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RESEARCH ARTICLE

The Effect of Diaphragm Awareness Exercise on Flow Experience and 1-min Paced Deep Breathing Assessment

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Abstract
This study aimed to examine the effect of diaphragm awareness exercise on flow experience and 1-minute paced deep breathing assessment. A total of 17 university students, seven males and ten females, aged 20.64±1.5 years, participated in the study voluntarily. The convenience sampling method was used in the study. The study is a single group, Pre-Post test design. Personal information form, 1-min Paced Deep Breathing measurement, and " Flow State Questionnaire " to determine flow experiences were used as data collection tools in the pre-test. Diaphragm awareness exercise were performed ones a week for eight weeks. In the post-test, the procedure applied in the pre-test was applied. According to the findings, significant differences were observed in SDNN (p= .035), Balance (p= .013), Concentration (p= .023), and flow (p= .009) of the study group after the diaphragm awareness exercise ($p<0.05$). However, no significant difference was observed in MHRR, RMSSD, and Coherence parameters ($p>0.05$). In conclusion, Diaphragm awareness exercises increases heart rate variability. It also positively affects the flow experience by increasing balance and concentration on work.

Keywords
Diaphragm awareness, Heart rate variability, Flow

INTRODUCTION

The foundations of breath psychology, celebrated for thousands of years in various wisdom and spiritual traditions, are studied in connection with many themes (like consciousness, embodiment, spirituality, and healing). Breath psychology practices are also considered in the context of health, sport, and skills training (Edwards, 2008).

Respiratory activity significantly alters the membrane potentials of preganglionic vagal and sympathetic neurons. The most prominent of these "respiratory pathways" is respiratory sinus arrhythmia, the rhythmic fluctuations of electrocardiographic R-R intervals observed in healthy people (Eckberg, 2003). Respiratory Sinus Arrhythmia (RSA) reflects the increase and decrease in cardiac sinus rhythm corresponding to inhalation and exhalation. Sympathetically mediated breathing (inhalation) is associated with increases in heart rate, while parasympathetically mediated exhalation is reflected by decreases in heart rate. It is a function of the processes that control respiration and thus gas exchange (Schwartz and Andrasik, 2017).

All people breathe differently depending on the mental and physical conditions they are in. In the event of a strain, when a person perceives the situation as a threat, the activity of the sympathetic nervous system increases. This leads to some physiological and mental symptoms. One of these symptoms is increased respiratory frequency. Breathing becomes frequent, superficial, and chest-related. The air goes to the upper part of the lungs. In normal breathing, however, air goes to

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the whole lungs and is related to the abdomen. This is called diaphragmatic breathing (Doğan, 2005, p.120-121). Many muscles are involved in breathing, the most important of which are the diaphragm, abdominal muscles, and inter-rib muscles (Pehlivan, 2015). Therefore, it is recommended to perform breathing exercises together with diaphragmatic breathing 2-3 times a day for 5-10 minutes (Doğan, 2005, p. 121; Tiryaki, 2000, p. 39).

Heart rate refers to the number of heartbeats in one minute (Ergen et al., 2011, p. 70). Heart rate variability refers to the detectable change in R-R intervals reflecting the autonomic balance between the sympathetic nervous system (SNS) and parasympathetic nervous system (PNS) acting on the sinoatrial node (Freeman et al. 2006). HRV is therefore considered a neuro-cardiac measure reflecting heart-brain interactions and autonomic nervous system dynamics (McCraty et al., 2009).

A number of strategies are helpful when a person wants to control heart rate variability. Diaphragmatic breathing, relaxation meditation, and cultivating positive emotion are tools to change heart rate variability (Moss, 2004). Diaphragmatic breathing is a critical tool for increasing heart rate variability and establishing a consistent heart rhythm. In diaphragmatic breathing, the individual breathes deeply, smoothly, and fully using the diaphragm muscles at the bottom of the lungs. With each breath, the individual fills the lungs completely but effortlessly and then empties the lungs completely and smoothly. Breathing continues evenly and smoothly at about six breaths per minute (Moss, 2004).

Flow theory is a theory proposed by Mihaly Csikszentmihalyi in 1975 (Orhun & Gülcan, 2022). According to the flow model, an individual's perceived level of difficulty and personal skills lead to their level of optimal experience (Csikszentmihalyi & Larson, 2014, p. 81).

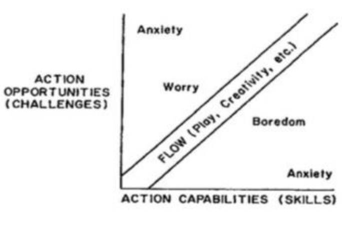


Figure 1. Model of The Flow State (Csikszentmihalyi & Larson, 2014, p. 147)

According to the model, the points that the individual should avoid in order to be in the flow channel are anxiety and worry. When action opportunities are perceived by the individual as exceeding their abilities, the resulting stress is experienced as anxiety. When action opportunities are in balance with the individual's skills, the state of flow is felt. If the skills exceed the difficulties, boredom and tiredness are experienced (Csikszentmihalyi & Larson, 2014, p. 147).

However, Csikszentmihalyi and Larson (2014) also state that whether or not a person is in flow does not entirely depend on the objective nature of the challenges available or the objective skill level. In fact, whether or not one is in flow depends entirely on one's perception of what challenges and skills are. According to Csikszentmihalyi and Larson, with the same objective level of action opportunities, a person can feel anxious one moment, bored the next, and in a state of flow immediately afterward. Therefore, it is impossible to say with certainty whether a person will be bored or anxious in a given situation.

Csikszentmihalyi (2022) states that every flow activity, including competition, chance, and any other dimension of experience, has a kind of exploration and features that take the person to a new reality. These activities push the person to a higher level of performance, which leads to a level of consciousness that was previously unimaginable. In other words, it transforms the essence, making it more complex. The development of this essence is the key point of flow activities (p.116-117).

Furthermore, Collingwood (1938) states that consciousness is autonomous, and only its decision determines whether to pay attention to a particular sensation or emotion. He states that a conscious being is not free to decide which emotion to have, but it is free to decide which emotion to place at the center of its consciousness. So in order to be conscious of pleasurable experiences, it is necessary to narrow the focus of attention to only the relevant stimuli. What we usually call "concentration" is intensely focused attention on a narrow range of stimuli (Csikszentmihalyi, 2022, p. 3-7).

Breathing training aims to restore a person's ability to maintain proper respiratory chemistry regardless of emotional state, activity, or respiratory rate. While some breathing practices may involve relaxation, the goal is breath training (Khazan, 2013).

In the literature, 1-minute paced deep breathing measurement has been used with parameters such as determining worker health (Six Dijkstra et al. 2019), differences between short- and long-term HRV measurements (McCraty et al. 2021), and perceived stress (Tripska et al. 2022). Studies also examine the effect of diaphragm awareness exercises on HRV using different protocols (Edwards, 2005; Rocha et al. 2020). There are studies on flow experience in the literature. However, from a different perspective, there is no study examining the effect of diaphragm awareness exercises on flow experience. Studies on flow experience have been evaluated by considering different parameters such as athletic mental energy and mindfulness (Öner, 2022), motivation regulation, and the role of personality (Turgut and Ümmet, 2021).

In this context, it is conceivable that the focus on breath and diaphragm movement in diaphragm mindfulness practices may affect balance, concentration on the task, and therefore the overall flow state with these. It may also cause some changes in heart rate variability parameters. In this context, this study aims to examine the effect of diaphragm awareness exercises on flow experience and 1-minute paced deep breathing assessment.

MATERIALS AND METHODS

Participants

A total of 17 university students, seven males, and ten females, voluntarily participated in the study. The convenience sampling method was used in the study. The study included individuals between the ages of 18-25 who were sedentary, did not have a systematic disorder, and did not regularly use medication. The study is a single group, Pre-Post test design.

This study used the G Power 3.1.9.7 software package to calculate the number of participants, setting $\alpha = .05$, power = 0.8, and effect size = 0.8. The calculated number of participants was 15. Considering an attrition rate 17 participants were recruited for this study.

Ethics Committee Approval of the study was taken from the Ethics Committee of Burdur Mehmet Akif Ersoy University before starting the research (Decision No: GO 2023/279) and, written informed consent was obtained from the participants before starting the study.

Table 1. Descriptive statistics

	N	X̄	Sd
Age	17	20.64	1.5

Data Collection Tools

Personal Information Form

It was created by the researchers in order to determine the age, gender, exercise status, and disease-medication status of the individuals.

Diaphragm Awareness Study

In the diaphragm awareness study, one of the exercise that increase diaphragm awareness in Önder (2019)'s 365 Gün Nefes (365 Days of Breathing) book were used. The exercise that increase diaphragm awareness was performed by the participants while sitting on a chair. The application format of the exercises is as follows;

Exercise: In a seated position, participants breathed in and out with the left hand on the navel (solar plexus) and the right hand on the chest. They were asked to notice that either one or both hands rose as they inhaled and vice versa as they exhaled. Participants were only asked to experience the current situation.

1-min Paced Deep Breathing Measurement

HRV was assessed with a 1-minute paced deep-breathing protocol. The 1-minute paced deep-breathing measurement was performed using the HeartMath brand emWave Pro+ device. The blood volume measurement sensor in the emWave Pro+ device was placed on the participant's earlobe and measured for 1 min, and MHRR, SDNN, RMSSD, and Coherence values were obtained.

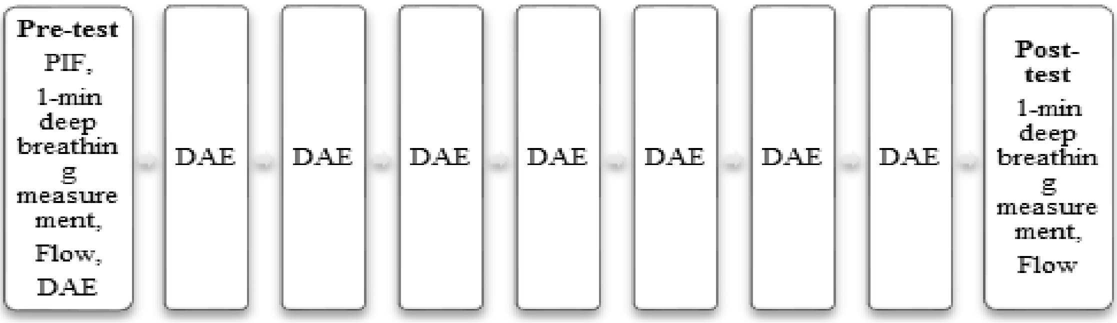
Flow State Questionnaire

This scale was developed by Magyarodi, Nagy, Soltesz, Mozes, and Olah (2013) and adapted into Turkish by Uz-Baş (2019) in order to examine the flow experience of individuals and their basic characteristics within the flow experience. It is a 5-point Likert-type scale consisting of "Strongly Disagree", "Disagree", "Undecided", "Agree" and "Strongly Agree" statements and a total of 12 items. The scale has two sub-dimensions: balance and concentration on work. A minimum score of 12 and a maximum score of 60 can be obtained from the scale. A high score on the scale indicates that the individual has a high level of flow experience. Cronbach Alpha internal consistency reliability coefficients of the scale were found to be .93 for the balance sub-dimension, .83 for the work concentration sub-dimension, and .91 for the total score.

Procedure

In the first session (pre-test), the personal information of the participants was collected. After the participants rested in a sitting position for 5 minutes, a 1-minute Paced Deep Breathing measurement was performed using the heart math emWave pro+ device. Immediately after the measurement, the participants were asked to fill in the Flow State Questionnaire to determine their flow experience. Then, diaphragm awareness exercise was practiced for ones a week for 8th weeks and the post-test was performed in the 9th week. In this study, diaphragm awareness exercises were performed in the subjects' breathing cycles in a sitting position for 10 minutes.

Participants were asked not to consume stimulants such as coffee 12 hours before the measurement. Measurements were collected between 11.00-14.00 hours. Diaphragm awareness exercise were conducted by a breathing instructor.



*PIF Personal information form, *DAE Diaphragm awareness exercise

Figure 2. Procedure

Statistical Analysis

SPSS statistics program was used in the analiyis of the data. Z scores were examined to determine the extreme values of the data. Values above -2.50 +2.5 were excluded from the Z scores data. Then, for the values of EM score p> 0.05, loss data assignment was made according to the average of the series. Normality test was performed using Shapiro Wilks test. HRV parameters and flow experience were considered dependent variables, and diaphragm awareness studies were considered independent variables. The effect of the application in the groups was evaluated by paired sample t-test. The significance of the difference between the averages was taken as α=0.05.

RESULTS

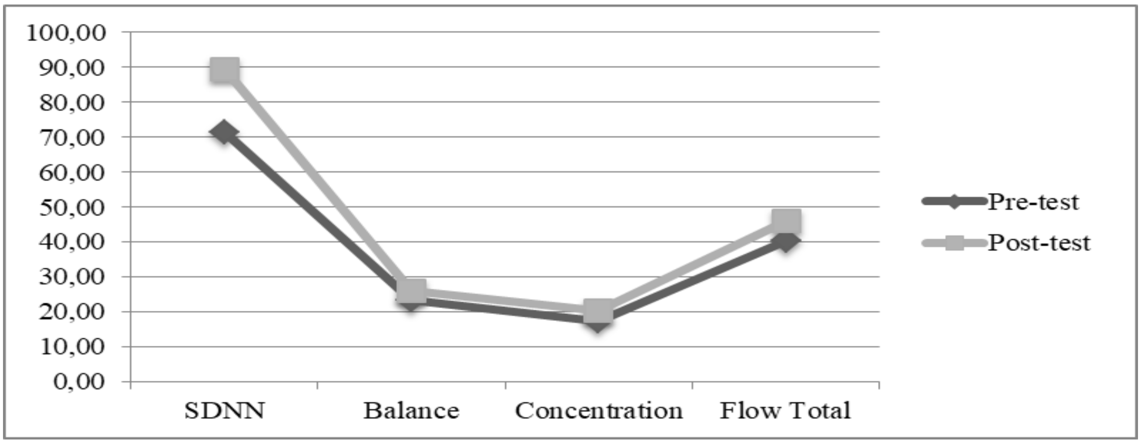


Figure 2. SDNN, Balance, Concentration and Flow total Chart before and after diaphragm awareness exercise

When Table 2 is examined, a significant difference was observed in SDNN (p= .035), Balance (p= .013), Concentration (p= .023), and Flow (p= .009) in the study group (p<0.05). However, no significant difference was observed in MHRR, RMSSD, and Coherence parameters (p>0.05).

Table 2. HRV parameters and flow experience before and after diaphragm awareness exercise

	Pre-test n=17				Post-test n=17	
	x̄	Sd			x̄	Sd
MHRR	29,18	9,17	t= -1.252	p=.229	32,22	11,92
SDNN	71,43	25,58	t= -2.302	p=.035*	89,32	33,86
RMSSD	47,86	11,93	t= -1.133	p= .274	52,18	18,36
C1	70,07	20,79	t= -2.024	p= .060	76,34	13,60
B	23,18	4,11	t= -2.803	p=.013*	25,88	2,14
C2	17,24	4,78	t= -2.512	p=.023*	20,18	2,98
FT	40,41	7,73	t= -2.960	p=.009*	46,06	4,24

*p<0.05 *C1 Coherence, B Balance, C2 Concentration , FT Flow Total

DISCUSSION

For this study, HRV was measured with various parameters, including SDNN, RMSSD, MHRR, and coherence. Results show that the diaphragm awareness exercises applied in the current study affected the SDNN parameter. Time domain indices of heart rate variability measure the amount of HRV observed during monitoring periods ranging from <1 minute to >24 hours. SDNN is one of these parameters. SDNN is the standard deviation of NN intervals (Shaffer and Ginsberg, 2017) and is a reliable and descriptive measure for the assessment of HRV (Schipke et al., 1999).

When the literature is examined, it is possible to find studies in which diaphragm applications positively affect heart rate variability. The study results of Subbalakshmi et al. (2014) show that diaphragmatic breathing causes more cardiac autonomic modulation in healthy subjects. According to the results of Hunt et al. (2021), diaphragmatic breathing caused significant increases in HRV. According to Moss (2004), a number of strategies help when a person wants to control heart rate variability. First, diaphragmatic breathing is a critical tool to increase heart rate variability and establish a consistent heart rhythm. In addition to diaphragmatic breathing, cognitive relaxation, and positive emotion help to achieve optimal increases in HRV. According to MacLean and Psych (2004), two aspects of breathing are crucial for achieving 'consistency' or optimal heart rate variability. One is respiratory mechanics, which emphasizes diaphragmatic breathing rather than thoracic or chest breathing. But more importantly, breathing frequency plays a critical role in bringing the heart and other physiological systems to a state of coherence or optimal functioning. When the literature was examined, it was observed that studies related to the diaphragm and HRV were also conducted on patient groups.

In addition, the diaphragm technique can reduce the mean resting heart rate. Immediately after diaphragm training, it can increase heart rate variability (Rocha et al. 2020). Recent evidence recognizes breathing skills as the original method of energy control, disease prevention, health promotion and quality of life improvement (Edwards, 2005). Results show that the literature supports the findings of the current study. According to the results of the study, diaphragm awareness exercises increase HRV.

In the present study, RMSSD and MHRR parameters are not significantly different. RMSSD is the root mean square of consecutive RR interval differences between normal heartbeats and provides an estimate of parasympathetic system of the heart (Shaffer and Ginsberg, 2017).Schipke et al. (1999) recommend SDNN as a reliable, easily accessible, and descriptive measure for the assessment of HRV due to the wide distribution of RMSSD and pNN50.

MHRR is the mean heart rate interval. MHRR is expressed as a time domain variable that indicates the magnitude of the acceleration-deceleration amplitudes of the heart. It is also a helpful parameter in the assessment of autonomic nervous system health (Six Dijkstra et al., 2019). The MHRR method is typically measured from a series of consecutive deep breaths, usually at least six breaths at a rate of five or six breaths per minute (Shields, 2009). In the current study, MHRR values did not differ significantly. However, when the pre-test and post-test averages were analyzed, it was observed that there was an increase. A lower MHRR indicates a higher health risk (Six Dijkstra et al., 2019).

There are studies on flow experience in the literature. However, from a different perspective, there is no study examining the effect of diaphragm awareness exercises on flow experience. Magyarodi and Olah (2015) found that the most typical solo flow activities are work, sports, creative activities, and reading. The most common social activities that trigger flow are work and sports. The choice of the most frequent flow-inducing activities in both solitary and interpersonal situations depends on the gender of the respondent, and various demographic factors may influence the frequency of flow experiences in different contexts. Öner (2022) study results showed that athletes' mindfulness, awareness, and refocus were significantly related to on-task flow, balance, and self-giving, and a non-judgmental attitude was only positively related to balance. Turgut and Ümmet (2021) study results show that when adults can motivate themselves in their lives, it will be easier for them to focus on any activity they perform (academic, housework, hobby, daily work, etc.) when their willpower to regulate their motivation is high, and it will be easier for them to fully concentrate and experience flow in the activity. As a result of Eryılmaz's (2018) study, it was seen that the balance between the challenges and skills dimension of the flow experience (balance between challenges and skills; activity adoption), which was examined through two structures, had an effect on self-efficacy. Wessling's (2022) study results show that there is a relationship between flow and well-being. As a result of Eryılmaz's (2018) study examining the flow experiences of individuals participating in recreational activities, it was found that the flow experience did not differ for the individual who performed the activity indoors and outdoors. In the current study, diaphragm awareness exercises and flow experience on breathing were performed indoors. When the literature is examined, it shows that the studies are mostly on the effect of recreational activities on flow experience. The results of the current study show that diaphragm exercises increase the balance and concentration skills of individuals by staying in the flow. Therefore, being in the flow in activities on breathing is realized after repetitions. Thus, repeating the diaphragm awareness exercises leads to an improvement in the flow experience.

In conclusion, Diaphragm awareness exercises increase heart rate variability. It also positively affects the flow experience by increasing balance and concentration on work. In future studies, it is recommended to increase the application time of diaphragm awareness studies and to apply them to a larger sample group by adding a control group. In addition, supporting diaphragm awareness studies with different breathing techniques on athletes will contribute to the literature.

Research Publishing Ethics

Ethics Committee Approval of the study was taken from the Ethics Committee of Burdur Mehmet Akif Ersoy University before starting the research (Decision No: GO 2023/279) and, written informed consent was obtained from the participants before starting the study.

Conflict of Interest

This study there is no conflict of interest. There is no financial support provider.

Author Contributions

Planned by the author: Study Design, Data Collection, Statistical Analysis, Data Interpretation, Manuscript Preparation, Literature Search. Author have read and agreed to the published version of the manuscript.

REFERENCES

Csikszentmihalyi, M. and Larson, R. (2014). Flow and the foundations of positive psychology. *Publisher: Springer;* p 81-147

Csikszentmihalyi, M. (2022*). Flow, The Psychology of Optimal Experience*. Ankara: Buzdağı Publishing. p.3-117

Doğan, O. (2005). *Sports Psychology*. Nobel Publishing. Adana

Eckberg, DL. (2003). Topical Review: The human respiratory gate. *The Journal of Physiology*; 548(2), 339-352.

Edwards, S. (2005). A psychology of breathing methods. *International Journal of Mental Health Promotion*; *7*(4), 30-36. https://doi.org/10.1080/14623730.2005.9721958

Edwards, S. D. (2008). Breath psychology: fundamentals and applications. *Psychology and Developing Societies*; 20(2), 131-164. https://doi.org/10.1177/097133360802000201

Ergen, E., Demirel, H., Güner, R., Turnagöl, H., Başoğlu, S., Zergeroğlu, AM., Ülkar, B. And Hazır, T. (2011). *Exercise Physiology Textbook.* Nobel Publishing. Ankara, p. 70

Eryılmaz, G. (2018) Relationship Between Flow Experiences, Positive and Negative Emotional State, Self Efficacy, Life Satisfaction Participants in Recreative Activities. Doctoral Thesis, Mersin University, Institute of Social Sciences, Mersin, Turkey.

Freeman, JV., Dewey, FE., Hadley, DM., Myers, J. And Froelicher, VF. (2006). Autonomic nervous system ınteraction with the cardiovascular system during exercise. *Proggress in Cardiovascular Diseases; 48*:342-62.

Hunt, M., Rajagopal, T., Cerecino, F. And O'Neil, M. (2021). Mindful versus diaphragmatic breathing: Spirituality moderates the impact on heart rate variability. *Mindfulness*; *12*, 2743-2753.

Khazan, IZ. (2013). *The Clinical Handbook Of Biofeedback: A Step-By-Step Guide For Training And Practice With Mindfulness.* John Wiley & Sons, E-book.

MacLean, B. And Psych, R. (2004). The heart and the breath of love. *Biofeedback*; *32*(4), 21-25.

Magyaródi, T., Nagy, H., Soltész, P., Mózes, T. And Oláh, A. (2013). Psychometric properties of a newly established flow state questionnaire. *The Journal of Happiness & WellBeing;* 1(2), 85-96.

Magyaródi, T. And Oláh, A. (2015). A cross-sectional survey study about the most common solitary and social flow activities to extend the concept of optimal experience. *Europe's Journal of Psychology*; *11*(4), 632.

McCraty, R., Atkinson, M., Tomasino, D. And Bradley, R. T. (2009). The coherent heart heart-braininteractions,psychophysiological coherence, and the emergence of system-wide order. *Integral Review: A Transdisciplinary & Transcultural Journal for New Thought, Research, & Praxis*; *5*(2).

McCraty, R., Atkinson, M. And Dispenza, J. (2021). One-Minute Deep Breathing Assessment and its Relationship to 24-Hour HRV Measurements. *Biofeedback*, 49(2), 27-37.

Moss, D. (2004). Heart rate variability and biofeedback. *Psychophysiology Today: The Magazine for Mind-Body Medicine;* 1, 4-11.

Orhun, B. N. And Gülcan, B., (2022). Bibliometric analysis of Csikszentmıhalyi's flow theory in tourism and recreation. *Journal of Gastronomy, Hospitality and Travel*; 5(3).

Önder, Ö. (2019). 365 Gün Nefes (*365 Days of Breathing)*. Kuraldışı Publishing. İstanbul

Öner, Ç. (2022). The determinative role of athletic mental energy and mindfulness in the flow experience of football players, *International*

Journal of Education Technology and Scientific Researches; 7(20), 2052-2085.

Pehlivan, F. (2015). *Biophysics.* Pelikan Publishing, p: 267-271

Rocha, HM., de Souza, HCM., Viana, R., Neves, VR. And De Andrade, AD. (2020). Immediate effects of rib mobilization and diaphragm release techniques on cardiac autonomic control in patients with chronic obstructive pulmonary disease: a pilot study. *Journal of Chiropractic Medicine*; *19*(3), 167-174.

Schipke, JD, Pelzer, M. And Arnold, G. (1999). Effect of respiration rate on short-term heart rate variability. *J Clin Basic Cardiol*; 2, 92-4

Schwartz, MS. And Andrasik, F. (2017). (Eds.). *Biofeedback: A Practitioner's Guide.* Guilford Publications.

Shaffer, F. And Ginsberg, JP. (2017). An overview of heart rate variability metrics and norms. *Frontiers in public health*; 258.

Shields, RW. (2009). Heart rate variability with deep breathing as a clinical test of cardiovagal function. *Cleve Clin J Med*; *76*(Suppl 2), S37-40.

Six Dijkstra, M., Soer, R., Bieleman, A., McCraty, R., Oosterveld, F., Gross, D. And Reneman, M. (2019). Exploring a 1-minute paced deep-breathing measurement of heart rate variability as part of a workers' health assessment. *Applied Psychophysiology and Biofeedback*; *44*, 83-96.

Subbalakshmi, N. K., Adhikari, P. And Shanmugavel Jeganathan, P. (2014). Comparative study on cardiac autonomic modulation during deep breathing test and diaphragmatic breathing in type 2 diabetes and healthy subjects. *Journal of Diabetes Investigation*; *5*(4), 456-463.

Tiryaki, Ş. (2000). *Sports Psychology: Concepts, Theories and Practice*. Eylül Publishing.

Tripska, K., Draessler, J. And Pokladnikova, J. (2022). Heart rate variability, perceived stress and willingness to seek counselling in undergraduate students. Journal of Psychosomatic Research, 160, 110972.

Turgut, T. And Ümmet, D. (2021). The mediating role of autotelic personality in the relationship between motivation regulation and flow experience in adults. *Pamukkale University Journal of Education (PUJE)*; 1-23.

Uz-Baş, A. (2019). Adaptation of Flow State Questionnaire Into Turkish, Validity and Reliability Study. I. International Science, Education, Art & Technology Symposium (s.1374-1379). İzmir, Turkey.

Wessling, J. (2022). Optimal Experience: The Relationship Between Flow, Psychological Richness And Well-Being. Bachelor's Thesis, University of Twente. Holland.