

RADIOGRAPHY OF THE ATHLETICS TRAINING MODERNISATION IN ROMANIA

Robert-Valentin MUNTEANU^{1*}, Corina ȚIFREA¹

¹ National University of Physical Education and Sport, Doctoral School, Bucharest, Romania

*Corresponding author: rmtatletism@gmail.com

<https://doi.org/10.35189/dpeskj.2022.61.2.4>

Abstract. *The purpose of the research is to identify the opinions of Romanian athletics coaches about the training process and the use of modern technology during the pandemic. The study participants are 115 coaches aged 18-60, $M = 42.15 (\pm 8.73)$ years, with a coaching experience between 1 and 38 years, $M = 19.22 (\pm 7.89)$ years). Of these coaches, 70 are men and 45 are women, 80 train junior athletes and 35 train senior athletes. They responded to an online questionnaire that revealed that more than half of the participants (57%) did not use modern devices in their training lessons. However, the use of such equipment is positively associated with competition participation ($p < 0.05$), and this statement is statistically certified by the Pearson correlation ($r = 0.57$). The role of modern technology in winning medals at national and international athletics competitions is highlighted by significant differences between participants, in the sense that those who used modern applications in the training process won a larger number of medals ($F = 2.73, p = 0.023$). Even if the use of modern technology has an influence on athletic performance, there are few Romanian coaches who can afford to purchase smart devices. It follows that modernising the training process is extremely necessary for predicting long-term sports performance so that our athletes can compete and train on an equal basis with international athletes.*

Keywords: *technology, athletics, training, devices, performance.*

Introduction

Athletics is a sports discipline that has been present at all editions of the ancient, modern and contemporary Olympic Games, and the number of events has gradually increased, just as the number of competitions (according to the system of athletic events and the international competition system) (Stoica, 2000). The revival of Romanian athletics is a necessity that can be achieved by modernising the means of work and the process of monitoring sports training. Numerous studies certify the viability of using modern technology in elite sport, with most devices being used for the individualisation of sports training (Haugen et al., 2019), because they offer accurate data that can be easily monitored.

Technology provides coaches with valuable information and tools to improve athletic performance, and computer use increases “the quantity and quality of information”, which “can spread rapidly in all areas of life” (Bicer et al., 2022).

Recent research validates the performance of various modern technologies developed to track the progress of athletes during training and competition, these studies being of real help to coaches who want to modernise their training process (Ghigiarelli et al., 2022; Van den Tillar, 2021). Indeed, technology is increasingly recognised and used worldwide with the intention of optimising the training process (Groom et al., 2011; Collins et al., 2015) and a lot of software applications are now available on smartphones and tablets. These applications provide coaches with a monitoring mechanism that allows the recording of data about

athletes during their performance (for example, technical analysis or data related to their physical condition). In addition to the usefulness of modern technology in the monitoring and control process, the improvement of investigation methods and devices has also led to elucidating neuromuscular mechanisms in elite athletes (Costache, 2019). It is unanimously recognised that coaches use various supportive tools to increase their athletes' efficiency during competition and help them achieve sports performance. Obviously, coaches play a fundamental role in increasing sports performance by monitoring the entire context in which the athlete develops, starting from their training programme (in physical, technical, tactical and psychological terms) and continuing with the quality of the equipment used and their social environment.

“A successful coaching outcome can be supported by useful and timely feedback to the athlete targeting performance defects. Systematic, objective, and reliable performance monitoring and evaluation performed by means of qualitative and quantitative analyses of performance variables can reinforce the link between research and coaching practice.” (Camomilla et al., 2018, p. 1)

Valid and reliable assessments of sports performance largely depend on standardised procedures and equipment that can provide accurate data. It is worth mentioning that performance in sprint events mainly relies on genetic predispositions, the training process and the support of interdisciplinary teams and modern equipment. Beyond a certain level, athletes are likely to train for years to improve their sprinting performance by a few hundredths of a second (Haugen et al., 2015), which is why they use as many supportive tools as possible, from highly-effective competition equipment to monitoring and/or training devices.

The context generated by the SARS-CoV-2 pandemic produced substantial changes in the training process, with loss of progress for elite athletes, reorientation of training planning in the medium and short term as well as major challenges of adapting to the new training and competition conditions. Coaches had a difficult task in that period, constantly seeking solutions to conduct training lessons, improving their knowledge and skills to properly manage online training and purchasing various digital applications and software programs.

Obviously, the pandemic period generated much controversy about training monitoring for elite athletes and brought major changes in their quality of life, starting from aspects related to the dimensions of neuroticism to those regarding communication with the coach and teammates and modification of the training programme (Cosma et al., 2021a). Roberts and Lane (2021) also pointed out that the restrictions and changes caused by the pandemic “were associated with a substantial increase in unpleasant emotions” (p. 7). Santi et al. (2021) highlighted in their study that the lockdown period had a negative effect on stress perception by both female and male coaches.

During the pandemic, coaches also faced “multiple challenges regarding the need to adjust training objectives, establish certain priorities in terms of physical, technical and tactical priorities, manage IT tools for online sessions” (Teodorescu et al., 2021, p. 18). Of course, there is a need to develop programmes to support coaches if another pandemic situation occurs, Santos et al. (2021) urging the authorities to reflect on these changes and take action by developing coach training programmes via online platforms, delivering coach certification programmes and providing the best opportunities for coaches. From a desire to deal with the situation, professional organisations have started to offer numerous online services aimed at

training coaches. Pérez-Camarero et al. (2022) give the example of the International Olympic Committee (IOC), which provides, via its Athlete365 Learning platform, “online training courses in various sporting fields, targeted at and accessible to coaches, athletes, referees and all interested parties” (p. 27).

Thus, the purpose of the present research is to identify the opinions of athletics coaches about the use of modern technology and smart equipment for monitoring sports training, which is a useful approach that can provide a clear radiography of the training process modernisation in Romanian athletics.

Methodology

Participants

Between June and December 2020, 200 coaches responded positively to the request for participation in a research that, in addition to the identification of job insecurity and work meaning (Cosma et al., 2021b), was also focused on the possibilities of using modern means in training lessons. The main study identified that “the material difficulties and job insecurity are neuralgic points of the Romanian sport, being accentuated by the COVID-19 pandemic” (Cosma et al., 2021b, p. 11). The second part of the questionnaire administered to coaches is the subject of the present study, which aims to identify the opinions of Romanian athletics coaches about the use of modern technology in their training sessions. Thus, 120 athletics coaches from all over the country agreed to take part in this research. Of them, 5 coaches did not accept the informed consent and were excluded from the study, therefore the responses of 115 coaches aged 18-60, $M = 42.15$, $SD = 8.73$, were finally analysed. The respondents’ experience in the coaching activity is between 1 and 38 years, $M = 19.23$ years, $SD = 7.89$. Of these participants, 70 are men and 45 are women, 80 coaches train junior athletes and 35 train senior athletes.

Instruments

Socio-demographic data were collected based on the respondents’ gender, age and experience in the field. In addition to the tools analysed in the previous study (Cosma et al., 2021b), the online questionnaire included items aimed at identifying the coaches’ opinions about the obtained results and the barriers to achieving sports performance in a pandemic context.

Responses to these items were analysed using a 5-point rating scale where 1 represents *to a very small extent* and 5 represents *to a very large extent*. The items of the opinion questionnaire addressed issues regarding: access to technology and the Internet during the pandemic; difficulty to provide athletes with information about online training; difficulty to monitor the online training of athletes; difficulty to organise individual and group online training sessions.

Examples of questions: *Do you currently use modern equipment and devices in the training process?*, *Do you currently use modern equipment and devices for athlete assessment and monitoring? If so, what type of devices do you use for athlete assessment?*,

Did your athletes benefit from psychological counselling during the pandemic?, Did your athletes benefit from psychological counselling before the pandemic?, What is the frequency of your training lessons per week during this period?”, What was the frequency of your training lessons per week before the emergence of the SARS-CoV-2 virus?”

Procedure

The present research was conducted in 2020, when an online questionnaire was designed and administered to Romanian athletics coaches. The questionnaire was disseminated to athletics coaches across the country via the Google Docs Forms on online communication platforms and groups created for athletics coaches, with an estimated response time of 10-15 minutes to complete the questionnaire items.

Research participation was voluntary and, after giving consent, respondents completed a set of online questionnaires. Anonymity was respected, as well as international ethical recommendations regarding the absolute confidentiality of the collected data and the participants' anonymity and security. No identification data such as name, phone number or email address were required. Respondents could withdraw from the study at any time without negative consequences.

Results

The first items of the questionnaire aimed to identify the coaches' experience regarding the participation of their athletes in national and international competitions, as well as the athletes' results.

Thus, most of the surveyed coaches (98.3%) have experience as regards participation in national competitions.

Of the 115 coaches, 81 trained athletes who had took part in international championships (Balkan Games, cups, Grand-Prix contests), therefore 70% of them have experience as regards participation in international competitions.

Almost half of the respondents (48%) benefited from the experience of participating with their athletes in European or world (indoor and/or outdoor) championships, with 55 coaches responding in the affirmative to the item about their access to high-level competitions.

Participation in the Olympic Games is the ultimate dream for any athlete and coach but also a confirmation of the technical staff effectiveness. Thus, 17 of the surveyed coaches had the opportunity to be close to the world's best performers.

The proof that the respondents are experienced coaches ($M = 19.23 \pm 7.89$ years) also lies in the fact that over 95% of them have won medals with their athletes in national competitions. Only 5 coaches (in their first years of activity) responded negatively regarding their athletes' ranking in the top 3.

As for the results obtained in international competitions, most of the coaches (65%) won medals with their athletes. Of the 115 respondents participating in this research, 27 won medals at the European Junior and Senior Athletics Championships, thus certifying their value. Although the number of medallists decreases as the competitive level increases, there are however 18 Romanian coaches (16%) with medals won at the World Junior and Senior

Athletics Championships. Among the surveyed respondents, there were also 3 coaches whose athletes had won medals at the Summer Olympics, the rest of the coaches responding in the negative to the question about winning Olympic medals.

From the coaches' responses to the questions regarding the use of modern technology in the training and monitoring process, it appears that more than half of the participants (57%) do not use modern devices in their training sessions. Only 16 of them use modern applications for the monitoring and video analysis of athletes' performance (Table 1), and 20 believe that the timer is a modern training device. Obviously, there are also smart timers (such as Witty, which uses photocells), but as far as we know, there are few such devices in Romania. Some coaches have devices that measure athletes' lactate levels, but none of them talks about devices that are useful in both the training and monitoring process. Also, 2 respondents did not want to provide this information, considering it a professional secret.

Table 1. *Devices used during training*

Type of device used	Frequency	Percent	Valid Percent	Cumulative Percent
No device	66	57.4	57.4	57.4
Laptop, tablet	11	9.6	9.6	67.0
Phone applications	9	7.8	7.8	74.8
Videos	4	3.5	3.5	78.3
Timer	20	17.3	17.3	94.4
Modern applications (lactate measurement)	3	2.6	2.6	96.8
Secret	2	1.8	1.8	100.0
Total	115	100.0	100.0	

As the research was carried out during the pandemic, the questionnaire also aimed to identify certain aspects related to the modifications and adaptations of the training lessons during that difficult period, most of the coaches (55.7%) conducting between 4 and 6 lessons per week. However, 27% of them managed to conduct 7 to 10 lessons per week (Table 2).

Table 2. *Training frequency during the pandemic*

Number of lessons per week	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 1-3 lessons per week	14	12.2	12.2	12.2
4-6 lessons per week	64	55.7	55.7	67.8
7-10 lessons per week	31	27.0	27.0	94.8
over 11 lessons per week	6	5.2	5.2	100.0
Total	115	100.0	100.0	

Compared to the period before the pandemic generated by the emergence of the SARS-CoV-2 virus (Romania entered the lockdown in March 2020), training frequency underwent significant changes because, prior to the outbreak of the pandemic, most coaches (67 respondents) conducted over 7 training lessons per week with their athletes (Table 3), while during the pandemic, only 37 coaches managed to carry out their training sessions with approximately the same frequency.

Table 3. *Training frequency before the pandemic*

	Number of lessons per week	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1-3 lessons per week	9	7.8	7.8	7.8
	4-6 lessons per week	39	33.9	33.9	41.7
	7-10 lessons per week	51	44.3	44.3	86.1
	over 11 lessons per week	16	13.9	13.9	100.0
	Total	115	100.0	100.0	

Because this period was difficult for both coaches and athletes, we considered it appropriate to ask a question to identify whether the athletes had benefited from psychological counselling provided by specialists during and/or before the outbreak of the pandemic in Romania. Unfortunately, only 2.6% of the surveyed coaches responded in the affirmative as regards both the pandemic and pre-pandemic periods (Table 4).

Table 4. *Psychological counselling before and during the pandemic*

		Frequency	Percent	Valid Percent	Cumulative Percent
Before the pandemic					
Valid	No counselling	112	97.4	97.4	97.4
	With counselling	3	2.6	2.6	100.0
	Total	115	100.0	100.0	
During the pandemic					
Valid	No counselling	112	97.4	97.4	97.4
	With counselling	3	2.6	2.6	100.0
	Total	115	100.0	100.0	

In addition to the many available technologies for physical and technical monitoring, there are also psychological applications, such as mental health tracking, which can “be used by athletes and their support staff to continue to document and record their psychological states” (Hurley, 2021, p. 3). Therefore, Romanian athletes and coaches could have used such applications to receive psychological support during the difficult period caused by the implementation of the lockdown.

Another modern means of training consists in practising imagery in a 3D environment. Virtual reality-based imagery involves all the sensory organs of the athlete, which is helpful for their mental training process (Bedir & Erhan, 2021).

These online solutions also have certain disadvantages (lack of trust felt by some participants, security threats, etc.), but compliance with ethical standards can provide important support for both athletes and coaches.

Table 5 shows that the use of modern equipment in the training lesson is positively associated with competition participation ($p = 0.036$), the Pearson correlation statistically certifying this statement ($r = 0.196$). The effect size index ($r^2 = 0.038$) reveals a very weak association between variables.

Table 5. Correlation between the use of modern equipment and competition participation

		1	2	3	4
1. Use of modern equipment in the training lesson	Pearson Correlation	1	.566**	.196*	.163
	P		.000	.036	.082
	N	115	115	115	115
2. Use of modern equipment for assessment and monitoring	Pearson Correlation	.566**	1		
	P	.000		.210	.058
	N	115	115	115	115
3. Competition participation level	Pearson Correlation	.196*	.118	1	.779**
	P	.036	.210		.000
	N	115	115	115	115
4. Medal-winning level	Pearson Correlation	.163	.178	.779**	1
	P	.082	.058	.000	
	N	115	115	115	115

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

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

Tables 6 and 7 show the differences in competition participation depending on the modern equipment used (coaches using modern equipment vs. coaches who do not use such devices). The application of the one-way ANOVA test reveals that there are no significant differences in the competition participation level depending on the equipment used ($F = 1.98, p = 0.087$).

Table 6. Descriptive statistics – The use of modern technology

Competition participation level	N	Mean	SD	SE	95% Confidence interval		Min	Max
					min	max		
No device	66	2.29	1.092	.134	2.02	2.56	0	4
Laptop, tablet	11	2.55	.934	.282	1.92	3.17	1	4
Phone applications	9	3.00	1.000	.333	2.23	3.77	1	4
Videos	4	3.00	.000	.000	3.00	3.00	3	3
Timer	20	1.86	1.167	.249	1.35	2.38	1	4
Modern applications	3	2.33	.577	.333	.90	3.77	2	3
Secret	2	1.83	.466	.234	.80	2.77	2	3
Total	115	2.31	1.087	.101	2.11	2.51	0	4

Table 7. Relationship between the competition participation level and the use of modern technology

Competition participation level	ANOVA				
	Sum	Df	Mean	F	Sig.
Between groups	11.215	5	2.243	1.979	.087
Within groups	123.515	109	1.133		
Total	134.730	114			

Analysing the role of modern technology in winning medals at national and international athletics competitions, significant differences were noted, in the sense that those using modern applications (for example, Coach Eye) in the training process won a higher number

of medals. The data are statistically supported by the ANOVA test results ($F = 2.73$, $p = 0.023$), which are shown in Tables 8 and 9.

Table 8. *Descriptive statistics – The use of modern technology*

Medal-winning level	N	Mean (Medals)	SD	SE	95% Confidence interval		Min	Max
					min	max		
No device	66	2.03	1.136	.140	1.75	2.31	0	5
Laptop, tablet	11	2.45	1.368	.413	1.54	3.37	0	4
Phone applications	9	2.89	1.364	.455	1.84	3.94	1	5
Videos	4	2.00	.000	.000	2.00	2.00	2	2
Timer	22	1.45	.671	.143	1.16	1.75	1	3
Modern applications	3	2.00	.000	.000	2.00	2.00	2	2
Secret	115	2.03	1.120	.104	1.82	2.23	0	5

Table 9. *Relationship between the medal-winning level and the use of modern technology*

Medal-winning level	ANOVA				
	Sum of Squares	df	Mean Square	F	Sig.
Between groups	15.912	5	3.182	2.731	.023
Within groups	127.010	109	1.165		
Total	142.922	114			

Discussion and Conclusion

The data analysis highlights significant differences between coaches who do not use modern applications and those who have such devices and use them in their training lessons, in the sense that the latter won a significantly higher number of medals. However, we did not investigate whether these medals were won at national or international competitions.

Numerous researchers (Slawinski et al., 2017; Sandamas et al., 2019) support the idea that more and more athletes and coaches from all over the world recognise that detailed and high-quality data can be used to make objective decisions regarding aspects of training and performance. Modern technology allows performing extensive measurements during both training and competition. However, Hurley (2021) argues that “over-burdening athletes with too much technology and data can result in increased stress and anxiety levels which their support team members should be cognisant of” (p. 12). From the single-beam photocell (Stewart et al., 2014) to split photocells (Haugen et al., 2013), audio and video start sensors (Impellizzeri et al., 2008) and infrared photoelectric systems (Hanley & Tucker, 2019), the world of devices is constantly developing due to new technologies.

However, scientists could make exciting and innovative discoveries by further exploiting these opportunities. With this technology, performance can now be assessed directly on the sports field rather than deduced from laboratory tests and simulations. Accurate measurements that previously required specialised laboratory equipment can now be performed by the coach during training and competition (Passfield & Hopker, 2017). These statements are also supported by the significantly improved athletic performance in the last

10-15 years worldwide, which is influenced by the decisive contribution of modern technology and the formation of interdisciplinary teams around an athlete.

It follows that the training process is constantly dynamic, and researchers and coaches are persistently seeking solutions to improve it. Unfortunately, according to our research, most of the Romanian coaches do not have modern devices for athlete monitoring and there are relatively few respondents who can afford to purchase them because they are quite expensive. Of course, Romanian athletics had numerous periods of glory throughout its history, but the last years were marked by a severe decline with mediocre-to-poor results at international level. If Romania had 20 professional athletes and won 23 medals at the Sydney Olympics, twenty years later, at the Tokyo Olympics (2020), 10 athletes managed to qualify for the ultimate competition, but none of them won medals.

In these conditions, modernising the training process becomes imperative for predicting long-term athletic performance, given that access to modern technology is not easy for Romanian sports clubs. Without the implementation of technology in the training process and without the correct and scientific monitoring of the training and competition, Romanian athletes will not be able to compete on an equal basis with foreign athletes who benefit from modern training devices, highly-effective equipment but also psychological monitoring.

One of the research limitations is the coaches' different perception of modern technology and the possibilities to implement it in the monitoring of athletic training. Depending on the objective pursued, these devices are used to identify the correctness of a movement, the execution technique of an element, the athletes' physical performance (strength, speed, coordination, endurance, agility, etc.), the risk of injury, but they can also provide psychological analysis and support. Further studies are needed to investigate the differences between coaches with international performance, coaches with national results and coaches without notable results, in relation to their frequency of using various types of modern equipment and applications.

References

- Bedir, D., & Erhan, S. E. (2021). The effect of virtual reality technology on the imagery skills and performance of target-based sports athletes. *Frontiers in Psychology, 11*: 2073. <https://doi.org/10.3389/fpsyg.2020.02073>
- Bicer, B., Orak, M. E., & Uzum, H. (2022). Examining the attitudes and usage levels of coaches towards technology in terms of athlete education. *Educational Research and Reviews, 17*(1), 14-23. <https://doi.org/10.5897/ERR2021.4216>
- Camomilla, V., Bergamini, E., Fantozzi, S., & Vannozzi, G. (2018). Trends supporting the in-field use of wearable inertial sensors for sport performance: A systematic review. *Sensors, 18*(2): 873, 1-50. <https://doi.org/10.3390/s18030873>
- Collins, D., Carson, H. J., & Cruickshank, A. (2015). Blaming Bill Gates AGAIN! Misuse, overuse and misunderstanding of performance data in sport. *Sport, Education and Society, 20*(8), 1088-1099. <https://doi.org/10.1080/13573322.2015.1053803>
- Cosma, G.-A., Chiracu, A., Stepan, A. R., Cosma, M. A., Nanu, M. C., Voinea, F., Bibi, K. W., Păunescu, C., & Haddad, M. (2021a). COVID-19 pandemic and quality of life among Romanian athletes. *International Journal of Environmental Research and Public Health, 18*(8): 4065. <https://doi.org/10.3390/ijerph18084065>

- Cosma, G.-A., Chiracu, A., Stepan, A. R., Barbu, D., Brabiescu-Călinescu, M. L., Voinea, F., Orțanescu, D., Țifrea, C., & Munteanu, R.-V. (2021b). Job insecurity and work meaning among Romanian sports coaches. *Applied Sciences*, *11*: 1186. <https://doi.org/10.3390/app112411862>
- Costache, R. (2019). *Biomecanica săriturilor pe orizontală în probele de atletism feminin - seniore: Analiză comparativă* (Teză de doctorat) [Biomechanics of horizontal jumps in women's athletics events - senior: A comparative analysis (Doctoral thesis)]. UNEFS Bucharest.
- Ghigiarelli, J. J., Ferrara, K. J., Poblete, K. M., Valle, C. F., Gonzalez, A. M., & Sell, K. M. (2022). Level of agreement, reliability, and minimal detectable change of the Musclelab™ Laser Speed device on force-velocity-power sprint profiles in Division II collegiate athletes. *Sports*, *10*(4): 57. <https://doi.org/10.3390/sports10040057>
- Groom, R., Cushion, C., & Nelson, L. (2011). The delivery of video-based performance analysis by England youth soccer coaches: Towards a grounded theory. *Journal of Applied Sport Psychology*, *23*(1), 16-32. <https://doi.org/10.1080/10413200.2010.511422>
- Hanley, B., & Tucker, C. (2019). Reliability of the OptoJump Next system measuring temporal values in elite racewalking. *Journal of Strength and Conditioning Research*, *33*(12), 3438-3443. <https://doi.org/10.1519/jsc.0000000000003008>
- Haugen, T., Breitschadel, F., & Seiler, S. (2019). Sprint mechanical variables in elite athletes: Are force-velocity profiles sport specific or individual? *PLoS ONE*, *14*(7): e0215551. <https://doi.org/10.1371/journal.pone.0215551>
- Haugen, T., Tonnessen, E., & Seiler, S. (2013). Anaerobic performance testing of professional soccer players 1995-2010. *International Journal of Sports Physiology and Performance*, *8*(2), 148-56. <https://doi.org/10.1123/ijsp.8.2.148>
- Haugen, T., Tonnessen, E., & Seiler, S. (2015). 9.58 and 10.49: Nearing the *citius* end for 100 m? *International Journal of Sports Physiology and Performance*, *10*(2), 269-272. <https://doi.org/10.1123/ijsp.2014-0350>
- Hurley, O. A. (2021). Sport cyberpsychology in action during the COVID-19 pandemic (opportunities, challenges, and future possibilities): A narrative review. *Frontiers in Psychology*, *12*: 621283, 1-15. <https://doi.org/10.3389/fpsyg.2021.621283>
- Impellizzeri, F. M., Rampinini, E., Castagna, C., Bishop, D., Ferrari Bravo, D., Tibaudi, A., & Wisloff, U. (2008). Validity of a repeated-sprint test for football. *International Journal of Sports Medicine*, *29*(11), 899-905. <https://doi.org/10.1055/s-2008-1038491>
- Passfield, L., & Hopker, J. G. (2017). A mine of information: Can sports analytics provide wisdom from your data? *International Journal of Sports Physiology and Performance*, *12*(7), 851-855. <https://doi.org/10.1123/ijsp.2016-0644>
- Pérez-Camarero, J., Martínez-Gallego, R., Guzmán, J. F. & Crespo, M. (2022). Online training of sports coaches: Bibliographic review. *Apunts Educación Física y Deportes*, *147*, 26-35. [https://doi.org/10.5672/apunts.2014-0983.es.\(2022/1\).147.03](https://doi.org/10.5672/apunts.2014-0983.es.(2022/1).147.03)
- Roberts, R. J., & Lane, A. M. (2021). Mood responses and regulation strategies used during COVID-19 among boxers and coaches. *Frontiers in Psychology*, *12*: 624119. <https://doi.org/10.3389/fpsyg.2021.624119>
- Sandamas, P., Gutierrez-Farewik, E. M., & Arndt, A. (2019). The effect of a reduced first step width on starting block and first stance power and impulses during an athletic sprint start. *Journal of Sports Sciences*, *37*(9), 1046-1054. <https://doi.org/10.1080/02640414.2018.1541161>
- Santi, G., Quartiroli, A., Costa, S., di Fronso, S., Montesano, C., Di Gruttola, F., Ciofi, E. G., Morgilli, L., & Bertollo, M. (2021). The impact of the COVID-19 lockdown on coaches' perception of stress and emotion regulation strategies. *Frontiers in Psychology*, *11*: 601743. <https://doi.org/10.3389/fpsyg.2020.601743>

- Santos, F., Cardoso, A., Pereira, P., & Strachan, L. (2021). Coach training within the COVID-19 pandemic: Challenges and potential pathways. *Frontiers in Psychology, 12*: 570706. <https://doi.org/10.3389/fpsyg.2021.570706>
- Slawinski, J., Termoz, N., Rabita, G., Guilhem, G., Dorel, S., Morin, J. B., & Samozino, P. (2017). How 100-m event analyses improve our understanding of world-class men's and women's sprint performance. *Scandinavian Journal of Medicine & Science in Sports, 27*(1), 45-54. <https://doi.org/10.1111/sms.12627>
- Stewart, P. F., Turner, A. N., & Miller, S. C. (2014). Reliability, factorial validity, and interrelationships of five commonly used change of direction speed tests. *Scandinavian Journal of Medicine & Science in Sports, 24*(3), 500-506. <https://doi.org/10.1111/sms.12019>
- Stoica, M. (2000). *Capacitățile motrice în atletism* [Motor skills in athletics]. Printech.
- Teodorescu, S., Bota, A., Popescu, V., Mezei, M., & Urzeală, C. (2021). Sports training during COVID-19 first lockdown: A Romanian coaches' experience. *Sustainability, 13*: 10275. <https://doi.org/10.3390/su131810275>
- Van den Tillar, R. (2021). Comparison of step-by-step kinematics of elite sprinters' unresisted and resisted 10-m sprints measured with Optojump or Musclelab. *Journal of Strength and Conditioning Research, 35*(5), 1419-1424. <https://doi.org/10.1519/jsc.0000000000002898>