



PSYCHOPHYSIOLOGICAL CONTRIBUTIONS OF RESISTANCE TRAINING (RT) FOR THE TREATMENT OF ANXIETY DISORDERS IN YOUNG ADULTS

REVIEW ARTICLE

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ABSTRACT

Physical exercise can represent one of the very accessible, beneficial, and side-effect-free treatment alternatives for individuals with anxiety disorders. Among the exercise models capable of producing physiological and psychological benefits, Resistance Training (RT) stands out. Thus, the aim of this research was to describe the psychophysiological contributions of Resistance Training (RT) to the treatment of anxiety disorders in young adults. To achieve this, a qualitative literature review was conducted through searches of scientific articles on the topic published in the following databases: National Center of Medicine; (PUBMED/MEDLINE); SCOPUS; *Periódicos CAPES*; *Biblioteca Virtual em Saúde (BVS)*; *Psicologia Brasil (BVS)*; Scientific Electronic Library Online (SCIELO); and Science Direct, considering studies published in the last 5 years. In this regard, the database search was conducted by combining two or more boolean operators applied as follows: (resistance training; OR acute resistance training; OR chronic resistance training; OR psychophysiological disorders; OR anxiety; OR anxiety disorders; AND young adults with anxiety disorders). As a result, five scientific articles were selected, meeting the inclusion criteria. Analyzing these scientific publications and establishing correlations and common results among them, it is concluded that RT is a highly effective therapeutic intervention in reducing anxiety disorder symptoms. It can be utilized as an alternative therapeutic strategy with



notable outcomes for symptom reduction, providing immediate, medium-term, and long-term responses.

Keywords: Resistance training, Anxiety, Young adults.

1. INTRODUCTION

Mental disorders are characterized by significant clinical disturbances in emotional regulation, cognition, and behavior, negatively affecting the psychological, biological, physiological, or developmental processes underlying mental functioning (American Psychiatric Association, 2014). Among these disorders, anxiety disorders are a highly prevalent group of mental health conditions that can have a profoundly debilitating impact on daily functioning and well-being (Swift *et al.*, 2014). They are characterized by excessive fear and anxiety, differentiated by objects or situations that evoke these feelings (specific phobias, social anxiety disorder, generalized anxiety disorder) and result in behavioral disturbances (Forster, 2012).

It is estimated that 264 million adults worldwide suffer from anxiety disorders. Of these adults, approximately 63% are female and 37% are male (Sabbagh *et al.*, 2022). Additionally, the World Health Organization (WHO) reported that in 2015, this disorder ranked sixth among all mental and psychosomatic illnesses worldwide, and fourth in highly developed countries, making it one of the most impactful chronic diseases globally (Ströhle; Gensichen; Domschke, 2018).

These mental disorders are increasingly associated with the emergence and progression of psychophysiological diseases, consequently disrupting the daily biological rhythms responsible for maintaining the homeostatic balance of most vital psychological and physiological functions. The imbalance in bodily homeostasis has contributed significantly to the increasing incidence of individuals developing chronic degenerative diseases such as adverse cardiovascular conditions, hormonal changes, sleep-wake cycle dysregulation, and premature mortality (Celano *et al.*, 2016). This underscores the need for alternative therapies, such as those obtained through the practice of Strength Training (ST) Physical Exercise, which has been proven to significantly improve these clinical conditions.



In this context, physical exercise can represent one of the accessible, beneficial, and side-effect-free treatment alternatives for individuals with anxiety disorders (Dishman, 1995). Previous studies have reported that physical exercise significantly reduces anxiety scores in youth, young adults, and the elderly, improving functional autonomy and quality of life (Da Silva *et al.*, 2019; Vancini *et al.*, 2017). Furthermore, other results also suggest these benefits for non-clinical populations resulting from the practice of physical exercise for the improvement of quality of life (Rebar *et al.*, 2015). However, despite many studies demonstrating the beneficial effects of aerobic exercise on mental health outcomes, Resistance Training (RT), though less known to the general public, is a form of physical exercise that also produces excellent physiological and psychological benefits (De Melo Araújo *et al.*, 2017).

RT is conceptualized as a strength-demanding exercise method aiming to overcome opposing forces, seeking to achieve maximum muscle contraction through different types of contractions (concentric, eccentric, and isometric). This training is effective for developing or maintaining physical, organic, and musculoskeletal capabilities. The practice of RT is recognized as a physical workout that, in addition to promoting various psychological benefits, is approved for preventing the loss of muscle mass and strength, promoting the maintenance of bodily functionality (NSCA, 2019). Another study asserts that RT performed by older adults can address some depressive symptoms and, consequently, improve their quality of life (De Melo Araújo *et al.*, 2017).

Thus, considering the high prevalence of Anxiety Disorders in young adults, this article aims to describe the main psychophysiological benefits resulting from the practice of RT as a therapeutic aid of utmost relevance for the treatment of this population.

2. MATERIALS AND METHODS

The present study is of a bibliographic and qualitative nature (Thomas; Nelson, 2002). A literature search for articles was conducted using the following databases: National Center of Medicine (PUBMED/MEDLINE), SCOPUS, *Periódicos CAPES*, *Biblioteca virtual em saúde* (BVS), *Psicologia Brasil* (BVS), Scientific Electronic Library Online (SCIELO), and Science Direct, published in the last 5 years. In this regard, the



database search was carried out through the combination of two or more boolean operators applied as follows: (resistance training; OR acute resistance training; OR chronic resistance training; OR psychophysiological disorders; OR anxiety; OR anxiety disorders; AND young adults with anxiety disorders).

2.1 ELIGIBILITY CRITERIA

The studies considered eligible for inclusion met the following criteria: 1) being a clinical trial published in an English-language peer-reviewed journal; 2) articles available for full reading; 3) studies addressing Resistance Training (RT) in an acute or chronic manner in individuals with anxiety disorders or symptoms; and 4) studies conducted on human subjects. Exclusion criteria were as follows: 1) systematic or literature review articles; 2) letters to the editor; 3) research projects; 4) duplicate articles; 5) articles not reporting individuals diagnosed with anxiety or symptoms; 6) not describing volume and intensity variables in the intervention protocol; 7) articles that do not fit the scope based on title and abstract.

2.2 CODING OF STUDIES

The eligible studies were accessed, and their data were individually extracted for the following variables: descriptive information about the subjects by included group, gender, age range, and training status; the number of subjects in each group; study duration; training frequency (days per week); training volume (number of sets and repetitions per exercise); and types of indicators for anxiety.

3. RESULTS

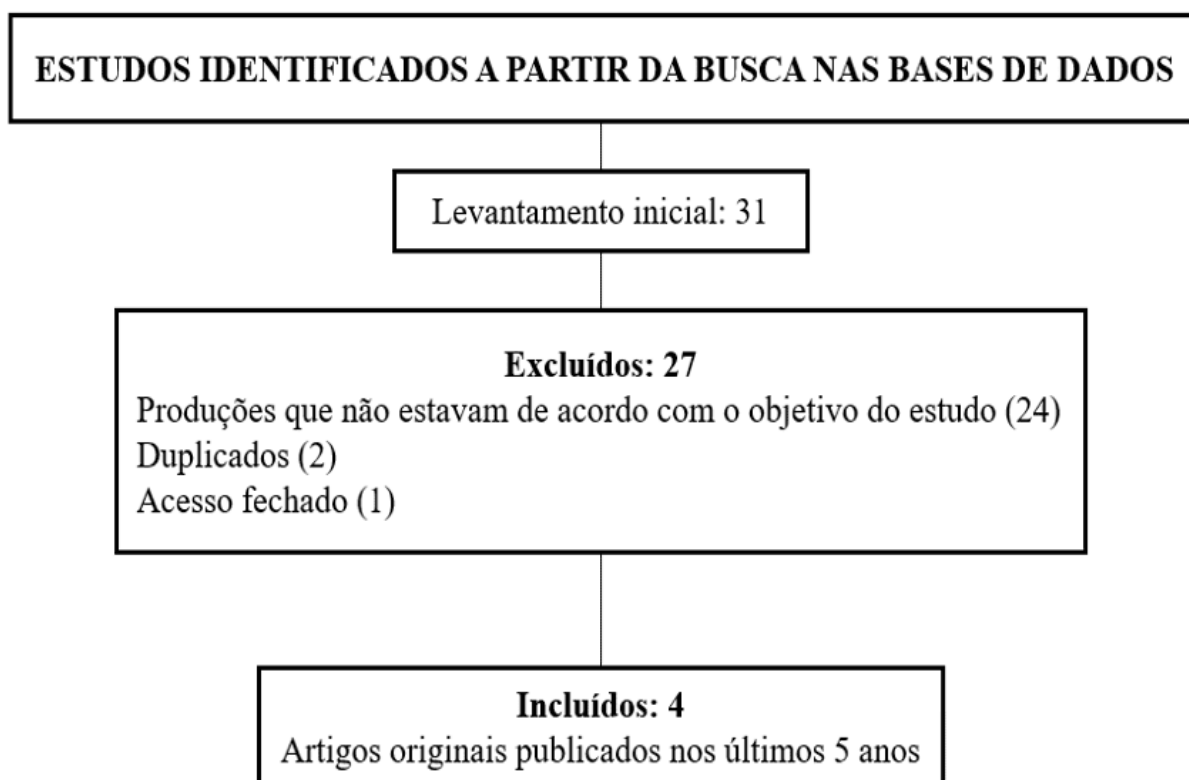
For a better understanding and as a didactic presentation of the literature review results, we have organized the presentation into two stages: i) Synthesis of the selected studies after searching and analyzing using the terms, as described in the methodology; ii) literature review divided into four subtopics: sample characteristics; anxiety indicators; RT protocol; and dose-response effect of RT on anxiety.



3.1 SYNTHESIS OF SELECTED STUDIES

In the first stage of the research, 7 articles were found on the PUBMED platform, of which only 2 met our inclusion criteria. Regarding the SCIELO search platform, we did not find any articles matching the descriptors. On the SCOPUS platform, we found 24 articles, with 5 meeting our inclusion criteria. Thus, 8 articles were initially included after reading the abstracts. After this stage, we identified 2 duplicate studies and 1 without open access to the full text, resulting in 4 articles eligible for the present review. The schematic representation of the review and article selection is presented in Figure 1. The syntheses of the selected studies are presented in Table 1.

Figure 1 - Schematic representation of the review and article selection



Source: Developed by the authors (2022).



Table 1: Syntheses of selected studies after searching and analysis using the terms "(resistance training OR acute resistance training OR chronic resistance training) AND (psychophysiological OR anxiety OR anxiety disorders) AND young adults"

Author	Sample	Objective	Duration/ Weekly frequency	RT Protocol	Anxiety Indicators	Key Findings
Akyüz, (2017)	Sedentary young adults (Males; n=20; 22.57±3.25 years)	To describe the effect of the eight-week exercise program on physical-social anxiety conditions in adult men	3 sessions/week for 8 weeks	8 whole-body exercises. First 4 weeks (40% of estimated 1 RM, 3 sets, 12 repetitions). Next 4 weeks (60% of estimated 1 RM, 3 sets, 12 repetitions)	Social Physical Anxiety Scale (SPAS) before and after 8 weeks of training	The 8-week RT protocol had a positive effect on strength and showed a significant difference in SPAS. Thus, SPAS was related to an increase in strength and, consequently, physical appearance
Faro et al. (2019)	Sedentary college women (n=34; 27±4.5 years)	Compare acute sessions of functional resistance training (FRT) versus traditional resistance training (TRT) on affect, state anxiety pleasure, and physiological measures in college women	4 sessions over 4 weeks	8 whole-body exercises. 2 sessions of FRT and 2 sessions of TRT (50% to 70% of 10RM, 2 sets of 10 repetitions)	Feeling Scale (FS) and State-Trait Anxiety Inventory (STAI) at pre, post-0, and post-15 min. Physical Activity Enjoyment Scale (PACES) immediately after each training session	Acute sessions of functional resistance training and traditional resistance training contributed to anxiety reduction and increased affective responses. Functional training showed more significant reductions in anxiety state than traditional resistance training
Gordon et al. (2020a)	Sedentary young adults (TR: n=14; 5 Males and 6	Quantify the effects of ecologically valid resistance training on anxiety and	2 sessions/week for 8 weeks	8 whole-body exercises (2 sets of 8 to 12 repetitions). 5 RM test for load	For initial screening: Psychiatric Diagnostic Screening Questionnaire (PDSQ-GAD) and	Ecologically valid resistance training significantly improves anxiety symptoms



	Females; 25.2±5.7 years) (GC: n=14; 5 Males and 6 Females; 28.4±6.6 years)	worry symptoms among young adults without anxiety disorders		manipulation	Pennsylvania State Worry Questionnaire (PSWQ). For anxiety assessment: State-Trait Anxiety Inventory subscale (STAI-Y2) and PSWQ for worry	among young adults without anxiety disorders and shows significant strength improvements, with small reductions in worry magnitude when compared to the control group
Gordon et al. (2020b)	Sedentary young adults (TR with GAD: n=12; 4 Males and 8 Females; 26.5±5.8 years); (TR without GAD: n=14; 5 Males and 9 Females; 25.2±5.7 years) (CG with GAD: n=15; 6 Males and 9 Females; 26.7±4.9 years); (CG without GAD: n=14; 5 Males and 6 Females; 28.4±6.6 years)	Quantify the acute and chronic effects of resistance training on signs and symptoms of Generalized Anxiety Disorder (GAD) among young adults with and without GAD	2 sessions/week for 8 weeks	8 whole-body exercises (2 sets of 8 to 12 repetitions). 5 RM test for load manipulation.	For initial screening: Psychiatric Diagnostic Screening Questionnaire (PDSQ-GAD) and Pennsylvania State Worry Questionnaire (PSWQ). For anxiety assessment: State-Trait Anxiety Inventory subscale (STAI-Y2), for worry PSWQ, depression assessed weekly using the Quick Inventory of Depressive Symptomatology (QIDS-SR16)	Investigating the effects of resistance training among individuals with emerging signs and symptoms of an anxiety disorder is particularly important



Gordon et al. (2021)	Sedentary young adults (TR: n=12; 4 Males and 8 Females; 26.5±5.8 years) (CG: n=15; 6 Males and 9 Females; 26.7±4.9 years)	Quantify the effects of ecologically valid resistance training on the state of anxiety disorder and symptoms of worry and anxiety among young adults with GAD.	2 sessions/week for 8 weeks	8 whole-body exercises (2 sets of 8 to 12 repetitions). 5 RM test for load manipulation	For initial screening: Psychiatric Diagnostic Screening Questionnaire (PDSQ-GAD) and Pennsylvania State Worry Questionnaire (PSWQ). For anxiety assessment: State-Trait Anxiety Inventory subscale (STAI-Y2) and for worry PSWQ	Ecologically valid resistance training, designed according to the guidelines of the WHO and ACSM, significantly improved the condition of generalized anxiety disorder (GAD) among young adults with GAD
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Caption: RT - Resistance Training; GAD - Generalized Anxiety Disorder; AGAD - Analogous Anxiety Disorder.

Source: Developed by the authors (2023).

3.2 LITERATURE REVIEW DIVIDED INTO SUBTOPICS

3.2.1 SAMPLE CHARACTERISTICS

As a result of the selection process, 109 subjects underwent 3 intervention models. Among the included studies, three used the same training protocol but varied the sample and research objectives (Gordon *et al.*, 2020b, 2020a, 2021). All five studies involved sedentary young individuals aged 18 to 35 years (Akyüz, 2017; Faro *et al.*, 2019; Gordon *et al.*, 2020a, 2020b, 2021). Regarding gender, one study included only men (Akyüz, 2017), another only women (Faro *et al.*, 2019), and three involved both genders (Gordon *et al.*, 2020a, 2020b, 2021).

3.2.2 INDICATORS FOR ANXIETY DISORDER

The indicators for anxiety disorder used in the selected studies were diverse. One study utilized the Social Physical Anxiety Scale (SPAS). Another chose questionnaires involving Feeling Scale (FS), State-Trait Anxiety Inventory (STAI), and Physical Activity



Enjoyment Scale (PACES) (Faro *et al.*, 2019). While three studies used the same protocol, involving sample screening, Psychiatric Diagnostic Screening Questionnaire (PDSQ-GAD), and Pennsylvania State Worry Questionnaire (PSWQ). For the assessment of training protocol moments, the State-Trait Anxiety Inventory subscale (STAI-Y2) and PSWQ were used (Gordon *et al.*, 2020a, 2021) with the addition of the Quick Inventory of Depressive Symptomatology (QIDS-SR16) due to depression symptoms being related to anxiety (Gordon *et al.*, 2020b).

3.2.3 RT PROTOCOLS

Most selected studies used an 8-week intervention period (Akyüz, 2017; Gordon *et al.*, 2020a, 2020b, 2021), except for one with a duration of 4 weeks to assess the acute effects of Resistance Training (RT) with functional training (Faro *et al.*, 2019). The weekly frequency varied in some studies, ranging from 1 session per week (Faro *et al.*, 2019), 2 days per week (Gordon *et al.*, 2020a, 2020b, 2021) to 3 days per week (Akyüz, 2017). Regarding exercise selection, all five studies used 8 whole-body exercises with moderate intensity (Akyüz, 2017; Faro *et al.*, 2019; Gordon *et al.*, 2020a, 2020b, 2021). Akyüz (2017) defined intensity as 40% to 60% of 1 RM, Faro *et al.* (2019) used 50% to 70% of 10 RM, and the others controlled intensity by a repetition range of 8 to 12 repetitions (Gordon *et al.*, 2020a, 2020b, 2021). For load control, studies used the 5 RM test (Gordon *et al.*, 2020a, 2020b, 2021), 10 RM (Akyüz, 2017; Faro *et al.*, 2019), and the Borg scale (Faro *et al.*, 2019; Gordon *et al.*, 2020a, 2020b, 2021). All protocols were performed to momentary muscle failure.

3.2.4 DOSE-RESPONSE EFFECT OF RT ON ANXIETY DISORDER

Responses to RT suggest improvement in mental and physical health with strength gains (Akyüz, 2017; Faro *et al.*, 2019; Gordon *et al.*, 2020a, 2020b, 2021). Emphasizing that functional training, when compared to RT, appears to generate greater effects on anxiety disorder (Faro *et al.*, 2019). Furthermore, anxiety improvement occurs immediately after RT, as there is a significant improvement in the first week of intervention (Gordon *et al.*, 2020a).



4. DISCUSSION

The aim of this literature review was to describe the effects of Resistance Training (RT) on anxiety disorders in young adults. Specifically, the study considered the characteristics of the RT protocol across different genders, experimental designs, and analytical models for anxiety indicators. Following the search strategy, five articles were deemed eligible for this study.

Regarding the findings, Akyüz's study (2017) suggests that 8 weeks of RT have a positive effect on strength and a significant difference in the Social Phobia Anxiety Scale (SPAS). Furthermore, dissatisfaction with physical appearance was observed to generate anxiety in individuals. The author emphasizes that the positive difference observed when comparing preliminary and final SPAS data can be considered along with the increase in strength and, consequently, physical appearance. In this sense, it can be suggested that these results are directly related to the practice of RT, as this training model can improve muscle strength (Lyristakis *et al.*, 2022), and its practice induces a combination of physiological and psychological changes in the individual capable of releasing endorphins that enhance well-being. These alterations are potential influences on anxiety reduction (Basso; Suzuki, 2017). Additionally, this exercise model induces changes in physical appearance, capable of improving self-esteem (Zamani Sani *et al.*, 2016) and self-image (Pop, 2016), thereby potentially reducing anxiety disorders related to insecurity about appearance (Hulme; Hirsch; Stopa, 2012).

On the other hand, the results of Faro *et al.*'s study (2019) suggest that Traditional Resistance Training (TRT) contributes to reductions in anxiety state and increases in affective responses immediately after and 15 minutes after an acute session. However, despite anxiolytic effects, the mechanisms mediating these effects are less clear (Teixeira-Neto *et al.*, 2014). Disorders related to anxiety disorders are associated with alterations in the function of the Hypothalamus-Pituitary-Adrenal (HPA) axis; thus, anxiety typically occurs concomitantly with unexpected or extended activation of the stress response along the HPA axis, resulting in hypervigilance, fear, and sympathetic dysregulation (Graeff; Zangrossi, 2010). Through cortisol activity modulation, RT can



affect anxiety at the level of the HPA axis (Stephens; Wand, 2012). However, further studies examining cortisol and anxiety responses simultaneously are needed for understanding the biological mediators of RT's anxiolytic effects (Teixeira-Neto *et al.*, 2014).

Regarding Gordon *et al.*'s studies (2020b, 2020a, 2021), it was found that ecologically valid RT based on guidelines significantly improved anxiety disorder symptoms among young adults. Additionally, a significant improvement in the analog generalized anxiety severity and clinically significant improvements in worry symptoms in the same population were observed. These findings may be related to the previously mentioned effects of RT on anxiety disorders. Importantly, these studies have **ecological validity, reinforcing** how generalizable the findings are to real-world scenarios or typical everyday life situations (Diehl; Wahl; Freund, 2017).

5. CONCLUSION

Based on the findings derived from this literature review on the proposed topic, it can be broadly inferred, aligning with the results from all the analyzed articles, that engaging in Physical Exercises through Resistance Training (RT) is an alternative therapy with highly significant and effective outcomes when employed with proper planning, implementation, and supervision by a Physical Education professional in the treatment of psychophysiological conditions in general.

Its notable beneficial/therapeutic influence, specifically in the treatment for reducing symptoms of Anxiety Disorders, was also corroborated. RT was proven to be a successful strategy for the immediate reduction of symptoms associated with this disorder, both shortly after the initiation of training and over the medium and long term.

Furthermore, based on the results obtained from the analysis of the researched scientific articles, it is essential to highlight specific points from each:

a) Protocols involving 8 weeks of Physical Exercise through RT had a positive effect on strength and showed a significant difference in improving the clinical conditions of Social Phobia Anxiety (SPAS).



- b) Acute sessions of functional training and traditional RT contributed to the reduction of Trait-State Anxiety (SAI) in pre, post-0, and post-15 minutes.
- c) Engaging in Physical Exercises through ecologically valid RT significantly improved anxiety symptoms among young adults with anxiety disorders and demonstrated significant improvements in their muscle strength.
- d) Investigating the effects of RT in individuals with emerging signs and symptoms of an anxiety disorder is particularly important, as evidenced by the results obtained through this type of physical exercise.
- e) Quantifying and qualifying the effects of ecologically valid RT on the state of anxiety disorders and symptoms of concern and anxiety among young adults with Analogous Anxiety Disorder (AGAD) are of utmost importance for science and human health.

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