



Effects of a 12-week Aerobic Workout Program on the Stress and Cortisol Levels in Male Adults

Ghulam Mustafa¹, Haseenullah², Sadia Mehreen³, Muhammad Israr Khan⁴

¹ Ph.D. Scholars at Department of Sports Sciences and Physical Education, Gomal University Dera Ismail Khan, Khyber Pakhtunkhwa, Pakistan. Email: mustafa.ghulam429@gmail.com

² Ph.D. Scholars at Department of Sports Sciences and Physical Education, Gomal University Dera Ismail Khan, Khyber Pakhtunkhwa, Pakistan. Email: haseenjan.ustb@gmail.com

³ Ph.D. Scholars at Department of Sports Sciences and Physical Education, Gomal University Dera Ismail Khan, Khyber Pakhtunkhwa, Pakistan. Email: sadiakhan4303@gmail.com

⁴ Ph.D. Scholars at Department of Sports Sciences and Physical Education, Gomal University Dera Ismail Khan, Khyber Pakhtunkhwa, Pakistan. Email: israrsport@gmail.com

ARTICLE INFO

Article History:

Received: May 19, 2023

Revised: June 28, 2023

Accepted: June 29, 2023

Available Online: June 30, 2023

Keywords:

Cortisol

Stress

Aerobic Exercise

Young Male Adults

Funding:

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

ABSTRACT

Stress management and regulating cortisol levels are essential for maintaining good health. Regular exercise has been linked to reducing stress and making sleep better. However, limited research has looked at how physical activity affects cortisol levels, stress, and sleep in adult men. This study investigated how doing aerobic exercise for 12 weeks can affect stress levels and the way the body regulates cortisol (a hormone that helps manage stress) in young men from Peshawar. The study utilized a pre-post intervention design, including assessments of stress levels and cortisol measurements before and after the exercise program. The findings of the study were blood serum cortisol levels decreased from 142.98 to 106.88 with a significance value of $p < .000$ while the perceived stress scale dropped from 32.76 to 23.71 with a significance value of $p < .000$. Aerobic exercise has the potential benefits of reducing stress and modulating cortisol levels in this population.

© 2023 The Authors, Published by iRASD. This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License

Corresponding Author's Email: mustafa.ghulam429@gmail.com

1. Introduction

The modern lifestyle often exposes individuals to high levels of stress, which can have negative impacts on their physical and mental health. Cortisol, a hormone released in response to stress, plays a significant role in regulating various physiological processes (Pulopulos et al., 2020).

As per the American Psychological Association, a significant proportion of the American population, over 40%, experiences physical stress and encounters challenges related to mental well-being. The prevalence of stress has reached epidemic proportions on a global scale, resulting in a range of adverse health outcomes and significant financial burdens associated with treatment. The identification of evidence-based, cost-effective, non-pharmacological therapies for the mitigation of physiological and psychological stress is of utmost importance (Hopper et al., 2019).

The hypothalamus, a component of the central nervous system, is often stimulated by stress, leading to the activation of the sympathetic nervous and endocrine systems. This activation results in several physiological responses, including increased blood pressure, insulin resistance, blood sugar levels, and susceptibility to sickness. Researchers have found that stress can make certain chronic illnesses, like diabetes, asthma, stomach ulcers, and heart diseases, more likely to happen.

Conventional basic, secondary, mental health or tertiary medical interventions are insufficient in addressing the chronic consequences arising from this stress. According to Ghram

et al. (2021), engaging in physical exercise is a viable approach to mitigating the negative effects of a sedentary lifestyle and lack of physical activity. Stress management and regulating cortisol levels are essential for maintaining good health. Regular exercise has been linked to reducing stress and improving sleep quality. However, limited research has looked at how physical activity affects cortisol levels, stress, and sleep in adult men.

This study investigated how doing aerobic exercise for 12 weeks can affect stress levels and the way the body regulates cortisol levels in young men from Peshawar. Cortisol, an endogenous hormone synthesized by the adrenal glands, assumes a crucial function in the regulation of metabolic processes, blood glucose concentrations, and inflammatory responses. Although cortisol plays a crucial role in maintaining general well-being, prolonged elevation of cortisol levels can give rise to a range of health complications such as anxiety, depression, sleep disturbances, and weight gain (Dziurkowska, 2021).

Many symptoms such as severe fluctuations in mental and emotional states, sleep disturbances, and elevated levels of cortisol can manifest as a consequence. Physical activity enhances the production of catecholamines and induces an equivalent increase in cortisol levels. This mediation functions as an anti-inflammatory agent and enhances immunological responses that have been inhibited. According to Taha and Mounir (2019), cortisol has been found to have beneficial effects on the respiratory system and various respiratory disorders.

The cortisol awakening response has an impact on sleep quality and cognitive focus. The levels of cortisol exhibit an elevation in response to a substantial degree of stress. Exercise-induced cortisol release differs from cortisol triggered by chronic stress, as exercise-related cortisol release can lead to the release of dopamine and endorphins, which contribute to stress reduction and improved mood (Sihanto et al., 2021).

Research has indicated that engaging in physical activity is an efficacious approach to reducing cortisol levels and enhancing the quality of sleep. Engaging in regular aerobic exercise has been associated with reduced cortisol concentrations and enhanced sleep patterns. Physical activity programs that combine exercise and cortisol regulation may have synergistic effects on stress reduction and sleep quality.

According to a study conducted by De Nys et al. (2022), there exists an association between physical activity and reduced cortisol levels, as well as enhancements in qualitative indicators of sleep quality. The research discovered a significant correlation between engaging in physical exercise and experiencing reduced cortisol levels, as well as enhancements in subjective evaluations of sleep quality. However, the research carried out by Zhai et al. (2020) did not find a significant association between sleep quality, activity levels, and cortisol levels over a long period.

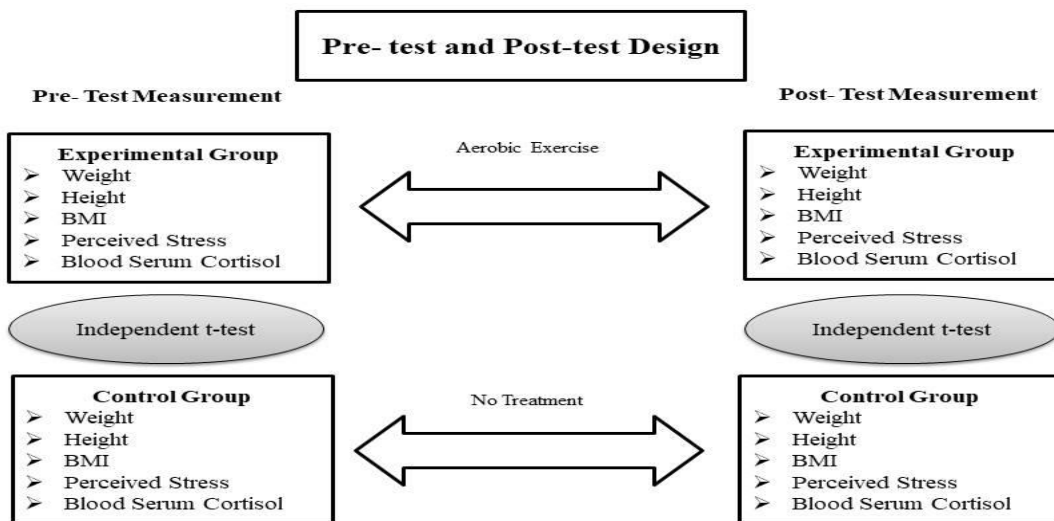
A systematic review and meta-analysis by Klin et al. (2021) discovered that both acute and regular exercise had a favourable influence on various aspects of sleep, including total sleep duration, sleep onset latency, and slow wave sleep. Conversely, rapid eye movement sleep is adversely affected by exercise. However, limited research has looked at how physical activity affects cortisol levels, stress, and sleep in adult men. This study investigated how doing aerobic exercise for 12 weeks can affect stress levels and the way the body regulates cortisol levels in young men from Peshawar.

2. Methodology

Conducting a pretest and posttest intervention design, this research study aimed to evaluate the effects of a 12-week aerobic exercise program on stress and cortisol levels in adult males residing in Peshawar. The exercise program included a structured protocol for aerobic activities, along with a control group for comparison. The exercise regimen encompassed closely monitored cardiovascular exercises such as jogging, cycling, and group fitness sessions, administered three times a week over a 12-week duration. In contrast, the control group refrained from participating in any form of exercise during this period.

For the study, a sample of 40 male adults aged between 18 and 30 years was recruited from Peshawar. This sample was divided into two groups: the exercise group consisting of 20

participants, and the control group also consisting of 20 participants. The allocation of participants to these groups was accomplished using a simple random sampling technique. Prior to participation, all individuals provided informed consent and underwent a screening process to ensure their eligibility based on predefined inclusion criteria.



2.1. Training protocol

Week	Nature of Exercise	Duration (Min)	Days/Week	Set (times)
1-2	Warm-up	10	5	2
	Aerobic Exercise	30		
	Cool Down	10		
3-4	Warm-up	10	5	2
	Aerobic Exercise	30		
	Cool Down	10		
5-6	Warm-up	10	5	2
	Aerobic Exercise	30		
	Cool Down	10		
7-8	Warm-up	10	5	2
	Aerobic Exercise	30		
	Cool Down	10		
9-10	Warm-up	10	5	2
	Aerobic Exercise	30		
	Cool Down	10		
11-12	Warm-up	10	5	2
	Aerobic Exercise	30		
	Cool Down	10		

2.1. Measures and Procedure for Collecting Blood Samples

In order to assess stress levels, established self-report measures such as the Perceived Stress Scale (PSS), a validated tool, were employed. The evaluation of cortisol levels was carried out through the analysis of blood samples obtained before and after the intervention.

Blood samples were collected at two distinct points: the pretest and post-test stages. This blood collection took place at the Qayyum Sports Complex in Peshawar and was performed by skilled professionals from the Realtime PCR Lab. Specifically, the blood samples for cortisol measurement were obtained from all participants at 8:30 AM on both occasions.

Following the blood collection process, the blood serum was meticulously separated, after which it underwent centrifugation at a temperature of -80°C . This procedure was undertaken to facilitate subsequent analysis. For the precise analysis of serum cortisol levels, a 25μ specimen was utilized. This was employed in conjunction with a sandwich enzyme-linked immunosorbent assay (ELISA) kit, which was administered at the real-time PCR laboratory.

3. Results

The anthropometric parameters of the participants were calculated by using their specific measurements. Independent, Paired t-tests and analysis of variance (ANOVA) were used to investigate alterations in stress levels and cortisol concentrations pre- and post-intervention.

Table 1: Analysis of Anthropometric Measurements of the Experimental Group

Variables	Test	n	Mean	S.D	df	P Value
Weight (kg)	pretest	20	74.32	14.293	19	.000
	posttest		70.62	12.732		
Height (cm)	pretest	20	156.62	212.36	19	.270
	posttest		157.12	243.12		
BMI	pretest	20	27.423	4.74	19	.000
	posttest		25.404	4.64		

The above table 1 shows the weight, height, and BMI of the participants in the exercise group. A decrease in the participants' weight indicates a favourable impact of twelve weeks of aerobic exercise on weight. The individuals selected for the present investigation were allocated to a designated exercise regimen, which resulted in the observed reduction in body weight. After twelve weeks of engaging in aerobic exercise, the average weight reduced from 74.32 kg at the initial assessment to 70.62 kg, with a statistically significant p-value of <0.000 . The height exhibits a negligible increase from 156.62 cm to 157.12 cm. The data reveals significant alterations in the body mass index (BMI) of the participants, suggesting a favourable impact resulting from twelve weeks of engaging in aerobic exercise. The study observed a reduction in body mass index as a result of the implementation of a specific exercise routine by all subjects. The initial mean value of BMI was 27.423 kg/m^2 before the participants underwent twelve weeks of Aerobic exercise. Following the exercise intervention, the mean value of BMI decreased to 25.404 kg/m^2 . This reduction in BMI was found to be statistically significant, as indicated by a P-value of < 0.000 . The decrease in body mass index can be attributed to the use of alternate days of aerobic exercise.

Table 2: Analysis of Perceived Stress Scale of Exercise and Control Group

Variable	Group	Test	N	Mean	S.D	df	P Value
Perceived Stress Scale (PSS)	Experimental	Pretest	20	32.76	7.913	19	.000
		Posttest		23.71	4.613		
	Control	Pretest	20	33.54	7.983	19	.672
		Posttest		34.72	8.234		

The table presented above displays the perceived stress levels reported by all subjects. The data presented demonstrates notable alterations in the stress levels of the individuals, so suggesting a favourable impact resulting from a twelve-week regimen of aerobic exercise on stress. The observed decrease in perceived stress can be attributed to the implementation of a specific exercise routine that was universally embraced by all participants in the investigated study. The initial mean value before the intervention was 32.76. Following twelve weeks of engaging in aerobic workouts, the mean value decreased to 23.71. The p-value we found is less

than 0.000, indicating a statistically significant result. The stress level in the control group exhibited a modest rise from the pretest measurement of 33.54 to 34.72, as shown by a p-value of .672. The stress reduction can be attributed to using different days of aerobic activity.

Table 3: Analysis of Blood Serum Cortisol Levels of Exercise and Control Group

Variable	Group	Test	N	Mean	S.D	df	P Value
Blood Serum Cortisol	Experimental	Pretest	20	142.98	67.94	19	.000
		Posttest		106.88	48.02		
	Control	Pretest	20	140.72	66.82	19	.872
		Posttest		141.81	67.92		

The aforementioned table presents the blood serum cortisol values of all subjects. The data presented demonstrates significant alterations in the blood serum cortisol levels among the participants, so suggesting a favourable impact resulting from twelve weeks of engaging in aerobic activity. The decrease in blood serum cortisol levels seen in this study can be attributed to the implementation of a specific workout routine that was administered to all participants. The initial average blood serum cortisol level before the pre-test was measured to be 142.98 nmol/L. Following twelve weeks of engaging in aerobic exercises, the average blood serum cortisol level decreased to 106.88 nmol/L. A significant reduction was found, as indicated by a p-value <0.000. In contrast, the control group did not exhibit any significant changes in cortisol levels. The average blood serum cortisol level before the pre-test in the control group was 140.72 nmol/L, and after the post-test, it was measured to be 141.81 nmol/L. The p-value for this comparison was found to be 0.872. The drop in blood serum cortisol can be attributed to the implementation of alternate days of aerobic activity.

4. Discussion

The main aim of this study was to find out how doing aerobic exercise for 12 weeks affects stress levels and cortisol (a hormone) levels in a group of male adults. The findings demonstrate statistically significant alterations in perceived stress and blood serum cortisol levels following the intervention period, implying a beneficial impact of aerobic exercise on the alleviation of stress. The decrease in stress and cortisol levels can be related to a specific workout plan that includes alternating days of aerobic activity.

The impact of a 12-week aerobic exercise regimen on stress and cortisol levels in male adults has been demonstrated through empirical evidence. A significant finding emerged indicating that engaging in regular endurance activities resulted in a reduction of stress levels among individuals when confronted with challenging circumstances (Shah et al., 2021). This means that there was a decrease in the stress hormone cortisol in the saliva and an improvement in the variation of heart rate. A group of researchers led by Cofré-Bolados conducted a study in (2019), researchers compared high-intensity interval training (HIIT) to continuous aerobic exercise at a less strenuous level. The results showed that both types of exercise led to a quick increase in the levels of free testosterone in the blood. However, there were no big differences in the amount of cortisol found in both situations. Another study by Caplin et al. (2021) found that exercise has been shown to mitigate psychological and physiological responses to stress, and increased fitness and frequent aerobic exercise have demonstrated benefits in terms of the physiological responses to psychosocial stressors.

In summary, the results of these studies indicate that aerobic exercise might elicit diverse outcomes on stress and cortisol levels in young adult males. While certain investigations demonstrate a decrease in stress response, others do not reveal any statistically significant alterations.

The findings of this study support previous research that looked at the connection between exercise and levels of cortisol in the body. A randomised controlled study conducted by Zeibig (2023) was to examine the effects of exercise training on cortisol stress reactivity among individuals diagnosed with major depressive disorder (MDD) who were receiving inpatient care. Although the study did not directly target young male adults, it is pertinent to

contemplate the implications of their findings within the framework of existing studies. The research done by Zeibig (2023) found that doing aerobic exercises for six weeks did not have a big effect on how cortisol (a hormone related to stress) reacted during a stress test. These data indicate that the influence of exercise on cortisol levels may exhibit variability based on the specific group under investigation.

However, it is important to recognize that how hard you exercise affects how your body's cortisol reacts. The study by Pesic et al., (2023) looked at how the intensity of exercise affects the body's response to releasing the hormone cortisol. The researchers discovered that engaging in exercise of moderate to high intensity, specifically sessions at 60% and 80% of the maximum oxygen consumption (VO₂ max), led to notable elevations in the levels of cortisol circulating in the body. On the other hand, engaging in low-intensity exercise at 40% of the maximum oxygen consumption (VO₂ max) did not yield noteworthy elevations in cortisol levels. It led to a decrease in cortisol levels after accounting for the drop in plasma volume. Therefore, it is plausible that the aerobic exercise program in the current study involved an intensity level that effectively regulated cortisol levels, leading to the observed reduction in stress and cortisol.

The decline in stress and cortisol levels observed in this study has several implications. Chronic stress has been strongly linked to the development of cardiovascular diseases (CVDs) (Nafisa et al., 2021). Elevated levels of cortisol, a hormone commonly linked to prolonged stress, are a potential factor in autonomic dysregulation and an increased susceptibility to cardiovascular diseases (CVDs), such as acute coronary syndromes and heart failure (Franklin et al., 2021). The 12-week aerobic exercise program for adult men may have positive effects on heart health. This is because it can help lower stress and cortisol levels in the body.

The findings of this study are a helpful addition to the growing amount of research that shows how physical exercise can help reduce stress. According to Herbert and others In simple words, regular aerobic exercise in 2020 has been found to improve mental well-being, reduce anxiety and depression, and make us stronger in dealing with stress. It is worth noting that the exercise protocol implemented in this study involved alternate days of aerobic exercise. This suggests that establishing a consistent exercise routine may be a crucial factor in achieving the observed positive effects on stress reduction and cortisol regulation.

5. Conclusion

The findings of the research indicate that the implementation of a 12-week aerobic exercise regimen yields favourable outcomes in terms of stress alleviation and cortisol management among young adult males. The results of this study support previous research that has shown a connection between physical activity and cortisol levels. Nevertheless, it is crucial to take into account that the intensity of exercise has a substantial impact on the modulation of cortisol response (Athanasίου et al., 2023). This research study offers significant findings regarding the possible advantages of aerobic exercise in enhancing mental well-being and cardiovascular health. Additional investigation is necessary to examine the enduring impacts of aerobic exercise on stress and cortisol levels within various demographic groups.

5.1. Recommendation

To enhance public awareness, it is imperative to organize a series of informative events such as seminars, workshops, and conferences centred around fitness. These platforms should encompass various aspects of fitness, including aerobic training, while simultaneously addressing effective methods for managing mental stress through home-based and gymnasium exercises.

Incorporating an exercise program into one's routine can prove to be a highly effective approach to diminishing stress levels and fostering overall well-being. This holds true for individuals of all genders. Specifically, individuals who fall under the categories of obesity and overweight are strongly encouraged to embark on aerobic exercise regimens as a means to manage weight and reduce mental stress.

Recognizing the intricate relationship between mental stress and cortisol levels, it becomes evident that aerobic exercise stands as a paramount solution. By engaging in such

exercise routines, individuals can significantly regulate both their mental stress levels and cortisol production.

References

- Athanasίου, N., Bogdanis, G. C., & Mastorakos, G. (2023). Endocrine responses of the stress system to different types of exercise. *Reviews in Endocrine and Metabolic Disorders*, 24(2), 251-266.
- Caplin, A., Chen, F. S., Beauchamp, M. R., & Puterman, E. (2021). The effects of exercise intensity on the cortisol response to a subsequent acute psychosocial stressor. *Psychoneuroendocrinology*, 131, 105336.
- Cofré-Bolados, C., Reuquen-López, P., Herrera-Valenzuela, T., Orihuela-Díaz, P., García-Hermoso, A., & Hackney, A. C. (2019). Testosterone and cortisol responses to HIIT and continuous aerobic exercise in active young men. *Sustainability*, 11(21), 6069.
- De Nys, L., Anderson, K., Ofosu, E. F., Ryde, G. C., Connelly, J., & Whittaker, A. C. (2022). The effects of physical activity on cortisol and sleep: A systematic review and meta-analysis. *Psychoneuroendocrinology*, 143, 105843.
- Dickerson, S. S., & Kemeny, M. E. (2004). Acute stressors and cortisol responses: a theoretical integration and synthesis of laboratory research. *Psychological bulletin*, 130(3), 355.
- Dziurkowska, E., & Wesolowski, M. (2021). Cortisol as a biomarker of mental disorder severity. *Journal of Clinical Medicine*, 10(21), 5204.
- Franklin, B. A., Rusia, A., Haskin-Popp, C., & Tawney, A. (2021). Chronic stress, exercise and cardiovascular disease: placing the benefits and risks of physical activity into perspective. *International journal of environmental research and public health*, 18(18), 9922.
- Ghram, A., Briki, W., Mansoor, H., Al-Mohannadi, A. S., Lavie, C. J., & Chamari, K. (2021). Home-based exercise can be beneficial for counteracting sedentary behaviour and physical inactivity during the COVID-19 pandemic in older adults. *Postgraduate Medicine*, 133(5), 469-480.
- Herbert, C., Meixner, F., Wiebking, C., & Gilg, V. (2020). Regular physical activity, short-term exercise, mental health, and well-being among university students: the results of an online and a laboratory study. *Frontiers in Psychology*, 11, 509.
- Hiruntrakul, A., Nanagara, R., Emasithi, A., & Borer, K. T. (2010). Effect of endurance exercise on resting testosterone levels in sedentary subjects. *Central European journal of public health*, 18(3), 169-172.
- Hopper, S. I., Murray, S. L., Ferrara, L. R., & Singleton, J. K. (2019). Effectiveness of diaphragmatic breathing for reducing physiological and psychological stress in adults: a quantitative systematic review. *JBIE Evidence Synthesis*, 17(9), 1855-1876.
- Johar, M., Shah, M., & Taha, H. (2015). Effect of low-intensity dance exercise: Hostility, anxiety and depression among sedentary overweight women in Malaysia. *Universal Journal of Psychology*, 3(3), 73-79.
- Kandhalu, P. (2013). Effects of cortisol on physical and psychological aspects of the body and effective ways by which one can reduce stress. *Berkeley Scientific Journal*, 18(1).
- Klaperski, S., von Dawans, B., Heinrichs, M., & Fuchs, R. (2014). Effects of a 12-week endurance training program on the physiological response to psychosocial stress in men: a randomized controlled trial. *Journal of Behavioural Medicine*, 37, 1118-1133.
- Kline, C. E., Hillman, C. H., Sheppard, B. B., Tennant, B., Conroy, D. E., Macko, R. F., ... & Erickson, K. I. (2021). Physical activity and sleep: An updated umbrella review of the 2018 Physical Activity Guidelines Advisory Committee report. *Sleep medicine reviews* 58, 101489.
- Mastura, J., Sofian, M., Fauzee, O., Bahaman, A. S., Salleh, A. R., & Muhammad Nazrul, S. (2012). Effect of low-impact Aerobic dance Exercise on Psychological Health (Stress) among Sedentary Women in Malaysia
- Mounir, K. M. (2019). Acute response of serum cortisol to different intensities of resisted exercise in the elderly. *Bulletin of Faculty of Physical Therapy*, 24(1), 20-25.
- Nafisa, A., Wattoo, F. H., Qayyum, M., & Gulfraz, M. (2021). The association between chronic stress, hair cortisol, and angiographically documented coronary atherosclerosis, a case-control study. *Stress*, 24(6), 1008-1015.
- Otinwa, G. O., & Akinyemi, J. S. (2019). Effects of Indigenous Aerobic Dance Music on the Physiological Variables of Female Workers in Lagos Metropolis. *ICHPER-SD Journal of Research*, 10(2), 8-12.
- Pesic, D., Djukic, M., Stanojevic, I., Živkovic, V., Bolevich, S., Bolevich, S., & Jakovljevic, V. (2023). Cardiorespiratory fitness mediates cortisol and lactate responses to winter and summer marches. *Journal of Medical Biochemistry*.

Pulopulos, M. M., Baeken, C., & De Raedt, R. (2020). The cortisol response to stress: The role of expectancy and anticipatory stress regulation. *Hormones and Behavior*, 117, 104587.

Shah, I., Habib, S. H., Yousafzai, Y. M., Ali, A., Ikram, S., Zia, H., & Said, R. (2018). Perceived Stress in Undergraduate Physical Therapy Students of Peshawar, Pakistan. *Pakistan Journal of Physiology*, 14(3), 60-63.

Shah, S. M. A., Mohammad, D., Qureshi, M. F. H., Abbas, M. Z., & Aleem, S. (2021). Prevalence, psychological responses and associated correlates of depression, anxiety and stress in a global population, during the coronavirus disease (COVID-19) pandemic. *Community Mental Health Journal*, 57, 101-110.

Wu, N. N., Tian, H., Chen, P., Wang, D., Ren, J., & Zhang, Y. (2019). Physical exercise and selective autophagy: benefit and risk on cardiovascular health. *Cells*, 8(11), 1436.

Zeibig, J. M. (2023). Efficacy of the exercise intervention "Impuls" across diagnostically heterogeneous mental disorders and its transdiagnostic mechanisms of action (Doctoral dissertation, Universität Tübingen).

Zhai, X., Ye, M., Wang, C., Gu, Q., Huang, T., Wang, K., ... & Fan, X. (2020). Associations among physical activity and smartphone use with perceived stress and sleep quality of Chinese college students. *Mental Health and Physical Activity*, 18, 100323.