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Impact of Different Forms of Physical Activity on Recovery in Eating Disorders: A Narrative Review

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Abstract

Background. Eating disorders (EDs) are among the most severe psychiatric disorders, associated with high mortality, a chronic course, and significant somatic and psychological burden. Contemporary treatment models increasingly incorporate physical activity as a potential supportive component of the recovery process. Scientific literature indicates that appropriately selected and supervised forms of exercise may positively affect both physical health and psychological functioning in patients with EDs. Particular therapeutic importance is attributed to resistance training, aerobic exercise, combined interventions, yoga and mind-body practices, as well as clinically supervised exercise programs, all of which may support the restoration of somatic functions, emotional regulation, and improvement in patients' quality of life.

Aim. The aim of this narrative review is to analyze the impact of different forms of physical activity on the course of recovery in individuals with eating disorders, with particular emphasis on resistance training, aerobic training, combined exercises, yoga/mind-body practices, and clinically supervised exercise programs.

Material and methods. A narrative review of the scientific literature was conducted, including studies involving individuals with eating disorders, such as anorexia nervosa (AN), bulimia nervosa (BN), and binge eating disorder (BED). Studies assessing the effects of specific forms of physical activity on patients' somatic and psychological parameters were included in the analysis. The research material was grouped according to the type of exercise intervention and subsequently subjected to a descriptive comparative analysis regarding its impact on recovery indicators.

Results. The analysis demonstrated that the effects of physical activity in the treatment of eating disorders (EDs) are strongly determined by the type of activity and the level of clinical supervision. Resistance training effectively stimulates muscle protein synthesis, promoting the restoration of fat-free mass (FFM), while also inducing osteogenesis and reducing both hypercortisolemia and anxiety related to body shape changes. Aerobic training, when implemented during a stable phase of the disorder, reverses cardiac muscle atrophy and hypovolemia by increasing SERCA2a protein expression and activating the renin–angiotensin–aldosterone (RAA) system. Combined training interventions showed greater effectiveness in reducing compulsive exercise behaviors in bulimia nervosa and binge eating disorder (BED) compared with cognitive behavioral therapy (CBT) alone. Yoga and mind-body practices, including MB-EAT programs, help restore impaired interoceptive awareness, reduce binge-eating episodes, and counteract self-objectification. Clinically supervised physical activity programs (PAE), integrating graded exercise with CBT-based interventions, constitute a safe and guideline-recommended method for transforming dysfunctional behavioral patterns.

Conclusions. Physical activity should not be routinely excluded from the treatment process of eating disorders, but rather incorporated as an integral and individualized component of therapy. The examined forms of physical activity, including resistance training, controlled aerobic exercise, and mind–body practices, contribute to reducing the somatic consequences of malnutrition, such as skeletal and cardiac muscle atrophy and osteopenia, while also enabling targeted improvement of psychobehavioral parameters, including restoration of interoceptive awareness and reduction of compulsive exercise behaviors. The key to ensuring metabolic

safety and long-term recovery is the integration of structured exercise programs with psychotherapy, particularly cognitive behavioral therapy (CBT).

Key words: eating disorders, physical activity, healthy exercise behavior, recovery, mental health

1. Introduction

1.1 Overwiew

Eating disorders (EDs) constitute one of the most severe groups of psychiatric disorders, characterized by high mortality, a chronic course, and significant somatic and psychosocial burden. Contemporary treatment models emphasize the need to combine psychotherapeutic, nutritional, and medical interventions; however, the role of physical activity in the recovery process remains a subject of intense debate. On the one hand, physical activity may function as a risk factor by reinforcing compulsive behavioral patterns, perfectionism, and emotion-regulation strategies based on excessive exercise. On the other hand, a growing body of research indicates that appropriately selected and supervised forms of physical activity may support the recovery process by improving both physical health parameters and psychological functioning.

In a systematic review, Rizk et al. (2020) emphasized that problematic physical activity is a common and clinically significant component of eating disorders, particularly anorexia nervosa [6]. At the same time, the authors highlighted the lack of clear guidelines regarding the safe incorporation of exercise into treatment. More recent analyses, such as the scoping review by Mathisen et al. (2023), indicate that supervised physical activity programs may provide health benefits without increasing the risk of exacerbating ED symptoms. These benefits include improvements in physical fitness and muscle strength, as well as reductions in psychological distress and improvements in quality of life [28]. Furthermore, the review by Teixidor-Batlle et al. (2025) suggests that various forms of physical activity, including resistance training, aerobic training, combined interventions, and mind-body practices, may support the recovery process [47].

Despite the growing number of publications, there is still a lack of studies synthesizing the impact of specific types of physical activity on the course of recovery in EDs. Existing research has primarily focused on the safety of exercise, the characterization of compulsive exercise behaviors, or the general effects of physical activity interventions, while often neglecting differences between specific forms of exercise and their potential therapeutic significance.

1.2 Research Objective

The aim of this review is to analyze the available studies on the effects of different forms of physical activity on the course of recovery in eating disorders. The review includes resistance-based interventions, aerobic training, combined training, mind-body practices, as well as exercise programs implemented in clinical settings.

1.3 Research Problems

Which types of physical activity (resistance, aerobic, combined, yoga/mind-body, and clinical programs) are used in the treatment of individuals with eating disorders?

How do different forms of physical activity influence recovery indicators such as BMI, strength, physical fitness, bone density, hormonal balance, psychological well-being, and quality of life?

Which forms of activity are potentially beneficial, and which may be associated with a risk of deterioration or relapse of symptoms?

1.4 Research hypotheses

1. Physical activity has a positive impact on the recovery process in eating disorders.

2. Different types of physical activity exert varied effects on recovery outcomes -resistance training and combined interventions provide greater physiological benefits than aerobic exercise alone.

3. Yoga and mind-body practices reduce psychopathological symptoms and compulsive exercise behavior to a greater extent than traditional forms of physical activity.

4. Unsupervised or excessive physical activity may increase the risk of relapse of eating disorder symptoms.

2. Research materials and methods

2.1 Participants

The study participants consisted of populations derived from primary research articles included in this narrative review. In order to be eligible for inclusion in the analysis, target populations had to meet the following criteria:

Clinical diagnosis: Individuals of any age and gender diagnosed with eating disorders (EDs), including anorexia nervosa (AN), bulimia nervosa (BN), binge eating disorder (BED), or other specified feeding and eating disorders (OSFED), established based on validated diagnostic criteria (e.g., DSM-5, ICD-10/11) or confirmed clinical assessment.

Intervention exposure: Patients actively engaged in specific, well-defined forms of sport-related physical activity, including resistance training, aerobic exercise, combined training, yoga and mind–body practices, as well as clinically supervised exercise programs.

Studies were excluded if they involved only healthy populations, elite athletes exhibiting the female athlete triad without a formal clinical diagnosis of an eating disorder, or animal models.

2.2 Procedure and data collection

The research procedure was based on a review of the available scientific literature addressing the impact of different forms of physical activity on the recovery process in eating disorders. During the selection of materials, published studies evaluating the effects of exercise on both somatic and psychological parameters in patients were identified. The methodological quality of the included studies was assessed using established principles of academic reliability, with particular attention to sample selection, clarity of exercise protocols, and validity of the

applied research instruments. Due to the nature of the study as a narrative review rather than a quantitative meta-analysis, no statistical software was used to calculate effect sizes; instead, the analysis relied on a logical and descriptive interpretation of findings reported in the scientific literature.

The collected literature was thematically organized according to the type of physical activity (resistance training, aerobic training, combined training, yoga/mind-body practices and clinical exercise programs), and subsequently subjected to a descriptive comparative analysis in terms of their effects on physical and psychological health indicators, which enabled the verification of the formulated research hypotheses.

3. Research results

3.1 Resistance training

In the course of eating disorders (ED), particularly anorexia nervosa, there is a significant reduction in fat-free mass (FFM), primarily involving skeletal muscle tissue. Prolonged energy deficiency leads to increased catabolic processes, reduced muscle protein synthesis, and impaired skeletal muscle function. As a result, decreases in muscle strength, functional capacity, and resting metabolic rate (RMR) are observed [6]. Resistance training counteracts these changes by stimulating muscle protein synthesis (MPS). This mechanism occurs mainly through activation of the mTOR (mammalian target of rapamycin) pathway, which is responsible for anabolic processes in muscle tissue. Regular strength training increases the activity of muscle satellite cells and enhances the synthesis of new protein fibers, thereby supporting the restoration of lost muscle mass [7]. The implementation of controlled resistance training enables the restoration of fat-free mass (FFM) and the recovery of normal muscle strength [1]. An increase in FFM is associated with improvements in RMR, which is often significantly reduced in individuals with ED as a result of the body's adaptation to chronic malnutrition [6]. Beyond the restoration of FFM, improvements in resting metabolism, and recovery of muscle strength, enhanced mobility and improved ability to perform daily activities have also been observed in individuals with eating disorders following the implementation of resistance training programs, which contributes to a reduction in the risk of injuries and falls [8]. In individuals with eating disorders, particularly anorexia nervosa, reduced bone mineral density (BMD), osteopenia, and an increased risk of osteoporosis and fractures are frequently observed. Prolonged energy deficiency leads to a shift in the balance between bone resorption and bone formation, resulting in weakened bone structure [9]. Axial loading generated during resistance exercise is a crucial stimulus for mechanoreceptors in bone tissue, inducing osteoblastic activity and supporting remineralization as well as improvements in BMD [1]. Mechanical loading increases interstitial fluid flow within the canalicular network surrounding osteocytes. This mechanical fluid movement activates membrane receptors and ion channels in osteocytes, leading to increased intracellular calcium levels and triggering signaling cascades involving prostaglandins, nitric oxide (NO), and the Wnt/β-catenin pathway. The Wnt/β-catenin signaling pathway stimulates osteoblast proliferation and activity. Additionally, mechanical loading reduces the secretion of sclerostin, a protein produced by osteocytes that inhibits bone formation. Lower sclerostin levels increase osteoblast activity and enhance mineral deposition in the bone matrix. Mechanical loading also increases the expression of anabolic factors such as IGF-1 (Insulin-like Growth Factor 1) and reduces the activity of pathways promoting bone resorption, thereby shifting bone metabolism toward bone formation [10], [11].

In contrast to aerobic exercise, resistance training does not generate such a high energy expenditure, and therefore does not disrupt the caloric balance necessary for body mass gain (BMI). Focusing exercise-based therapy on the development of fat-free mass (FFM) through mechanical resistance provides patients with a sense of control over somatic changes. Shifting the emphasis from "weight gain" to "rebuilding muscle structure and strength" significantly reduces therapeutic resistance and fear of body-related changes, which are often distressing for patients [1].

In individuals with eating disorders, chronic hypercortisolemia is commonly observed, which exacerbates muscle catabolism, bone resorption, and metabolic disturbances. This occurs because the body interprets starvation as a state of severe metabolic stress, leading to increased secretion of corticotropin-releasing hormone (CRH) by the hypothalamus and adrenocorticotropic hormone (ACTH) by the pituitary gland [12]. Resistance training also affects endocrine system functioning through the activation of neurohormonal and metabolic mechanisms associated with physiological adaptation to exercise. One of the most important effects is the modulation of the hypothalamic–pituitary–adrenal (HPA) axis. During strength training, there is a transient increase in ACTH and cortisol secretion; however, regular training adaptation leads to more efficient regulation of the stress response and a reduction in chronic activation of the HPA axis. This mechanism is associated with improved glucocorticoid receptor sensitivity and decreased basal cortisol secretion [13].

Resistance training also affects the growth hormone-IGF-1 (GH/IGF-1) axis. In response to mechanical muscle tension and microdamage to muscle fibers, pulsatile secretion of growth hormone (GH) increases, which stimulates hepatic production of IGF-1. IGF-1 activates the PI3K/Akt/mTOR signaling pathway responsible for muscle protein synthesis, satellite cell proliferation, and anabolic processes [15]. Individuals with ED often exhibit so-called GH resistance, characterized by elevated GH levels alongside low IGF-1 concentrations resulting from malnutrition [14]. Adequate energy availability combined with resistance training may partially improve the functioning of this axis by enhancing the body's anabolic sensitivity [1].

Individuals with eating disorders (EDs) often use dietary restriction, binge eating, compensatory behaviors, or compulsive physical activity as a way of coping with difficult emotions such as anxiety, shame, tension, or a perceived loss of control [3], [4]. Compared with individuals without eating disorders, they more frequently rely on emotion regulation strategies such as emotional suppression and emotional avoidance [3]. Appropriately guided resistance training may support the development of more adaptive emotion regulation strategies [1]. One such strategy is cognitive reappraisal, which involves changing the way difficult emotions and situations are interpreted. Instead of responding with dietary restriction or compensatory behaviors, individuals learn to perceive physical and emotional discomfort as a transient state [3]. Strength training helps reduce psychological tension and improve tolerance of emotional discomfort through the activation of dopaminergic and serotonergic pathways in the central nervous system. In the case of dopaminergic activation, which involves increased activity of dopaminergic neurons in the mesolimbic and mesocortical pathways (VTA-nucleus accumbens-prefrontal cortex), there is an increase in dopamine release within reward system structures. Dopamine modulates motivational processes and reduces tension. In the case of serotonergic activation, there is increased activity of raphe nuclei neurons in the brainstem and greater availability of serotonin (5-HT) in limbic structures and the prefrontal cortex. Serotonin regulates mood, impulse inhibition, and emotional processing, leading to affect stabilization and reduced vulnerability to anxiety and stress responses [5]. Regular resistance training

enhances a sense of agency and control over one's body, which is of particular importance for individuals with ED in the recovery process [2], [3].

3.2 Aerobic training

Aerobic training in eating disorders (EDs) demonstrates effects that depend on nutritional status and clinical supervision. Under conditions of malnutrition, such activity may exacerbate energy deficiency and reinforce metabolic adaptations characteristic of starvation. In contrast, during the stable phase of recovery, when adequate energy intake is ensured, aerobic exercise may support improvements in cardiorespiratory fitness and autonomic nervous system function [16]. The principal characteristic of prolonged, rhythmic physical activity involving large muscle groups, performed at low to moderate intensity and relying predominantly on aerobic ATP resynthesis, is the enhancement of cardiovascular and respiratory system efficiency [17].

Individuals with eating disorders, particularly those with anorexia nervosa, exhibit reduced cardiovascular capacity, including bradycardia, decreased cardiac muscle mass, and reduced stroke volume, which result from chronic malnutrition and adaptive reduction of hemodynamic load [18]. Chronic dehydration, decreased plasma oncotic pressure due to hypoalbuminemia, and suppression of the renin-angiotensin-aldosterone (RAA) system caused by systemic hypometabolism contribute to significant hypovolemia [20]. Aerobic training implemented exclusively under conditions of metabolic stabilization and positive energy balance leads to partial normalization and reversibility of the aforementioned hemodynamic disturbances [19].

An increase in cardiac muscle mass occurs as a result of cyclic stretching of the ventricular walls, which induces mechanotransduction mediated by integrins and focal adhesion kinase (FAK) complexes. This activates the physiological phosphoinositide 3-kinase (PI3K) and Akt kinase (protein kinase B) signaling cascade together with its downstream effector mTORC1. This pathway stimulates mRNA translation and the synthesis of structural proteins. Serial sarcomerogenesis subsequently occurs, in which new sarcomeres are added to the ends of existing ones, leading to elongation of cardiomyocytes without a substantial increase in their cross-sectional area [21].

The increase in stroke volume (SV) induced by aerobic training is a direct consequence of intracellular calcium handling and myocardial contraction kinetics. This process is initiated by the induction of a strong positive lusitropic effect resulting from upregulation of SERCA2a pump expression and parallel phosphorylation of phospholamban (PLN). Removal of the inhibitory effect of PLN enables accelerated sequestration of calcium ions into the sarcoplasmic reticulum during diastole, allowing effective accumulation of a greater calcium pool. During systole, the stored calcium is rapidly and synchronously released through ryanodine receptors (RyR2) via the calcium-induced calcium release (CICR) mechanism, thereby inducing a positive inotropic effect [22].

Mechanisms restoring normal volemia in patients with EDs include cyclic, transient reductions in renal blood flow during exercise sessions, which stimulate renal renin secretion, activate the renin-angiotensin-aldosterone (RAA) system, and promote vasopressin (ADH) release. At the cellular level of the renal collecting ducts, increased expression of aquaporin-2 (AQP2) water channels and epithelial sodium channels (ENaC) occurs. This results in enhanced sodium and water reabsorption, initiating an increase in plasma volume [23], [24]. Furthermore, repetitive aerobic activity associated with increased cardiac output stimulates hepatocytes to

enhance the biosynthesis and secretion of albumin into the vascular bed. The resulting increase in intravascular protein concentration elevates plasma oncotic pressure [25].

Controlled and individualized training, implemented strictly under conditions of metabolic stabilization and sustained positive energy balance, ceases to function as a factor perpetuating pathological symptomatology (e.g., compulsive calorie-burning behaviors) and instead becomes a therapeutic intervention capable of reversing profound hemodynamic dysfunctions [19]. Thus, the crucial issue is not the elimination of physical activity itself, but rather the transformation of its function from a compulsive behavior aimed at weight reduction and anxiety regulation into a consciously controlled therapeutic intervention supporting the restoration of somatic and psychological functioning [26]. Supervised aerobic training in individuals with eating disorders did not lead to deterioration of anthropometric parameters or body weight loss; instead, it was associated with improved cardiovascular fitness, increased muscle strength, and a reduction in pathological beliefs regarding food and physical activity [26].

In the LEAP (compuLsive Exercise Activity theraPy) study, patients reported that therapeutically supervised aerobic physical activity increased awareness of their emotional and cognitive mechanisms associated with exercise. In some individuals, gradual reductions in cognitive rigidity, perfectionism, and automatic compulsive behaviors were observed. Patients also emphasized improved ability to recognize fatigue signals and bodily needs, which facilitated restoration of interoception and more flexible behavioral regulation [27].

3.3 Combined exercises

Combined training, involving the integration of aerobic and resistance exercise components, is increasingly described in the literature as a potentially valuable element in the treatment of eating disorders, particularly anorexia nervosa, provided that it is strictly supervised and implemented as an adjunct to standard therapy rather than as its substitute [1].

Studies employing combined interventions (e.g., moderate-intensity aerobic exercise combined with resistance training) have demonstrated not only improvements in physical fitness, but also favorable changes in body weight and body composition [1], [6]. Some studies additionally reported reductions in dysfunctional exercise patterns, improved body acceptance, and greater adherence to treatment [29]. In a randomized study comparing cognitive behavioral therapy (CBT) with a program combining physical exercise and dietary therapy (PED-t) in women with bulimia nervosa or binge eating disorder (BED), a significant reduction in compulsive exercise severity was observed in the PED-t group, along with a decrease in the proportion of patients exceeding the clinical threshold for compulsive exercise. Although both approaches improved symptoms, only the combined intervention demonstrated a reduction in the number of patients exceeding the compulsive exercise (CE) threshold [30]. This study provides empirical support for the hypothesis that incorporating supervised combined exercise sessions into treatment may reduce problematic activity patterns [30]. Nevertheless, there remains a necessity for individualized programming, strict medical and dietary supervision, and the inclusion of combined training solely as a component of a multidisciplinary treatment plan rather than as a stand-alone therapy [28].

In the general population, the effects of combined training on body composition are characterized predominantly by increases in fat-free mass (FFM). Short-term interventions (8-16 weeks) typically result in gains of approximately 1-2 kg of FFM, accompanied by reductions

in fat mass and decreases in body fat percentage [31]. In the context of eating disorders (EDs), direct evidence regarding body composition outcomes following combined training remains limited. However, with appropriate patient selection, medical and nutritional supervision, and individualized load adjustment, programs incorporating both resistance and aerobic components appear to support restoration of fat-free mass, improvements in muscular strength and function, and safe body weight gain. Nevertheless, most available data in ED populations derive from small samples or studies with limited randomization; therefore, direct extrapolation of effect sizes from general populations to patients with EDs should be approached with caution [1], [6], [28], [30].

3.4 Yoga and mind-body practices

Yoga is an integrated system of practices combining control of the body, breath, and attention in order to regulate psychophysiological processes and promote self-regulation and well-being [32]. In the classical approach, the aim of yoga is the deepening of consciousness and the attainment of mental stability, whereas in the contemporary context society often focuses primarily on its somatic and therapeutic aspects [32], [33].

The principal therapeutic mechanism of yoga and mind–body practices is the reconstruction of interoceptive awareness, understood as the ability to accurately perceive, differentiate, and interpret signals originating from within the body, such as hunger, satiety, or muscular tension, which are profoundly impaired in patients with eating disorders. In one study investigating disturbances in body-signal perception among individuals with eating disorders, so-called interoceptive accuracy was assessed using heartbeat detection tasks. Patients with anorexia nervosa demonstrated markedly lower ability to recognize their own somatic states compared with healthy control subjects [35], [36].

The studies discussed in this section examined the effects of structured yoga sessions and mindfulness techniques on a range of precisely defined psychopathological, behavioral, and physiological parameters [34], [37], [38], [39], [41]. Among individuals practicing yoga, statistically significant reductions in the frequency of compulsive binge-eating episodes were observed in patients suffering from binge eating disorder (BED) and bulimia nervosa, which the authors directly associated with reductions in psychophysiological tension and compensatory compulsions [34], [38]. Through mind-body practices, patients gained psychological resources and the capacity to “contain” difficult emotional states such as anger, anxiety, or rejection without resorting impulsively and automatically to pathological behaviors such as starvation or binge eating [34], [38].

Participants in yoga interventions experienced reductions in dysmorphic body image disturbances together with increased acceptance of their own somatic limitations and improvement in so-called body appreciation, measured using the standardized Body Appreciation Scale (BAS) and monitoring of body-checking behaviors [34], [39]. A correlation was also identified between regular practice of asanas and breathing techniques and improved body weight stability, including BMI stabilization, in patients with anorexia nervosa, in whom yoga did not induce undesirable weight loss provided that it was conducted in a non-strenuous form [34].

Based on results obtained from mood and affect assessment questionnaires, including the Beck Depression Inventory (BDI) and the State-Trait Anxiety Inventory (STAI), the authors demonstrated that yoga-based interventions generated significant reductions in both generalized

and situational anxiety symptoms, as well as depressive symptom severity [34]. It has been shown that yoga practice stimulates the parasympathetic nervous system via vagal nerve activation, resulting in reductions of physiological stress markers and attenuation of hypothalamic-pituitary-adrenal (HPA) axis hyperactivity [40]. Structured yoga sessions also led to a significant reduction in drive for thinness and diminished somatic anxiety in women presenting subclinical ED symptoms [37].

Yoga and mind-body interventions effectively disrupt the phenomenon of self-objectification by shifting the patient's cognitive perspective away from the external aesthetics of the body toward an accepting, internal representation of the self. Yoga promotes attentional reorientation: patients ceased processing their bodies as "aesthetic objects to be evaluated" and instead began perceiving them as "experiencing subjects." This directly attenuated dysmorphophobic anxiety fixation [39].

In a study involving patients with bulimia nervosa and binge eating disorder that utilized Mindfulness-Based Eating Awareness Training (MB-EAT), consisting of a structured mindfulness training program focused on the process of eating, a transition was observed from rigid dietary rules such as obsessive calorie counting and strictly imposed meal schedules toward intuitive eating based on biological trust in internal hunger and gastric satiety signals. Patients regained the ability to derive sensory pleasure from eating through mindful registration of sensory satiety, achieved by instructing participants to maximally engage oral chemosensory receptors during the first bites of food. Attention was intentionally redirected from anxious automatic thoughts toward the physical properties of the stimulus, including taste profile, texture, and temperature. Patients reported becoming aware of the moment when food ceased to taste as intensely pleasurable, thereby facilitating recognition of satiety. Participation in the MB-EAT program directly reduced pathological guilt, shame, and anxiety associated with food consumption [41].

In comparisons between women engaging in strength and aerobic training and women practicing mind-body forms of activity, time spent in traditional fitness training was strongly associated with higher levels of self-objectification, more frequent body monitoring, and higher indicators of eating disorder symptomatology. Conversely, time spent practicing yoga correlated with lower self-objectification and reduced appearance-related pressure. Traditional exercise intensified fixation on external bodily characteristics, whereas yoga attenuated this process [42].

3.5 Clinically supervised exercise programs

Supervised physical activity allows for the direct targeting and reduction of dysfunctional or compulsive exercise behaviors [28], which, in the absence of appropriate intervention, constitute one of the most persistent symptoms of eating disorder psychopathology and a major risk factor for rapid relapse [44]. Through psychoeducational components and controlled exercise sessions, patients learn to distinguish the pathological urge to burn energy from the health-promoting and functional role of movement. This contributes to reductions in anxiety levels, decreased body dissatisfaction, and alleviation of general behavioral symptoms associated with eating disorders [28].

In individuals struggling with binge eating disorder (BED), regular exercise programs integrated into multidisciplinary care have been shown to significantly reduce both the

frequency and severity of binge-eating episodes, demonstrating high complementary efficacy alongside traditional cognitive behavioral therapy (CBT) [43].

Clinically supervised movement-based interventions have been implemented in the form of PAE (physical activity and exercise) protocols, consisting of supervised and progressively graded physical activities combined with psychoeducation and cognitive behavioral techniques (CBT) [28], [45]. A typical PAE session began with a brief assessment of the patient's condition, including sleep, nutritional intake, anxiety level, and psychoeducation regarding physical activity as a tool for improving physical fitness, emotional regulation, and quality of life. This was followed by approximately 30 minutes of supervised, graded activity (e.g., walking, yoga, mobility exercises, or light resistance exercises), with instructions focused on bodily sensations and functional capacity rather than calorie expenditure. Subsequently, the program incorporated approximately 20 minutes of therapeutic CBT-based work aimed at identifying thoughts driving compulsive exercise behaviors and planning alternative emotional regulation strategies. The entire process was conducted within a multidisciplinary team setting [28], [45].

From a clinical perspective, supervised multidisciplinary exercise programs are preferred in patients with eating disorders due to considerations of safety, somatic monitoring, and integration with psychological therapy [28]. Clinical guidelines recommend risk assessment and graded progression of activity, emphasizing that initial exercise sessions should be supervised, with the possibility of gradually increasing patient autonomy as clinical condition improves [46]. As previously mentioned, clinically supervised exercise programs commonly incorporate resistance, aerobic, and gymnastic components [28], which suggests that they may provide the somatic and metabolic benefits associated with individual forms of physical activity [1], [6], [8], [19], [26], [27], [29], [34].

4. Discussion

The analyzed scientific literature indicates that physical activity constitutes a key element in the recovery process of individuals with eating disorders (EDs). Its therapeutic significance depends primarily on the type of activity performed, the degree of clinical supervision, the patient's metabolic status, and the psychological function that exercise serves for a given individual. The obtained findings support the first research hypothesis, which assumes that appropriately selected forms of physical activity may positively influence the recovery process in eating disorders. The majority of the analyzed studies demonstrated improvements in somatic parameters such as muscular strength, cardiorespiratory fitness, body composition, and metabolic functioning, as well as reductions in psychopathological symptoms, including anxiety, depression, compulsive exercise, and body dissatisfaction [1], [6], [26], [28], [34]. At the same time, scientific evidence emphasizes that these benefits occur almost exclusively under controlled conditions, with adequate energy intake ensured and with physical activity integrated into both somatic treatment and psychotherapeutic interventions.

5. Conclusions

The strongest evidence regarding improvements in physiological parameters concerned resistance training and combined exercise programs, thereby supporting the second research hypothesis. Resistance training demonstrated particular importance in the restoration of fat-free mass (FFM), improvement of muscular strength, and enhancement of bone mineral density

(BMD) [1], [8], [10]. This is of particular clinical relevance in anorexia nervosa, where chronic energy deficiency leads to pronounced muscular catabolism and osteopenia. An important aspect of resistance training was also its relatively low energy expenditure compared with aerobic activity, which may reduce the risk of reinforcing the pathological drive to burn calories. Studies emphasized that shifting the therapeutic narrative from "weight gain" toward "rebuilding strength and bodily functionality" reduced patients' resistance to treatment and increased acceptance of the recovery process [1].

Findings concerning aerobic training were more complex and strongly dependent on the clinical context. Under conditions of malnutrition and active ED symptomatology, aerobic activity may deepen energy deficiency, reinforce compulsive exercise patterns, and exacerbate hormonal and hemodynamic dysfunctions [16], [18]. However, during the phase of metabolic stabilization, under conditions of positive energy balance and strict therapeutic supervision, aerobic training demonstrated the capacity to improve cardiovascular fitness, autonomic nervous system functioning, and overall physical performance [19], [26]. A particularly important conclusion emerging from the analyzed studies was that the primary clinical problem is not physical activity itself, but rather its compulsive nature and its role in emotional regulation through anxiety reduction and body weight control [26], [27]. This indicates that effective treatment should not rely solely on prohibiting exercise, but rather on transforming the psychological meaning of physical activity.

Programs combining aerobic and resistance training demonstrated beneficial effects on both physical and psychological parameters, suggesting that this form of intervention may possess the most comprehensive therapeutic profile. Combined interventions were associated with improvements in body composition, increases in muscular strength, and reductions in dysfunctional exercise patterns [29], [30]. Nevertheless, it is important to note that most available studies involved small sample sizes and short follow-up periods, which limits the generalizability of the findings. Large-scale, long-term randomized studies evaluating the effects of combined training on remission durability and relapse risk in EDs are still lacking.

The findings of the analyzed studies strongly support the third research hypothesis concerning the specific role of yoga and mind-body practices in reducing psychopathological symptoms. In contrast to traditional forms of exercise focused primarily on performance or physical appearance, yoga and mindfulness-based interventions emphasize the development of interoceptive awareness, body acceptance, and emotional regulation [34], [39], [41]. Studies demonstrated reductions in compulsive binge eating, decreases in anxiety and depressive symptoms, reductions in dysmorphophobic symptoms, and improvements in relationships with food and one's own body [34], [37], [38]. Particularly noteworthy is the observed transition from self-objectification toward a more subjective and internally grounded perception of the body. This may have important therapeutic implications, as many individuals with EDs function on the basis of excessive focus on external appearance evaluation and body control [39], [42]. Mind-body interventions may therefore be especially valuable in the treatment of patients presenting high levels of anxiety, perfectionism, and interoceptive disturbances. The literature increasingly emphasizes that eating disorders are not solely disorders of eating behavior or body weight, but also involve profound disturbances in emotional regulation and perception of internal bodily signals [35], [36]. In this context, mindfulness-based practices may constitute an important complement to classical psychotherapeutic approaches.

One of the most important conclusions emerging from this review concerns the significance of clinically supervised physical activity programs. The majority of studies indicate that the

degree of supervision and the integration of exercise within multidisciplinary treatment are decisive for both the safety and effectiveness of interventions [28], [45], [46]. Such programs enable continuous monitoring of patients' somatic condition, gradual progression of exercise intensity, and simultaneous therapeutic work targeting the cognitive and emotional mechanisms underlying compulsive exercise. This is particularly important because problematic physical activity represents one of the most persistent symptoms of EDs and is strongly associated with relapse risk [44].

The fourth research hypothesis, assuming that unsupervised or excessive physical activity may increase the risk of clinical deterioration and symptom relapse, was also confirmed. Numerous publications emphasized that compulsive exercise functions as a mechanism of anxiety reduction, emotional regulation, and compensation for caloric intake [3], [6], [27]. In such cases, physical activity ceases to serve a health-promoting function and instead becomes an element perpetuating the psychopathology of the disorder.

Nevertheless, the accumulated evidence suggests that appropriately selected and clinically supervised physical activity should be gradually and consciously incorporated into comprehensive eating disorder treatment as a highly important factor supporting both somatic and psychological recovery.

6. Disclosure

6.1 Author Contributions

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AI: AI was utilized for two specific purposes in this research. Text analysis of clinical reasoning narratives to identify linguistic patterns associated with specific logical fallacies. Assistance in refining the academic English language of the manuscript, ensuring clarity, consistency, and adherence to scientific writing standards. AI were used for additional linguistic refinement of the research manuscript, ensuring proper English grammar, style, and clarity in the presentation of results. It is important to emphasize that all AI tools were used strictly as assistive instruments under human supervision. The final interpretation of results, classification of errors, and conclusions were determined by human experts in clinical medicine and formal logic. The AI tools served primarily to enhance efficiency in data processing, pattern recognition, and linguistic refinement, rather than replacing human judgment in the analytical process.

All authors have read and agreed to the published version of the manuscript.

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