



Impact of Aerobic Exercise on Cortisol Levels, Perceived Stress and Total Mood Disturbance in Women Aged 20-40

Nadia Mukhtar¹, Riffat Aisha², Sohail Ahmad Khan³, Sidra Tul Muntaha⁴, Mehreen Saba⁵, Sohail Roman⁶

¹ In-charge (Sports), Female Campus International Islamic University, Islamabad:
nadiaalikhan14@gmail.com

² Lecturer Bahauddin Zakariya University Multan: riffat.aisha@yahoo.com

³ Senior Director Physical Education: dpegcckaror@gmail.com

⁴ Student of Master of Philosophy, Gomal University Dera Ismail Khan:
tulumtahasidra406@gmail.com

⁵ Lecturer Department of Sports Sciences, Bahauddin Zakariya University Multan:
mehreensaba@bzu.edu.pk

⁶ Lecturer Department of Sports Sciences Physical Education, Gomal University Dera Ismail Khan: roman614015@gmail.com

Corresponding Author: riffat.aisha@yahoo.com

Abstract

Objectives of the Study: *This study aimed to comprehensively examine the effects of a 12-week aerobic exercise intervention on cortisol levels, perceived stress, and total mood disturbance among women aged 20-40 residing in District Dera Ismail Khan, Pakistan.*

Materials and Methods: *A total of 50 female participants were recruited using convenient sampling from various gyms in District Dera Ismail Khan. Participants were randomly assigned to either the Aerobic Exercise group (n = 25) or the Control group (n = 25). Baseline assessments of cortisol levels,*



perceived stress, and total mood disturbance were conducted using standardized measures. The Aerobic Exercise group participated in supervised aerobic exercise sessions, consisting of moderate-intensity activities such as brisk walking, jogging, or cycling, for 60 minutes every alternate day over a period of 12 weeks. The Control group was instructed to maintain their regular lifestyle without any prescribed exercise regimen. Post-intervention assessments were conducted for both groups to evaluate changes in cortisol levels, perceived stress, and total mood disturbance.

Results: Participants in the Aerobic Exercise Group demonstrated a significant decrease in cortisol levels from pre-intervention ($M=18.5$ $\mu\text{g/dL}$, $SD=3.2$) to post-intervention ($M=15.2$ $\mu\text{g/dL}$, $SD=2.8$), whereas the Control Group showed minimal changes. Similarly, perceived stress scores significantly decreased in the Aerobic Exercise Group (pre: $M=28.6$, $SD=4.5$; post: $M=24.3$, $SD=3.8$), whereas the Control Group exhibited marginal changes. Furthermore, total mood disturbance scores significantly decreased in the Aerobic Exercise Group (pre: $M=45.2$, $SD=6.1$; post: $M=38.7$, $SD=5.4$), while remaining relatively stable in the Control Group. The results indicated a significant intervention effect for cortisol levels ($t=-4.782$, $p<0.001$), perceived stress ($t=-3.891$, $p<0.001$), and total mood disturbance ($t=-6.381$, $p<0.001$).

Conclusion: The findings of this study highlight the positive impact of a 12-week aerobic exercise intervention on cortisol regulation, perceived stress, and total mood disturbance among women aged 20-40 in District Dera Ismail Khan, Pakistan. Aerobic exercise emerged as an effective non-pharmacological intervention for enhancing mental well-being and stress resilience in this population. These findings underscore the importance of promoting regular aerobic exercise as part of comprehensive mental health promotion strategies in similar populations.

Keywords: Aerobic exercise, cortisol levels, perceived stress, total mood disturbance, women, Pakistan.

Introduction

Aerobic exercise, characterized by sustained rhythmic movements that elevate heart rate and increase oxygen consumption, has garnered substantial attention for its potential benefits on physical and mental health. The origins of aerobic exercise can be traced back to ancient civilizations, where physical activities such as running, swimming, and dancing were integral components of daily life (Kretchmar et al., 2023; Cooper, 1968). However, it wasn't until the latter half of the 20th century that scientific exploration into the benefits of aerobic exercise gained momentum.

In the 1960s and 1970s, the work of Kenneth H. Cooper, a physician in the United States Air Force, played a pivotal role in popularizing the concept of aerobic exercise. Cooper's landmark book "Aerobics" emphasized the importance of sustained, rhythmic physical activity in improving cardiovascular health and overall fitness (Cooper, 1968). This groundbreaking research laid the foundation for subsequent studies exploring the physiological and psychological benefits of aerobic exercise.

Over the decades, numerous investigations have corroborated Cooper's findings and expanded our understanding of the multifaceted effects of aerobic exercise on health. Of particular interest is the relationship between aerobic exercise and stress regulation. Research has consistently demonstrated that engaging in regular aerobic exercise can modulate the body's stress response system, leading to reductions in cortisol levels, the primary stress hormone (Smith & Merwin, 2018). Moreover, aerobic exercise has been associated with decreases in perceived stress, defined as an individual's subjective appraisal of the level of stress they

experience, as well as reductions in total mood disturbance, encompassing various negative mood states such as tension, depression, and fatigue (Morga et al., 2021; Chase, & Hutchinson, 2015; Craft & Perna, 2004; Salmon, 2001).

Furthermore, aerobic exercise interventions have been shown to yield benefits beyond stress reduction, including improvements in cognitive function, self-esteem, and overall quality of life (Erickson et al., 2019; North et al., 1990). These findings highlight the broad-ranging impact of aerobic exercise on mental health outcomes.

However, while there is substantial evidence supporting the beneficial effects of aerobic exercise on stress and mood regulation, further research is needed to elucidate the mechanisms underlying these effects, particularly in specific demographic groups and cultural contexts. Pakistani women aged 20-40 residing in District Dera Ismail Khan represent a population of interest due to the unique cultural, social, and environmental factors that may influence their stress levels and participation in aerobic exercise (Shahzad et al., 2019; Bano et al., 2020). Despite the recognized benefits of aerobic exercise on stress reduction and mental well-being, there is a gap in understanding how these benefits manifest specifically among Pakistani women aged 20-40 residing in District Dera Ismail Khan. While studies conducted in other contexts have demonstrated the positive effects of aerobic exercise on cortisol levels, perceived stress, and mood disturbance, the cultural, social, and environmental factors unique to District Dera Ismail Khan may influence the efficacy of aerobic exercise interventions in this population.

Moreover, there is a lack of research examining the specific barriers and facilitators to engaging in aerobic exercise among Pakistani women in this age group, as well as the perceived benefits and preferences for different types of

aerobic activities. Understanding these factors is essential for designing effective interventions that are culturally sensitive and tailored to the needs of the target population.

Therefore, the primary objective of this study is to examine the impact of aerobic exercise on cortisol levels, perceived stress, and mood disturbance among Pakistani women aged 20-40 residing in District Dera Ismail Khan. Additionally, this study aims to explore the barriers and facilitators to engaging in aerobic exercise in this population, as well as their preferences for different types of aerobic activities. By addressing these research questions, this study seeks to contribute to the existing literature on aerobic exercise and mental health while also providing insights that can inform the development of culturally appropriate interventions to promote physical activity and mental well-being among Pakistani women in District Dera Ismail Khan.

Methods and Materials

Study Design

This study utilized a quasi-experimental design to investigate the impact of aerobic exercise on cortisol levels, perceived stress, and total mood disturbance among women aged 20-40 in District Dera Ismail Khan, Pakistan. Participants were divided into two groups: an Aerobic Exercise group and a Control group.

Participants

A total of 50 female volunteers aged between 20 to 40 years were recruited from different gyms in District Dera Ismail Khan using convenient sampling. The participants were briefed about the study protocols and provided written informed consent before enrollment. They were assured of the voluntary nature of their participation and their right to withdraw at any time.

Intervention

The Aerobic Exercise group underwent a 12-week program of aerobic fitness training, with sessions conducted every alternate day for 60 minutes each. The exercise sessions were supervised by trained instructors and included various aerobic activities such as jogging, brisk walking, cycling, and aerobic dance.

Data Collection

Pre-tests were conducted before the intervention, including measurements of body mass index (BMI), flexibility tests, Perceived Stress Scale (PSS) questionnaire, Profile of Mood States (POMS) questionnaire, and blood serum cortisol levels. Body measurements were taken using a measuring tape, and flexibility tests were performed using standardized protocols. Blood samples for cortisol analysis were collected before and after the intervention and analyzed using enzyme-linked immunosorbent assay (ELISA) at a certified laboratory. Post-tests were administered after three months of following the aerobic exercise schedule, and the same variables measured in the pre-test phase were analyzed in the post-test phase.

Ethical Considerations

Ethical approval was obtained from the Ethics Review Board of Gomal University Dera Ismail Khan, Pakistan, and informed consent was obtained from all participants. The study adhered to ethical guidelines for research involving human participants.

Data Analysis

Data analysis was conducted using SPSS Version 27. Descriptive statistics such as mean, standard deviation, were calculated for numerical and categorical

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variables. Paired sample t-tests, were performed to compare mean differences between groups and assess relationships between variables.

Results

Table 1: Body Measurements

Measurement	Aerobic Exercise Group (Mean \pm SD)	Control Group (Mean \pm SD)
Height (cm)	162.8 \pm 5.3	163.2 \pm 4.8
Weight (kg)	60.5 \pm 7.2	61.2 \pm 6.9
BMI	22.8 \pm 2.1	23.1 \pm 2.0
Neck Circumference	32.1 \pm 1.5	32.3 \pm 1.4
Arm Circumference	28.6 \pm 2.0	28.9 \pm 1.8
Chest Circumference	85.4 \pm 3.2	85.7 \pm 3.0
Waist Circumference	72.3 \pm 4.5	72.7 \pm 4.3
Hip Circumference	88.6 \pm 3.8	89.0 \pm 3.6
Thigh Circumference	52.7 \pm 2.8	52.9 \pm 2.6
Calf Circumference	34.5 \pm 1.9	34.8 \pm 1.7

Table 1 presents the body measurements of participants in both the Aerobic Exercise group and the Control group. In terms of height, there was a slight difference observed, with participants in the Aerobic Exercise group having a mean height of 162.8 cm (SD = 5.3) and those in the Control group having a mean height of 163.2 cm (SD = 4.8). Similarly, there were minor variations in weight and BMI between the two groups, with slightly lower values seen in the Aerobic Exercise group compared to the Control group. For instance, the mean weight was 60.5 kg (SD = 7.2) in the Aerobic Exercise group and 61.2 kg (SD = 6.9) in the Control group, while the mean BMI was 22.8 (SD = 2.1) and 23.1 (SD = 2.0) respectively. Furthermore, the measurements of various body

circumferences such as neck, arm, chest, waist, hip, thigh, and calf showed similar trends. Participants in the Aerobic Exercise group generally exhibited slightly lower mean values compared to those in the Control group. For example, the mean neck circumference was 32.1 cm (SD = 1.5) in the Aerobic Exercise group and 32.3 cm (SD = 1.4) in the Control group. Similar patterns were observed for arm circumference, chest circumference, waist circumference, hip circumference, thigh circumference, and calf circumference.

In this table, there were some minor differences in body measurements between the Aerobic Exercise group and the Control group, the variations were not substantial. These findings suggest that both groups had relatively similar body compositions at the beginning of the study, indicating a balanced distribution of participants across the two groups.

Table 2: Flexibility Test Scores

Flexibility Test	Aerobic Exercise Group (Mean ± SD)	Control Group (Mean ± SD)
Shoulder Elevation	25.6 ± 3.1	24.8 ± 2.9
Back Extension	28.3 ± 4.0	27.5 ± 3.8
Sit-and-Reach	18.9 ± 2.5	17.8 ± 2.3

Table 2 displays the results of the flexibility tests conducted on participants in both the Aerobic Exercise group and the Control group. Three specific flexibility tests were administered: shoulder elevation, back extension, and sit-and-reach. In the shoulder elevation test, participants in the Aerobic Exercise group exhibited a mean score of 25.6 (SD = 3.1), whereas those in the Control group had a slightly lower mean score of 24.8 (SD = 2.9). Similarly, for the back extension test, participants in the Aerobic Exercise group demonstrated a mean score of 28.3 (SD = 4.0), while those in the Control group had a mean score of 27.5 (SD = 3.8). These results suggest that participants in the Aerobic Exercise group had slightly

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higher flexibility in both shoulder elevation and back extension compared to the Control group, although the differences were relatively small.

In the sit-and-reach test, which measures flexibility in the lower back and hamstring muscles, participants in the Aerobic Exercise group achieved a mean score of 18.9 (SD = 2.5), whereas those in the Control group obtained a slightly lower mean score of 17.8 (SD = 2.3). Once again, the Aerobic Exercise group showed slightly better flexibility compared to the Control group in this particular test. The results indicate that participants in the Aerobic Exercise group tended to have slightly higher flexibility scores across all three tests compared to those in the Control group. This suggests that engaging in regular aerobic exercise may have a positive impact on flexibility, particularly in the shoulder, back, and lower body muscles.

Table 3: Cortisol Levels

Cortisol Levels ($\mu\text{g/dL}$)	Pre-Intervention	Post-Intervention
Aerobic Exercise Group	18.5 \pm 3.2	15.2 \pm 2.8
Control Group	18.2 \pm 3.0	18.1 \pm 3.1
n	25	25
t-value	-4.782	
df	48	
Sig (p-value)	<0.001	

The data presented in Table 3 illustrates the cortisol levels, measured in $\mu\text{g/dL}$, for both the Aerobic Exercise Group and the Control Group at two different time points: pre-intervention and post-intervention. In the Aerobic Exercise Group, the

mean cortisol level decreased from 18.5 $\mu\text{g/dL}$ (SD = 3.2) before the intervention to 15.2 $\mu\text{g/dL}$ (SD = 2.8) after the intervention. Conversely, in the Control Group, there was a slight decrease from 18.2 $\mu\text{g/dL}$ (SD = 3.0) to 18.1 $\mu\text{g/dL}$ (SD = 3.1). The t-value of -4.782, with degrees of freedom (df) equal to 48, indicates a significant difference between the pre-intervention and post-intervention cortisol levels in the Aerobic Exercise Group. This difference was further supported by the significance level (p-value) of less than 0.001, suggesting a highly significant reduction in cortisol levels following the aerobic exercise intervention. These findings suggest that engaging in regular aerobic exercise may have a notable impact on cortisol regulation, potentially indicating a reduction in stress levels and improved stress resilience among participants in the Aerobic Exercise Group compared to the Control Group. The results indicate that the 12-week aerobic exercise program was associated with a significant decrease in cortisol levels among participants in the Aerobic Exercise group. This finding suggests that aerobic exercise may have a beneficial effect on stress regulation and cortisol secretion, potentially contributing to improved overall well-being.

Table 4: Perceived Stress Scores

Perceived Stress Score	Pre-Intervention	Post-Intervention
Aerobic Exercise Group	28.6 \pm 4.5	24.3 \pm 3.8
Control Group	28.9 \pm 4.3	27.6 \pm 4.0
n	25	25
t-value	-3.891	
df	48	
Sig. (p-value)	<0.001	

Table 4 presents the perceived stress scores for both the Aerobic Exercise Group and the Control Group before and after the intervention. In the Aerobic Exercise

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Group, the mean perceived stress score decreased from 28.6 (SD = 4.5) before the intervention to 24.3 (SD = 3.8) after the intervention. Similarly, in the Control Group, there was a decrease from 28.9 (SD = 4.3) to 27.6 (SD = 4.0). The t-value of -3.891, with degrees of freedom (df) equal to 48, indicates a significant difference between the pre-intervention and post-intervention perceived stress scores in the Aerobic Exercise Group. This difference is further supported by the significance level (p-value) of less than 0.001, signifying a highly significant reduction in perceived stress levels following the aerobic exercise intervention. These findings suggest that participation in regular aerobic exercise may lead to a notable decrease in perceived stress levels, indicating potential improvements in stress management and overall psychological well-being among participants in the Aerobic Exercise Group compared to the Control Group. The significant reduction in perceived stress scores observed in the Aerobic Exercise group suggests that engaging in regular aerobic exercise may have a positive impact on perceived stress levels. This finding is consistent with previous research indicating that physical activity can help reduce feelings of stress and improve overall mental well-being. Overall, the results indicate that the 12-week aerobic exercise program was associated with a significant decrease in perceived stress levels among participants in the Aerobic Exercise group. This suggests that aerobic exercise may serve as an effective strategy for managing stress and promoting psychological health.

Table 5: Total Mood Disturbance Scores

Total Mood Disturbance Score	Pre-Intervention	Post-Intervention
Aerobic Exercise Group	45.2 ± 6.1	38.7 ± 5.4
Control Group	44.9 ± 5.8	44.8 ± 5.9
n	25	25

Total Mood Disturbance Score	Pre-Intervention	Post-Intervention
t-value	-6.381	
df	48	
Sig. (p-value)	<0.001	

Table 5 presents the total mood disturbance scores for both the Aerobic Exercise Group and the Control Group before and after the intervention. In the Aerobic Exercise Group, the mean total mood disturbance score decreased from 45.2 (SD = 6.1) before the intervention to 38.7 (SD = 5.4) after the intervention. In contrast, in the Control Group, there was only a minimal change from 44.9 (SD = 5.8) to 44.8 (SD = 5.9). The t-value of -6.381, with degrees of freedom (df) equal to 48, indicates a significant difference between the pre-intervention and post-intervention total mood disturbance scores in the Aerobic Exercise Group. This difference is further supported by the significance level (p-value) of less than 0.001, indicating a highly significant reduction in total mood disturbance following the aerobic exercise intervention. These findings suggest that engaging in regular aerobic exercise may lead to a substantial improvement in mood states, including reductions in tension, depression, and fatigue, among participants in the Aerobic Exercise Group compared to the Control Group. The significant reduction in total mood disturbance scores observed in the Aerobic Exercise group suggests that engaging in regular aerobic exercise may have a positive impact on mood regulation and psychological well-being. This finding is consistent with previous research indicating that physical activity can help improve mood and reduce symptoms of depression and anxiety. The results indicate that the 12-week aerobic exercise program was associated with a significant improvement in mood states among participants in the Aerobic Exercise group. This suggests that aerobic exercise may be an effective intervention for enhancing emotional health and overall quality of life.

Discussion

The findings of the present study revealed several significant outcomes related to the impact of aerobic exercise on cortisol levels, perceived stress, and total mood disturbance among women aged 20-40 in District Dera Ismail Khan, Pakistan. These findings provide valuable insights into the potential benefits of aerobic exercise for mental well-being and stress management in this population.

Cortisol Levels: The study demonstrated a significant decrease in cortisol levels among participants in the Aerobic Exercise group following the 12-week intervention. This finding is consistent with previous research indicating that regular aerobic exercise can lead to reductions in cortisol secretion (Smith & Smith, 2016). Cortisol is a stress hormone associated with the body's physiological response to stressors, and elevated levels of cortisol have been linked to negative health outcomes such as anxiety and depression (McEwen, 2017). The observed decrease in cortisol levels suggests that engaging in aerobic exercise may help regulate the stress response system and promote physiological resilience to stress.

Perceived Stress: Participants in the Aerobic Exercise group reported a significant reduction in perceived stress levels compared to the Control group. This finding aligns with previous studies that have demonstrated the stress-relieving effects of aerobic exercise (Salmon, 2001). Regular physical activity has been shown to enhance coping mechanisms, increase feelings of self-efficacy, and improve overall psychological well-being, all of which contribute to lower perceived stress levels (Stults-Kolehmainen & Sinha, 2014). The current study adds to this body of literature by providing evidence of the beneficial effects of aerobic exercise on perceived stress specifically among women in Pakistan.

Total Mood Disturbance: Participants in the Aerobic Exercise group also exhibited a significant improvement in total mood disturbance scores, indicating enhancements in mood states such as tension, depression, and fatigue. This finding is consistent with previous research demonstrating the mood-enhancing effects of aerobic exercise (Craft & Perna, 2004). Aerobic exercise has been shown to stimulate the release of endorphins and other neurotransmitters that contribute to feelings of well-being and relaxation (Mikkelsen et al., 2017). The current study underscores the potential of aerobic exercise as a non-pharmacological intervention for improving mood and emotional health.

Linking with Other Studies: The findings of this study are supported by a wealth of existing research on the benefits of aerobic exercise for mental health and stress management. For example, a meta-analysis by Stanton et al. (2018) found that aerobic exercise interventions were associated with significant reductions in both perceived stress and cortisol levels across various populations. Similarly, a longitudinal study by Firth et al. (2018) reported that higher levels of physical activity were predictive of lower levels of depression and anxiety over time.

Moreover, cultural and contextual factors may influence the effectiveness of aerobic exercise interventions. For instance, a study by Herring et al. (2016) found that social support and community engagement played crucial roles in sustaining physical activity among women in diverse cultural settings. Therefore, future research should consider cultural nuances and societal norms when designing and implementing exercise programs aimed at improving mental health outcomes. In conclusion, the findings of the present study contribute to the growing body of evidence supporting the beneficial effects of aerobic exercise on cortisol levels, perceived stress, and total mood disturbance among women in District Dera Ismail Khan, Pakistan. These findings have implications for public

health interventions aimed at promoting physical activity as a means of enhancing mental well-being and stress resilience in this population.

Conclusion

In conclusion, the findings of this study provide robust evidence supporting the beneficial effects of aerobic exercise on cortisol levels, perceived stress, and total mood disturbance among women aged 20-40 in District Dera Ismail Khan, Pakistan. Through a rigorously designed 12-week intervention, participants in the Aerobic Exercise group demonstrated significant improvements in both physiological and psychological outcomes compared to those in the Control group.

Firstly, the significant decrease in cortisol levels observed among participants in the Aerobic Exercise group highlights the stress-reducing effects of regular aerobic exercise. Cortisol, known as the body's primary stress hormone, plays a crucial role in the body's physiological response to stressors. The observed reduction in cortisol levels suggests that engaging in aerobic exercise may help regulate the stress response system, leading to improved stress resilience and physiological adaptation to stress.

Furthermore, participants in the Aerobic Exercise group reported a substantial decrease in perceived stress levels post-intervention. Perceived stress, an individual's subjective appraisal of stressors in their environment, is closely linked to mental health outcomes such as anxiety and depression. The observed reduction in perceived stress suggests that aerobic exercise may serve as an effective coping mechanism for managing stress and promoting psychological well-being.

Additionally, the significant improvement in total mood disturbance scores among participants in the Aerobic Exercise group underscores the mood-enhancing

effects of regular exercise. Mood disturbance encompasses a range of negative mood states, including tension, depression, anger, fatigue, and confusion. The observed improvements in mood states following the aerobic exercise intervention suggest that regular physical activity may contribute to enhanced emotional resilience and improved overall mood regulation.

Overall, the findings of this study have important implications for public health initiatives aimed at promoting mental well-being and stress management among women in District Dera Ismail Khan, Pakistan. By highlighting the potential benefits of aerobic exercise as a non-pharmacological intervention for improving mental health outcomes, this study provides valuable insights into the development of targeted interventions and programs tailored to the specific needs of this population.

In conclusion, the findings of this study underscore the importance of incorporating regular aerobic exercise into lifestyle behaviors as a proactive strategy for promoting mental well-being and stress resilience. By fostering a holistic approach to health that encompasses both physical and psychological dimensions, aerobic exercise offers a promising avenue for enhancing overall quality of life and fostering resilience in the face of stressors.

Future Suggestions

Further research is warranted to deepen our understanding of the relationship between aerobic exercise and mental health outcomes. Future studies could explore the long-term effects of aerobic exercise interventions on cortisol regulation, stress resilience, and mood stability among diverse populations. Additionally, investigations into the mechanisms underlying the observed improvements in mental health following aerobic exercise are needed to elucidate the physiological and psychological pathways involved.

Practical Implications

The findings of this study have several practical implications for individuals, healthcare professionals, and policymakers. Incorporating regular aerobic exercise into one's lifestyle may serve as a proactive strategy for managing stress, improving mood, and enhancing overall well-being. Healthcare providers can play a crucial role in promoting physical activity as an integral component of mental health care. By advocating for the inclusion of exercise prescriptions in treatment plans and supporting patients in adopting healthy lifestyle behaviors, clinicians can empower individuals to take proactive steps towards better mental health.

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