benefits with most respondents (76.9% from Cape Town, 76.3% from Durban and 61.4% from Port Elizabeth) reporting that the presence of the stadium in their respective localities had increased the number of tourists coming into the area (V1). Cape Town emerged as the area with the most positive inclination to the statement, with M = 3.97 and SD = 0.995, followed by Durban, with M = 3.84 and SD = 0.825, and Port Elizabeth, with M = 3.64 and SD = 1.092. Overall, the respondents across all three study areas expressed positive views with regards to the statement, recording a combined M = 3.819 and SD = 0.997 (Table 3). Similarly, there were generally well-held perceptions of media coverage of the area (75.4% from Cape Town, 76.6% from Durban and 62.3% from Port Elizabeth) from respondents as a consequence of the presence of the stadia (V2). In concurrence, one of the key resource persons linked to the Cape Town Stadium noted that; "People keep on thinking about the stadium and events not happening in the stadium… if you have Lionel Ritchie, Linkin Park or Lady Gaga (performing here), you have people flying in from all over the world and they don't (only) come for the concert. They arrive three days before the concert, do the concert and then stay on for the rest of the week and then fly out. The economic spin-off for the city runs into millions and millions of Rands… So, while people may keep highlighting that the stadium is making an operational loss, it takes one concert (at the stadium) to push forty million Rands worth of direct spend into the city." While the Durban respondents reported slightly higher positive attitudes, with M = 3.86 and SD = 0.676, than did Cape Town, with M = 3.8 and SD = 0905, Port Elizabeth reported the least positive attitudes, with M = 3.61 and SD = 1.091. Again, the overall perceptions of the respondents were quite positive, with M = 3.772 and SD = 0.930 (Table 3).

With regards to the novelty status and tourism potential of these stadia, one of the key resource persons, a stadium management official from the City of Cape Town postulated that: "The amount of advertising the city got out of the Rugby Sevens tournament, for example, is simply phenomenal, and makes the stadium a powerful tool for positioning the city as a preferred tourism and events destination." In addition, the triangulated responses reported in relation to the novelty status of the stadia mostly highlighted that the stadia represented within the urban landscape, an aura and reminder of the tall order achieved by the hosting of the 2010 FIFA World Cup. These enlisted views were further encapsulated in the words of a key informant who contributed the following: "…and so our strategy is [i.e. has] been to try and keep it (the stadium) rather, and also that it is something a bit special; you know, it's not something that just anyone can go and use, it's kept for something special."

Furthermore, the study's results also noted that most of the respondents (79.7% from Cape Town, 76.5% from Durban and 63.3% from Port Elizabeth) expressed pride for the construction of the stadium in their respective areas (V3). Overall, the respondents displayed positive perceptions across all three study areas,

DOI 10.30892/gss.1404-074

with a combined M = 3.857 and SD = 0.995, hinting at potential future support from the residents, who, over time, might have developed an affinity towards the stadia as a result of their novelty effects. In a nuanced twist though, one of the key resource persons noted that the invisible hand of FIFA played a key role in the determination of the location of the Cape Town stadium in Green Point, which even though a novel artefact, makes it difficult for the city to leverage on its urban renewal and regeneration efforts. Respondents (79.7% from Cape Town, 70.2% from Durban and 62.9% from Port Elizabeth) further indicated that they remained enthusiastic and optimistic about the ability of the stadia to be used to develop football in the country, with most of the stadia also having the capacity to host multi-purpose activities (V4). While soccer remains a major sporting code in South Africa, attendance at the majority of PSL games has been minimal, as most fans prefer to watch games on TV, which begs the question of promoters having propounded that these stadia were intended to promote participation and also redress the backlog in sport infrastructure. Quizzed on how the stadia could engender sustainability, one of the key resource persons (an official from the City of Cape Town), in referring to the potential move of the local rugby franchise into the stadium as its anchor tenant indicated that the Newlands Stadium, which was currently harbouring the rugby franchise, was approaching the end of its life cycle, leading to the opportunity to lure the local rugby franchise to the Cape Town Stadium. Additionally, the majority of the respondents (77.0% from Cape Town, 76.0% from Durban and 62.9% from Port Elizabeth) were of the view that the stadia could be used to promote the image of the country (V5), a view that was corroborated by a member of the Green Point Ratepayers' and Residents' Association in noting that: "It was very clear what they [FIFA] wanted from the very beginning, that they preferred Green Point, a location in front of Table Mountain, the surroundings and, as the results show, it is a marvellous place and makes the stadium a powerful tool for positioning the city as a preferred tourism and events destination."

The contemporary emphasis on the ability of sport mega-events to deliver legacies also raised the question of how the benefits could be leveraged and sustained post-event, especially in terms of the event-related infrastructure, such as the stadia (Rocha and Barbanti, 2015). Regarding the future potential of the stadia to promote the development of other activities to ensure their financial sustainability in the long-term, 76.2% of the respondents from Cape Town, 70.6% of those from Durban and 63.6% from Port Elizabeth were in concurrence (V6). With a combined M = 3.759 and SD = 0.928, the results again show that the perceptions were generally positive, with such a positive indication raising nuances as to why, in their current situations, the upkeep of the stadia is consistently reported to be burdensome for the taxpayer. Considering that most of the stadia were constructed as multi-purpose facilities, officials should consider the development of local events around the stadia, taking cognisance of the local realities, considering the meetings, incentives, conventions, and events (MICE) industry as a potential option for leverage. Interestingly, although current debates are rather contentious in relation to the present unsustainable nature of the stadia, most respondents (60.9% of the respondents from Cape Town, 61.1% from Durban and 35.8% from Port Elizabeth)

indicated that the use of public funds in support of the event was acceptable (V7), which one could assume is motivated by the intangible outcomes such as novelty, image enhancement and other socio-psychological effects that the stadia could have engendered. In a similar manner, 69.1% of the respondents from Cape Town, 68.1% from Durban and 61.4% in Port Elizabeth agreed with the assertion that the stadia could be used to leverage, and to attract, the hosting of other major and/or mega-events in the future, hinting at generally positive inclinations as to the future potential of the stadia in bidding for and hosting other events (V8).

Table 2. Infrastructure legacy impact dimensions linked to stadium construction (in %)

CPT *n*=400; DUB *n*=320; PE *n*=400																
V#	**Type of impact**	**Strongly disagree**			**Disagree**			**Neutral**			**Agree**			**Strongly agree**		
		CPT	DUB	PE	CPT	DUB	PE	CPT	DUB	PE	CPT	DUB	PE	CPT	DUB	PE
V1	The stadium has increased the number of tourist visits to the area.	2.3	3.0	5.1	8.3	2.3	9.8	12.5	18.4	23.7	**44.1**	**60.2**	**38.4**	32.8	16.1	23.0
V2	The stadium has increased positive media coverage of the area.	2.0	0.0	4.8	7.5	3.6	11.4	15.0	19.8	23.7	**54.6**	**63.4**	**38.4**	20.8	13.2	21.7
V3	I feel proud that the stadium was built in my city/area.	0.0	0.7	9.8	6.8	2.7	7.3	13.8	20.1	20.5	**46.1**	**57.0**	**38.6**	33.3	19.5	23.7
V4	I am confident that the stadium can be used to promote the development of football in the area/country.	0.5	0.0	9.8	4.8	2.0	9.8	15.0	27.9	17.4	**58.1**	**51.8**	**39.9**	21.6	18.4	23.0
V5	The stadium can be used to promote/ market the image of the city/country.	0.3	0.7	8.6	6.3	1.3	10.6	16.5	21.9	17.9	**48.4**	**57.8**	**35.6**	28.6	18.3	27.3
V6	The stadium can be used to promote the development of other activities to ensure its financial sustainability in the long-term.	1.0	1.0	5.1	8.3	3.3	11.4	14.5	25.1	19.9	**55.6**	**56.1**	**44.4**	20.6	14.5	19.2
V7	I feel that the use of public funds in support of the stadium was acceptable.	3.0	2.0	4.3	8.0	5.6	12.4	28.1	32.2	**38.5**	**39.6**	**50.8**	34.9	21.3	9.3	9.9
V8	The stadium can be used for leverage to attract the hosting of other major events / mega-events in the future.	2.5	2.3	6.6	9.5	3.3	12.4	18.8	26.3	19.7	**51.1**	**50.0**	**40.7**	18.0	18.1	20.7
V9	The cost of maintenance for the usage of the stadium poses challenges for local communities	2.8	3.6	5.6	11.8	21.2	27.8	28.1	49.3	38.1	34.1	18.9	22.2	23.3	7.0	6.3
V10	The stadium is a "White Elephant" (waste of public money) and should be demolished	19.5	12.5	17.7	28.8	38.0	**43.4**	25.8	29.6	19.7	18.3	16.2	11.6	5.3	3.7	7.6

CPT= Cape Town, DUB= Durban, PE= Port Elizabeth

DOI 10.30892/gss.1404-074

The combined score across all three study areas was M = 3.692, indicating that the inclinations from the respondents as to the future potential of the stadia are generally positive. While these results might seem promising in terms of the outlook for the bidding and hosting of future events, the example of the 2022 Commonwealth Games being rescinded by South Africa is a worrying prospect for future mega-event bids and a compromising prospect on image enhancement that such infrastructure may portend when used for such events (Table 2). The country also lost the bid to host the 2023 Rugby World Cup (Ray, 2017), raising questions as to how soon in the current lifecycle of these stadia other major events could be leveraged. Anecdotal and scholarly work suggests that to ensure that future legacy objectives materialise, it is critical that legacy plans be conceptualised at an early stage in the lifecycle of the event planning, with clearly articulated expectations ensuring the goals are plainly identified and that the authority in charge of legacy is pinned down.

Table 3. Infrastructure legacy impact dimensions linked to stadium construction (in %)
Combined mean scores

	DUB	CPT	PE	COMBINED
Type of infrastructure legacy impact dimension	**M**	**M**	**M**	**M**
The stadium has increased tourists visits to the area	3.97	3.84	3.64	3.819
The stadium has increased positive media coverage of the area	3.85	3.86	3.61	3.772
I feel proud that the stadium was built in my city/area	4.06	3.92	3.59	3.857
I am confident the stadium can be used to promote the development of football in the area/country	3.95	3.87	3.56	3.795
The stadium can be used to promote/ market the image of the city/country	3.99	3.92	3.62	3.843
The stadium can be used to promote the development of other activities to ensure its financial sustainability in the long-term	3.86	3.80	3.61	3.759
I feel that the use of public funds in support of the event was acceptable	3.68	3.60	3.34	3.539
The stadium can be used to leverage to attract the hosting of other major/mega-events in the future	3.73	3.78	3.57	3.692
I have become a participant of sport activities due to the construction of the stadium	3.33	3.04	3.12	3.162
I have become a spectator of sport activities due to the construction of the stadium	3.47	3.09	3.13	3.232
The cost of maintenance for the usage of the stadium poses challenges for local communities	3.63	3.04	2.96	3.212
The stadium is a “White Elephant” (waste of public money) and should be demolished	2.65	2.61	2.48	2.580

CPT= Cape Town, DUB= Durban, PE= Port Elizabeth
M= Mean.

Mounting evidence, especially in the developing context, presents challenges to the ability of mega-events in producing sustainably positive stadium

infrastructure legacies (Bama and Tichaawa, 2020; Boykoff, 2014; Cottle, 2010; Molloy and Chetty, 2015). In this vein, a significant portion of Cape Town respondents (57.4%) indicated that the maintenance costs of the stadium were exorbitant, while 25.9% and 28.5% gave similar responses in Durban and Port Elizabeth, respectively (V9). The results seemed to lean towards the proposition in certain quarters that mega-events are agents of homogenisation, with policies that lead to the production of white elephants (Cottle, 2010; Molloy and Chetty, 2015). Because of the diversity of debates as to whether mega-events are agents of homogenisation, propagating policy models and white elephants across the globe, scholars, event organisers, and the public alike need to be careful not to generalise from the impacts of one event to others. As such the views of respondents were sought on whether the stadia constituted white elephants and should be demolished. Although resolute that the costs of keeping the structures operational were in some cases excessive, the responses, in this case, were varied. In a twist of responses, most of the respondents (48.3% in Cape Town, 50.5% from Durban and 61.1% from Port Elizabeth) disagreed with any suggestions of demolition (V10). As such while the rejection of the demolition option might also have highlighted the affinity and attachment to, and the sense of pride in the stadia, as held by the residents, in order to maximise positive sustainable legacies, support from all stakeholder sectors is required.

Conclusions

The focal thrust of this study was the urban infrastructure legacy impacts of mega-event stadia in the Global South with a specific consideration of South Africa's 2010 stadia. The study presented an initiation point for the analysis of the legacy constructs of mega-events infrastructure development and their sustainability within developing economies, specifically with regards to South Africa's hosting of the 2010 FIFA World Cup, and, revealed a dichotomy of views among stakeholders in relation to the legacy impacts of mega-event stadia with both benefits and costs being highlighted. While the construction of the stadia had promoted the urban renewal strategy of the respective locations, one of the key outcomes was that poor stakeholder engagement had hampered community support for the stadia, and the results in certain cases, were quite contentious. Due to calls from experts for legacy impacts of mega-events to be tested over time, and obtain further insights of the post-2010 stadium infrastructure legacy impacts, a systematic analysis of residents' and other key stakeholders' perceptions should be conducted in a longitudinal endeavour, and should focus on the sustainability of the urban planning contradictions affecting the infrastructural legacy outcomes. Another contention for further review would be in relation to the novelty considerations, the increase in comfort, the improved view, and the enhanced atmosphere of the stadia with the associated benefits being community pride and other health-related benefits, among others.

Furthermore, a key issue that was not considered as part of the scope of this research entailed examining the net economic gain/loss to the various host communities, as a result of the construction of the stadia, and it is therefore

DOI 10.30892/gss.1404-074

suggested that this form the basis of further enquiry into the subject matter. Evidently, due to the mutable timelines that were in place for the construction of the stadia, and accompanied by the contentious debates that surrounded the issue, the host LOC's became more engulfed with planning to try to meet the FIFA datelines and therefore paid less attention to the infrastructure legacy planning thereby ignoring future considerations as to what becomes of the stadia post-event. An outcome of the present study was the nuanced view that the event owners exercised undue influence in selecting the locations of such event infrastructure as the stadia. It is recommended that the event owners such as FIFA, in making suggestions, engage with the government authorities in the host communities, and take into account the wider ramifications of the post-event realities that the investments are bound to attract.

Additionally the study found that there was a concerted paucity in consultation between key stakeholder groups. It is, therefore, imperative to set up a framework to guide how the communication between the different stakeholders groups involved in, and impacted on by, such events should be managed more braodly. A final recommendation is for the incorporation of the voices of all stakeholder groups in examining the long-term stadium infrastructure legacy impacts of mega-events, specifically in relation to economies in transition.

Acknowledgements

This paper forms part of a doctoral research submitted to School of Tourism and Hospitality at the University of Johannesburg. The University of Johannesburg is thanked for funding the current research.

References

Agha, M. (2013). The economic impact of stadia and teams: The case of minor league baseball. *Journal of Sport Economics*, 14(1), 227-252.

Allen, D., Knott, B. & Swart, K. (2013). Africa's tournament: The branding legacy of the 2010 FIFA World Cup. *The International Journal of the History of Sport*, 30(16), 1994-2006.

Alm, J., Tofft-Jørgensen, L., Brandt, H., Bang, S., Pedersen, A., Candy, J. & Flickr, A. S. (2012). *World Stadium Index: Stadiums built for major sporting events-bright future or future burden?* (web-source: http://www.playthegame.org/fileadmin/documents/World_Stadium_Index_ Final.pdf (Accessed on 2017.08.11).

Almeida, B. S. D., Júnior, M. W. & Pike, E. (2014). The 2016 Olympic and Paralympic Games and Brazil's soft power. *Contemporary Social Science*, 9(2), 271-283.

Bama, H. K. N. (2018). *Sustainable mega-event infrastructure development in developing economies: a case study of the infrastructural legacy impacts of selected 2010 FIFA World Cup stadia in South Africa*. Unpublished PhD thesis. University of Johannesburg, Johannesburg.

Bama, H. K. N. & Tichaawa, T. M. (2020). Mega-event and stadium legacies in the Global South: the case of South Africa. In *New Directions in South African Tourism Geographies*, 129-145. Springer, Cham.

Bama, H. K. N., & Tichaawa, T. M. (2016). Mega-event infrastructure development and sustainability contestations in the developing context: The 2010 FIFA World Cup in South Africa. *African Journal of Hospitality, Tourism and Leisure,* 5(3), 1–18.

Bama, H. K. N., & Tichaawa, T. M. (2015). Major sporting events and responsible tourism: Analysis of the 2013 Africa Cup of Nations (AFCON) tournament in Port Elizabeth, South Africa. *African Journal for Physical, Health Education, Recreation and Dance,* 21, 205-219.

Bassa, Z. & Jaggernath, J. (2010). Living close to 2010 stadiums: Residents' perceptions of the 2010 FIFA World Cup and stadium development in Durban, South Africa. *Alternation,* 17(2), 121-145.

Black, D. (2007). The symbolic politics of sport mega-events: 2010 in comparative perspective. *Politikon,* 34(3), 261-276.

Blomgren, J. & Valkonen, T. (2007). Characteristics of urban regions and all-cause mortality in working-age population: Effects of social environment and interactions with individual unemployment. *Demographic Research,* 17(5), 109-134.

Bob, U. & Kassens-Noor, E. (2012). An indicator framework to assess the legacy impacts of the 2010 FIFA World Cup. *African Journal for Physical, Health Education, Recreation and Dance (AJPHERD)*, Supplement 1, 12-21.

Bocarro, J., Byers, T. & Carter, C. (2018). Legacy of sporting and non-sporting mega event research. *Legacies and mega-events: Facts or fairy tales*, 7-24.

Boykoff, J. (2014). *Celebration capitalism and the Olympic Games*. London: Routledge.

Brittain, I., Bocarro, J., Byers, T. & Swart, K. (eds.). (2018). *Legacies and Mega Events: Fact or Fairy Tales?.* London: Routledge.

Byers, T., Hayday, E.J. & Pappous, A. (2019). A new conceptualization of mega sports event legacy delivery: Wicked problems and critical realist solution. *Sport Management Review*, doi:10.1016/j.smr.2019.04.001.

Cashman, R. & Horne, J. (2013). Legacy management. In *Managing the Olympics*. Edited by Frawley, S. & Adair, D. Houndmills: Palgrave Macmillan.

Cezne, E. (2014). Sports mega-events and development: A critical analysis of Brazil's hosting of the 2014 FIFA World Cup and 2016 Summer Olympic Games. Unpublished Bachelor's thesis. Norwegian University of Life Sciences, As.

Chappelet, J. & Junod, T. (2006). A tale of 3 Olympic cities: What can Turin learn from the Olympic legacy of other Alpine cities? In *Major sport events as opportunity for development* (pp. 83-90). Edited by Torres, D. Valencia.

Chen, Y., Qu, L. & Spaans, M. (2013). Framing the long-term impact of mega-event strategy on the development of the Olympic host cities. *Planning Practice & Research*, 28(3), 340-359.

Clark, J., Kearns, A. & Cleland, C. (2016). Spatial scale, time and process in mega-events: The complexity of host community perspectives on neighbourhood change. *Cities*, 53, 87-97.

Coates, D. (2007). The tax benefits of hosting the Super Bowl and the MLB All-Star Game: The Houston experience. *International Journal of Sport Finance*, 1(4), 239-252.

Cornelissen, S. (2007). Crafting legacies: The changing political economy of global sport and the 2010 FIFA World Cup. *Politikon,* 34(3), 241-259.

Cornelissen, S., Bob, U. & Swart, K. (2011). Towards redefining the concept of legacy in relation to sport mega-events: Insights from the 2010 FIFA World Cup. *Development Southern Africa*, 28(3), 307-318.

Cottle, E. (2010). *A preliminary evaluation of the impact of the 2010 FIFA World Cup in South Africa*. (web-source: http://www.lrs.org.za/docs/A%20Preliminary%20Evaluation%20of%20the%20Impact%20of%20the%202010%20World%20Cup%20by%20EddieCottle.pdf (Accessed on 2011.06.18).

Desai, A. & Vahed, G. (2010). World Cup 2010: Africa's turn or the turn on Africa? *Soccer and Society,* 11(1-2), 154-167.

Douglas, B. (2015). *World Cup leaves Brazil with bus depots and empty stadiums*. (web-source: http://www.bbc.com/sport/0/football/32073525, (Accessed at: 2019.06.18).

Erten, S. & Özfiliz, S. (2006). Stadium construction and sustainability: The review of mega-event stadiums (1990-2012). *1st International CIB Endorsed METU Postgraduate Conference, Ankara, Turkey* (525-541). (web-source: http://www.irbnet.de/daten/iconda/06059012396.pdf, (Accessed on 2010.04.11).

Ferrari, S. & Guala, C. (2017). Mega-events and their legacy: Image and tourism in Genoa, Turnin and Milan. *Leisure Studies*, 36(1), 199-137.

Gaffney, C. (2013). Between discourse and reality: The un-sustainability of mega-event planning. *Sustainability*, 5(9), 3926-3940.

Gaffney, C. (2015). The urban impacts of the 2014 World Cup in Brazil. In *Mega-events and globalisation: Capital and spectacle in a changing world order* (pp. 167-185). Edited by Gruneau, R. & Horne, J. London: Routledge.

DOI 10.30892/gss.1404-074

Giampiccoli, A., Lee, S. S. & Nauright, J. (2015). Destination South Africa: Comparing global sports mega–events and recurring localised sports events in South Africa for tourism and economic development. Current Issues in Tourism, 18(3), 229–248.

Girginov, V. (2011). Governance of London 2012 Olympic Games legacy. *International Review for the Sociology of Sport*, 47(5), 543-558.

Grix, J. & Brannagan, P.M. (2017). Of mechanisms and myths: Conceptualizing state's 'soft power' strategies through sports mega-events. *Diplomacy and Statecraft*, 27(2), 251-272.

Gold, J. R. & Gold, M. M. (Eds.). (2016). *Olympic cities: City agendas, planning, and the world's games, 1896–2020* (3rd ed.). London: Routledge.

Groothuis, P. A. & Rotthoff, K. W. (2014). Surveying the literature and the people: The economic impact of sports teams and civic pride. *Social Science Research Network,* 14(5), 1-22.

Gunter, A. (2014). Mega events as a pretext for infrastructural development: The case of the All African Games Athletes Village, Alexandra, Johannesburg. *Bulletin of Geography. Socio-economic Series,* 23(23), 39-52.

Hemmonsbey, J. & Tichaawa, T. M. (2018). The effects of major sport event leveraging for tourism and destination branding: The case of South Africa as an emerging destination. *GeoJournal of Tourism and Geosites*, 21(1), 213-282.

Hemmonsbey, H. & Tichaawa, T. M. (2019). Using non-mega events for destination branding: A stakeholder perspective. *GeoJournal of Tourism and Geosites*, 24(1), 252–266.

Hlabane, B. (2012). The political, economic and social impact of hosting mega-sports events: The 2010 South Africa World Cup in comparative perspective, unpublished PhD thesis, Ritsumeikan Asia Pacific University, Oita, Japan.

Humphrey, L. & Fraser, G. (2016). 2010 FIFA World Cup stadium investment: Does the post event usage justify the expenditure? *African Review of Economics and Finance*, 8(2), 3-22.

Ilieş, A., Dehoorne, O., Wendt, J. & Kozma, G. (2014). For geography and sport, sport geography or geography of sport, *GeoSport for Society*, 1(1-2), 7-18.

Jaworek, M., Karaszewski, W., Kuczmarska, M. & Kuzel, M. (2020). Investment expenditure on sport infrastructure in Poland: diagnosis, general trends, and possible prospects. *Journal of Physical Education and Sport,* 20(2), 1106-1114.

Johnson, R. B. & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational researcher*, 33(7), 14-26.

Jory, S. & Boojihawon, D. (2011). The economic implications of the FIFA 2010 World Cup in South Africa. *African Journal of Business and Economic Research*, 6(1), 7-21.

Kassens-Noor, E., Vertalka, J. & Wilson, M. (2019). Good games, bad host? Using big data to measure public attention and imagery of the Olympic Games, *Cities*, 90(2), 229-236,

Kassens-Noor, E. & Kayal, P. (2016). India's new globalization strategy and its consequences for urban development: The impact of the 2010 Commonwealth Games on Delhi's transportation system. *International Planning Studies*, 21(1), 34-49.

Kiernan, P. (2014). World Cup hit Brazil's economy hard. *Wall Street Journal.* (web-source: https://blogs.wsj.com/moneybeat/2014/07/18/world-cup-hit-brazils-economy/ (Accessed on 2019.06.18).

Kim, H., Choe, Y., Kim, D. & Kim, J. (2019). For Sustainable Benefits and Legacies of Mega-Events: A Case Study of the 2018 PyeongChang Winter Olympics from the Perspective of the Volunteer Co-Creators, *Sustainability*, 11, 2473.

Koch, N. & Valiyev, A. (2016). Urban boosterism in closed contexts: Spectacular urbanization and second-tier mega events in three Caspian capitals. *Eurasian Geography and Economics*, 56(5), 575-598.

Koehler, P. (2012). *Why do some stadium redevelopment projects succeed where others fail? An analysis using macro-level trends in stadium building*. Colgate University, Summer 2012. (web-source: https://www.colgate.edu/docs/default-source/default-document-library/koehler-pdf.pdf?sfvrsn=0, (Accessed on 2015.06.18).

Kunzmann, K. R. (2016). Crisis and planning? A commentary. *European Planning Studies*, 24(7), 1313-318.

Leopkey, B. & Parent, M. M. (2012). Olympic Games legacy: From general benefits to sustainable long-term legacy. *International Journal of the History of Sport,* 29(6), 924-943.

Lin, G. C. S. & Xu, Z. (2019). Remaking China's urban space of the spectacle: Mega-events, temporary growth, and uneven spatial transformation in Shanghai. *Geoforum,* 102, 126–136.
Maharaj, B. (2011). 2010 FIFA World Cup: (South) Africa's time has come? *South African Geographical Journal*, 93(1), 49-62.
Mills, B. M. & Rosentraub, M. S. (2013). Hosting mega-events: A guide to the evaluation of development effects in integrated metropolitan regions. *Tourism Management,* 34, 238-246.
Molloy, E. & Chetty, T. (2015). The rocky road to legacy: Lessons from the 2010 FIFA World Cup South Africa stadium program. *Project Management Journal*, 46(3), 88-107.
Montgomery, M. R. (2008). The urban transformation of the developing world. *Science,* 319(5864), 761-764.
Moshoeshoe, M. (2014). Residents' perceptions of the 2010 FIFA World CupTM in Port Elizabeth: A pre- and post-event comparison. Unpublished Master's dissertation. Cape Peninsula University of Technology, Cape Town.
Müller, M. (2017). How mega-events capture their hosts: event seizure and the World Cup 2018 in Russia. *Urban Geography*, 38(8), 1113-1132.
Müller, M. & Gaffney, C. (2018). Comparing the Urban Impacts of the FIFA World Cup and Olympic Games From 2010 to 2016. *Journal of Sport and Social Issues*, 42(4), 247-269.
Patel, K. (2016). Brazilian perspectives on the 2014 FIFA World Cup and the 2016 Olympic Games. *University of Vermont Honors College senior theses*, Paper 113.
Philips, C. & Barnes, M. (2015). Whose legacy is it, anyways? A tale of conflicting agendas in the building of the Hamilton Pan Am Soccer Stadium. *Annals of Leisure Research*, 18(4), 549-568.
Preuss, H. (2007). The conceptualisation and measurement of mega sport event legacies. *Journal of Sport and Tourism,* 12(3-4), 207-227.
Preuss, H. (2011). A method for calculating the crowding-out effect in sport mega-event impact studies: The 2010 FIFA World Cup. *Development Southern Africa,* 28(3), 367-385.
Preuss, H. (2013). The contribution of the FIFA World Cup and the Olympic Games to green economy. *Sustainability,* 5(8), 3581-3600.
Preuss, H. (2015). A framework for identifying the legacies of a mega sport event. *Leisure studies*, 34(6), 643-664.
Ray, C. (2017). South Africa loses bid to host 2023 Rugby World Cup. (web-source: https://www.timeslive.co.za/sport/rugby/2017-11-15-south-africa-lose-bid-to-host-2023-rugby-world-cup/ (Accessed on 2019.06.18).
Ren, X. (2017). Aspirational urbanism from Beijing to Rio de Janeiro: Olympic cities in the Global South and contradictions. *Urban Affairs,* 39(7), 894–908.
Robbins, G. (2012). Major international events and the working poor: Selected lessons for social actors stemming from the 2010 soccer World Cup in South Africa. WIEGO Technical Brief. *Urban Policies*, 5, 1-29.
Rocha, C. M. & Barbanti, V. J. (2015). Support for the 2014 FIFA World Cup and the 2016 Olympic Games. *Journal of Physical Education and Sports Management*, 2(2), 66-87.
Rosentraub, M. S. (2010). *Major league winners: Using sports and cultural centers as tools for economic development.* Boca Raton, FL: CRC Press.
Smith, A. & Fox, T. (2007). From 'event-led' to 'event-themed' regeneration: The 2002 Commonwealth Games legacy programme. *Urban Studies*, 44(5/6), 1125-1143.
Steinbrink, M., Haferburg, C. & Ley, A. (2011). Festivalisation and urban renewal in the Global South: Socio-spatial consequences of the 2010 FIFA World Cup. *South African Geographies*, 93(1), 15-28.
Stewart, A. & Rayner, S. (2016). Planning mega-event legacies: uncomfortable knowledge for host cities. *Planning perspectives*, 31(2), 157-179.
Sturgess, D. & Brady, C. (2006). Hosting the FIFA World Cup economic boon or winner's curse? *Journal of Current Economic Analysis and Policy*, 7(4), 145-164.
Swart, K. & Bob, U. (2012). Mega sport event legacies and the 2010 FIFA World Cup. *African Journal for Physical, Health Education, Recreation and Dance,* Supplement 1, 1-11.
Swart, K. & Bob, U. (2009). Venue selection and the 2010 World Cup: A case study of Cape Town. In *Development and dreams: The urban legacy of the 2010 Football World* Cup*.* Edited by Pillay, B. Tomlinson, R. & Bass, O. Cape Town: HSRC Press, 114-130.

DOI 10.30892/gss.1404-074

Thomson, A., Cuskelly, G., Toohey, K., Kennelly, M., Burton, P. & Fredline, L. (2018). Sport event legacy: A systematic quantitative review of literature. *Sport Management Review*, 1-27.

Tichaawa, T. M. & Bama, H. K. N. (2012). Green Point residents' perceptions of the 2010 FIFA World Cup: A post-event analysis. In: *African Journal for Physical, Health Education, Recreation and Dance (AJPHERD),* 18(2), 22-32.

Tichaawa, T. M., Bama, H. K. N. & Swart, K. (2015). Community perceptions of the socio-economic legacies of the 2010 FIFA World Cup in Nelson Mandela Bay, Port Elizabeth: A four-year post-event analysis. *African Journal for Physical, Health Education, Recreation and Dance*, 21(4:2), 1383-1395.

Tomlinson, A. (2014). Olympic legacies: Recurrent rhetoric and harsh realities. *Contemporary Social Science,* 9(2), 137-158.

Wood, A. (2017). Advancing development projects through mega-events: The 2010 football World Cup and bus rapid transit in South Africa. *Urban Geography*, 1-7.

Zimbalist, A. (Ed.). (2017). *Rio 2016: Olympic Myths, Hard Realities*. Washington, D.C.: Brookings Institution Press.

© **GeoSport for Society**, volume 14, no. 1/2021, pp. 47-55, DOI 10.30892/gss.1405-071

GEOSPORT FOR SOCIETY
Scientific Journal founded in 2014 under aegis of University of Oradea (Romania), University of Debrecen (Hungary), University of Gdánsk (Poland)
ISSN 2393-1353
Edited by Oradea University Press
1, University Street, 410087, Oradea, Romania
Journal homepage: *http://geosport.uoradea.ro*

Assessing the anxiety level of a volleyball team

Ioan Sabin SOPA [1*]

1. University "Lucian Blaga" Sibiu, Faculty of Science, Department of Environmental Science, Physics, Physical Education and Sport, Address: Str. Dr. Ion Rațiu, No. 5-7, Sibiu, Romania, e-mail: sabin.sopa@ulbsibiu.ro

* *Corresponding author*

Citation: Sopa, I.S. (2021). Assessing the anxiety level of a volleyball team. *Geosport for Society*, 14(1), 47-55. https://doi.org/10.30892/gss.1405-071

Article history: 21.04.2021; Revised: 25.05.2021; Accepted: 24.06.2021, Available online: 30.06.2021

Abstract: Modern sport activity implies a lot of stress and anxiety, factors that can limit the performance level of a sportive in any category. The study focused on highlighting the importance of assessing the level of anxiety of a volleyball team. The research took place in the season 2019-2020, between 01 September 2019 and 31 March 2020, at the women volleyball club ACS Alpha Sport Team from Sibiu, Romania. The research sample was the mini volleyball representative of ACS Alpha Sport Team, composed of 15 volleyball players of female gender (n=15), with age between 8-11 years old (10.07±2.04 years old) experience of 1-2 years. The research method used was the Sport Competition Anxiety Test (SCAT) used to assess the anxiety level of the sportive before and after the competition, also, the questionnaire results were analyzed using descriptive statistic indicators. The research of our investigation showed that the initial anxiety level evaluated at the initial testing in September 2019 (average 23.33) was considered high, the final evaluation of anxiety showed real improvement in the anxiety level (average of 17.33). The research conclusions highlighted the idea that using special training for psychological preparation, playing official games, and friendly games can improve mental strength and reduce anxiety.

Keywords: anxiety, competition stress, volleyball

Introduction

Sports psychology is a branch of psychology that applies psychological concepts to sports or exercise. These values are often used to improve efficiency. The sport psychologist is interested in helping every sport participant reach his or her potential as an athlete. If helping a young athlete develops self-control and confidence results in superior athletic performance (Ramakrishnan et al., 2015).

Anxiety has become a fundamental topic in sport psychology and has undergone extensive research due to its impact on performance. Anxiety plays an

DOI 10.30892/gss.1405-071

essential role in the acquisition of motor skills as well as athletic performance. Anxiety can either increase or decrease performance (Kar, 2013). An emotion that is characterized by feelings of dread and tension. It is not emotionally neutral, unlike arousal, which is at the negative end of the affect spectrum (Cox, 2002).

Athletes, whether novice or elite, whether young or old, often feel anxiety. In this scenario, even though an athlete has worked diligently, practiced, and planned a mature technique, the athlete will not perform optimally (Hasanah and Refanthira, 2019). In this situation, an emphasis on physical fitness and the correct technique would not be enough to motivate an athlete to succeed optimally. Coaches and athletes must be mindful that psychological factors may have a significant impact on athlete success. Psychology is regarded as one of the most important aspects in achieving peak success and well-being in athletics (Dosil, 2006).

Anxiety is a natural reaction to challenges in the world, and it serves as part of the planning for the "fight or flight" response. Sporting rivalry promotes related psychological and physiological reactions because the ego, or our sense of self-esteem, is often threatened (Dandona, 2015). Essentially, this occurs when the demands of preparation or competition outweigh one's perceived skill, anxiety is the inevitable outcome. Anxiety is one of the most exciting and essential areas of focus in sport psychology and has continued to attract tremendous research interest (Weiss and Gill, 2005).

Several authors have regarded competitive anxiety as one of the most studied areas in the discipline of sport psychology (Mellalieu et al., 2006; Wadey and Hanton, 2008). It has been defined as "a trait and/or state-like response to a stressful sport-related situation, which the individual perceives as potentially stressful, resulting in a range of cognitive appraisals, behavioral responses, and physiological arousals" (Ford et al., 2017; Ong and Chua, 2021).

Generally, there are two types of anxiety: state anxiety and trait anxiety (Kar, 2013). State anxiety involved feeling of apprehension, tension, fear, and increased physiological arousal (Kar, 2013). This is an immediate emotional state response to the specific situation. State anxiety also consists of somatic and cognitive anxiety (Kar, 2013). Somatic anxiety is closely related to physiological aspects of anxiety, including physical symptoms such as rapid heartbeat, shortness of breath and muscular (Martinent et al., 2010). Another component of state anxiety is cognitive anxiety which refers to worry and emotional distress for upcoming events (Filaire et al., 2001). Trait anxiety involves an experience of anxiety over a long period towards stressful environments (Kornspan, 2012). At any point of life, everybody has the risk of experiencing psychological disorders such as fatigue, depression, and anxiety (Khabiri, 2018). Anxiety is often experienced by athletes, amateur and elite sports athletes, either young or mature athletes (Hasanah and Refanthira, 2020). Athletes experience anxious thoughts just before the crucial games and tournaments due to self, coaches and team management (Khan et al., 2011). These reflexions may have an effect on on-field performance either positively or negatively depending on the attitude of athletes and their background. Nayek and Chatterjee, (2013), mental skill (Sangari et al., 2013), the strength of opponent team (Abenza et al., 2009), strength of own team (Kar, 2013; Szabo et al., 2014) etc.

Methods of research

The primary method of research was the SCAT (Sport Competition Anxiety Test) that was used for assessing the anxiety level of the sportive before and after the competition. The results of the questionnaire were analyzed using descriptive statistic indicators.

The Sport Competition Anxiety Test (SCAT) developed by Rainer Martens in 1977 and actualized by the same author in 1990 (Martens et al., 1990) was used to measure sports-related competition anxiety. Before conducting the test, the procedure of the questionnaire and the purpose of the test were briefly clarified to all subjects for better comprehension and motivation. The SCAT questionnaire contains fifteen questions, and the subjects were asked to respond franckly to each question about how they felt in general at the time of competition with one of the following variants of answer: Rarely, Sometimes, Often. Scores obtained for each question were calculated and added, representing an individual's total score on Sports Competition Anxiety (SCAT Score).

The questionnaire had 15 items with three variants of an answer, each response had a preset number of points attributed, and in the end, all the points were summed, and the result was interpreted.

Analyze of the questionnaire: each question received a certain number of points, depending on the level of anxiety they were analyzing. Each athlete's answer was marked with 0, 1, 2, or 3 points, after which all the points were added, and they were classified in a level of anxiety (small, medium, or high). Questions 1, 4, 7, 10, and 13 received 0 points regardless of the athletes' answers.

The interpretation scale showed that subjects with a lower score than 17 points had a low anxiety level, subjects that scored between 17 points and 24 points have an average level of anxiety and subjects with more than 24 points had a high level of anxiety. Descriptive Statistic (Mean, Standard Deviation), Independent t-test was applied to analyze and compare the degree of Sports Competitive Anxiety of ACS Alpha Sport Team volleyball players. The level of significance of p was set at 0.05.

Study Design and Subjects

The research took place in the season 2019-2020, between 01 September 2019 and 31 March 2020, at the women volleyball club ACS Alpha Sport Team from Sibiu, Romania. The sample of research was the mini volleyball representative of ACS Alpha Sport Team, composed by 15 volleyball players of female gender (n=15), with age between 8-11 years old (10.07±2.04 years old) with an experience of 1-2 years. The study took place at the University "Lucian Blaga" from Sibiu having the approval of the Ethic Committee and respecting the Declaration of Helsinki (2013). It also met the ethical standards for Sport and Exercise Science Research. Since the General data protection regulation entered into the appliance on 25 May 2018 (Regulation (EU) 2016/679).

The research protocol and the purpose of the experiment were explained to all participants in advance, and because it was a study that involved minors, and at the beginning of the experiment, the written informed consent was obtained from the parents.

DOI 10.30892/gss.1405-071

The research was divided in two parts; the initial testing that took place at the beginning of the season 2019-2020 in September 2019, and the second part of the research the final evaluation of the anxiety at the end of the season in February 2020.

Results

The research results part of the article was structured in two parts, the Initial test results with Table 1 and Figure 1 and the second part that analyzed the results from the Final test with Table 2 and Figure 2. Also, the results from the initial to the final testing were compared and can be seen in Figure 3.

Table 1. Initial test for competition anxiety of the team

Subjects	Sport competition anxiety index
Subject 1	25
Subject 2	24
Subject 3	25
Subject 4	24
Subject 5	23
Subject 6	26
Subject 7	20
Subject 8	23
Subject 9	22
Subject 10	24
Subject 11	20
Subject 12	25
Subject 13	25
Subject 14	23
Subject 15	21
Average	**23.33**
Standard deviation	**1.88**
Min	**20**
Max	**26**
Median	**24**
Module	**25**

Table 1 presents the initial testing results at the anxiety test, showing an average 23.33 anxiety value considered using the anxiety level scale as an average level of anxiety, with the highest value of 26 and a low value of 20. As a first conclusion of the initial anxiety assessment, we can say that the level of sport competition anxiety in the volleyball team was raised; our players have a terrible anxiety tolerance due to inexperience and fear of losing.

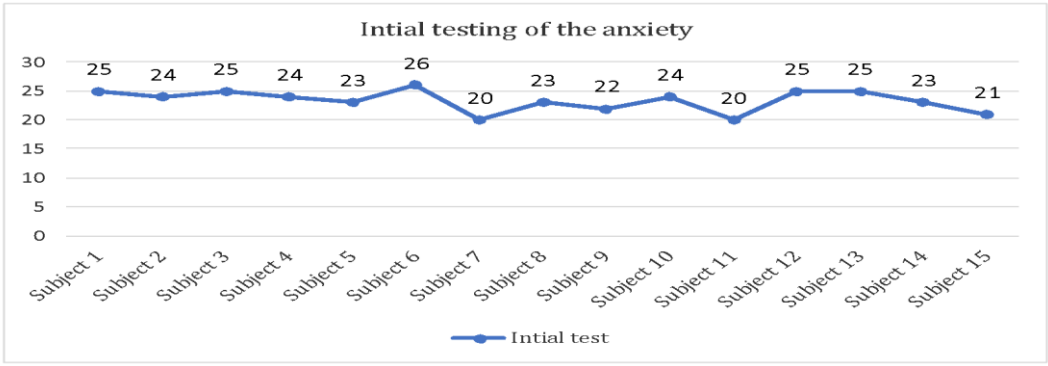


Figure 1. The initial testing of the anxiety

The second part of the research included the final evaluation of the anxiety level of the volleyball team. After six months of games and mental preparation, the anxiety test was repeated, and the final evaluation results were registered (Table 2 and Figure 2) and compared with the initial assessment.

Table 2. Initial test for competition anxiety of the team

Subjects	Sport competition anxiety index
Subject 1	20
Subject 2	17
Subject 3	19
Subject 4	16
Subject 5	15
Subject 6	21
Subject 7	11
Subject 8	15
Subject 9	19
Subject 10	20
Subject 11	14
Subject 12	16
Subject 13	22
Subject 14	21
Subject 15	14
Average	**17.33**
Standard deviation	3.22
Min	17
Max	22
Median	17
Module	20

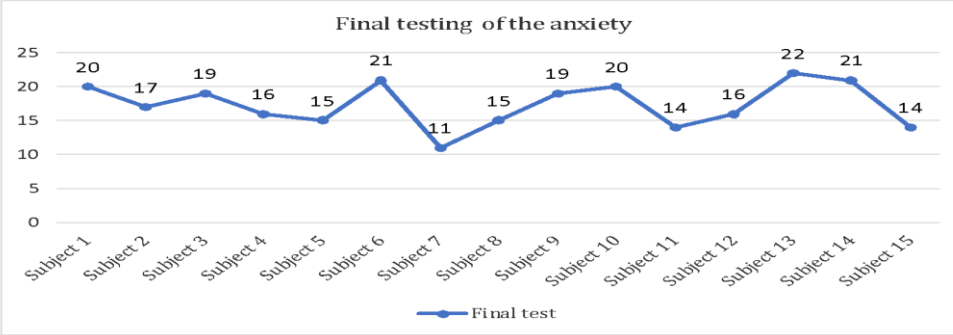


Figure 2. The final testing of the anxiety level

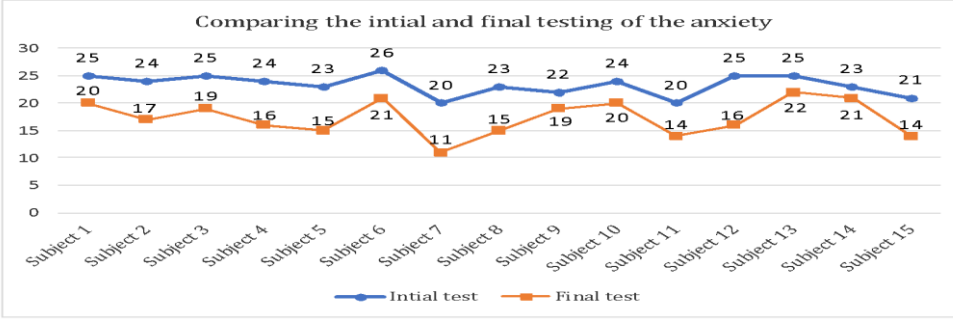


Figure 3. Comparing the results of the initial and final testing of the anxiety level

DOI 10.30892/gss.1405-071

Discussion

There has been lesser research conducted in trait anxiety, which has been described as a predisposition to evaluate situations as threatening, thus resulting in state anxiety (Mellalieu et al., 2006). The research results showed that anxiety levels influence sportive performance also depending on their experience level and skills. The research of our investigation showed that the initial anxiety level evaluated at the initial testing in September 2019 (average 23.33) was considered high, highlighting the idea that players from our team were scared about starting the competition. After six months of training, psychological evaluation and competition, the final evaluation of anxiety showed real improvement in the anxiety level (average of 17.33) highlighting the idea that using special training for psychological preparation, playing official games and also friendly games can improve the mental strength and also reduce the anxiety level.

Research in competitive anxiety has emerged once again in the past few years, with the efforts of researchers such as Jones, Mullen, and Hardy (2019) and Cheng and Hardy (2016) at the forefront of advancing the conceptualization and understanding of the area. These researchers propose a modified multidimensional framework of competitive anxiety, which is represented by three dimensions: Cognitive anxiety, which has the subcomponents of worry and self-focused attention (both private and public); physiological anxiety, which has the subcomponents of autonomic hyperactivity and somatic tension; and a regulatory dimension, which reflects the adaptive nature of the anxiety response, and consists of the subcomponent perceived control (Cheng and Hardy, 2016; Cheng et al., 2009; Jones et al., 2019, Ong and Chua, 2021).

Our findings are supported by the other research study by Qureshi, 2015, indicating a significant difference between the means of Table Tennis players and Volleyball players on scores of sports competition anxiety test score. The findings of our study are also in line with the findings by Rastogi and Katiyar, 2014. They discovered a major disparity in the scores of sport performance anxiety measures between chess players and cricket players. Another research, Kerketta (2015), found no substantial difference between the Competitive Anxiety of the two groups of District level Volleyball and Soccer players of Bilaspur. A study by Khan and Aziz, 2015, revealed the same contradictory result with our study as they found no significant difference between basketball players and track running athletes of their sports competition anxiety.

Carter and Weissbrod (2011) explored the relationship between gender and enjoyment of competition and various indicators of mental health and adjustment in a sample of college students who report that they highly value athletics. The Sport Anxiety Scale, Multi-perfectionism Scale, State-Trait Anxiety Inventory (Trait), Beck Depression Inventory, and Perception of Competition Scale were completed by 137 students. According to the findings, among women, satisfaction of competition was correlated with lower levels of athletic anxiety, as well as a strong association between positive self-perception when winning and self-and socially oriented perfectionism, as well as the relationship between poor perception when failing and self-and socially oriented

perfectionism. In males, satisfaction of competition was associated with lower levels of general anxiety and depression, but not athletic anxiety.

Several papers explored the planning component of psychology in training (Szabo et al., 2020, Sopa and Szabo, 2015), planning the growth of strength (Tulbure et al., 2020), and the importance of psychology in the game of volleyball (Szabo, 2014; Szabo, 2015a; Szabo, 2015b; Szabo and Sopa, 2015; Szabo et al., 2019). I came across an article that addressed also the planning aspect of stress management among students (Popa et al., 2020) as well as one that addressed the sports psycho-pedagogical planning aspect (Ardelean et al., 2020; Ardelean et al., 2021).

Past research has demonstrated the impact that competitive anxiety can have on sporting performance, with a meta-analysis by Woodman and Hardy (2003) indicating a significant adverse effect for cognitive anxiety on sport performance. Other studies have shown that high anxiety situations cause athletes to engage in excessive error monitoring (Masaki et al., 2017); reduce anticipation timing performance (Duncan et al., 2016); decrease search rate and processing efficiency (Nieuwenhuys et al., 2008); and have a negative effect on shooting accuracy in soccer (Wilson et al., 2009). Competitive anxiety has also been shown in past research to heighten the risk of sport injury (Ford et al., 2017), with a review study indicating that competitive trait anxiety is a risk factor for musculoskeletal injury in athletes (Cagle et al., 2017; Ong and Chua, 2021).

Conclusions

The anxiety level represents a big issue in nowadays sport performance having a significant impact on the evolution of sport teams. Anxiety manifests many times before essential competitions or official games, highlighting the lack of mental preparation or a low level of experience. This mental blocking can affect the team's performance and diminish the level of anxiety has proven to also improve the results of sports teams. The study focused on analyzing the anxiety level of a volleyball team. It was structured on two evaluations, one in September 2019 – the initial evaluation of anxiety level, and one in February 2020 that analyzed the final level of anxiety of the team. It was observed that the final anxiety level (average 17.33) was lower than the initial one (23.33). The conclusions of our investigation highlighted that anxiety represents a serious problem in sport competition and that if we train our team with mental coaching and psychological evaluation, we can prevent the rise of the anxiety level and also improve sportive results.

References

Ardelean M., Neagu N., Szabo, D. A., (2021). Pedagogical considerations regarding the structure of high school upper cycle syllabuses, for the "Theoretical Sports Training" school subject (Note II). *Health, Sports & Rehabilitation Medicine*, 22(1), 36–39. https://doi.org/10.26659/pm3.2021.22.1.36

Ardelean M., Neagu N., Szabo, D. A., (2020). Pedagogical considerations regarding the structure of high school lower cycle syllabuses, for the "Theoretical Sports Training" school subject (Note I). *Health, Sports & Rehabilitation Medicine*, 21(4), 256-259. https://doi.org/10.26659/pm3.2020.21.4.256

Abenza, L., Alarcon, F., Pinar, M.I., Urena, N. (2009). Relationship between the anxiety and performance of a basketball team during competition. Revista de Psicologia Deporte, 18, 409-413.

DOI 10.30892/gss.1405-071

Cagle, J.A., Overcash, K.B., Rowe, D.P., & Needle, A.R. (2017). Trait anxiety as a risk factor for musculoskeletal injury in athletes: A critically appraised topic. *International Journal of Athletic Therapy and Training,* 22(3), 26-31. https://doi.org/10.1123/ijatt.2016-0065

Carter, M.M., Weissbrod, C.S. (2011). Gender differences in the relationship between competitiveness and adjustment among athletically identified college students. Scientific Research, 2(2), 85-90.

Cheng, W.-N. K., Hardy, L., & Markland, D. (2009). Toward a three-dimensional conceptualization of performance anxiety: Rationale and initial measurement development. *Psychology of Sport and Exercise*, 10(2), 271-278. https://doi.org/10.1016/j.psychsport.2008.08.001

Cheng, W.-N. K., & Hardy, L. (2016). Three-dimensional model of performance anxiety: Tests of the adaptive potential of the regulatory dimension of anxiety. *Psychology of Sport and Exercise*, 22, 255-263.

Cox, R. H. (2002). *Sport psychology: Concepts and applications (5th Ed.)*. New York: McGraw Hill.

Dandona, A. (2015). A Study on Anxiety of Sports and Non-sports Personnel. *International Journal of Health, Physical Education and Computer Science in Sports,* 18(1), 7-12.

Dosil, J. (2006). *The Sport Psychologist's Handbook: A Guide for Sport-Specific Performance Enhancemnet.* John Wiley & Sons Ltd. DOI:10.1002/9780470713174

Duncan, M.J., Smith, M., Bryant, E., Eyre, E., Cook, K., Hankey, J., Jones, M.V. (2016). Effects of increasing and decreasing physiological arousal on anticipation timing performance during competition and practice. *European Journal of Sport Science,* 16(1), 27-35. https://doi.org/10.1080/17461391.2014.979248

Filaire, E., Sagnol, M., Ferrand, C., Maso, F., & Lac, G. (2001). Psychophysiological stress in judo athletes during competitions. *Journal of Sports Medicine and Physical Fitness,* 41(2), 263-268.

Ford, J.L., Ildefonso, K., Jones, M.L., & Arvinen-Barrow, M. (2017). Sport-related anxiety: Current insights. *Open Access Journal of Sports Medicine*, 8, 205-212.

Hasanah, U., Refanthira, N. (2019). Human problems: competitive anxiety in sport performer and various treatments to reduce it, Advances in Social Science, Education and Humanities Research, 395, 144-148.

Hasanah, U., Refanthira, N. (2020). Human Problems: Competitive Anxiety in Sport Performer and Various Treatments to Reduce It. *Advances in Social Science, Education and Humanities Research*, *Conference: Proceedings of the 5th ASEAN Conference on Psychology, Councelling, and Humanities (ACPCH 2019),* 395, 144-147. https://doi.org/10.2991/assehr.k.200120.031

Jones, E.S., Mullen, R., & Hardy, L. (2019). Measurement and validation of a three factor hierarchical model of competitive anxiety. *Psychology of Sport and Exercise,* 43, 34-44. https://doi.org/10.1016/j.psychsport.2018.12.011

Kar, S. (2013). Measurement of Competition Level Anxiety of College Level Athletes by Using SCAT. *International Journal of Engineering Science and Innovative Technology,* 2(3), 367-75.

Kerketta, I. (2015). A Comparative study of sports competition Anxiety between district evels male Volleyball and soccer players. *International Journal of Physical Education, Sports and Health.* 1(3), 53-55.

Khabiri, M., Ali Moghadam Zadeh, Kalash, R.M., Asadi, A., Mehrsafar, A.H. (2018). The effect of positive self-talk intervention on psychophysiological responses of competitive anxiety and self-confidence in elite athletes. *Neuropsychology,* 3(4), 93–102.

Khan, Z., Haider, Z., Ahmad, N., & Khan, S. (2011). Sports Achievement. Motivation and Sports Competition Anxiety: A Relationship Study. *Journal of Education and Practice*, 2(4), 1-5.

Kornspan, A. S. (2012). *History of Sport and Performance.* The Oxford Handbook of Sport and Performance Psychology, 3.

Martens, R. (1977). *Sports competitive Anxiety Test.* Champaign III: Human kinetics.

Martens, R., Burten, D., Vealey, R., Bump, L. Smith, D. (1990). *The Development of the Competitive State Anxiety Inventory* (CSA-2). Champaign, Illinois.

Martinent, G., Ferrand, C., Guillet, E., Gautheur, S. (2010). Validation of the French version of the Competitive State Anxiety Inventory-2 Revised (CSAI-2R) including frequency and direction scales. *Psychology of Sport and Exercise,* 11(1), 51-57. doi:10.1016/j.psychsport.2009.05.001

Masaki, H., Maruo, Y., Meyer, A., & Hajcak, G. (2017). Neural correlates of choking under pressure: Athletes high in sports anxiety monitor errors more when performance is being evaluated. *Developmental Neuropsychology,* 42(2), 104-112.

Mellalieu, S. D., Hanton, S., & Fletcher, D. (2006). *A competitive anxiety review: Recent directions in sport psychology research.* In S. Hanton & S. D. Mellalieu (Eds.), Literature reviews in sport psychology(pp. 1-45). Hauppauge, NY: Nova Science.

Nayek, B., Chatterjee, K. (2013). Comparative study on pre-competition anxiety between national and state level women athletes*. IOSR Journal of Sports and Physical Education,* 1(2), 33-6.

Nieuwenhuys, A., Pijpers, J. R., Oudejans, R. R., & Bakker, F. C. (2008). The influence of anxiety on visual attention in climbing. *Journal of Sport and Exercuse Psychology,* 30(2), 171-185. https://doi.org/10.1123/jsep.30.2.171

Ong, N. C. H., & Chua, J. H. E. (2021). Effects of psychological interventions on competitive anxiety in sport: A meta-analysis. *Psychology of Sport and Exercise,* 52(2021) 101836 https://doi.org/10.1016/j.psychsport.2020.101836

Qureshi, D. R. (2015). Comparative Study of Anxiety Test between College Level Table Tennis and Volleyball Players. Scholars Impact, 2(1), 41-44.

Popa C. O., Schenk A., Rus A., Szasz S., Suciu N., Szabo D.A., Cojocaru C. (2020). The Role of Acceptance and Planning in Stress Management for Medical Students, *Acta Marisiensis - Seria Medica*, 66(3), 101-105.

Ramakrishnan, K. S., Sathya, P., Bhavi, G. (2015). Assessment of Anxiety in Sports Person Pre & Post Sports PerfomanceA Study on: Levels ofAnxiety inIndividual Vs Group Sport. *International Journal of Innovative Research in Science, Engineering and Technology,* 4(9), 8901-8905. https://doi.org/10.15680/IJIRSET.2015.0409085

Sangari, M., Fotrousi, F., Masrour, F. F. (2012). Relationship between mental skill and competitive anxiety in female national football players. *World Appl. Sci. J.,* 20(8), 1175-8.

Sopa, I.S., Szabo, D.A. (2015). Testing agility and balance in volleyball game. Discobolul Phys Educ Sport Kinetother J, 11(41), 167-174.

Szabo, D.A. (2015a). Modalities of Using the Information Provided by the Statistical Program Click and Scout for Improving the Outside Hitters Service Efficiency in Volleyball Game. *The European Proceedings of Social & Behavioral Sciences EpSBS,* XI, 341-347. http://dx.doi.org/10.15405/epsbs.2016.06.47

Szabo, D.A. (2015b). Study on improving the service unforced errors in volleyball game by using a statistical software. *Conference proceedings of eLearning and Software for Education (eLSE),* 3, 320-326.

Szabo, D.A., & Magdaș, L. (2014). Increasing the defensive efficiency in volleyball using the statistical program "Click&Scout". *Conference proceedings of eLearning and Software for Education (eLSE),* 1, 223-228.

Szabo, D.A., Neagu, N., & Sopa, I.S. (2020). Research regarding the development and evaluation of agility (balance, coordination and speed) in children aged 9-10 years. *Health, Sports & Rehabilitation Medicine*, 21(1), 33-40. https://doi.org/10.26659/pm3.2020.21.1.33

Szabo, D.A., Neagu, N., Teodorescu, S., & Sopa, I.S. (2019). Modalities of exploatation the information provided by the Click & Scout statistical program in preparing volleyball attack players. *International Journal of Applied Exercise Physiology*, 8(2.1), 852-859.

Szabo, D.A., & Sopa, I.S. (2015). Study on the Interpretation of the Results in a Volleyball Game by Using a Specific Program of Statistics. *Procedia Social and Behavioral Sciences, Elsevier Publication*, 180C, 1357-1363.

Szabo, A., Szucs, A., Gaspar, Z., Sule, K. (2014). Anxiety and affect in successful and less successful elite female basketball players: In-situ sampling before six consecutive games. *Lase Journal of Sports Science,* 5(2), 75-92.

Tulbure R. E., Neagu N., Szabo, D. A., (2020). Comparative study on the development of the motor skill (strength) through the circuit method versus dynamic games in physical education classes. *Health, Sports & Rehabilitation Medicine*, 21(4), 223-230. https://doi.org/10.26659/pm3.2020.21.4.223

Wadey, R., & Hanton, S. (2008). Basic psychological skills usage and competitive anxiety responses: perceived underlying mechanisms. *Research Quarterly for Exercise and Sport,* 79(3), 363-373. https://doi.org/10.1080/02701367.2008.10599500

Weiss, M. R., Gill, D. L. (2005). What goes aroung: re-emerging themes in sport and exercise psychology. *Research Quarterly for Exercise and Sport,* 76, 71-87.

Wilson, M. R., Wood, G., & Vine, S. J. (2009). Anxiety, attentional control, and performance impairment in penalty kicks. *Journal of Sport and Exercise Psychology,* 31(6), 761-775.

Woodman, T., & Hardy, L. (2003). The relative impact of cognitive anxiety and self-confidence upon sport performance: A meta-analysis. *Journal of Sports Sciences,* 21(6), 443-457.

© **GeoSport for Society**, volume 14, no. 1/2021, pp. 56-66, DOI 10.30892/gss.1406-073

GEOSPORT FOR SOCIETY
Scientific Journal founded in 2014 under aegis of University of Oradea (Romania), University of Debrecen (Hungary), University of Gdánsk (Poland)
ISSN 2393-1353
Edited by Oradea University Press
1, University Street, 410087, Oradea, Romania
Journal homepage: *http://geosport.uoradea.ro*

Linear kinematic analysis of cinematic biomechanics in semi-squat knee flexion: a case study

Dan Alexandru SZABO[1*], Nicolae NEAGU[1], Andreea ILIEŞ[1], Mariana ARDELEAN[1]

1. George Emil Palade University of Medicine, Pharmacy, Science, and Technology, Romania, Address: Str. Gheorghe Marinescu, No. 38, C.P. 540139, Târgu Mureș, Romania, e-mails: dan-alexandru.szabo@umfst.ro, nicolae.neagu@umfst.ro, iliesa1911@gmail.com, mariana.ardelean@umfst.ro

* *Corresponding author*

Citation: Szabo, D.A., Neagu, A., Ilieș, A., & Ardelean, M. (2021). Linear kinematic analysis of cinematic biomechanics in semi-squat knee flexion: a case study. *Geosport for Society*, 14(1), 56-66. https://doi.org/10.30892/gss.1406-073

Article history: 19.05.2021; Revised: 10.06.2021; Accepted: 25.06.2021, Available online: 30.06.2021

Abstract: The study emphasized the necessity of kinesiology and biomechanical movement analysis in today's physical education, kinesiotherapy, and sports. Our experiment observed a biomechanical motion configuration of semi-squat knee flexion, vertical position, angle, speed, and acceleration. The Kinovea software, version 0.9.3, is utilized as a study tool for biomechanical investigation employing some specific kinesiological characteristics of the movement. The findings of the biomechanical action emphasized the unique semi-squat knee flexion and extension, displaying the complete action from a certain linear angle, angular velocity, and acceleration.

Keywords: biomechanical movement, kinesiology, semi-squat knee flexion

Introduction

Angular and linear kinetics and kinematics can be accomplished using the inverse dynamics method described by Whittlesey and Robertson (2004) as 'the mechanism by which forces and moments of force are indirectly determined by the kinematics and inertial properties of moving bodies (Sanders et al., 2016). The center of mass (CM) location can be accomplished by modeling the body as a set of rigid connections (Sanders et al., 2016). Linear and angular momentum can be extracted from linear and angular displacements concerning the digitized coordinates' reference axes. Angular moments of the body segments concerning each axis are then calculated, and the net torque of each axis is derived as derivatives of the entire body angular momentum of each axis (Sanders et al., 2016).

The inverse dynamic method can also help swimming research provide quantitative knowledge on linear and angular motion (Sanders et al., 2016).

A modern kind of prosthetic management has newly gone recommended - position management (Geethanjali, 2016). This supports on the findings of past dimensionality-decrease experiments conducted on hand kinematics (Santello et al., 1998; Todorov and Ghahramani, 2004; Ingram et al., 2008; Portnova-Fahreeva et al., 2020). In some experiments, the Principal Component Analysis was used to simplify complex hand grip kinematics by discovering a decreased proportion of linear input signal combinations that describe much of the heterogeneity found in data capture. These variations cover a latent variety of kinematics (Portnova-Fahreeva et al., 2020). The sports practices will enhance skills (Sopa, 2015; Sopa, 2019a; Sopa, 2019b), sustain wellbeing, build community harmony and connectivity (Sopa, 2014), and facilitates the learning of correct movement from a biomechanical point of view.

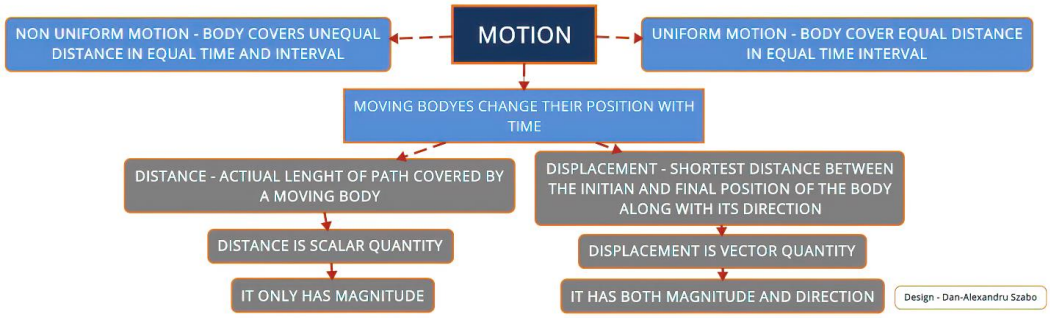


Figure 1. The human motion

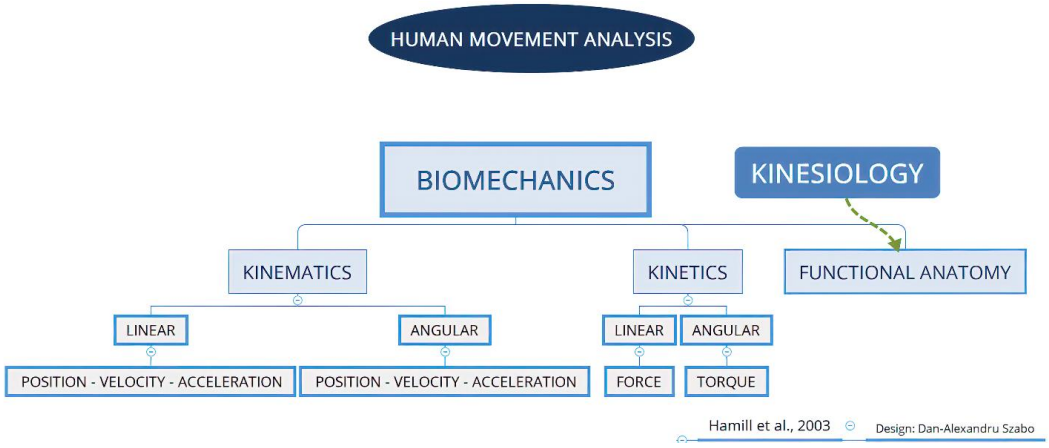


Figure 2. Human movement analysis
(Source: Hamill et al., 2003)

Traditionally, three types of data are known to explain human movements fully: kinematic, kinematic, and electromyographic (EMG) (Winter, 1991; Lencioni et al., 2019). Kinematic data include displacement and alignment of body parts, joint angles,

DOI 10.30892/gss.1406-073

and spatial-temporal gait parameters. Kinetic data include ground reaction forces (GRF), mechanic moments, lower limb powers, kinetic and potential energy (Lencioni et al., 2019). Muscle activation patterns are studied by electrical signals (EMGs) consistent with muscle fiber contraction, which can be recorded non-invasively by surface electrodes connected to the skin over the muscle belly (Lencioni et al., 2019).

Sports biomechanics is usually practiced employing wearable detectors which empower non-invasive data acquisition during movements (Taborri et al., 2016). Moreover, wearable detectors allow athletic activity to be conducted in the biological world, overwhelming the ecological constraint of laboratory experiments, such as the use of the optoelectronic 3D device, nevertheless evaluated to be the golden criterion for movement evaluation (Tabori et al., 2016; van der Kruck and Reijne, 2018).

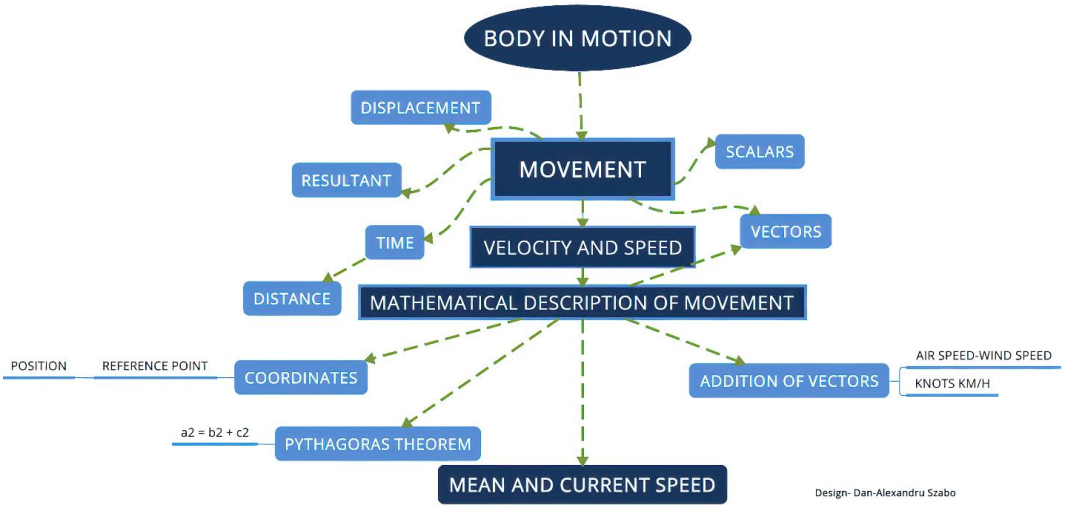


Figure 3. The body movement

Inertial sensors (Kos and Umek, 2019; Kinnunen et al., 2019; Gopfert et al., 2017), force sensors (Lee et al., 2017; Buckeridge et al., 2015; Kos and Umek, 2018a), and electromyography sensors (Brochner et al., 2018; Cruz Ruiz et al., 2015) appear frequently utilized for objective and covert quantification of kinematics, kinetics, and muscle movement during sports events. One exciting path for wearable sensor usage is the real-moment biofeedback processes (Kos and Umek, 2018b) that can give improved input knowledge to athletes and/or coaches at the same time (Kos and Umek, 2019; Umek and Kos, 2016; Kos et al., 2019). Lee et al. (Lee et al., 2017) found that hip, knee, and ankle joint forces and moments, measured based on a conventional inverse dynamic study using motion capture data and the ground response force, were higher mid-turn than for short-turn ski carving. Purevsuren et al., (Purevsuren et al., 2018) concluded that short trackers had intense internal rotational moments when the knee was flexed. However, this conclusion may not be accurate because pressure insoles can only approximate the usual force component on the plantar surface and hence the moment (free moment) and force components parallel to the plantar surface. Instead, horizontal plane forces are essential for short-track speed skating (van der Kruk et al.,

2018). In comparison, only short skating was used in the study when skaters are either approaching, leaving, or within a curve (van der Kruk et al., 2018). Applications of surface electromyography (SEMG) in sports science have been increasingly widespread and diversified over the last decade (Merletti and Muceli, 2019). Thanks to wireless networks' emergence, SEMG is now primarily used as a descriptive instrument and in quantitative studies. Bipolar (i.e. using a series of two electrodes) setups are widespread in sports science to record non-invasive summation of action potentials through the skin, giving an analog signal as output that defines the electrical potential difference (voltage) measured between the two electrodes (Merletti and Muceli, 2019).

Methodology

Study Design and Subjects

The study methodology was clarified, and informed consent was received from the subject to interpret the findings and publish them. Both activities have been carried out following the specifications of the Helsinki Declaration.

This thesis focuses on the premise of using Kinovea, version 0.9.3, kinetic, and biomechanical analysis program, and we can strengthen the teaching method in biomechanics and kinesiology (Szabo et al., 2020).

The case study analyzes the leg's biomechanical linear movement on a student's semi-squat knee flexion. The student was in the first term at the Master's curriculum Physical Therapy and Functional Rehabilitation at "G. E. Palade" University of Medicine, Pharmacy, Science, and Technology from Târgu Mureș, Romania. The objective of this experiment appears to emphasize the circumstance that specialized biomechanical measurements, such as linear kinematics, can exclusively be obtained through the aid of videotape analysis tools minus any additional mechanisms of assistance (Szabo et al., 2020).

Both assessments were transported abroad in the practical workshop in Biomechanics and Kinesiology from 16-September 2020 to 28-September 2020 at the headquarters of the Discipline of Human Movement Sciences (Szabo et al., 2020).

Procedure

The testing technique involved multiple trials of execution of semi-squat knee flexion and was reported as the strongest and accurate scientific execution. The program used to analyze the movement of the subject was Kinovea, version 0.9.3.

Table 1. Linear kinematics – from frame 0 to frame 2568

Time (ms)	SPEED			ACCELERATION		
	Angle 1 - o	Angle 1 - a	Angle 1 - b	Angle 1 - o	Angle 1 - a	Angle 1 - b
0	-	-	-	-	-	-
33	14.4588089	19.88516617	20.06421852	-	-	-
67	13.91840935	18.05595398	17.57689857	-16.50285912	-55.76958466	-49.3273735
133	12.87868881	14.6063633	15.55068398	-26.75684929	-44.2489357	-68.76911163
167	11.57306957	13.21319866	12.1863184	-45.64212036	-42.52270126	-108.4627838
200	9.834025383	11.76978779	8.315422058	-31.9717617	-41.17425156	-72.73350525

DOI 10.30892/gss.1406-073

267	10.49862099	9.806860924	8.878773689	37.76114273	-8.549201965	49.04633331
300	11.9592638	9.896280289	10.60621071	22.76117897	5.938308716	39.62181854
333	12.01695824	10.20298958	11.52183914	-25.6070919	4.003691673	21.79558563
400	8.318258286	9.666053772	11.81884766	-42.19184113	-16.22542381	-24.61861038
433	7.436578751	9.081001282	10.41789436	-12.46854496	-11.00447941	-22.66716576
467	7.486515045	8.931974411	10.30678177	14.32147217	4.285830975	19.49443817
533	9.998731613	10.00110817	11.16951084	45.38505554	15.63881397	-45.73445892
567	11.41944122	10.41012096	8.667492867	41.42559814	8.368052483	-61.88111115
600	12.76212215	10.55931854	7.04158783	46.51765823	2.498581171	-15.22095871
667	15.52557755	10.40012455	15.24921608	-12.23161125	-8.871285439	468.5710754
700	13.70657158	9.985014915	38.90926361	-100.9677048	-12.24093246	953.4970093
733	8.79029274	9.583564758	78.85444641	-101.2564087	-6.708684444	1373.266724
800	9.644400597	10.06261921	186.4218597	6.18184042	28.05942345	1609.255493
833	7.364401817	11.40926552	237.8653259	52.57108307	56.15736008	1351.076538
867	13.15127659	13.80872631	276.5485535	353.4708862	86.25759888	916.4918823
933	50.93548584	21.01438332	310.6651001	604.8991699	113.4147415	332.1832886
967	71.29470062	24.7288723	321.1611023	593.0803833	100.9663849	349.0402222
1002	90.49829102	27.74958038	333.9486389	525.3041992	76.14069366	348.1257324
1068	118.5794907	30.91671181	348.7219543	320.1601563	21.49717712	83.69590759
1102	127.6933594	31.242033	349.9667664	194.1765137	1.975132942	69.21057129
1135	131.532486	31.04846764	353.3388062	-9.88407135	-8.989545822	161.7615509
1202	115.1553726	30.28544426	370.3468323	-376.0195923	-6.385743141	252.4327393
1235	101.9507599	30.2163887	377.5965576	-310.9258118	5.826210499	133.3746338
1268	94.41434479	30.67409515	379.2438965	-91.56030273	20.87622833	34.03640366
1335	104.5520248	32.47192383	389.2814026	293.887146	15.65455437	426.9640503
1368	115.4474411	32.65325928	408.3486633	266.2252197	-8.261001587	550.5096436
1402	122.3111954	31.92085457	426.004425	77.00702667	-35.59354019	361.1493835
1468	109.9370422	27.80055618	424.9711304	-402.7821045	-82.52157593	-419.5175781
1502	93.71585846	24.77411652	404.4550781	-509.6691589	-89.65662384	-787.5653687
1535	75.93837738	21.81980324	372.4347534	-505.2731323	-77.10263824	-1124.958008
1602	47.93202209	18.37613678	275.2306824	-323.6434326	-33.48536301	-1786.376831
1635	38.42105484	17.3970871	210.2477264	-267.2239075	-38.91363525	-2096.359375
1668	30.10623169	15.78031254	135.3881683	-192.6002197	-62.85666656	-2362.535645
1735	25.50746727	10.24510956	39.42596436	-12.38614082	-79.69115448	1098.280151
1768	24.7469635	7.888103962	125.9126282	-33.15065765	-58.85387802	2490.628418
1802	23.29607582	6.319125175	205.5691071	110.7941589	-49.75124741	2219.383545
1868	52.61846161	3.383494377	330.6090698	659.7818604	35.57683945	1525.462524
1902	76.15002441	6.942567348	375.721283	680.927063	142.7825623	1175.789185
1935	98.04128265	12.90813637	409.0428162	637.3983154	186.5229492	819.1052856
2002	141.1400299	26.00279808	440.5660706	724.3531494	203.0322723	171.5869598

2035	166.9888153	32.9287529	441.8077087	794.690918	210.7038116	-60.0773468
2068	194.1517334	40.05828476	436.5584717	780.5303955	208.7981262	-223.8317108
2135	238.3856354	52.79893112	413.3502197	447.4147644	158.6675262	-490.3284302
2168	248.9017487	57.44140244	394.1679993	146.3161926	112.2802963	-668.7575073
2202	248.1459961	60.28884888	368.7391968	-194.8187103	52.16920853	-758.1934814
2268	215.0220337	59.12810516	330.7597046	-681.0819092	-89.96979523	-81.02420044
2302	190.4727631	54.91982651	338.1860352	-734.1412354	-158.1170044	480.055603
2335	166.0494385	48.58054352	362.7829285	-734.6373901	-215.2737122	799.817749
2402	112.7065735	31.14025688	408.4132996	-988.630127	-300.6525574	148.2341919
2435	75.51820374	20.50376701	401.4280396	-1223.613892	-325.2480164	-613.8639526
2468	31.08256721	9.443833351	367.4640808	-806.2472534	-268.9533386	-1269.656372
2535	55.64744186	8.405345917	271.4120178	-	-	-
2568	-	-	-	-	-	-

Results

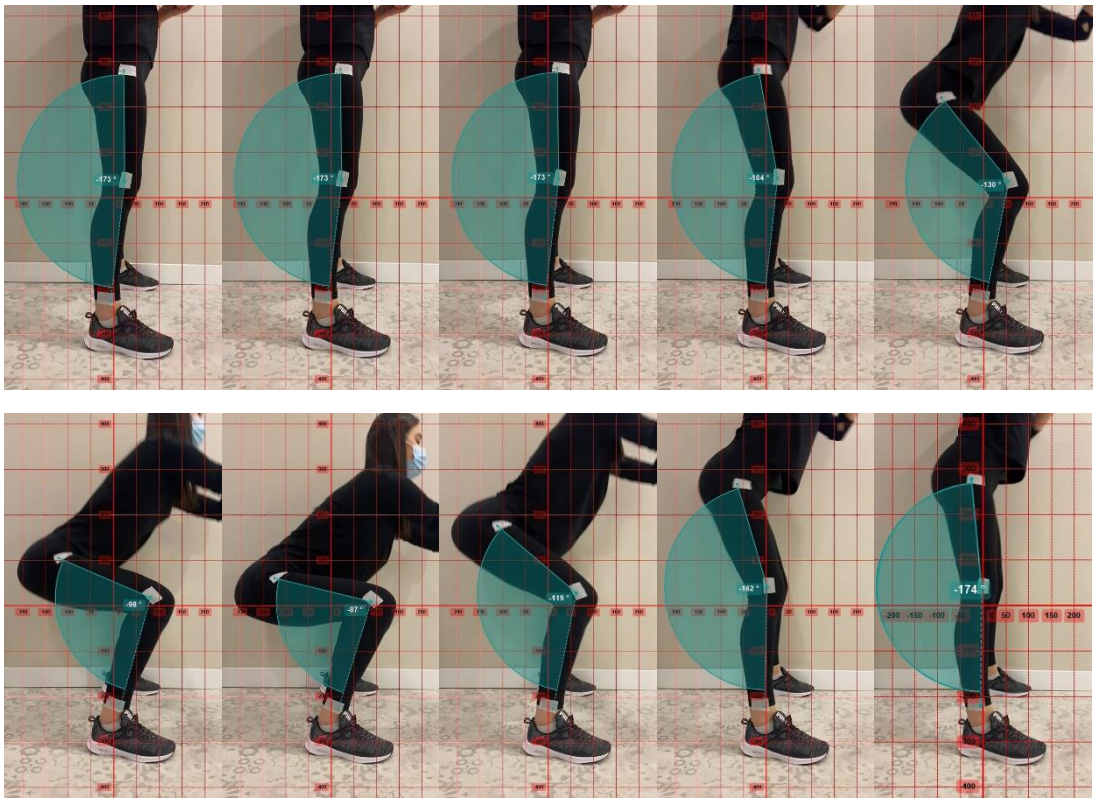


Figure 4. Graphical representation of linear variation in the semi-squat knee flexion

DOI 10.30892/gss.1406-073

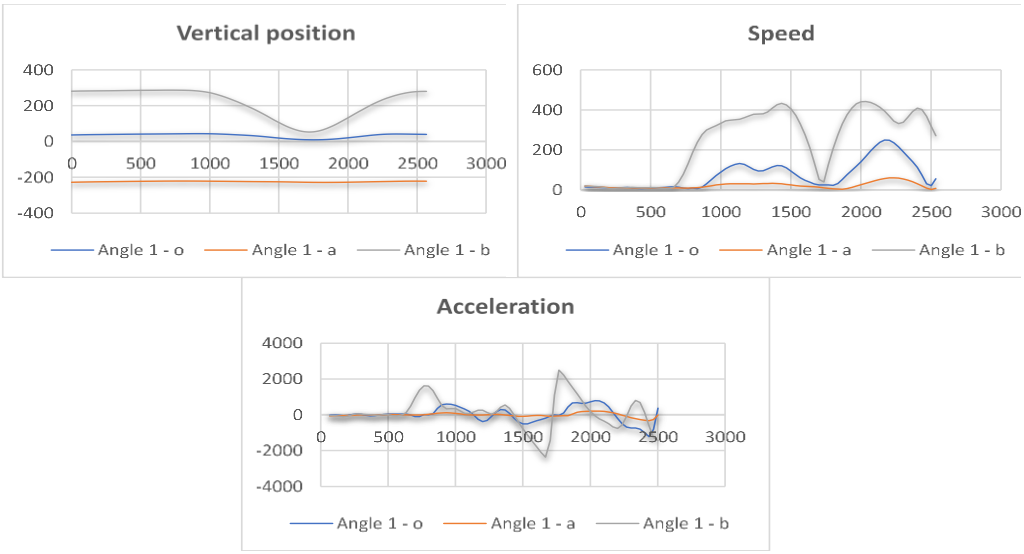


Figure 5. Representation of vertical position, speed and acceleration in the semi-squat knee flexion

Discussion

The purpose of this study was to investigate the linear kinematics and kinetics extracted from digital video. This complements the work of Sanders et al. (2015) and Szabo et al. (2020) to determine the reliability of linear and angular kinematics and kinetics. Although several systematic analyses already available in the literature have shown the efficiency, relevance, and utility of inertial sensors for sports applications (de Magalhaes et al., 2014; Johnston et al., 2019; Camomilla, et al., 2015), an outline of particular applications that can be applied by evaluating kinematics, kinetics, muscle function, and physiological parameters via a wearable. Our research highlighted the importance and viability of kinematic analysis in discovering the mechanism of lower member movement. Other scientific research also highlighted the importance of informatics programs in sports (Szabo et al., 2019) and preventing body dysfunctions (Sopa et al., 2019).

The evaluation of motor performance in sport is becoming more critical due to strengthening competitiveness and financial incentives among athletes. Wearable devices can provide crucial training and competitive success results. Among other sensor options, inertial sensors are the most commonly used, while force measurement devices and electromyography allow more knowledge on kinetics, and related muscle activity levels may offer further insight into the motor actions of athletes (Taborri et al., 2020).

The forces created by an athlete will provide helpful insight into their future success and risk of injury. Variables based on stand-alone force measures include the pressure center (CoP) (Buckeridge et al., 2015), the force path as a surrogate indicator of performance (Kinoshita et al., 2017), and the impact powers (Saponara, 2017). In

conjunction with kinematic tests, force data were used to approximate mechanical capacity (van der Kruk et al., 2018), joint kinetics (Lee et al., 2017; Purevsuren et al., 2018), and muscle intensity (Urbanczyk, 2019).

The effect of workload and cadence on muscle coordination is essential, as muscle coordination has an impact on mechanical performance (Blake et al., 2012; Wakeling et al., 2010) and strength production (Dorel et al., 2012; Samozino et al., 2007; Wakeling et al., 2010), but few studies have looked at spatiotemporal muscle excitation-workload-training relationships across multiple muscles.

In an ice hockey kinematic analysis, scientists (Buckeridge et al., 2015) found that joint kinematics and plantar intensity application techniques remained remarkably stable through trials for a given subject. This was predicted during cyclical events such as running. Muscle function is customarily adjusted to retain the preferred direction of motion, i.e., maintaining joint angle trajectories (Nigg, 2001). Excellent reliability was observed for joint kinematics and plantar strength tests, while overall waveform intensity EMG showed moderate to an excellent agreement for each of the five measured muscles (Buckeridge et al., 2015).

Effective coaching results may be accompanied by proper and prompt input to the athlete on goal success shortcomings (Camomilla et al., 2015). Systematic, analytical, and accurate performance measurement and assessment, carried out using qualitative and quantitative analysis of mechanical variables that decide performance, will improve the correlation between research and coaching practices, especially in elite sports. An alternative to classical laboratory-based assessment is the use of magneto and inertial sensors that can calculate movement-related data, linear and angular motion, without room constraints and bulky setup (Armstrong et al., 2007, Dellaserra, 2014). The latest generation of inertial sensors is compact, low-cost, easy-to-use, and allows exercises to be carried out during training or competition, opening new insights in sports sciences. The use of wearable inertial sensors has recently been analyzed in swimming (de Magalhaes et al., 2014), running (Norris, 2014), and strength and ballistic evaluation (Mc Master et al., 2014).

Conclusions

The research theory has been verified, and, using Kinovea, version 0.9.3, kinetic, and biomechanical analysis program, the teaching method in the practical work of the Biomechanics and Kinesiology discipline has been strengthened. The students' input was often encouraging and, by using Kinovea software alone, they were able to put into reality the ideas accumulated in the course, the notions of biomechanics, kinesiology, and linear kinematics (acceleration, speed, and vertical position).

References

Armstrong, S. (2007). Wireless connectivity for health and sports monitoring: a review. *Br J Sports Med,* 41(5), 285-289.

Blake, O.M., Champoux, Y., & Wakeling, J.M. (2012). Muscle coordination patterns for efficient cycling. *Med Sci Sports Exerc,* 44, 926–938.

DOI 10.30892/gss.1406-073

Brøchner, N.N., Hug, F., Guével, A., Colloud, F., Lardy, J., & Dorel, S. (2018). Changes in motor coordination induced by local fatigue during a sprint cycling task. *Medicine and Science in Sports and Exercise*, 50(7), 1394–1404. https://doi.org/10.1249/MSS.0000000000001572.

Buckeridge, E., Levangie, M.C., Stetter, B., Nigg, S.R., & Nigg, B.M. (2015). An on-ice measurement approach to analyse the biomechanics of ice hockey skating. *PLoS One*, 10(5), e0127324. https://doi.org/10.1371/journal.pone.0127324.

Camomilla, V., Bergamini, E., Fantozzi, S., & Vannozzi, G. (2015). In-field use of wearable magneto-inertial sesnors for sports performance evaluation. *33rd International Conference on Biomechanics in Sports*; 1425–1428.

Cruz Ruiz, A.L., Pontonnier, C., Sorel, A., & Dumont, G. (2015). Identifying representative muscle synergies in overhead football throws. *Computer Methods in Biomechanics and Biomedical Engineering*, 18(sup1):1918–1919. https://doi.org/10.1080/10255842.2015.1070581.

de Magalhaes, F.A., Vannozzi, G., Gatta, G., & Fantozzi, S. (2014). Wearable inertial sensors in swimming motion analysis: a systematic review. *Journal of Sports Sciences*, 33(7), 732–745. https://doi.org/10.1080/02640414.2014.962574.

Dellaserra, C.L. (2014). Use of integrated technology in team sports: a review of opportunities, challenges, and future directions for athletes. *J Strength Cond Res,* 28(2), 556-73.

Dorel, S., Guilhem, G., Couturier, A., & Hug, F. (2012). Adjustment of muscle coordination during an all-out sprint cycling task. *Med Sci Sports Exerc*, 44, 2154–2164.

Göpfert, C., Pohjola, M.V., Linnamo, V., Ohtonen, O., Rapp, W., & Lindinger, S.J. (2017). Forward acceleration of the centre of mass during ski skating calculated from force and motion capture data. *Sports Engineering*, 20(2), 141–153. https://doi.org/10.1007/s12283-016-0223-9.

Hamill, J., & Knutzen, K.M. (2006). *Biomechanical basis of human movement*. Lippincott Williams & Wilkins.

Ingram, J.N., Körding, K.P., Howard, I.S., & Wolpert, D.M. (2008). The statistics of natural hand movements. Exp. Brain Res. 188, 223–236. https://doi.org/10.1007/s00221-008-1355-3

Johnston, W., O'Reilly, M., Argent, R., & Caulfield, B. (2019). Reliability, validity and utility of inertial sensor systems for postural control assessment in sport science and medicine applications: a systematic review. *Sports Medicine*, 49(5),783–818. https://doi.org/10.1007/s40279-019-01095-9.

Kinnunen, H., Häkkinen, K., Schumann, M., Karavirta, L., Westerterp, K. R., & Kyröläinen, H. (2019). Training-induced changes in daily energy expenditure: methodological evaluation using wrist-worn accelerometer, heart rate monitor, and doubly labeled water technique. *PLoS One*, 14(7), e0219563. https://doi.org/10.1371/journal.pone.0219563.

Kinoshita, H., Obata, S., Nasu, D., Kadota, K., Matsuo, T., & Fleisig, G.S. (2017). Finger forces in fastball baseball pitching. *Human Movement Science*. 54, 172–181. https://doi.org/10.1016/j.humov.2017.04.007.

Kos, A., Milutinović, V., & Umek, A. (2019). Challenges in wireless communication for connected sensors and wearable devices used in sport biofeedback applications. *Future Generation Computer Systems*, 92, 582–592. https://doi.org/10.1016/j.future.2018.03.032.

Kos, A., & Umek, A. (2018a). *Biomechanical Biofeedback Systems and Applications*. Cham: Springer International Publishing.

Kos, A., & Umek, A. (2018b). Smart sport equipment: SmartSki prototype for biofeedback applications in skiing. *Personal and Ubiquitous Computing*, 22(3), 535–544. https://doi.org/10.1007/s00779-018-1146-1.

Kos, A., & Umek, A. (2019). Wearable sensor devices for prevention and rehabilitation in healthcare: swimming exercise with real-time therapist feedback. *IEEE Internet of Things Journal*, 6(2), 1331–1341. https://doi.org/10.1109/JIOT.2018.2850664.

Lee, S., Kim, K., Kim, Y. H., & Lee, S. (2017). Motion anlaysis in lower extremity joints during ski carving turns using wearable inertial sensors and plantar pressure sensors. 2017 IEEE International Conference on Systems, Man, and Cybernetics (SMC), pp. 695–698.

Lencioni, T., Carpinella, I., Rabuffetti, M., Marzegan, A., & Ferrarin, M. (2019). Human kinematic, kinetic and EMG data during different walking and stair ascending and descending tasks. *Scientific data*, *6*(1), 309. https://doi.org/10.1038/s41597-019-0323-z

Mc Master, D. T. (2014). A brief review of strength and ballistic assessment methodologies in sport. *Sports Med,* 44(5), 603-23.

Merletti, R., & Muceli, S. (2019). Tutorial. Surface EMG detection in space and time: best practices. *Journal Electromyography and Kinesiology*, 49:p. 102363. https://doi.org/10.1016/j.jelekin.2019.102363.

Nigg, B.M. (2001). The role of impact forces and foot pronation: A new paradigm. Clinical Journal of Sport Medicine 11, 2–9.

Norris, M. (2014). Method analysis of accelerometers and gyroscopes in running gait: A systematic review. *Curr Sports Med Rep,* 8(3), 136-41.

Portnova-Fahreeva, A.A., Rizzoglio, F., Nisky, I., Casadio, M., Mussa-Ivaldi, F.A., & Rombokas, E. (2020). Linear and Non-linear Dimensionality-Reduction Techniques on Full Hand Kinematics. Frontiers in bioengineering and biotechnology, 8, 429. https://doi.org/10.3389/fbioe.2020.00429

Purevsuren, T., Khuyagbaatar, B., Kim, K., & Kim, Y.H. (2018). Investigation of knee joint forces and moments during short-track speed skating using wearable motion analysis system. *International Journal of Precision Engineering and Manufacturing*, 19(7):1055–1060.

Samozino, P., Horvais, N., & Hintzy, F. (2007). Why does power output decrease at high pedaling rates during sprint cycling? *Med Sci Sports Exerc.,* 39: 680–687.

Sanders, R.H., Gonjo, T., & McCabe, C.B. (2015) Reliability of three-dimensional linear kinematics and kinetics of swimming derived from digitized video at 25 and 50 Hz with 10 and 5 frame extensions to the 4th order Butterworth smoothing window. Journal of Sports Science and Medicine 14, 441-451.

Sanders, R. H., Gonjo, T., & McCabe, C. B. (2016). Reliability of Three-Dimensional Angular Kinematics and Kinetics of Swimming Derived from Digitized Video. *Journal of sports science & medicine*, *15*(1), 158–166.

Santello, M., Flanders, M., & Soechting, J.F. (1998). Postural hand synergies for tool use. J. Neurosci. 18, 10105–10115. https://doi.org/10.1523/JNEUROSCI.18-23-10105.1998

Saponara, S. (2017). Wearable biometric performance measurement system for combat sports. *IEEE Transactions on Instrumentation and Measurement*, 66(10), 2545–2555. https://doi.org/10.1109/TIM.2017.2677679.

Sopa, I.S. (2014). Study regarding group cohesion at primary school level. Buletin of the Transilvania University of Braşov, 7.1(56), 67-74.

Sopa, I.S. (2019a). The influence of external factors in the efficiency of basketball scoring. *Bulletin of the Transilvania University of Brasov*, 12(1), 137-144.

Sopa, I.S. (2019b). Developing attack point in volleyball game using plyometric exercises at 13-14 years old volleyball players. *Bulletin of the Transilvania University of Brasov*, 12(2), 67-76.

Sopa, I.S., Neagu, N., & Gliga, C.A. (2019). Correlation between body mass index and the apparition of spine, knee and feet deficiency in youth population. *International Journal of Applied Exercise Physiology*, 9(1), 8-15.

Sopa, I. S. (2015). Testing agility skill at a basketball team. *Discobolul, Physical Education, Sport and Kinetotheraphy Journal*, 9(42), 101-108.

Szabo, D.A., Neagu, N., Teodorescu, S., Pomohaci, M., & Sopa, I.S. (2019). Does smart electronic devices influence the body deficiencies development at kids who practice swimming? *International Journal of Applied Exercise Physiology*, 8(2.1), 798-803.

Szabo, D.A., Neagu, N., & Sopa, I.S. (2020). Kinematic angular analysis of cinematic biomechanics in forearm flexion: a case study. Geosport for Society, 13(2), 131-139. https://doi.org/10.30892/gss.130xx-065

Taborri, J., Keogh, J., Kos, A., Santuz, A., Umek, A., Urbanczyk, C., van der Kruk, E., & Rossi, S. (2020). Sport Biomechanics Applications Using Inertial, Force, and EMG Sensors: A Literature Overview. *Applied bionics and biomechanics*, 2041549. https://doi.org/10.1155/2020/2041549

Taborri, J., Palermo, E., Rossi, S., & Cappa, P. (2016). Gait partitioning methods: a systematic review. *Sensors*, 16(1), 66. https://doi.org/10.3390/s16010066.

Todorov, E., Ghahramani, Z. (2004). Analysis of the synergies underlying complex hand manipulation," in The 26th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (San Francisco, CA: IEEE;), 4637–4640.

Umek, A., Kos, A. (2016). The role of high-performance computing and communication for real-time biofeedback in sport. *Mathematical Problems in Engineering*; 11. https://doi.org/10.1155/2016/4829452.

DOI 10.30892/gss.1406-073

Urbanczyk, C.A., Mcgregor, A.H., & Bull, A.M.J. (2019). Modelling scapular biomechanics to enhance interpretation of kinematics and performance data in rowing. *Proceedings of the 37th International Conference of Biomechanics in Sports,* 1–4.

van der Kruk, E., & Reijne, M.M. (2018). Accuracy of human motion capture systems for sport applications; state-of-the-art review. *European Journal of Sport Science*, 18(6):806–819. doi: 10.1080/17461391.2018.1463397.

van der Kruk, E., Reijne, M.M., de Laat, B., & Veeger, D.J. (2018). Push-off forces in elite short-track speed skating. *Sport Biomechanics*, 18(5), 527–538. https://doi.org/10.1080/14763141.2018.1441898.

van der Kruk, E., van der Helm, F.C.T., Veeger, H.E.J., & Schwab, A.L. (2018). Power in sports: a literature review on the application, assumptions, and terminology of mechanical power in sport research. *Journal of Biomechanics*, 79, 1–14. https://doi.org/10.1016/j.jbiomech.2018.08.031.

Wakeling, J.M., Blake, O.M., & Chan, H.K. (2010). Muscle coordination is key to the power output and mechanical efficiency of limb movements. *J Exp Biol*., 213, 487–492.

Whittlesey S.N., & Robertson D.G. (2004) Two dimensional inverse dynamics. Research Methods in Biomechanics. Eds: Robertson D.G.E., et al. Chapter 5. Champaign, IL: Human Kinetics; 103.

Winter, D. A. (1991). *Biomechanics and motor control of human gait: normal, elderly and pathological*.

GEOSPORT FOR SOCIETY

Volume 14, no. 1/2021 pp. 1-66

ISSN 2393-1353