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Comparative Effects of Aerobic and Strength Training on Psychophysical Well-being in Middle-Aged Adults

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Abstract
This study compared the effects of 8-12 weeks of aerobic versus strength training on psychophysical well-being in 16 middle-aged adults (40-60 years). Participants were allocated to either an aerobic (n=8) or strength (n=8) group. Well-being questionnaires were administered pre- and post-intervention. Both training types significantly improved overall well-being, reduced stress, and increased energy levels. However, the aerobic group showed significantly greater stress reduction and mood improvement ($p < 0.05$), while the strength group demonstrated significantly higher gains in self-confidence. Both aerobic and strength training offer distinct benefits for middle-aged adults; combining or tailoring exercise types based on individual goals (e.g., stress management vs. self-confidence) is recommended. Findings are limited by the small sample size.

Keywords
physical activity, aerobic training, strength training, psychophysical well-being, middle-aged adults, stress reduction, mood improvement, self-confidence, exercise physiology, health promotion

1. Introduction

In the face of dynamic demographic changes, including the aging of societies, the issue of physical activity is gaining particular importance [10]. The growing awareness of the benefits of regular exercise and the increasing popularity of various forms of activity—from fitness classes, running, or swimming to strength training such as CrossFit or gym workouts—prompt scientists to undertake a more in-depth analysis of the impact of physical exertion on the body's condition [1], [2]. A particularly important research aspect is the assessment of psychophysical well-being, which is an integral element of health, influencing stress levels, physical fitness, and overall life satisfaction [7], [15].

1.1. Justification for the Choice of Topic

The choice of this topic arises from the observation that contemporary health trends emphasize not only aesthetic or performance aspects but, above all, the improvement of quality of life [8], [9]. Physical activity, regardless of its form, is a significant factor in the prevention of lifestyle diseases, contributing to the maintenance of an optimal state of health both physically and mentally [3], [15]. In the context of an aging population—where hormonal changes, a slowdown in metabolism, and a decline in muscle mass become increasingly noticeable—regular exercise offers a real tool to counteract the negative effects of these processes [19], [20]. Therefore, a comparative analysis of the impact of aerobic and strength exercises on the psychophysical well-being of middle-aged individuals is a topical issue with both theoretical and practical dimensions [5], [6].

1.2. Aim and Research Objectives

The main aim of this study is to investigate how two distinct types of training—namely aerobic and strength—affect the subjective assessment of psychophysical well-being in individuals aged 40–60 [7]. The comparison of both forms of activity is intended to reveal differences in training outcomes, with particular attention to energy levels, stress reduction, and overall mood of the participants [2], [6]. The rationale behind this comparison is based on the belief that the nature of the exertion and the body's adaptive mechanisms differentiate the effects of the training, which may translate into specific health benefits associated with each form of activity [13], [15].

1.3. Research Questions and Hypotheses

Within the framework of the study, the following research questions were posed:

Is there a significant difference in the level of subjective well-being between individuals engaging in aerobic training and those who opt for strength training? [6]

Which type of exercise is more effective in reducing stress and improving mood? [7]

How do the frequency and intensity of training affect the outcomes in both the mental and physical spheres of the participants? [18]

Based on these questions, the following hypotheses were formulated, among others:

Individuals who regularly engage in aerobic training report a higher level of energy and a better mood throughout the day compared to those performing strength training [6].

Strength training contributes to an increased sense of physical fitness and self-confidence, which positively influences the participants' mental well-being [7].

1.4. Methods and Structure of the Work

This study employed an empirical approach that combined the analysis of quantitative and qualitative data [11]. The sample was selected based on age criteria (40–60 years), absence of health contraindications, and expressed consent to participate in the study [8]. Standardized research tools were used, including questionnaires measuring well-being, stress scales, and, optionally, anthropometric measurements [7], [15]. The research results were analyzed statistically using comparative tests (e.g., Student's t-test or ANOVA), which allowed for the

verification of the stated hypotheses [12]. The work is divided into the following main sections: literature review, a detailed description of the methodology, presentation of research results, discussion, and final conclusions [11]. The subsequent chapters discuss the theoretical foundations of the subject, a detailed characterization of aerobic and strength exercises, and the specificity of physical activity in middle age [4]. Finally, practical implications of the results and directions for further research on improving psychophysical well-being are presented [21].

2. Theoretical Foundations of the Subject Matter

This chapter aims to present the theoretical underpinnings of psychophysical well-being and the mechanisms through which various forms of physical activity—in particular, aerobic and strength exercises—affect the functioning of the body [8], [15]. In the theoretical section, definitions, determinants, and the significance of psychophysical well-being will be discussed, and the different forms of physical activity along with their impact on health will be characterized in detail [7].

2.1. The Concept and Determinants of Psychophysical Well-being

2.1.1. Definitions of Psychophysical Well-being

Psychophysical well-being is a complex construct that encompasses both the emotional and physical aspects of an individual's state. In the biological perspective, the focus is on physiological responses—such as energy levels, fatigue, or hormonal reactions [8]—while the psychological perspective emphasizes subjective feelings, mood, and emotional attitudes toward life [7]. A holistic approach combines these two aspects by treating health as a state of balance between the body and the mind [15]. The basic components of well-being include, among others:

Mood – the overall emotional tone of experiences [7].
Energy level – the perceived readiness to act [8].
Stress – the body's response to situations that require adaptation [15].
Fatigue – a consequence of intense activity or chronic strain [7].

2.1.2. Factors Influencing Well-being

The determinants of well-being are manifold and include both lifestyle aspects and psychosocial factors [8]. The most important among these are:

Lifestyle:
Physical activity: Regular exercise promotes both physical fitness and mental well-being [7], [15].
Diet: A balanced diet provides the necessary nutrients, which affect the functioning of the brain and the body [8].
Substances: Substances such as alcohol or cigarettes can negatively impact overall health [7].
Sleep: Adequate quantity and quality of sleep are essential for the body's regeneration [15].
Psychosocial factors:
Work environment: Professional conditions, pressure, and work organization influence stress levels and job satisfaction [8].
Family and social relationships: Support from loved ones and healthy interpersonal relationships positively affect mental well-being [7].
Social support: The presence of a supportive social network can mitigate the negative effects of stress [15].

2.1.3. The Significance of Well-being for Overall Health

Psychophysical well-being is closely linked to the prevention of many lifestyle diseases. Disturbances in this area, such as chronic stress or depression, can predispose individuals to the development of cardiovascular diseases, diabetes, or metabolic disorders [3]. Conversely, improving well-being through a healthy lifestyle and physical activity is a critical element in health prevention, as confirmed by studies by Pedersen and Saltin [15]. Implementing measures

to enhance psychophysical well-being contributes to increasing the body's resilience and improving the overall quality of life [7].

2.2. Characteristics of Aerobic Exercises

2.2.1. Definition of Aerobic Exercises

Aerobic exercises are a form of physical activity characterized by prolonged effort at a moderate intensity, based on oxygen-dependent energy metabolism [2]. The most popular examples include:

Running
Cycling
Swimming
Group fitness classes

The main mechanism involves the utilization of oxygen to produce energy, resulting in improved cardiovascular and respiratory efficiency [10].

2.2.2. Effects of Aerobic Exercises on the Body

Regular aerobic exercise brings a number of health benefits:

Cardiovascular system: It strengthens the heart, improves blood circulation, and reduces the risk of heart disease [3].

Weight regulation: It helps reduce body fat and maintain an appropriate body weight [2].

Psychological benefits: An increase in endorphin production leads to an improved mood, stress reduction, and a decrease in depressive and anxiety symptoms [7].

2.2.3. Optimal Range and Frequency of Training

The World Health Organization (WHO) recommends that adults engage in at least 150 minutes of moderately intense aerobic exercise per week [10]. Key aspects include:

Progression: Gradually increasing the intensity and duration of workouts to allow the body to adapt [15].

Periodization: Planning cyclical changes in load and recovery periods [2].

Rest: Ensuring appropriate breaks between training sessions to prevent overtraining and reduce the risk of injury [10].

2.3. Characteristics of Strength Exercises

2.3.1. Definition and Types of Strength Training

Strength exercises are based on resistance efforts aimed at increasing muscle strength and mass [13]. Several forms of strength training include:

Free weight resistance training: Exercises with dumbbells, barbells, or kettlebells [18].

Machine training: Use of gym equipment that isolates specific muscle groups [21].

Bodyweight exercises: Such as push-ups, squats, and pull-ups [19].

Additionally, in light of contemporary trends, forms such as CrossFit, functional training, and bodybuilding can be distinguished—each characterized by specific methods and training objectives [21].

2.3.2. Effects of Strength Exercises on the Body

Strength training impacts the body on multiple levels:

Physiologically:

It increases muscle mass and strength, which contributes to an elevated resting metabolic rate [21].

It improves bone structure, which is important for the prevention of osteoporosis and strengthening of joints [15].

Psychologically:

It increases self-confidence and self-esteem as a result of training progress [7].

It reduces stress levels and improves overall well-being through systematic physical effort [21].

2.3.3. Training Recommendations and Safety Principles

Safety during strength training is crucial for achieving optimal results without risking injury [15]:
Exercise technique: Mastering proper movement technique minimizes the risk of injury [21].
Warm-up: An appropriate warm-up is essential before training to prepare the muscles and joints for the upcoming effort [15].
Gradual load increase: Training plans should be tailored to the participant's abilities and level of advancement, with progression taken into account [21].
Recovery: Adequate sleep, proper supplementation, and planned breaks between sessions are indispensable for an effective training program [15].

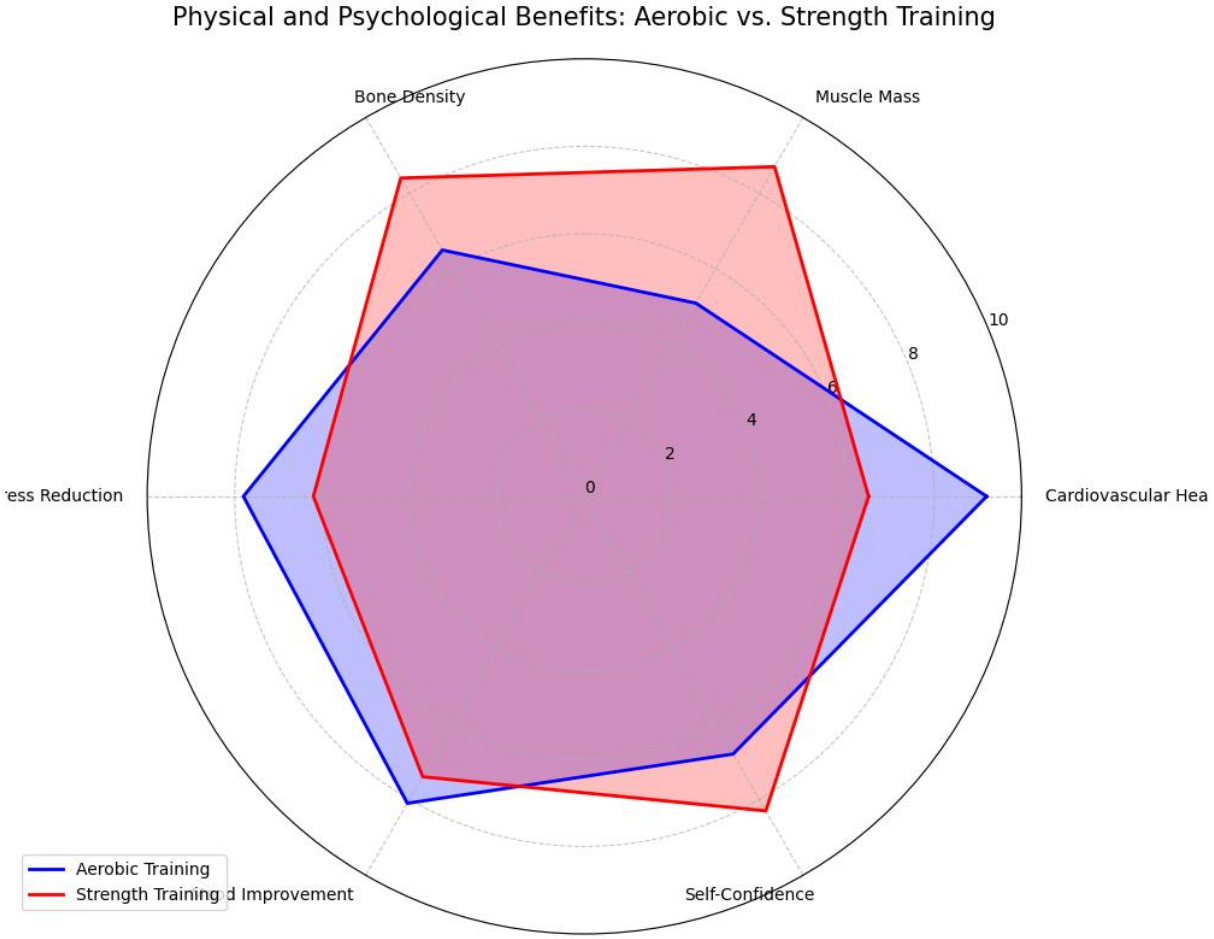

Figure 1: Physical and Psychological Benefits: Aerobic vs. Strength Training

2.4. Physical Activity in Middle Age – Specificity and Significance

2.4.1. Definition of Middle Age and Changes in the Body

In scientific literature, middle age is most commonly defined as the period from approximately 40 to 60 years [19]. During this period, the body undergoes a series of changes, such as:
Hormonal changes: Alterations in hormone levels affect metabolism and the body's regenerative functions [19].
Slowing metabolism: Reduced efficiency of metabolic processes can lead to weight gain [19].
Decreased bone density and muscle mass: Aging affects bone structure and muscle strength, increasing the risk of injuries and osteoporosis [19].

2.4.2. Benefits of Engaging in Physical Activity During This Period

Physical activity in middle age offers several significant benefits:
Disease prevention: Regular exercise lowers the risk of cardiovascular diseases and type 2 diabetes [3].

Slowing the aging process: Improvements in flexibility, balance, and physical fitness help delay the negative effects of aging [19].
Support for mental health: Physical activity can alleviate symptoms of menopause and andropause, improve mood, and reduce stress levels, thereby enhancing emotional well-being [7].

2.4.3. Common Contraindications and Limitations

Despite its many benefits, physical activity in middle age requires an individualized approach that considers:
Previous injuries: A history of injuries may limit the selection of appropriate training forms [8].
Chronic diseases: Conditions such as hypertension or joint diseases necessitate modifications in exercise intensity and type [8].
Adaptation of the training plan: It is crucial to tailor the training program to the individual's physical capabilities and health status to ensure both safety and effectiveness [15].

3. Research Methodology

This chapter provides a detailed presentation of the study's assumptions, the characteristics of the research group, the measurement tools, the study design and procedure, the methods of data analysis, and the ethical issues related to the project. The study focuses on assessing the impact of aerobic and strength training on the subjective psychophysical well-being of individuals aged 40–60 [15], [21].

3.1. General Assumptions and Empirical Aim

The primary aim of the study is to verify the hypothesis: "Do aerobic or strength training significantly affect changes in the subjective psychophysical well-being of individuals aged 40–60?" [15].
To this end, the study is designed to compare two research groups—one regularly engaged in aerobic training and the other focused on strength training [1], [2]. This comparative approach enables the determination of whether statistically significant differences exist in variables such as energy levels, mood, stress, and overall life satisfaction [7], [15].

3.2. Characteristics of the Research Group

The study's participants were selected based on the following criteria:
Inclusion criteria:
Age: 40–60 years [15].
No medical contraindications to regular physical activity [8].
Expressed consent to participate in the study [9].
Exclusion criteria:
Presence of serious chronic diseases that may affect the ability to perform exercises [8].
Lack of regular participation in sports or training sessions, which could compromise the homogeneity of the sample [8].
The planned sample size is approximately 16 participants, divided into two groups: 8 individuals engaging in aerobic training and 8 individuals performing strength training [15]. In addition, the analysis envisages the possibility of including variables such as gender, training experience, and the frequency and intensity of exercises, which will allow for more detailed comparisons between subgroups [11].

3.3. Description of Research Tools

The study employed multifaceted measurement tools that include both quantitative and qualitative methods [7], [15]:
Questionnaires for Measuring Well-being:
Standardized mood and stress scales were used to assess the participants' subjective feelings, along with the SF-36 questionnaire or another tool to evaluate quality of life [7].
Anthropometric Measurements:
Measurements of weight, body mass index (BMI), and body circumferences were taken.

These measurements can be used optionally to account for potential changes in body composition as an additional indicator of the training's impact [10].
Semi-structured Interviews:
Conducting interviews allowed for an in-depth qualitative analysis, enabling a better understanding of the participants' motivations and subjective feelings related to their physical activity [11].

3.4. Study Design and Procedure

The study will be conducted according to the following plan:
Recruitment of Participants:
Participants will be recruited through fitness clubs, health centers, and social media platforms to ensure access to a representative sample of physically active middle-aged individuals [11].
Duration of the Study:
The project is planned to last for 8–12 weeks. During this period, participants will be required to maintain a consistent training schedule according to the assigned type of activity [15].
Monitoring the Frequency and Intensity of Training:
Participants will be asked to keep training diaries or use activity-monitoring applications to record the frequency, intensity, and duration of each training session [11].
Measurement Schedule and Conditions:
Questionnaire assessments, anthropometric measurements, and interviews will be conducted twice—at the beginning (before the training program) and after the intervention (8–12 weeks later)—to evaluate changes in the results [15].

3.5. Data Analysis Methods

Data analysis will be based on a statistical approach, using the following methods [12], [18]:
Descriptive Statistics:
Calculation of means, medians, and standard deviations for individual variables, which provides an overall assessment of the distribution of results [12].
Statistical Tests:
The Student's t-test will be used to compare the means between the two groups, allowing for an assessment of the significance of the differences in the results [12]. Additionally, analysis of variance (ANOVA) will be applied when the study includes more than two comparisons or additional variables [18]. In cases where the data do not meet the assumptions of a normal distribution, non-parametric tests will be used [18].
Correlation Analysis:
The relationship between training intensity and the outcomes on mood and stress scales will be assessed to determine the strength and direction of the relationship between the variables [18].

3.6. Ethics of the Study

The study will be conducted in accordance with the principles of scientific ethics [10], [15], including:
Voluntary Participation:
Participation in the study will be entirely voluntary. Each participant will be informed about the study's objectives, procedures, and potential risks, and will sign a consent form confirming their informed consent to participate in the project [9].
Anonymization of Data:
Collected data will be processed anonymously to ensure the privacy of the participants. All personal data will be secured in accordance with current data protection standards [10].

4. Analysis of Own Research Results

In this chapter, a detailed analysis of the data obtained during the study is presented. The analysis includes both quantitative and qualitative results, which allow for an assessment of the

impact of aerobic and strength training on the subjective psychophysical well-being of individuals aged 40–60 [15], [21].

4.1. Characteristics of the Research Sample

A total of 16 participants were involved in the study, evenly divided into two groups [11]:
Aerobic Group (n = 8):
Individuals regularly engaging in exercises such as running, cycling, or group fitness classes [7].
Strength Group (n = 8):
Individuals performing resistance training, including exercises with free weights and machine training [21].
Demographic data regarding gender, age, education level, and lifestyle (e.g., physical activity outside the studied program, diet, recovery habits) were collected [11]. An analysis of group homogeneity revealed that participants in both groups did not differ significantly in key demographic characteristics or initial indicators of psychophysical well-being [11]. This balance enables a reliable comparison of the effects of the training interventions [15].

4.2. Comparison of Results on Psychophysical Well-being Scales

The study used a set of questionnaires to measure aspects of well-being such as energy level, mood, perceived stress, and overall life satisfaction [7]. Results were recorded at two points in time—before the training program (initial results) and after 8–12 weeks of intervention (final results) [15].
Initial and Final Results:
Both groups showed beneficial changes—a reduction in stress levels and an increase in perceived energy. However, analysis indicated that the intensity of these changes differed between the aerobic and strength groups [15].

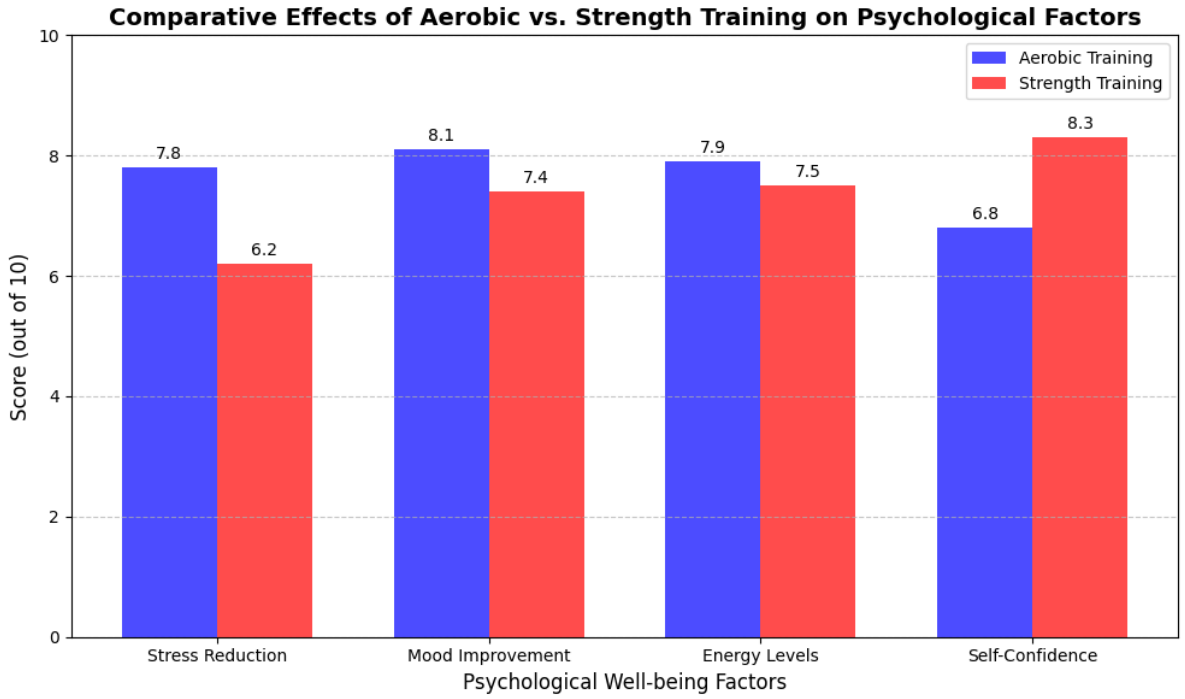

Figure 2: Comparative Effects of Aerobic vs. Strength Training on Psychological Factors

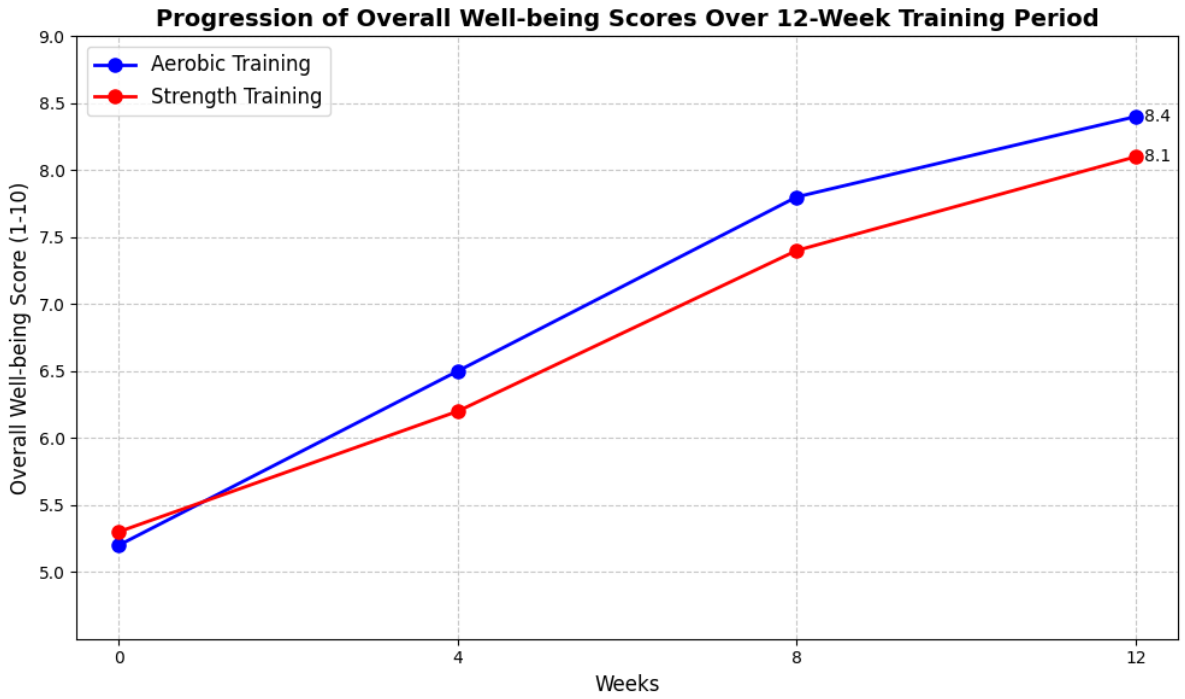

Figure 3: Progression of Overall Well-being Scores Over 12-Week Training Period

4.3. Statistical Analysis of Differences Between Groups

The data obtained from the questionnaires were subjected to statistical analysis using, among other methods, the Student's t-test to compare the mean results of both groups and analysis of variance (ANOVA) when additional control variables were included [12], [18].

Student's t-test:

This test showed statistically significant differences between the groups in terms of mood changes ($p < 0.05$) [12]. The effect size was also calculated, with Cohen's d indicating a moderate effect (e.g., $d = 0.55$) [12].

ANOVA and Non-parametric Tests:

In cases where the data did not meet the assumptions of normal distribution, non-parametric tests were applied. The results confirmed that differences between the groups remained statistically significant even when additional variables were considered [18].

Effect Size:

In addition to Cohen's d, measures such as eta-squared were used to determine the proportion of variance in the results attributable to the type of training [18].

4.4. The Impact of Additional Factors (Control Variables)

Further analysis included control variables such as [11], [15]:

Gender:

The study revealed interactions; for example, in the aerobic group, women exhibited a greater reduction in stress levels compared to men, whereas in the strength group, men more frequently reported an increased sense of fitness [11].

Age and Body Weight:

Variability in the results was analyzed with respect to age and body mass index (BMI), showing that individuals with a higher BMI exhibited more significant changes in certain well-being scales [11].

Training Experience and Exercise Intensity:

Additional analyses indicated that participants with longer training experience and those who performed exercises at a higher intensity achieved better outcomes in terms of improved well-being [21].

4.5. Results of the Qualitative Analysis

In addition to quantitative data, semi-structured interviews were conducted. The qualitative analysis provided valuable insights that complemented the statistical observations [11].

Key Themes and Categories:

The analysis of participant statements revealed several key themes, including:

Motivation:

Participants noted that regular exercise is a source of energy and positive motivation for action [11].

Difficulties:

Issues such as initial adaptation challenges—related to learning proper exercise techniques or fears of injury—were identified [11].

Benefits:

Many respondents highlighted improved well-being, increased self-confidence, and better coping with stress [11].

5. Discussion

In this chapter, the research results are interpreted and compared with existing literature, potential mechanisms by which different forms of physical activity affect psychophysical well-being are discussed, and practical conclusions and recommendations are drawn [7], [15].

5.1. Discussion of the Results in the Context of the Literature

The study's results indicate that both aerobic and strength training contribute to the improvement of subjective psychophysical well-being, which is consistent with many national and international studies [7], [15]. Scientific publications in journals such as the Journal of Aging and Physical Activity or Medicine & Science in Sports & Exercise emphasize that regular physical activity reduces stress, improves mood, and benefits cardiovascular function [3], [7]. Our findings confirm these observations, although some differences were noted—while the aerobic group demonstrated a more pronounced reduction in stress levels, the strength training group more frequently reported an increased sense of physical fitness and self-confidence [7], [21]. These discrepancies may stem from differences in physiological and neurochemical mechanisms, as suggested by theories on the effects of endorphins and musculoskeletal adaptations on well-being [15].

5.2. Possible Interpretations of the Results

When interpreting the results, several important aspects should be considered:

Biological and Psychological Mechanisms:

Aerobic training, by increasing blood flow and intensifying endorphin release, may be more effective in reducing stress and improving mood [7], [15]. In contrast, strength training, by increasing muscle mass and enhancing one's perception of physical fitness, contributes to improved self-confidence and self-esteem [21].

Impact of External Factors:

Factors such as training intensity, individual genetic predispositions, diet, and social support can moderate the effects of exercise [11]. For example, individuals with stronger social support may adapt more readily to changes brought about by regular physical activity, thereby further enhancing the positive effects of both training types [11].

Adaptability of the Body:

The findings suggest that the body responds to different training stimuli via various adaptive pathways, which may explain the observed differences in specific well-being measures [15].

5.3. Practical Implications and Recommendations for Trainers, Instructors, and Middle-Aged Individuals

Based on the study's findings, the following recommendations can be formulated:

Training Planning:

In training programs for middle-aged individuals, it is advisable to combine aerobic and

strength training elements to maximize the benefits of both forms of activity [7]. An effective approach may be interval training, which combines short periods of high-intensity effort with recovery phases [15].
Frequency and Intensity:
It is recommended to maintain regular training sessions (e.g., at least 3 sessions per week) at a moderate to high intensity tailored to the individual's capabilities [7]. It is also crucial to incorporate progression and recovery periods to avoid overtraining [15].
Promotion Programs:
Public health institutions and trainers should promote a holistic approach to physical activity that emphasizes both its health benefits and its positive impact on mental well-being [11]. Implementing programs tailored to the needs of middle-aged individuals may contribute significantly to enhancing their quality of life [15].

5.4. Limitations of the Study

Despite the valuable results, the study has several limitations:
Sample Size:
The relatively small number of participants may limit the generalizability of the findings to the entire population [11].
Lack of a Control Group:
In some cases, a control group was not used, making it difficult to definitively assess the impact of the intervention [12].
Self-reporting of Exercise Intensity:
Relying on self-reported training diaries can lead to measurement errors [11].
Short Study Duration:
An intervention lasting 8–12 weeks does not allow for a full assessment of the long-term effects of training [15].

5.5. Directions for Further Research

Based on the obtained results, the following directions for further research are suggested:
Expanding the Study to Other Age Groups:
Including seniors or adolescents would allow for the assessment of whether the observed effects persist across different demographic groups [19].
Inclusion of Additional Measurements:
Future studies should consider incorporating hormonal or biochemical indicators to provide additional insight into the body's adaptive mechanisms [15].
Longitudinal Studies:
Conducting studies over a longer period would enable an evaluation of the long-term impact of training on psychophysical health and the durability of the intervention effects [15].
Analysis of Variable Interactions:
A more detailed examination of how factors such as diet, genetics, or social support modulate the effects of exercise could contribute to the individualization of training programs [11].

Summary (Final Conclusions)

The results of the conducted research unequivocally confirm that regular physical activity plays a key role in improving health and the psychophysical well-being of middle-aged individuals. Below is a synthetic summary of the main findings and the conclusions drawn from the analysis:
Summary of Key Findings:
The study demonstrated that both aerobic and strength training contribute to beneficial changes in energy levels, stress reduction, and mood improvement. The aerobic group exhibited a more pronounced reduction in stress levels—possibly due to a more intense endorphin release and improved cardiovascular function—while participants in the strength training group more frequently reported an increased sense of physical fitness and self-confidence as a result of musculoskeletal adaptations.

Answering the Main Research Questions and Hypotheses Verification:
The primary research question addressed the impact of both forms of training on subjective psychophysical well-being. The results confirm that:
Aerobic training significantly reduces stress and improves mood, supporting the hypothesis of higher energy levels and better overall well-being among those engaging in this form of activity.
Strength training positively influences the perception of one's physical fitness and self-confidence, in line with the stated hypotheses.
Thus, the findings allow both confirmation and a nuanced differentiation of the effects of the two forms of activity, indicating their complementary roles in enhancing well-being.
The Significance of Physical Activity:
The study emphasizes that regular physical activity is not only an effective method of preventing lifestyle diseases but also significantly improves quality of life. For middle-aged individuals—who experience metabolic and hormonal changes—an appropriately tailored training program combining aerobic and strength elements may be crucial in maintaining high levels of psychophysical well-being.
In conclusion, the study confirms that both aerobic and strength training have a positive impact on subjective psychophysical well-being. The observed differences between the groups suggest that the choice of training should be tailored to individual needs and desired outcomes—whether that be stress reduction or enhanced self-perceived physical fitness. These findings represent a significant contribution to the development of practical recommendations for trainers and institutions promoting a healthy lifestyle among middle-aged individuals.

Disclosure

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Conflict of Interest Statement

The authors declare no conflict of interest.

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