Ejercicio físico y síntomas de depresión y ansiedad en estudiantes universitarios: una revisión sistemática con metaanálisis

Physical exercise and symptoms of depression and anxiety in college students: a systematic review with meta-analysis

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Abstract

Introduction: The prevalence of emotional health problems among university students has significantly increased. In this context, physical exercise has been considered a viable and beneficial intervention for preventing anxiety and depression in this population.
Objective: This study aimed to investigate the effects of exercise or physical activity on depression and/or anxiety in university students through a systematic review based on the PRISMA Statement guidelines.
Methodology: A systematic search was conducted in the PubMed, Scopus, Scielo, Lilacs, and PsycInfo databases until January 2021. The search strategy used was: "physical exercise" [or] "physical activity" [and] depression [or] anxiety [and] students [or] "university students".
Results: The selected studies, despite certain methodological limitations, showed positive effects of physical exercise in reducing symptoms of anxiety and depression among university students.
Discussion: The results were consistent with existing literature, indicating that physical exercise may be an effective complementary strategy for managing emotional disorders in young university populations. The relevance of considering the specific characteristics of this population for proper identification and treatment was also highlighted.
Conclusions: It is concluded that physical exercise is an accessible and potentially effective option to be implemented on university campuses. It can be used alone or in combination with psychotherapeutic and/or pharmacological interventions, depending on the identified need.

Keywords

Physical Exercise; Physical activity; Depression; Anxiety; Students; University students.

Resumen

Introducción: La prevalencia de problemas de salud emocional entre estudiantes universitarios ha aumentado significativamente. En este contexto, el ejercicio físico ha sido considerado una intervención viable y beneficiosa para la prevención de la ansiedad y la depresión en esta población.
Objetivo: Este estudio tuvo como objetivo investigar los efectos del ejercicio o la actividad física sobre la depresión y/o ansiedad en estudiantes universitarios, a partir de una revisión sistemática basada en las directrices de la Declaración PRISMA.
Metodología: Se realizó una búsqueda sistemática en las bases de datos PubMed, Scopus, Scielo, Lilacs y PsycInfo, hasta enero de 2021. Se utilizó la siguiente estrategia de búsqueda: "physical exercise" [or] "physical activity" [and] depression [or] anxiety [and] students [or] "university students".
Resultados: Se encontraron estudios que, a pesar de presentar limitaciones metodológicas, demostraron efectos positivos del ejercicio físico en la reducción de los síntomas de ansiedad y depresión en estudiantes universitarios.
Discusión: Los resultados fueron consistentes con la literatura, indicando que el ejercicio físico puede ser una estrategia complementaria eficaz para enfrentar los trastornos emocionales en jóvenes universitarios. Además, se destacó la importancia de considerar las particularidades de esta población en cuanto a la identificación y el tratamiento de estas condiciones.
Conclusiones: Se concluye que el ejercicio físico es una opción accesible y potencialmente eficaz para ser implementada en los campus universitarios, pudiendo utilizarse de forma aislada o en combinación con intervenciones psicoterapéuticas y/o farmacológicas, según la necesidad identificada.

Palabras clave

Exercício Físico; Atividade Física; Depressão; Ansiedade; Estudantes; Estudantes Universitários.

Introduction

University students are exposed to various stressful situations throughout the academic trajectory, and therefore, are considered a high-risk population for the prevalence and diagnosis of psychopathologies, such as anxiety and depression (Sladek & Doane, 2016; Rith-Najarian, Boustani & Chorpita, 2019). Commonly and culturally begins the academic life very young, going through experiences and significant changes such as housing, social interaction, distance from family, friends, and increased demand for inte-llectual activities that are requirements of the undergraduate courses themselves, responsibilities that an adult life, far from parental influence requires (Pedrelli, Nyer, Yeung, Zulauf & Wilens, 2014).

The mental health of Brazilian university students has become a reason for scientific deepening. It is also believed that this population has negative behaviors with regard to their own health (Padovani et al., 2014), from devaluation or neglect for psychoaffective symptoms (Huang et al., 2018), to drug consum-ption, inadequate diet, sedentary lifestyle (Mao et al., 2019), unhealthy behaviors, poor diets, loneliness, interpersonal problems and excessive alcohol consumption (Schofield et al., 2016).

Current studies indicate that the impoverished mental health of students, is portrayed in the literature commonly by the prevalence of symptoms of anxiety and depression, especially in health courses (Grasdalsmoen et al., 2020; Padovani et al., 2014). In addition, there is a real incidence of factors such as dissatisfaction with the quality of sleep and physical inactivity, especially, it is obtained that the anxiety levels of those who practice physical exercise regularly, symptoms when compared to sedentary individuals (Leão et al., 2018).

Thus, it is believed that the decline in physical activity practiced is significant at the time of entry and stay in college, since the levels of physical activity in the phases of transition from elementary school to high school, followed by higher education and entry into the labor market, have a significant decrease throughout life. In addition, sedentary lifestyle has a progressive trend of almost four times among individuals who perform the transition from high school to higher education (Larouche et al., 2012).

Given this scenario, it is observed that this population has been studied and that in addition, there is a growing initiative focused on mental health prevention programs. Review and meta-analysis research highlights that prevention and treatment programs for mental health problems, aimed at university students, are commonly offered through psychotherapies, based mostly on cognitive behavioral theory and psychoeducation (Barnett et al., 2021). Other types of interventions with the same purpose are mentioned in the literature in smaller proportions, such as relaxation programs, social skills training, mindfullness, meditation (El Morr et al., 2020), and others (Barnett et al., 2021; Rith-Najarian, Boustani, Chorpita, 2019).

However, even with treatment possibilities being often offered, a small minority of students receive adequate treatment, and the vast majority of young people follow without any intervention (Auerbach et al., 2016). The reasons raised for the low rate of treatment of mental health problems in university stu-dents include attitudinal barriers, lack of knowledge about the provision of mental health services, fear of stigmatization (Clement et al., 2015)feeling related to the ability to deal with problems on their own, low risk perception (Mojtabai et al., 2011), inability to identify pathological symptoms and the need for treatment for them (Erbert et al., 2018).

Although studies are found that prove the effectiveness of regular physical exercise (Eather et al., 2019; Faro et al., 2019; Herbert et al., 2020; Paolucci et al., 2018) or physical activities in general (López-Rodríguez et al., 2017; Papp et al., 2019) as significant elements in reducing levels of anxiety, depression, stress and mood swings, there is little use of this tool as a preventive practice or even treatment of these psychopathologies. Thus, there is an iniquity in the scientific literature on this subject, since there is signi-ficant and sufficient evidence on the relevance of physical exercise for mental health, systematic reviews or meta-analyses that reconcile this type of intervention to mental health problems in university students were not found.

It is also observed that there is little incentive for physical practice as a factor for improving psychological aspects in general among college students. Therefore, we sought to answer the following research question: Are exercises or physical activities effective in reducing symptoms of psychopathologies such as depression and/or anxiety in university students? And with this, can we encourage physical exercise as a categorical and effective intervention for the prevention of mental health problems within

universities?

Given this context and the gap in the literature on the subject presented focused on university students, as well as the importance of investigating this universe due to the exponential increase of young students in This research aims to investigate the effects of exercise or physical activity in depression and/ or anxiety in university students.

Method

This study was designed as a systematic review and followed the recommendations of the PRISMA Statement (Preferred Reporting Items for Systematic Review and Meta-analyses: The PRISMA Statement) by Moher et al., 2009.

Article Selection and Sample

The search was performed in the Pubmed, Scopus, Scielo, Lilacs, and PsycInfo databases until January 2021. As keywords and markers, the following search strategies were used: ("Depression"[MeSH] OR de-pression[Title/Abstract]) AND ("Anxiety"[MeSH] OR anxiety[Title/Abstract]) AND ("Exercise"[MeSH] OR "Physical Activity"[Title/Abstract]).

This review included randomized clinical trials, non-randomized clinical trials, and interventions with pre- and post-testing, which evaluated psychological variables of depression or anxiety and depression and anxiety, containing interventions of exercises, physical activities, or sports, consisting of college students, with full online access, available in Portuguese, Spanish, and English, and published in the years 2010 to 2020. The delimitation of the date is due to the proposal of this review to perform a current survey of scientific productions on the theme presented.

After the search in the databases and with the results found, the procedure of reading the title, abstract, and analysis of the selected studies was adopted with the objective of verifying whether they fit the scope of the research. The exclusion criteria were: articles that performed analyses with populations other than college students, studies that did not relate the variables in question, systematic literature reviews and/or meta-analyses, case studies, and studies that only analyzed physical exercise or only depression/anxiety in college students.

Categorization of Articles

The full reading and filing of the articles selected for analysis were carried out. The research points were the relationship between depression and anxiety and the practice of physical exercise or physical activity, the applicability of exercise programs or physical activities for this population, the results of these inter-ventions against the evaluations of symptoms/markers of depression and anxiety, before and after the intervention, type of activity, training or sport used in the intervention, results on significant changes in markers of mental health and well-being after the intervention, data collection that estimate the rela-tionship between physical exercise and symptoms of depression and anxiety in undergraduates.

Concordance Analysis

The results of the systematic review were submitted to an analysis of agreement between two independent judges (IMR and RZB). The initial agreement percentage obtained was 98%. Then, the principal investigator provided the necessary feedback on the design of the selected studies, objectives, and inclusion criteria, obtaining a final agreement of 100%.

Evaluation of Study Quality

For the evaluation of the methodological quality of the studies (Figure 2), we used the revised Cochrane Risk-of-bias tool for Randomized Trials - RoB2 (Sterne et al., 2019), which evaluates the following domains of risk of bias: 1) selection bias (randomization), 2) bias of bias of intervention (blinding), 3) bias of missing data, 4) bias of measurement of results, 5) bias of selective reporting of results.

Statistical Analysis

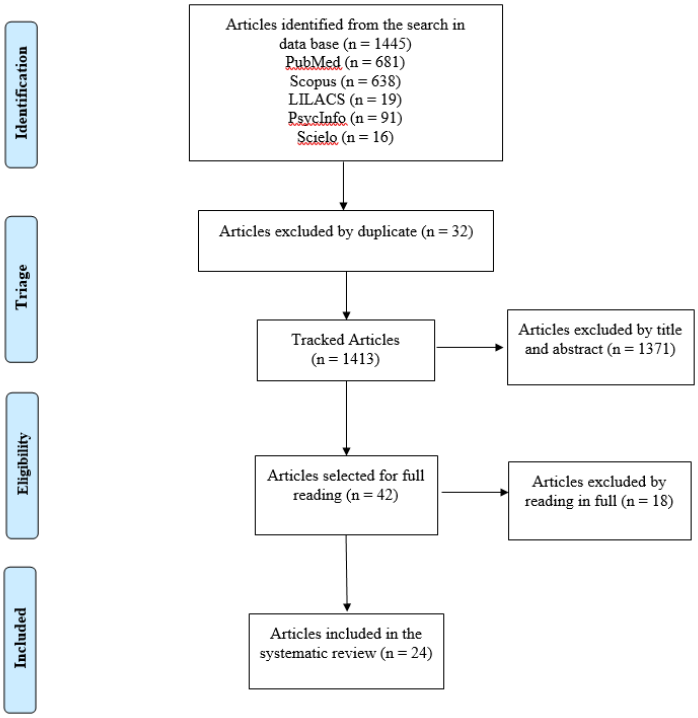
Initially the descriptive data in mean and standard deviation were standardized. Then, the variation of means (post - pre) and their respective standard deviation were calculated. The comparisons were made

through the standardized mean differences, due to the low repetition of the psychological instruments. Heterogeneity was analyzed by means of the Tau^2, Q, and I^2 tests, using the restricted maximum likelihood estimator. We chose random or fixed effect models according to the presence or absence of heterogeneity, respectively. In each model, we analyzed the standardized residuals in order to find discrepant studies (i.e., outliers). We adopted 5% as the level of statistical significance in all analyses.

Results

Electronic searches of the databases identified 1445 articles. After analysis, 32 were excluded for duplica-tes and 1371 after reading the titles and abstracts. Of the 42 articles selected for full analysis, 18 were ex-cluded for not meeting the criteria of pre-established inclusion. In the end, 24 studies were included in the systematic review. The selection process is detailed in the Flowchart (Figure 1).

Figure 1. Flowchart of the selection process of the scientific studies



Study Characteristics

The articles included in the search are mostly productions from the years 2019 and 2020, with the years 2010 to 2012 being the least number of productions found. Between 2014 and 2015 no manuscripts were found that met the inclusion criteria of the research. Although these gaps in study publication are relevant, the results show that in general, there was a positive acceleration in relation to the quantity of articles published in the search period, with greater emphasis on the period from 2016 to 2020. Based on the 24 studies included (2465 participants), Table 1 presents the references of the studies adopted in the research in chronological order, country of origin, evaluative and methodological characteristics, and information about the intervention used.

Table 1. Characteristics of the studies included in the systematic review

Author(s)	Year	Country	Design	N	Gender (%)	Evaluative Measures	Intervention/ Duration
Mailey et al	2010	EUA	ECR	47	68,1% F 31,9% M	STAI, BDI	Online - report of the participants
Akendere & Demir	2011	Turquia	ECR	160	50% F 50% M	BDI	Dance, 3 times a week for 12 weeks
Khorvash et al	2012	Irã	ECR	120	100% M	BDI, KAQ, Amostra sanguínea	Strength and aerobic exercises, 2 sessions per week, for 10 weeks
Shirifard et al	2012	Irã	ECNR	51	56,9% F 43,1 M	STAI	Weight training and volleyball, 3 times a week for 8 weeks
Hatami, Shokrollahi & Haidari	2013	Irã	Intervenção com pré e pós teste	50	100% F	28-GHQ	Fitness exercises, 3 times a week, one hour per session, for 4 weeks
Kim, Yang & Schroeppel	2013	EUA	ECR	30	NE	BDI, STAI, GSE	Kouk Sun Do ,3 times a week for 4 weeks
Aras & Ewert	2016	Turquia	ECNR	19	NE	CSAI-2, Teste físico	Climbing, 90 minutes per session for 8 weeks
Falsafi	2016	EUA	ECR	67	86,4% F 13,6 M	BDI, HAS, SSI, SCS	Mindfulness and yoga, 75 minutes a week for 8 weeks
Yazici et al	2016	Turquia	Intervenção com pré e pós teste	76	57,8% F 42,2% M	SCL-90-R, BAI, BDI	Tennis, 90 minutes per session, once a week, for 13 weeks
Alsaraireh & Aloush	2017	Jordânia	Intervenção com pré e pós teste	181	NE	CESD-R	Combination of aerobic, strength and meditation exercises, 3 times a week for 10 weeks
López-Rodríguez et al	2017	Espanha	ECR	121	74,7 % F 25,3% M	PSQI, CES-D	Biodanza, 4 sessions of 90 minutes
Sadeghi et al	2017	Irã	ECR	85	43,6% F 56,4% M	BDI, The Automatic Thoughts Questionnaire, DAS.	Aerobic exercises, 3 times a week, 60 minutes each session, 8 sessions
Albracht-Schulte & Robert-McComb	2018	EUA	Intervenção com pré e pós teste	56	100% F	BDI, STAI-Y2	YogaFit standardized and choreographed, and keep quiet and resting, a 30-minute session
Paolucci et al	2018	Canadá	ECR	55	71% F 29% M	BAI, BDI, Teste físico	Stationary cycle ergometer, moderate to tin intensity, 3 times a week for 6 weeks
Eather et al	2019	Austrália	ECR	53	66% F 34% M	STAI, PSS, Testes físicos	Combinations of aerobic and endurance exercises, 3 times a week for 8 weeks, increasing progressively with each session
Faro et al	2019	EUA	Intervenção com pré e pós-teste	34	100% F	STAI, PACES	Traditional resistance training and functional training for 4 weeks
Mulcahy et al	2019	EUA	ECR	63	93,6% F 6,4% M	STICSA, GSES	Tai-chi, a single 30-minute session
Papp et al	2019	Suécia	ECR	54	NE	HADS, PSS, PSQI, ISI	High-intensity yoga, once a week, 1 hour each session, for 6 weeks
Herbert et al	2020	Alemanha	ECR	185	52,4% F 41,6% M	STAI, BDI, PANAS, SCI	Aerobic exercises, 2 times a week, for 6 weeks
Ojeda et al	2020	Chile	Intervenção com pré e pós teste	30	100% F	STAI e Testes Físicos	Zumba, 2 times a week, 60 minutes each session, for 10 weeks
Muir et al	2020	Canadá	Intervenção com pré e pós teste	49	65,3% F 32,7% M	PAR-Q, MHI-38	Light aerobic exercises, supervised strength and flexibility exercises, 45 minutes per session, for 18 sessions, and exercise counseling for 30 minutes
Yunus, Tan & Romli	2020	Malásia	ECR	36	86,1% F 13,9% M	IPAQ, FOSQ, DASS-21.	Video games with motion sensor, 3 times a week, 30 minutes for 6 weeks
Zhang & Luo	2020	China	ECNR	780	NE	SCL 90	Water sports, 3 times a week, 50 minutes each session, for 8 weeks
Zuo & Yue	2020	China	Intervenção com pré e pós teste	63	49,3% F 50,7% M	SCL 90, SDS	Basketball, badminton, yoga, weight training and rugby for 5, 8, 11 and 14 weeks

Notes: DASS-2: Depression, Anxiety, and Stress Scale, FOSQ: Functional Outcome Sleep Questionnaire, IPAQ: International Physical Activity Questionnaire, KAQ: Kettle Anxiety Questionnaire, MHI-38: Mental Health Inventory-38, PAR-Q: Physical Activity Readiness Questionnaire, STAI: State-Trait Anxiety Inventory, PANAS: Positive and Negative Affect Schedule, BDI: Beck Depression Inventory, BAI: Beck Anxiety Inventory, SCI: Stress and Coping Inventory, STICSA: State-Trait Inventory for Cognitive and Somatic Anxiety, GSES: General Self-Efficacy Scale, PSS: Perceived Stress Scale, HADS: Hospital Anxiety and Depression Scale, PSQI: Pittsburgh Sleep Quality Index, ISI: Insomnia Severity Index, PACES: Physical Activity Enjoyment Scale, FS: Feeling Scale, SSI: Student-Life Stress Inventory, SCS: Self-compassion Scale, STAI-Y2: Spielberger's State-Trait Anxiety Inventory, CES-D: Center for Epidemiologic Studies Depression Scale, DAS: Dysfunctional Attitude Scale, CSAI-2: Competitive Sport Anxiety Inventory-2, HAS: Hamilton Anxiety Scale, GHQ: General Health Questionnaire, SCL-90: Symptom Checklist 90, SDS: Self Rating Depression Scale, ECR: Ensaio clínico randomizado, ECNR: Ensaio clínico não randomizado, F: Feminino, M: Masculino, NE: não especificado, Zumba: mistura de passos de ginástica aeróbica e danças Latinas, Biodanza: música, canto, movimentos, e interações de grupo.

Objectives and Results

The objectives and main results of the studies included in the review are described in Table 2. The results of the included studies were analyzed, corroborating with the objectives of the present study. Therefore, results that relate variables of exercise and/or physical activity and the participants' mental health conditions are praised. The studies that made proposals with other variables are not presented directly in Table 2.

Of the 24 studies included in the systematic review, only three did not find significant results of improvement for psychological variables after the interventions used (Eather et al., 2019, Papp et al., 2019, Ojeda et al., 2020), above all, the results did not indicate signs of negative impact for anxiety and/or depression with the practice of the proposed interventions. No pattern was found among the modalities of the studies to claim greater mental health benefit. Above all, for the most part, the included studies explored aerobic exercise (Hatami, Shokrollahi & Haidari, 2013; Sadeghi et al., 2017, Paolucci et al., 2018; Herbert et al., 2020; Muir et al, 2020), combinations of aerobic exercise with resistance exercise (Khorvash et al., 2021, Alsaraireh & Aloush, 2017; Eather et al., 2019), and various sports (Yazici et al., 2016; Yunus, Tan & Romli, 2020; Zhang & Luo, 2020; Zuo & Yue, 2020).

Other dance modalities (Akendere & Demir, 2011; López-Rodríguez et al., 2017; Ojeda et al., 2020) are also mentioned to a lesser extent, as well as variations of lower intensity exercises such as yoga (Falsafi, 2016; Albracht-Schulte & Robert-McComb, 2018; Papp et al., 2019) and tai-chi (Kim, Yang & schroeppel, 2013; Mulcahy et al., 2019) also demonstrate positive and significant responses.

Table 2. Objectives and results of the studies included in the systematic review

Study	Objetives	Results
Mailey et al., 2010	To examine the feasibility of an online physical activity intervention, and to understand whether physical activity and self-efficacy can be associated with changes in anxiety and depression.	Anxiety decreased nonsignificantly in the EG, and increased in the CG. In addition, there was a non-significant decrease in depression in both EG and CG.
Akendere & Demir, 2011	Examine the effects of dance on depression..	Depression levels decreased significantly after intervention for the EG. There were no significant changes in depression for the CG.
Khorvash et al., 2012	Investigate the effects of strength and endurance training on levels of depression, anxiety, and inflammatory markers of C-reactive protein.	Reduction of anxiety in 27% and 37% for depression in EG after the intervention.
Shirifard et al., 2012	Check whether group or individual training has an impact to reduce anxiety	Reduction of anxiety state after the intervention, especially group exercise was more effective than individual exercise in reducing levels of anxiety state.
Hatami, Shokrollahi & Haidari, 2013	Research the effects of regular physical activity on poor sleep, anxiety and depression in college students	There were statistically significant differences in depressive and anxiety symptoms in EG after the intervention, while the CG did not show changes.
Kim, Yang & Schroeppel, 2013	To examine the effects of Kouk Sun Do on the mental health of university students with anxiety symptoms.	There was a statistically significant difference in the symptoms of trait anxiety and depression between EG and CG, in the period of 4 weeks of intervention.
Aras & Ewert, 2016	To examine the effect of 8 weeks of climbing training on anxiety, and to understand whether this practice can be suggested as a type of physical activity to control anxiety levels in sedentary and relatively	Significant changes were found before and after the intervention in EG, indicating decreased levels of anxiety. In addition, after the intervention, the EG showed a significant increase in VO2max. No change was observed in the pre and

	healthy adults.	post GC test.
Falsafi, 2016	To compare the effectiveness of two types of interventional practices, mindfulness including self-compassion yoga, to deal with depression and anxiety in college students.	Compared to the CG, the symptoms of anxiety, depression and stress decreased significantly from the pre-intervention and follow-up evaluations in both intervention groups (yoga and mindfulness).
Yazici et al., 2016	To investigate whether tennis practice has beneficial effects on depression, anxiety and psychological in general, in a non-clinical population of young people.	There was a significant decrease in anxiety and depression scores after the intervention. All other general psychological factors decreased, especially phobia, paranoid thoughts, insomnia and anorexia, were significantly lower after the intervention.
Alsaraireh & Aloush, 2017	To evaluate the levels of depression in nursing students and to compare the effectiveness between mindfulness meditation and physical exercise in the management of depression in this population.	Both groups showed a significant decrease in depression scores in the post-test evaluation. However, meditation participants showed significantly higher relief in their depression score than the exercise group.
López-Rodrigués et al., 2017	Examine the one-month effects of a Biodanza program on stress, depression and sleep quality during the academic period, with college students and purchase the changes observed with the control group.	After the intervention there was a significant difference between EG and CG in the variables stress and depression. The EG also showed significant differences between pre and post test for depression, stress and sleep quality.
Sadeghi et al., 2017	Determine the effectiveness of group aerobic exercises in depression, automatic thoughts and dysfunctional assumptions, and finally test cognitive changes during aerobic exercise in depression.	There was a significant difference in depression scores for post-test evaluation between CG and SG.
Albracht-Schulte & Robert-McComb, 2018	To examine the effect of an acute YogaFit intervention versus an acute sitting rest intervention for anxiety-related anxiety state and physiology, i.e., heart rate and heart rate variability.	Anxiety state decreased significantly from onset to post-condition for yoga and rest, but returned to baseline values after exposure to emotional stimuli in both experimental conditions.
Paolucci et al., 2018	Examine the effect of six weeks of physical exercise on mental health and pro-inflammatory cytokines at a university where students who are known to have a higher risk of developing depression than the general population.	Depression decreased after TCMI and TIAI in relation to CG. Above all, there was no significant difference in the comparison of types of intervention. Anxiety and perceived stress were lower in GETCMI than in CG. GETIAI despite having decreased depression, perceived stress increased in relation to GETCMI.
Eather et al., 2019	To evaluate the preliminary efficacy and applicability of an 8-week High Intensity Interval Training program for young adult students in a university setting.	No significant differences were found in psychological measures of anxiety or perceived stress in both groups (EG and CG), in pre and post-test measures. There were significant improvements in measures of muscle fitness (flexion) and maximum oxygen consumption test.
Faro et al., 2019	To compare acute episodes of functional training versus a traditional resistance session, with moderate intensity in pre- and post-result measures of affect, state of anxiety and pleasure at university age, with new women in resistance training.	Anxiety state decreased significantly from pre to post test and from pre to post test 15 minutes after, in both types of training. Comparisons between conditions revealed that decreases in anxiety from pre- to post-15 in the functional training condition were significantly higher than the traditional training condition.
Mulcahy et al., 2019	Examine Tai-Chi as a method of reducing anxiety and increasing self-efficacy and improving performance among Bachelor of Nursing students experiencing a simulation of patient care.	The EG presented a significant reduction in somatic anxiety than the CG in the post-test. The self-efficacy variable was significantly higher for EG in the post-test than in the CG. Above all, there were no differences in performance between groups in the post-test.
Papp et al., 2019	Investigate the 6-week effects of a High Intensity Yoga program on symptoms of depression, anxiety, sleep, stress, complaints and self-rated health.	There were no differences between the groups in anxiety, depression, stress, sleep or self-rated health. However, when investigating associations within EG, the intervention was associated with lower depression scores, improved sleep quality, and less insomnia.
Herbert et al., 2020	Examine mental health, well-being and regular physical activity in college students and explore the potential benefits of a short aerobic exercise program for college students, in an online model applied and a model applied in the laboratory.	There was a relationship between regular physical activity, cardiovascular fitness, mental health and well-being in university students. Results showed a significant decrease in depressive symptoms between pre and post-test and between experimental groups. For GE online, 73.68% showed improvements in depressive symptoms after the intervention. Perceived stress also decreased significantly after exercise intervention.
Ojeda et al., 2020	To determine the effects of a physical exercise program based on Zumba on the levels of trait and state anxiety, anthropometric variables, grip strength and VO2max in Chilean university students.	No significant changes were found in the variables analyzed for any of the groups between the pre and post-test.
Muir et al., 2020	Examine the impact of the "UWorkItOut Uwin"	Significant reduction in anxiety and depression scores in the

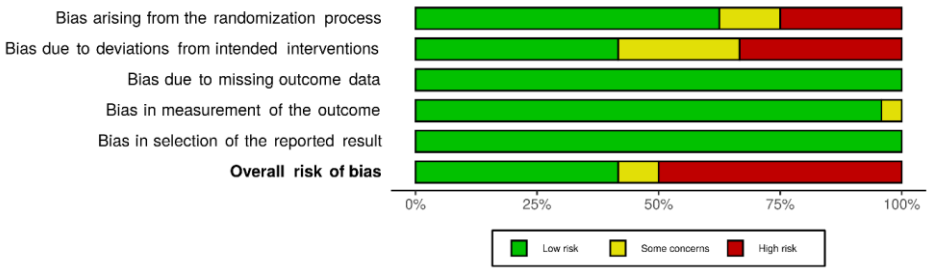
	program on the psychological distress of university students.	statistical analysis from pre to post-intervention. Small effect size for the depression variable (d = .36).
Yunus, Tan & Romli, 2020	Investigate the feasibility and potential efficiency of using video game Xbox 360 Kinnect no cuidado da saúde de estudantes universitários.	There was potential improvement in sleep and mental health variables between EG and CG before and after the intervention. Statistically significant reductions were found after the intervention in EG for the variables anxiety, stress and functional evaluation of sleep.
Zhang & Luo, 2020	Analyze the differences in mental health of university students from different areas and discuss the feasibility of applying water sports as therapy to improve the mental health of these students.	Water sports have helped significantly improve the mental health of college students, allowing them to overcome difficulties and reduce negative emotions such as depression and anxiety, as well as improve fitness and helpdevelop good physical exercise habits.
Zuo & Yue, 2020	Publicize the promotional effects of exercise on depression in college students.	Physical exercise had a positive impact on the mental health of university students in all sports offered, especially in improving depression.

Note: CG: Control Group, EG: Experimental Group, VO2max: Maximal Oxygen Volume, GETIAI: High Intensity Interval Training Experimental Group, GETCIM: Continuous Moderate Intensity Training Experimental Group, TCIM: Continuous Moderate Intensity Training, TIAI: High Intensity Interval Training.

Evaluation of Study Quality

The quality of the studies included in the review is detailed in Figure 2 and 3, which show the risk-of-bias trend for each domain analyzed, as well as the specified risk percentages for each domain, using the RoB 2 tool (risk-of-bias tool for randomized trials). It can be seen that 10 studies have low risk of bias, two were classified as "some concerns" regarding the analyzed domains of bias, and 12 had high risk of bias.

Figure 2. Percentage of total bias risk in each domain analyzed by RoB 2



Although most studies were rated as having a low risk of bias, there are methodological concerns in some aspects, especially regarding intervention bias and outcome selection. This suggests the need to interpret the findings with caution, considering these methodological limitations.

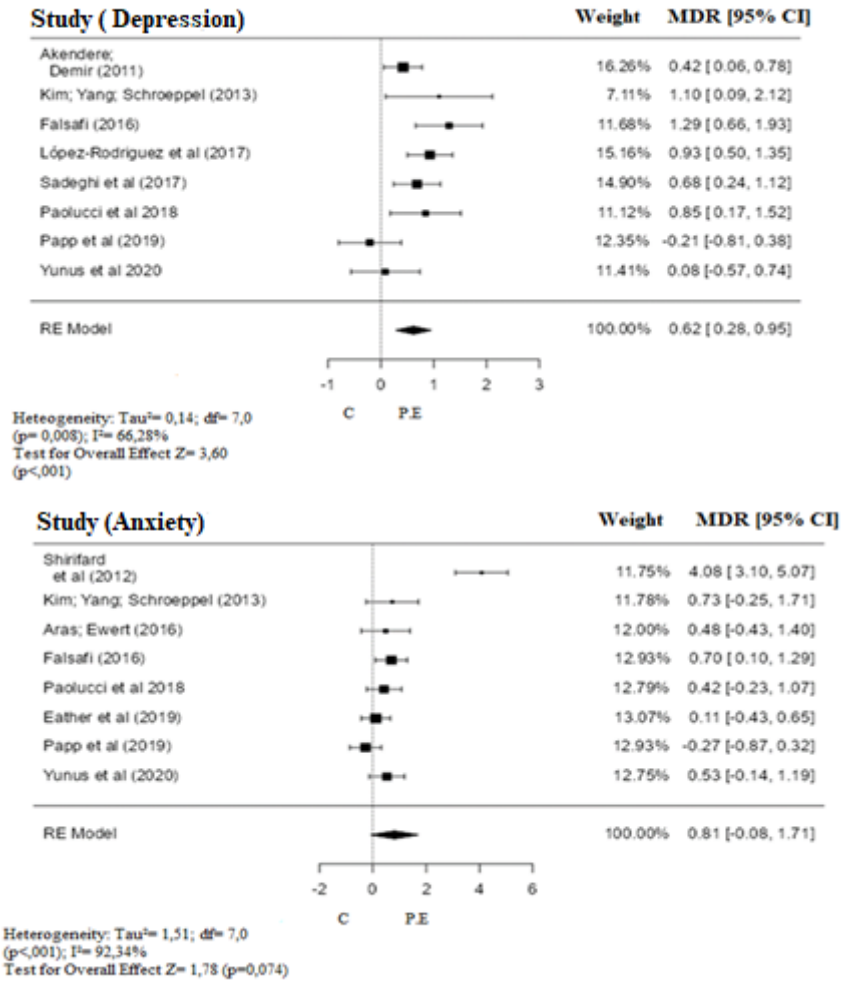
The studies by Aras and Ewert (2016), Yazici et al. (2016), Alsaraireh & Aloush (2017), Huerta et al. (2020), Muir et al. (2020), Zhang & Luo (2020) and Zuo & Yue (2020) present a high risk of bias in multiple domains, including randomization and deviations in the intervention. This compromises the reliability of the results of these studies. Studies such as Mailey et al. (2010), Khorvash et al. (2012), Shirifard et al. (2012), Paolucci et al. (2018), Eather et al. (2019), Mulcahy et al. (2019), Papp et al. (2019) and Herbert et al. (2020) present a low risk of bias in almost all domains, indicating greater methodological robustness. The tool helps to understand that, although there are studies with a high risk of bias, the majority present good methodological quality. However, aspects related to randomization and deviations in interventions must be taken into account when interpreting the results of the review.

Figure 3. Evaluation of the methodological quality of the studies included in the review

Metanalysis

A total of 11 studies eligible for statistical calculation were included. Studies with a cross-sectional design or with missing data, due to the impossibility of inclusion in the statistical model, were excluded. Figure 4 presents the fixed models with different types of exercise interventions for the two variables studied, depression and anxiety. In the model analysis for the depression variable, a total of 8 studies were included in the analysis, and 8 studies were included in the model regarding the anxiety variable.

Figure 4. *Forest Plot of the comparison of exercise interventions for depression and anxiety in college students*



Abbreviations: CI: Confidence Interval, MDR: Mean Difference Raw, RE: Random Effect, C: Control, P.E: Physical Exercise.

In the depression model, based on 8 studies (481 participants), the mean standardized differences in the individual studies ranged from -0.2119 to 1.2933, with most estimates being positive (88%). There was heterogeneity (Q(7) = 19.010, p=0.008, tau^2 = 0.1474, I^2 = 66.28%) and the residuals (< 2.73) revealed that there were no outliers in the model. Although none of the studies can be considered overly influential, there was a reduction in depression levels after the proposed intervention with distinct physical practices.

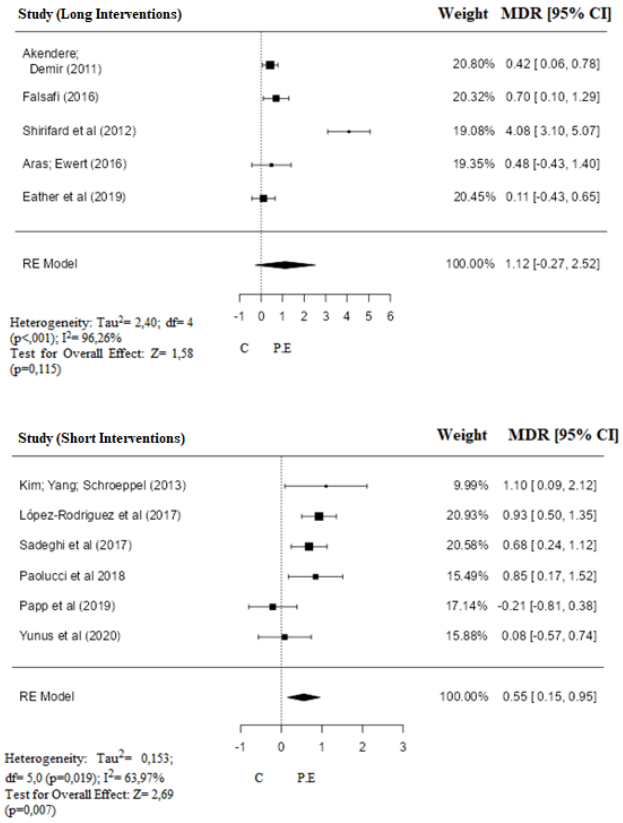
In the anxiety model, a total of 08 studies (303 participants) standardized mean differences ranging from -0.2747 to 4.0820 were found, with the majority also being positive (88%). The mean score differed significantly from zero (z = 4.4105, p<0.0001), and according to the Q-test, the true results appear to be heterogeneous (Q(7) = 59.7313, p < 0.0001, I^2 = 88.2809%). Given the residual analysis, it was observed that the studies by Shirifard et al (2012) and Papp et al (2019) had values greater than ± 2.7344 and therefore may be potential outliers in the context of this model.

In this case, considering the statistical model excluding the outliers (n=6), the heterogeneity became non-significant (Q(5) =2.5696, p = 0.7660, I^2 =0.0000%), with observed standardized mean differences ranging from 0.1094 to 0.7287, with most estimates being positive (100%).

A new stratification was performed to compare the influence of the intervention duration. Thus, in

Figure 5 it is possible to observe a statistical model for studies that had short duration (from 4 to 6 weeks), and a statistical model for studies that had prolonged duration (from 8 to 12 weeks). The results show that n=5 studies contemplate interventions of 8 or more weeks, the average standardized differences observed ranged from 0.1094 to 4.0820, most of the positive estimates (100%), the average outcome did not differ significantly from zero (z =1.58, p =0.115). According to the Q test, the results demonstrate heterogeneity (Q(4) = 52.0468, p < 0.0001, tau^2 = 2.4077, I^2 = 96.2596%). A 95% prediction range for the results is given between -2.2233 and 4.4700. Thus, although the average result is estimated as positive, in some studies the actual result may indeed be negative. The study by Shirifard et al (2012) had a value greater than 2.5758 and may be a potential outlier in the context of this model.

Figure 1. Comparative Forest Plot of Stratification Between Interventions with Longer Duration (8 to 12 Weeks) and Interventions with Shorter Duration (4 to 6 Weeks) for Both Variables (Depression and Anxiety)



Abbreviations: CI: Confidence Interval, MDR: Mean Difference Raw, RE: Random Effect, C: Control, P.E: Physical Exercise.

For the model of interventions with short duration, a total of k=6 studies were included in the analysis. The observed standardized mean differences ranged from -0.2119 to 1.1030, with most estimates being positive (83%). According to the Q test, the results seem to be heterogeneous (Q(5) = 13.4713, p = 0.0193, tau^2 = 0.1539, I^2 = 63.9718%). A forecast range of 95% for the true results is given by -0.3150 to 1.4206. None of the studies had a value higher than ±2.6383 and, therefore, there was no indication of outliers in the context of this model.

Discussion

This study aimed to investigate the effects of exercise or physical activity on symptoms of depression or anxiety in university students, through a systematic review of the literature with meta-analysis. In general, it is possible to identify positive results of the training performed by the studies included in the research.

Although there is still no pattern of type or duration of practice for depression, the results presented here are promising as a non-pharmacological alternative, corroborating with other meta-analysis studies (Kvam et al., 2016; Schuch et al., 2016). In this sense, Schuch et al (2016) sought to establish what effects exercise has on depression, comparing exercises with passive control groups. The results showed a relevant effect of exercise on depression when compared to control conditions, being even more significant in studies that included participants who had a diagnosis of major depression, assuming a certain exercise may exert antidepressant potential in these cases.

It was observed that interventions of exercise, sports or dance compared to no intervention resulted in positive effects for the experimental condition. On the other hand, exercise compared with psychotherapeutic treatment brings small and non-significant effects, as well as when compared to pharmacological treatment in patients with severe pathology. In particular, exercise interventions combined with pharmacological treatment have moderate and non-significant effects in relation to drug treatment in a singular way (Kvam et al., 2016).

Considering the results of the present review, it can be noticed that physical exercise can be considered favorable for the treatment of depression in young students, especially in conditions of little or no treatment. This beneficial relationship can be enhanced since a large part of college students do not receive adequate treatment for the pathology, or do not seek treatment, even when the availability of physical education services is limited of psychotherapy on college campuses is present (Auerbach et al., 2016; Erbert et al., 2018).

The meta-analysis revealed that 88% of the studies reviewed show favorable results for exercise. Furthermore, the studies included in this research also point to significant results for exercise interventions that are geared towards aiding in the treatment of anxiety (Mailey et al., 2010; Shirifard et al., 2012; Aras & Ewert, 2016; Albracht-Schulte & Robert-McComb, 2018; Faro et al., 2019; Mulcahy et al., 2019; Yunus, Tan & Romli, 2020). Although the evidence found in the literature is more robust for research and surveys focused on depression, the decrease of anxious symptoms through physical training has also been evidenced in other systematized research (Stonerock et al., 2015; Frederiksen et al., 2021). However, the results of the meta-analysis show that it cannot be claimed that the intervention practices of the included studies are fully effective in treating anxiety (Figure 4).

Although the type of intervention for greater benefits is unclear, other studies reveal that aerobic exercise or combinations of aerobic exercise with resistance training, are used in anxious subjects and point to improvement, decreasing anxiety symptoms, compared to the passive group or usual care treatments (Stonerock et al., 2015).

The second model of the meta-analysis points out that interventions of short duration (four to six weeks) may have more efficacy on symptoms of depression or anxiety when compared to the longer intervention model (eight or more weeks). The total duration that an exercise program should have in order to obtain the expected results against psychopathologies such as depression and anxiety is still unclear in the literature. Some studies point out that regarding the frequency of exercises, it can vary from one to three times a week, and the duration can be from four to sixteen weeks (Rocha et al., 2019; Minghetti et al., 2018; Kerling et al., 2018, Olson, Brush, Ehmann & Alderman, 2018; Haller et al., 2018) which highlights a methodological gap under this specificity of training.

Given the results of this study, we believe in the importance of keeping a person with symptoms of depression or anxiety active, beyond the specifics of the training program and type of activity performed. Therefore, it becomes an important point that the choice of modality and its frequency should be related to the motivational factors of the individual or sample in question, because it is known that the person with depression shows varying degrees of anxiety and demotivation, it is important that these exercise plans are performed by qualified health professionals, with monitoring and maintenance of the exercise plan. Thus, there should be a personalized programming and whenever necessary an adjustment in the exercise plan to thus obtain better results (Rocha et al., 2019).

Although it was not part of the analysis and scope of this research, it should be noted that the combination of physical exercise and psychotherapy is positively evidenced in the literature (Bourbeau et al., 2020; Frederiksen et al., 2021). This combination may be more effective in improving symptoms of depression and anxiety, regardless of the type of exercise used, its intensity and degree of diagnosis of psychopathologies, when compared to psychotherapeutic interventions alone (Bourbeau et al., 2020).

Studies point out that the benefits of psychotherapy with a focus on psychological construction and proposed behavior change, added to the physiological changes caused by physical exercise as emotion regulation, neurologically identified in the hippocampus, anterior cingulate cortex and prefrontal cortex, are potentially better and greater than both types of interventions delivered alone (Erickson et al., 2011; Lemmens et al., 2016; Liu et al., 2017).

Although studies of high methodological quality are evidenced (Mailey et al., 2010; Kim, Yang & Schroeppel, 2013; Falsafi, 2016; López-Rodrigués et al., 2017; Paolucci et al., 2018; Eather et al., 2019; Mulcahy et al., 2019; Papp et al., 2019; Herbert et al., 2020; Yunus, Tan & Romli, 2020), limitations were found in this research that need to be acknowledged. A literature search was performed with a broad search strategy, as well as the systematization of the search according to the Prisma protocol, in order to find and include all manuscripts that met the inclusion criteria for analysis, but it is aware that relevant studies may not have been included, even with the methodological care described here.

In general, the research limitation is established by the heterogeneity of the studies, both in their sample size and in the interventions used and their duration. Furthermore, the inclusion criteria for the participants of the present studies, in their majority, did not count on previous and precise diagnoses of depression and/or anxiety. However, they present measurement parameters made by validated scales that show an estimate (and not a diagnosis) of the intensity level of each psychopathology, which can make it difficult to analyze the results and confirm the benefits that the proposed interventions can result in as a treatment. The small number of people in the sample was also a limitation presented by some of the authors. As well as the difficulty of monitoring people in the execution and compliance with the interventions proposed by the study, evidenced by the exclusion of some studies present only in the review.

Another point worth mentioning is the data on the use of antidepressant or anxiolytic drugs that was hidden from the previous analysis in most studies, or even inserted as an exclusion criterion in most studies. The lack of this data, although not the objective of the research, may make it difficult to understand the action of physical exercise in conjunction or not with the possible pharmacological action.

And finally, it is worth noting that the evaluative measures for psychological variables are mostly validated and extensively tested psychometric scales, most notably, only Aras and Ewert (2016), Paolucci et al (2018), Eather et al (2019), and Ojeda et al (2020) performed physical tests of maximal oxygen consumption as an evaluative parameter to understand changes in physical conditioning in post-test analyses. Thus, the results presenting improvement in strength and/or physical conditioning associated with improved mental health may be contestable, as it is unclear whether exercise had an influence on the health and physical performance of the participants due to the lack of evaluative measures for this variable.

No studies produced in Brazil were found to compose the sample of this review, nor were there other reviews supporting the same objectives in international publications. Although this data points to a scarcity of scientific productions on this topic and for the same target audience, the results observed in this review are believed to hold potential, as they encompass solid data that can contribute to the expansion of scientific literature.

Conclusions

Although limitations were found in the research, we sought to summarize and analyze studies on the effects of physical exercise on anxiety and/or depression in young university students. Given the results, we conclude that physical exercise may be an important element to be considered in the treatment and prevention of psychopathologies. It is believed that, even with the limitations of the research, the interventions appear to be effective in the treatment of mild to moderate symptoms, especially in the reality and routine of young university students, who have peculiar characteristics and inaccuracies in the identification and appropriate treatment. In addition, it may be an accessible option for implementation on university campuses, through the encouragement of team sports or even the initiation of activities such as functional training, yoga, dance, and others. In addition, these practices can also be combined with psychotherapeutic or even pharmacological interventions in cases identified

as necessary.

In view of the results of this research, it is considered that people with depression or anxiety should remain physically active regardless of the type, frequency, or intensity of the physical exercise practiced. Furthermore, the motivation and preference for physical activity practiced by the person presenting symptoms should be taken into consideration, rather than a structured and supervised plan, thus obtaining better results. Finally, the objective of treating depression should not be limited to the remission of depressive symptoms, as occurs only with pharmacological treatment, but should emphasize functional recovery, socialization and improvement of the person's physical health related to self-image, self-esteem and daily motivation.

In this context, it is essential to continue research in this field of knowledge, since physical exercise is a promising strategy that should be included as a treatment option for people with depression or anxiety. Future research should be conducted with greater methodological quality, through studies with randomized samples, systematic, planned and well-described intervention strategies, in controlled environments, expanding and strengthening the scientific evidence in this area of research, especially in view of the gaps presented in the literature to date, thus providing improvements in the physical and mental health and quality of life of young university students through physical exercise.

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