Performance Analysis in Sport and Exercise

Ankara University Performance Analysis in Sports Application and Research Center

Available online 29 June 2023

The Acute Effect of Zero Gravity Chair and Breathing Exercises on Soccer Players HRV

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Abstract

This study aims to determine the acute effect of breathing exercises on soccer players' HRV while lying down on a zero-gravity chair. According to this purpose, 12 soccer players participated in the study. To collect data, Inner Balance HeartMath biofeedback device was used. During the pretest soccer players sat in an upright position and their HRV measurements were taken. After a few minutes, soccer players were asked to lie down on a zero gravity chair inhale in 4 seconds and exhale in 4 seconds (4X4 Breathing Exercise). The results have shown that there is a significant difference between pretest and posttest. The zero-gravity chair and HRV breathing exercises have an acute effect on soccer players' coherence and autumn nerve system in a positive way.

Keywords: Heart rate variability, breathing exercises, zero gravity chair, soccer

INTRODUCTION

The most popular game in the world, which is soccer, has come to a point where physical performance may not be enough to achieve success. Many factors affect the performance in soccer like talent, training mentally and physically, financial status, management, stress management, sports phycology, training science, etc. (Carling, Williams & Reilly, 2007; Diment, 2014; Surujlal, 2016). When all these factors come together in soccer it may bring the clubs or players' performance to an optimal level. However, there is one factor that is hard to measure or control which is phycological factors because it could change depending on the nationality, person, culture, childhood, etc. (Kashima, 2000). This is also valid for athletes because every athlete has a different motivation and psychology (Mitić et. all., 2021). However, this is not an obstacle in sports psychology, there are many ways to measure psychological

parameters like scales and wearable technology (Aldırmaz, 2022; Ekmekçi, 2022, Beşler, 2022). Recent studies have shown that wearable technology can be used to measure mental and psychological power in sports (Seshadri et. all., 2017; Waqar et. all., 2021).

Psychophysiology is one of the disciplines in psychology which considers physiology and psychology together. In simple words, the body and the mind can't be separated from feelings (Hugdahl, 1995). In the psychophysiological perspective heart rate variability (HRV) is a very important tool to have an idea about how the autonomic nervous system works. In short, it gives information about how coherent the person is (McCraty & Zayas, 2014).

HRV is also an important variable in sports to understand the athlete's mental condition. Recent studies about HRV in sports are increasing to improve the performance of athletes physically and mentally (Pagaduan et. all., 2020; Gül, 2022). It is known that when an athlete is coherent (the autonomic nervous system is in balance according to their HRV) their mental performance also goes up to an optimal level which affects their physical performance accordingly (Ekmekçi, 2022).

Soccer is a long, hard, challenging, and multi-minded game that requires patience and a high level of mental performance (Fink et. all., 2018). For 90 minutes or more soccer players have to concentrate and focus on many things and keep up their mental performance high which is related to their HRV and coherence. It's known that HRV training and breathing exercises have positive effects on the autonomic nervous system (Raghuraj et. all., 1998; Pal & Velkumary, 2004; Russo et. all., 2017). In addition, the body position also influences the autonomic nerve system, HRV, and coherence (McLaughlin et. all., 1978; Ko et. all., 2008). In a soccer match or training, there are times when players can do short breathing exercises and players have half-time breaks to do HRV training with any postural position. This could be a great opportunity for soccer players to bring their autonomic nervous system to balance. In different terms, soccer players can be more coherent if they use these times to do quick breathing exercises.

According to the information above the purpose of this study is to determine the acute effect of breathing exercises on soccer players' HRV while lying down on a zero-gravity chair.

METHODS

Research Design

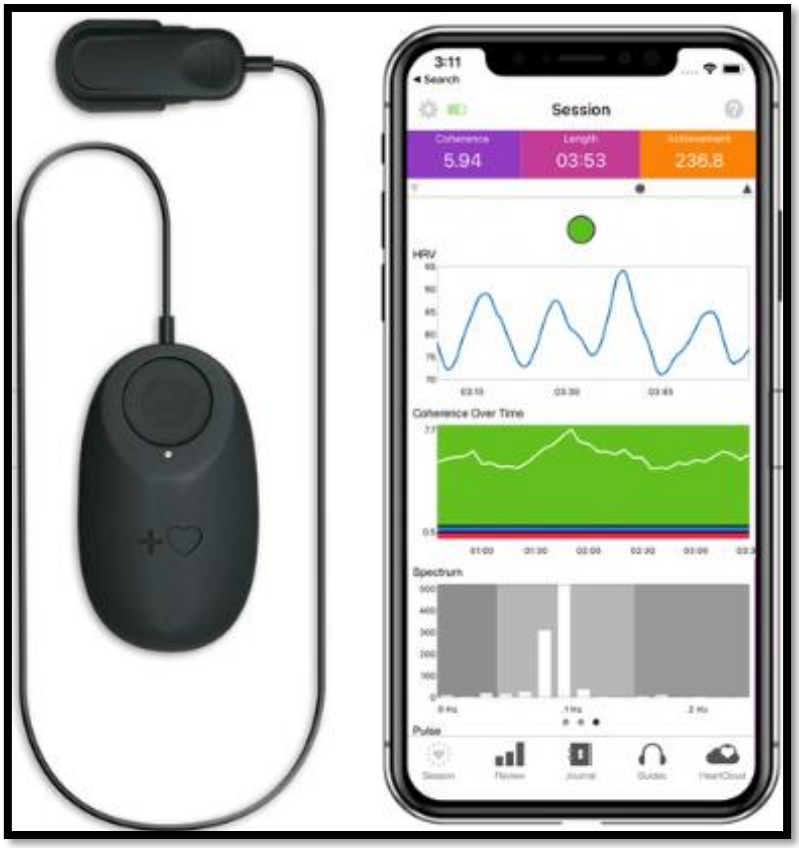
Quantitative research design and crossover experimental method were preferred during the study. Crossover experiments are designed to have a balance where all subjects receive the same application and participate for the same time and number of periods (Lui, 2016).

Research Group

The research group is consisting of 12 actively licensed male soccer players in Denizli/Turkey. A purposive voluntary sampling method was preferred. The criterion is that the players must be licensed football players for at least 5 years and have no knowledge and experience in mental training or breathing techniques.

Data Collection Tools

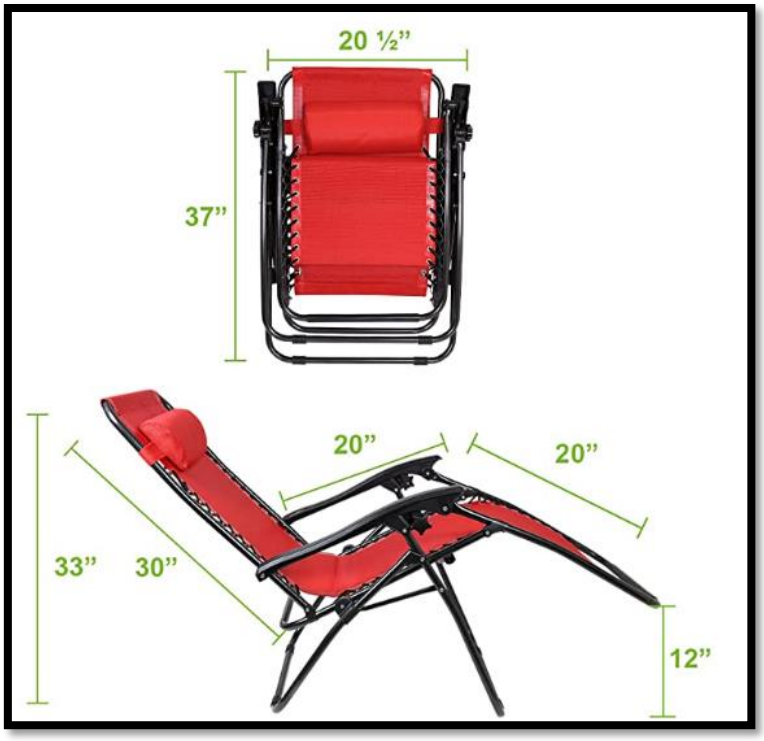
Inner Balance HeartMath: this is an innovative approach to improving emotional well-being. It teaches you to change your heart rhythm pattern to create physiological coherence; a scientifically measurable state characterized by increased order and harmony in our mind, emotions, and body. This wearable technology gives you HRV coherence feedback in real-time and over time. Inner Balance Bluetooth uses BT4.0 (BLE-Bluetooth Low Energy) which works at an output power range of 0.5 milliwatts (mW) or less, this is lower than mobile phones which have output levels between 250 mW and 2000 mW. The tiny Bluetooth emitter is attached to the garment near the heart and the small clip with the sensor is attached to the left earlobe. It could be connected to any smart device via Bluetooth. It gives quantitative data about the HRV (coherence). This device can be charged and used for long hours (Thapliyal et all., 2017; HeartMath.com).



(HeartMath.com)

Figure 1. Inner Balance HeartMath Bluetooth and Android Application

Zero Gravity Chair: This foldable and portable special chair does not collect any data, but it allows being in the best body position for HRV measurements. ZGC (zero gravity chair) can be used as a more convenient, comfortable, secure, stable, and safer option to do HRV analysis (Dehghanojamahalleh et. all., 2020).



(amazon.com)

Figure 2. Zero Gravity Chair (ZGC)

Procedures

First, soccer players were voluntarily invited to Pamukkale University Faculty of Sports Sciences Psychophysiology Laboratory and informed about the study. Consent forms were filled in and signed by the participants and researcher. Confounding variables were minimized there was no one else in the room other than the researcher. Also, there weren't any noises or objects around that would affect the participant. Inner Balance HeartMath Bluetooth device was used to collect data (see Figure 1). The first measurements (Pre-test) were made while soccer players sat in a normal chair position (upright) for 5 minutes without doing any extra breathing exercises. After the first measurement participants were informed and thought how to breathe using the diaphragm and then they were transferred to Zero Gravity Chair and asked to inhale in 4 seconds and exhale in 4 seconds using the diaphragm (4X4 HRV Breathing Exercise). The eyes were open during all measurements, and only the body position changed, a zero gravity chair was used and breathing exercises were done during the second measurement (post-test).

Statistical Analyses

To analyze the data SPSS 24 was used. The Shapiro-Wilk test was used to determine the normality of the distribution because the number of participants is less than 50. Paired sample t-test was used to compare pre-and pos-test results.

FINDINGS

Table 1.1. *Demographic Information of The Research Group*

Player Nick Name	**Age**	**Soccer Age**	**Position**	**Gender**
Nuri	21	6	Goalkeeper	Male
Benhur	26	10	Striker	Male
Arda	18	7	Mid Field	Male
Umut	24	9	Defense	Male
Efe	21	5	Defense	Male
Serkan	22	8	Mid Field	Male
Hakan	21	6	Mid Field	Male
Ali	21	7	Defense	Male
Can	22	8	Defense	Male
Deniz	23	7	Striker	Male
Ahmet	21	6	Defense	Male
Kenan	30	14	Mid Field	Male
Mean	**20,7**	**7,15**		

The research group consists of 12 soccer players (N=12). Every soccer player has been given a nickname. The age mean of the soccer players is 20.7. In addition, soccer players have been playing soccer (soccer age) for 7,15. Which is defined as the soccer age.

Table 1.2. *T-Test Results of Heart Rate Variability of Soccer Players*

	N	Mean x̄ Coherence	SD ±	t	p
HRV While Sitting *(Pretest)*	12	1,2250	0,30785	-7,977	0,000
HRV While Breathing on ZGC *(Posttest)*	12	2,5083	0,73911		

The pretest coherence levels of soccer players are x̄=1,2250 while posttests results are x̄=2,5083. The results have shown that there is a significant difference between pretest and post-test results.

DISCUSSION

The results of the study have shown that the zero-gravity chair and breathing exercises have an acute effect on soccer players' coherence. During the posttest, soccer players had a low coherence (1,2250) while sitting in a normal upright position. However, when they lay down on the zero-gravity chair and asked to do breathing exercise their coherence level increased to 2,5083. The academic literature shows that zero gravity chair influences the autonomic nervous system and HRV positively (Dehghanojamahalleh et. all., 2020). Dehghanojamahalleh et. all. (2020) also claims that a zero gravity chair (ZGC) could be a better alternative because it can be used as a more convenient, secure, stable, and safer option than the traditional HRV analysis. Another study has proven that postural position affects the autonomic nervous system (Ko et. all., 2008). This is very important because it is known that the autonomic nervous system is related to HRV which affects the coherence of an individual (Nuuttila et. all., 2017).

This study has shown that the results are parallel with the literature, HRV training and the position of the body affect the autonomic nervous system. However, studies about zero gravity chairs and HRV related to athletes are limited in sports literature. On the other hand, HRV studies related to athletes' physical and mental performance are widespread (Perry et. all., 2019). Boullosa et. all., (2013) claim that the practice of night-time HRV results in autonomic adaptation in professional soccer players. This study was applied to long-term soccer players which have a chronic effect on soccer players. Our recent study has also proved that HRV training, especially using zero gravity chairs also has an acute effect on soccer players'

autonomic nerve system. According to the literature and this recent study, HRV training could increase soccer players' coherence acutely and chronically. If these results are taken into consideration HRV training using zero gravity chairs could be a new way of recovering soccer players mentally and physically. Imagine a soccer team going in to break room after the first half of the match. They are losing 1-0 and the match is very intense and stressful all they need to do is calm down and manage their stress. This is where the zero-gravity chair comes in supported with HRV breathing exercises. If soccer players or coaches use zero gravity chairs and HRV breathing exercises they could see the benefits in the long or short term easily. Because it's scientifically known that when an individual is coherent and their autumn nerve system is in balance they perform better mentally and physically (Elbers & McCraty, 2020).

CONCLUSION

In conclusion, the results of the study have proven that when HRV breathing exercises are supported with a zero gravity chair it brings the autonomic nervous system of the soccer players into balance and their coherence levels increase significantly. In simple words, after applying the breathing exercise on zero gravity chair soccer players feel better mentally and physically. This could be an effective way to manage stress and perform better mentally and physically for soccer players considering soccer is a multifunctional and intense game.

LIMITATIONS

- This study is limited to 12 soccer players.
- This study is limited to the acute effect experimental method.
- Data collection is limited with Inner Balance Heart Math Biofeedback Device

RECOMMENDATIONS

- This study could be done on different sports branches and more athletes.
- Zero gravity chairs could be used by soccer clubs.
- Meditation and mental training rooms could be part of the changing room.
- Zero gravity chair and HRV breathing exercises should be combined for better results.

REFERENCES

1. Aldırmaz, C. Spor Psikolojisi ve Giyilebilir Teknoloji: EEG Kullanımı. İlgar Doğan, Y. (Ed.) Spor bilimlerinde güncel konular ve yaklaşımlar-2 (313-326). Konya: Çizgi Kitabevi, 2021.
2. Beşler, H. K. Futbol Antrenörlerinde Zihinsel Hazırlık ve Giyilebilir Teknoloji. İzmir: Serüven Yayınevi, 2022.
3. Boullosa, D. A., Abreu, L., Nakamura, F. Y., Muñoz, V. E., Domínguez, E., & Leicht, A. S. Cardiac autonomic adaptations in elite Spanish soccer players during preseason. International journal of sports physiology and performance, 8(4), 400-409, 2013.
4. Carling, C., Williams, A. M., & Reilly, T. Handbook of soccer match analysis: A systematic approach to improving performance. Psychology Press, 2005.
5. Dehghanojamahalleh, S., Balasubramanian, V., & Kaya, M. Preliminary Comparison of Zero-Gravity Chair With Tilt Table in Relation to Heart Rate Variability Measurements. IEEE Journal of Translational Engineering in Health and Medicine, 8, 1-8, 2020
6. Diment, G. M. Mental skills training in soccer: A drill-based approach. Journal of Sport Psychology in Action, 5(1), 14-27, 2014.
7. Ekmekci, R. Mental Training in Sports (3b). Ankara: Detay Yayıncılık, 2022.
8. Elbers, J., & McCraty, R. HeartMath approach to self-regulation and psychosocial well-being. Journal of Psychology in Africa, 30(1), 69-79, 2020.
9. Fink, A., Bay, J. U., Koschutnig, K., Prettenthaler, K., Rominger, C., Benedek, M., ... & Memmert, D. Brain and soccer: Functional patterns of brain activity during the generation of creative moves in real soccer decision-making situations. Human brain mapping, 40(3), 755-764, 2019.
10. Gül, V. The Changes on HRV after a Wingate Anaerobic Test in Physically Active Adults. Performance Analysis in Sport and Exercise, 1(1), 53-59, 2022.
11. Hugdahl, K. Psychophysiology: The mind-body perspective. Harvard University Press, 1995.
12. Kashima, Y. Conceptions of culture and person for psychology. Journal of cross-cultural psychology, 31(1), 14-32, 2000.
13. Ko, J. H., Kuo, T. B., & Lee, G. S. Effect of postural change on nasal airway and autonomic nervous system established by rhinomanometry and heart rate variability analysis. American journal of rhinology, 22(2), 159-165, 2008.
14. Lui, K. J. Crossover designs: testing, estimation, and sample size. John Wiley & Sons, 2016.
15. McCraty, R., & Zayas, M. A. Cardiac coherence, self-regulation, autonomic stability, and psychosocial well-being. Frontiers in psychology, 1090, 2014.
16. McLaughlin, L. J., Goldman, H., Kleinman, K. M., & Korol, B. The influence of body position on autonomic nervous system function. The Pavlovian journal of biological science: official journal of the Pavlovian, 13, 29-41, 1978.
17. Mitić, P., Nedeljković, J., Bojanić, Ž., Franceško, M., Milovanović, I., Bianco, A., & Drid, P. Differences in the psychological profiles of elite and non-elite athletes. Frontiers in Psychology, 12, 635651, 2021.

18. Nuuttila, O. P., Nikander, A., Polomoshnov, D., Laukkanen, J. A., & Häkkinen, K. Effects of HRV-guided vs. predetermined block training on performance, HRV and serum hormones. International Journal of Sports Medicine, 38(12), 909-920, 2017. https://doi.org/ 10.1055/s-0043-115122
19. Pagaduan, J. C., Chen, Y. S., Fell, J. W., & Wu, S. S. X. Can heart rate variability biofeedback improve athletic performance? A systematic review. Journal of Human Kinetics, 73, 103, 2020.
20. Pal, G. K., & Velkumary, S. Effect of short-term practice of breathing exercises on autonomic functions in normal human volunteers. Indian Journal of Medical Research, 120(2), 115, 2004.
21. Perry, J., Hansen, A., Ross, M., Montgomery, T., & Weinstock, J. Effectiveness of athletes' mental strategies in maintaining high heart rate variability: utility of a brief
    athlete-specific stress assessment protocol. Journal of Clinical Sport Psychology, 13(1), 41-55, 2019.
22. Raghuraj, P., Ramakrishnan, A. G., Nagendra, H. R., & Telles, S. Effect of two selected yogic breathing techniques on heart rate variability. Indian Journal of physiology and pharmacology, 42, 467-472, 1998.
23. Russo, M. A., Santarelli, D. M., & O'Rourke, D. The physiological effects of slow breathing in the healthy human. Breathe, 13(4), 298-309, 2017.
24. Seshadri, D. R., Drummond, C., Craker, J., Rowbottom, J. R., & Voos, J. E. Wearable devices for sports: new integrated technologies allow coaches, physicians, and trainers to better understand the physical demands of athletes in real time. IEEE pulse, 8(1), 38-43, 2017.
25. Surujlal, J. Influence of organizational support on retirement planning and financial management of professional soccer players. Polish Journal of Management Studies, 13(2), 164-174, 2016.
26. Thapliyal, H., Khalus, V., & Labrado, C. Stress detection and management: A survey of wearable smart health devices. IEEE Consumer Electronics Magazine, 6(4), 64-69. https://doi.org/10.1109/MCE.2017.2715578, 2017.
27. Waqar, A., Ahmad, I., Habibi, D., Hart, N., & Phung, Q. V. Enhancing athlete tracking using data fusion in wearable technologies. IEEE Transactions on Instrumentation and Measurement, 70, 1-13, 2021.
28. https://store.heartmath.com (access date: 14.04.2023)
29. https://www.amazon.com/Geniqua-Gravity-Recliner-Reclining_Furniture/dp/B07ZHMZWNX?th=1 (access date: 14.04.2023)