








Impact of physical activity on anxiety levels during the COVID-19 pandemic: an integrative review

Impacto da atividade física sobre os níveis de ansiedade durante a pandemia de COVID-19: uma revisão integrativa

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ABSTRACT

Introduction: The pandemic caused by the new Coronavirus (COVID-19) has become one of the great torments of the 21st century. Social distancing was adopted as a measure to prevent the spread of the virus. Although necessary, this confinement can trigger emotional disorders. Physical activity has positive effects on physical well-being and mental health, including the possibility of reducing psychological suffering. **Objective:** To describe the impact of physical activity on anxiety levels during social isolation due to COVID-19, among young people and adults. **Methods:** An integrative review was performed following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) recommendations. Searches were performed between May and July 2021 in the APA PsycINFO, Medline (via PubMed), and Lilacs (via VHL) electronic databases. **Results:** Of the 95 scientific articles found, 12 were considered eligible. The analyzed studies showed that, during confinement, women became less physically active, while men performed more physical activities and had lower levels of anxiety. Additionally, the higher the scores for physical activity, the lower the anxiety symptoms. **Conclusion:** Individuals who remained physically active or increased the amount of daily physical activities with moderate and/or vigorous intensities had lower levels of psychological disorders during the social distancing imposed by COVID-19.

Keywords: psychological well-being; lockdown; coronavirus; physical exercise; mental health.

RESUMO

Introdução: A pandemia causada pelo novo Coronavírus (COVID-19) se tornou um dos grandes tormentos do século XXI. O distanciamento social foi adotado como medida para evitar o avanço da pandemia. Apesar de necessário, esse confinamento pode desencadear transtornos emocionais. A atividade física tem efeitos positivos sobre o bem-estar físico e a saúde mental, incluindo a possibilidade de redução de sofrimentos psicológicos. **Objetivo:** Descrever o impacto da prática de atividades físicas sobre os níveis de ansiedade durante o isolamento social devido à COVID-19, entre jovens e adultos. **Métodos:** Foi realizada uma revisão integrativa de acordo com as recomendações dos principais itens para relatar Revisões Sistemáticas e Meta-análises (PRISMA). As buscas foram realizadas entre maio e julho de 2021 nas bases de dados eletrônicas APA PsycINFO, Medline (via PubMed) e Lilacs (via BVS). **Resultados:** Dos 95 artigos científicos encontrados, 12 foram considerados elegíveis. Os estudos analisados mostraram que, durante o confinamento, as mulheres se tornaram menos ativas fisicamente, enquanto os homens realizaram mais atividades físicas e apresentaram níveis menores de ansiedade. Adicionalmente, quanto mais altos os escores da prática de atividades físicas, menores foram os sintomas de ansiedade. **Conclusão:** Os indivíduos que se mantiveram fisicamente ativos ou aumentaram a quantidade de atividades físicas diárias com intensidades moderadas e/ou vigorosas apresentaram menores níveis de transtornos psicológicos durante o distanciamento social imposto pela COVID-19.

Palavras-chave: bem-estar psicológico; confinamento; coronavírus; exercício físico; saúde mental.

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Introduction

The disease caused by the new coronavirus, named COVID-19, is a severe acute respiratory syndrome caused by the SARS-CoV-2 virus [1]. The first cases began to be monitored by the World Health Organization (WHO) in December 2019 in Wuhan, the largest city in China's Hubei province [2].

With the growth in the number of confirmed cases of the disease, also reported by other countries, the outbreak was declared a Public Health Emergency of International Concern. On March 11, 2020, COVID-19 was characterized by the WHO as a pandemic [3]. To date, thousands of lives have been lost as a result of this disease. According to WHO guidelines, to prevent the spread and transmission of the virus on a large scale, it is necessary to adopt measures of public health infection control, risk management, education, and health promotion [4].

Among the measures to prevent the spread of the pandemic, preventive recommendations were widely publicized, such as hand washing, frequent use of gel alcohol in the hands, use of face masks, and physical distancing. Most countries have implemented social isolation policies for citizens, except for those workers in services considered essential [5]. However, despite being necessary, social isolation can generate psychological suffering, which negatively impacts the behavior of individuals, causing disturbances with physical and mental consequences [6-8].

Studies carried out during quarantine have found that some mental disorders can be triggered [9-12]. There was an increase in the prevalence of psychiatric morbidity and psychological distress during the pandemic in several countries [13,14]. The predominance of anxiety and stress-related disorders can be directly linked to generalized uncertainties about the future, especially the risk of contracting the virus and dying or the fear that loved ones will contract and die [15].

Physical exercise has positive effects on mental health and physical well-being and can minimize behavioral problems. Among the benefits is a possible decrease in mild and moderate levels of depression and anxiety, as well as a likely reduction in negative emotional responses to stress and psychoactive substance abuse (i.e. alcohol, stimulants, caffeine, tobacco, inhalants, cannabis, hallucinogens, opioids, and sedatives) [16-18].

During the regular practice of physical exercise, and even a few hours later, in the recovery phase, stress hormones and inflammatory responses remain at low levels. In contrast, neutrophils, natural killer (NK) cells, cytotoxic T cells, immature B cells, and monocytes circulate at high rates [19]. When repeated regularly, these exercise-induced transient increases in antipathogenic leukocytes increase immunosurveillance, reduce disease risk, and decrease systemic inflammation, helping to prevent respiratory illness and, consequently, protect against infections such as COVID-19 [20].

In sum, regular physical activities cause beneficial physiological adaptations to rest heart rate, blood pressure, stroke volume, and cardiac output, promoting improvements in the cardiorespiratory system and musculoskeletal performance, generating well-being and satisfaction in the quality of life of individuals [21]. In addition,

physical activity acts as a non-pharmacological analgesic, stimulating the production of endorphins, which contribute to improving mood and reducing hormones associated with increased anxiety and stress, such as adrenaline and cortisol [19].

Different investigations during the COVID-19 pandemic show that the practice of physical activity improves anxiety levels due to the increase in well-being neurotransmitters, such as endorphin and serotonin [19,21]. In turn, improving physical condition helps to improve self-image and can reduce the emergence of other disorders in pandemic times [19]. Therefore, this integrative review aimed to describe the effects of physical activity on anxiety levels during social isolation due to the COVID-19 pandemic.

Methods

Design

This integrative review was conducted in accordance with the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [22]. A strategic search was carried out for scientific articles published in journals with double-blind peer reviews. Participants in the observed surveys were people from different populations. The intervention observed was the regular practice of physical activity during the COVID-19 pandemic. The outcome analyzed was the effect of physical activity on anxiety levels.

Databases and search strategy

The searches took place between May 5 and July 22, 2021, in the following electronic databases: American Psychological Association (APA) PsycINFO, Medical Literature Analysis and Retrieval System Online (Medline) via Pubmed, and Latin American and Caribbean Health Sciences Literature (Lilacs) via Virtual Health Library (VHL). We used the descriptors: “covid”, “exercise”, “physical activity”, “mental health”, and “anxiety.” These terms and their synonyms were combined using the Boolean operators OR (between synonyms) and AND (between the terms) to form the search phrase.

Study selection criteria

To ensure the reliability of the integrative review, two evaluators conducted the searches independently, during the screening of the titles, abstracts, and keywords of the primary research. In case of discrepancies in the inclusion or exclusion of studies, a third evaluator was consulted. The complete reading of the texts of the pre-selected articles aimed to verify whether the practice of physical exercises affected the anxiety symptoms of the young and adult population during the COVID-19 pandemic.

The following were included: a) studies that used protocols to analyze the level of physical activity practiced by individuals; b) studies that used instruments to assess the psychological and general well-being of individuals; c) temporal arc

between 2019 and 2021. We excluded: a) studies that did not use physical exercises as one of the strategies to reduce the participants' anxiety behavioral problems and disorders; b) sample studies with participants ≤ 17 years of age.

Assessment of the methodological quality of the studies

To assess the quality of the report of the methods of the studies included in this review, weaknesses, and strengths, we used the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) tool [23]. This tool has a checklist of items with recommendations on what should be included in a more accurate and complete description of observational studies.

Data collection procedures

The data extracted from the studies were: country, study design, sample size, age, gender/sex, population, sample recruitment method, objectives, measures/instruments, conclusion, physical activity levels, anxiety levels, and results.

Results

The search identified 95 scientific articles (APA PsycINFO = 69; Medline = 14; Lilacs = 12). After applying the eligibility criteria, 12 studies were selected for inclusion in this integrative review (Figure 1).

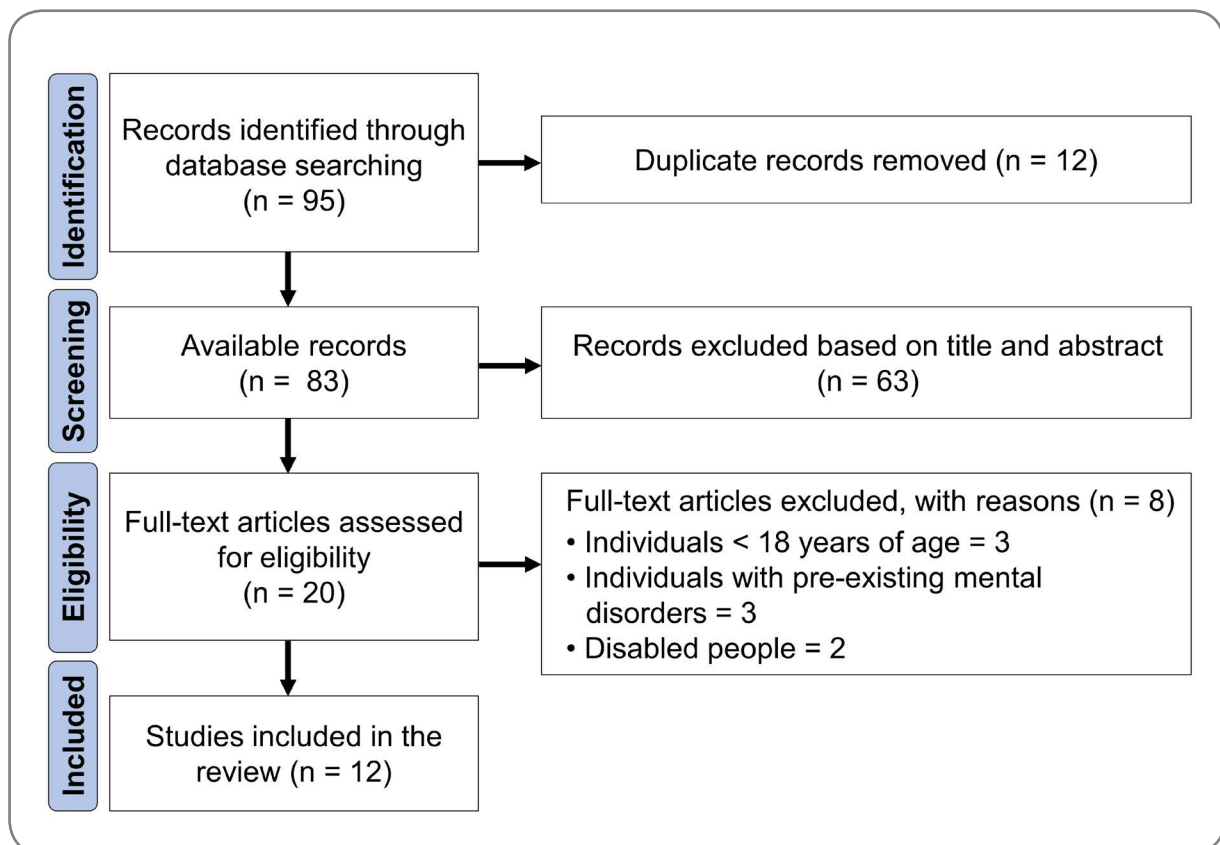


Figure 1 - Flowchart of the selection process of studies included in the review

The main characteristics of the included studies are summarized in Table I. All studies [24-35] were written in English and were published between 2020 and 2021. Most studies (83%) had a cross-sectional design [24-26,28,29,31-35] and two studies (17%) used a longitudinal design [27,30]. The samples ranged from 66 [27] to 8425 [31] individuals, with a mean age of 20 to 44 years old. All studies recruited participants virtually.

Table I - Main characteristics of the studies included in the review

Authors, year	Country	Study design	Sample size (age, in years)	Gender/Sex	Population	Recruitment
Antunes <i>et al.</i> , 2020 [24]	Portugal	transversal	1404 (36.4 ± 11.7)	F = 977 (69.6%) M = 426 (30.3%) NI = 1 (0.1%)	General population	Social networks and newspapers
Romero-Blanco <i>et al.</i> , 2020 [25]	Spain	transversal	213 (20.5 ± 4.56)	F = 172 (80.8%) M = 41 (19.2%)	University students	Online questionnaire (Google Forms)
Xiang <i>et al.</i> , 2020 [26]	China	transversal	1396 (20.68 ± 1.84)	F = 515 (36.9%) M = 881 (63.1%)	University students	Internet via WeChat public platform
Zhang <i>et al.</i> , 2020 [27]	China	longitudinal	66 (20.7 ± 2.11)	F = 41 (62.1%) M = 25 (37.9%)	University students	Internet via WeChat public platform
Alzahrani <i>et al.</i> , 2021 [28]	Saudi Arabia	transversal	518 (37.3 ± 14.3)	F = 169 (32.6%) M = 349 (67.4%)	General population	Social networks Twitter, Facebook, WhatsApp
Antunes <i>et al.</i> , 2021 [29]	Portugal	transversal	1404 (36.4 ± 11.7)	F = 977 (69.6%) M = 426 (30.3%) NI = 1 (0.1%)	General population	Social networks (Facebook and Instagram) and regional newspapers
Czenczek-Lewandowska <i>et al.</i> , 2021 [30]	Poland	longitudinal	506 (24.67 ± 4.23)	F = 355 (70.2%) M = 151 (29.8%)	Residents in Southeast Poland	Online questionnaire (Google Forms)
Faulkner <i>et al.</i> , 2021 [31]	United Kingdom, Ireland, New Zealand, and Australia	transversal	8425 (44.5 ± 14.8)	F = 5956.5 (70.7%) M = 2468.5 (29.3%)	Physically active individuals	Online questionnaire (Google Forms)

Table I - Continuation.

Authors, year	Country	Study design	Sample size (age, in years)	Gender/Sex	Population	Recruitment
Gierc <i>et al.</i> , 2021 [32]	Australia Canada USA Hong Kong Ireland Philippines UK/Northern Ireland	transversal	522 (32.2 ± 13.6)	F = 452 (86.8%) M = 66 (12.6%) Not binary = 2 (0.8%) NI = 2 (0.4%)	English speaking adults	Internet via hyperlink to an online questionnaire
Kirmizi <i>et al.</i> , 2021 [33]	Turkey	transversal	170 F = 28 (median: 23 in the 1 st quartile and 28 years in the 3 rd quartile) M = 29 (median: 24 in the 1 st quartile and 39 years in the 3 rd quartile)	F = 85 (50.0%) M = 85 (50.0%)	Individuals living in the urban area	Social networks (Instagram, Facebook, WhatsApp)
Puccinelli <i>et al.</i> , 2021 [34]	Brazil	transversal	1853 (38.6 ± 12.4)	F = 1110 (59.9%) M = 743 (40.1%)	General population	Websites, email, and social networks (Instagram, Facebook, WhatsApp)
Reigal <i>et al.</i> , 2021 [35]	Spain	transversal	328 (37.06 ± 10.82)	F = 209 (63.7%) M = 119 (36.3%)	General population of the region of Andalusia	Social networks

USA = United States of America; UK = United Kingdom; F = female; M = male; NI = not informed

Table II presents the objectives, measurement instruments, and conclusions.

Table II - Objectives, measures (instruments), and results of studies included in the review

Studies	Objectives	Measures/ Instruments	Results
Antunes <i>et al.</i> [24]	To understand the life habits (sleep, food, physical activity) of the Portuguese adult population and analyze the levels of anxiety and the satisfaction of basic psychological needs during the COVID-19 pandemic.	IPAQ-SF STAI BNSG-S	Men showed higher values for total energy expenditure and for competence satisfaction. The group of younger adults, aged between 18 and 34 years, had higher anxiety scores, lower competency satisfaction scores, and lower levels of physical activity.
Romero-Blanco <i>et al.</i> [25]	To analyze the changes in the practice of physical activity, adherence to the Mediterranean diet, and motivation to sedentary behavior, resulting from alcohol and tobacco consumption, anxiety/depression symptoms of university students, during confinement.	IPAQ-SF EQ-5D PREDIMED TTM	Students spent more time doing physical activities, but when their usual environment was limited, they spent more time sitting. There were no changes in behavior among students who, even before confinement, were already overweight or obese.
Xiang <i>et al.</i> [26]	To assess the relationship between the type of physical activity (adequate/inadequate) and anxiety and depression during the COVID-19 outbreak.	IPAQ-SF SAS SDS	The prevalence rate of anxiety among university students was 31% and that of depression was 41.8%; Moderate and high intensities of physical activities such as resistance training and housework were protective factors against anxiety or depression among college students.
Zhang <i>et al.</i> [27]	To examine the mitigating effects of exercise on mental disorders and determine the dose-response relationship between physical activity and mental distress.	IPAQ-SF C-PSQI DASS-21 BPAQ	The adequate amount of weekly physical activity to minimize negative emotions was about 2500 METs, corresponding to daily physical activities of 108 min at a light intensity, 80 min at moderate intensity, or 45 min at vigorous intensity.
Alzahrani <i>et al.</i> [28]	To investigate associations between physical activity and levels of psychological status and quality of life in Saudi adults during the COVID-19 pandemic.	IPAQ-SF DSM-5 PCL-5 HRQoL SF-8 DASS-9	Physical activity and psychological state levels revealed that, regardless of the level of psychological impact, there was a significant increase in quality of life improvement for highly active and sufficiently active practitioners compared to inactive participants.
Antunes <i>et al.</i> [29]	To examine the associations between physical activity, different levels of anxiety, and perceived satisfaction of basic psychological needs, during social isolation due to the 2019 coronavirus pandemic.	IPAQ-SF STAI BNSG-S	People with higher levels of physical activity have higher values of autonomy and competence satisfaction, and lower levels of anxiety, both when analyzing the variation related to the physical activity category, and when testing the moderating effect on gender in the associations between physical activity and state of anxiety.
C z e n c z e k - Lewandowska <i>et al.</i> [30]	To analyze the magnitude of the harmful effects of the COVID-19 pandemic on the physical and mental well-being of the young population.	IPAQ-SF FFQ-6 PSQI GAD-7	The pandemic caused a significant reduction in physical activity levels and a prolonged sedentary time, a significant increase in the feeling of generalized anxiety and worsening of sleep quality, and a significant increase in the consumption of alcohol and fatty foods.

Table II - Continuation

Studies	Objectives	Measures/ Instruments	Results
Faulkner <i>et al.</i> [31]	To assess the amount of exercise performed, mental health, and well-being during social restrictions due to the COVID-19 pandemic among young and physically active populations.	IPAQ-SF SCS DASS-9 WHO-5	Individuals who reduced the amount of physical exercise due to social restrictions had worse mental health and well-being; Individuals who maintained or increased the amount of physical exercise during the pandemic demonstrated a positive change or no decline in mental health and well-being.
Gierc <i>et al.</i> [32]	To investigate associations between changes in regular physical activity (moderate to vigorous) and mental health (depressive and anxiety symptoms, and life satisfaction) in adults during the COVID-19 pandemic.	IPAQ-SF PHQ-9 GAD-7 SWLS	Individuals who maintained or increased levels of physical activity demonstrated less psychological disturbance; Individuals with a decline in the practice of regular physical activity with moderate and/or vigorous intensities reported relatively greater psychological distress and lower life satisfaction.
Kirmizi <i>et al.</i> [33]	To compare the relationship between the levels of anxiety between genders and investigate the symptoms with the practice of physical activity.	IPAQ-SF SHAI NMQ	Women became less physically active than men and had a higher level of anxiety.
Puccinelli <i>et al.</i> [34]	To study the impact of social distancing and the association between physical activity level and mood state (symptoms of depression and anxiety).	IPAQ PHQ-9 GAD-7	The higher presence of symptoms related to anxiety and depression was associated with low levels of physical activity, low monthly family income, and younger age. Higher percentage of men without a mood disorder among the most physically active.
Reigal <i>et al.</i> [35]	To analyze the relationships between the level of physical activity, mood, state of anxiety, and health perception in a group of adults in the COVID-19 pandemic.	IPAQ-SF POMS STAI GHQ-12	The practice of physical activity is related to better mental health states, better mood, fewer anxiety symptoms, and better self-perception of health.

IPAQ-SF = International Physical Activity Questionnaire Short-form; STAI = State-Trait Anxiety Inventory; BNSG-S = Basic Need Satisfaction in General Scale; EQ-5D = questionário EuroQol 5D para avaliar o estado de saúde e a existência de problemas de ansiedade/depressão; PREDIMED = Questionário de avaliação da dieta mediterrânea; TTM = Modelo transteórico; SAS = Self-Rating Anxiety Scale; SDS = Self-Rating Depression Scale; C-PSQI = Pittsburgh Sleep Quality Index Chinese version; DASS-21 = Depression Anxiety Stress Scale; BPAQ = Buss-Perry Aggressive Questionnaire; DSM-5 = Diagnostic and Statistical Manual of Mental Disorders; PCL-5 = Posttraumatic Stress Disorder Checklist; HRQoL SF-8 = Health-related Quality of Life Short Form-8; DASS-9 = Depression, Anxiety and Stress Scale-9; FFQ-6 = Modified Food Frequency Questionnaire; PSQI = Pittsburgh Sleep Quality Index; GAD-7 scale = Generalized Anxiety Disorder, 7-item; SCS = Stages of Change scale for exercise behaviour change; WHO-5 = World Health Organisation-5 Well-being Index; PHQ-9 = Patient Health Questionnaire, 9-itens; SWLS = Satisfaction with Life Scale; SHAI = Short Health Anxiety Inventory; NMQ = Nordic Musculoskeletal Questionnaire; POMS = Profile of Mood States; GHQ-12 = General Health Questionnaire

Table III displays the results associated with the practice of physical activities and levels of anxiety.

Table III - Relationship between physical activity and anxiety levels

Study	Physical activity levels	Anxiety states	Result
Antunes <i>et al.</i> [24]	Low: 447 ± 31.8 Moderate: 697 ± 49.6 High: 260 ± 18.5	Anxiety state: 45.1 ± 11.2 Anxiety trait: 37.9 ± 10.3	Higher levels of PA are recommended to lessen the effects of anxiety in people who have decreased amounts of PA.
Romero-Blanco <i>et al.</i> [25]	Vigorous PA days = 2.19 ± 2.02 Moderate PA days = 3.15 ± 2.05 Minutes of vigorous PA = 30.66 ± 30.94 Moderate PA minutes = 47.74 ± 50.80 Total minutes of weekly PA = 383.17 ± 438.90	EuroQoL 5D (EQ-5D) = 366.20 ± 409.69	PA reduced anxiety levels.
Xiang <i>et al.</i> [26]	Mean (min/week) of intense PA: 90.09 ± 78.53; moderate PA: 133.34 ± 79.70; light PA: 157.45 ± 95.31	Anxiety: Severe: -0.121, T=-4.066 (p<0.001*), Moderate: -0.012, T=0.391 (p<0.695), Low: NA *Statistically significant Depression: Severe: -0.179, T=-6.071 (p<0.001*), Moderate: -0.095, T=3.221 (p=0.001*), Low: NA	PA reduced anxiety levels.
Zhang <i>et al.</i> [27]	Recommends an average of 2500 METs of PA per week	Reduction of psychological damage. The ideal amount to decrease anxiety levels was 2500 MET/week.	PA reduced anxiety levels.
Alzahrani <i>et al.</i> [28]	Inactive: < 600 MET/wk Sufficiently active: ≥ 600 MET/week Very active: ≥ 3000 MET/week Health-related QoL Scale: the average impact of COVID 19 on perceived QoL. They report a low level of impact associated with high perceived QoL, at least 3000 MET-min/wk, (=n predictable marginal mean HRQoL = 89.13; p=0.008) than when they engaged in less than 600 MET-min/week (p=0.019) and moderate (p<0.001). For individuals who reported a moderate level of impact from COVID 19, concerning the expected marginal average, those who practiced between 600 and 3000 MET/wk, the average was higher (77.34 vs. 79.08), evidencing the increase in PA high impact of COVID 19, at least 600 MET/without PA increased the QoL perception (66.15; p=0.019).	Psychological suffering. People who reported high, moderate, and low. Among high, those in psychological distress were lower when they engaged in at least 600 MET-min/week of total PA (predicted marginal mean psychological distress = 44.31) than when they engaged in less than 600 MET-min/week of the total PA.	PA reduced anxiety levels.

Table III - Continuation.

Study	Physical activity levels	Anxiety states	Result
Antunes <i>et al.</i> [29]	Participants reported PA levels as low: 447 ± 31.8; moderate: 697 ± 49.6; high: 260 ± 18.5	Anxiety state: low: 46.94 ± 11.51; moderate: 44.79 ± 11.04; high: 42.68 ± 10.40 Anxiety trait: low: 39.70 ± 10.71; moderate: 37.42 ± 9.88; high: 36.01 ± 9.98	PA reduced anxiety levels.
Czenczek-Lewandowska <i>et al.</i> [30]	PA = 8752.5 median MET ± 5288.9 Anxiety level. General Pre-PA: Mild (74.7%), Moderate (18.4%), Moderate-Severe (5.1%), Severe (1.8%).	PA = 5483.0 median MET [PA reduction] ± 4933.3 Post-PA general anxiety level: mild (48.0%), moderate (32.8%), moderate-severe (11.3%), severe (7.9%) (PA) (general anxiety) Z=9.59, p<0.001.	Increased levels of emotional disorders, but with possibilities of reduction through higher PA scores.
Faulkner <i>et al.</i> [31]	IPAQ-SF ratings n (%) Low PA [707 (8.4%)], Moderate [4,521 (53.7%)], High [3,198 (37.9%)].	Spearman's correlation coefficient (rho [95% CI]) showed negative correlations between PA and anxiety (rho = -0.13 [-0.15, -0.11]; p<0.001) during the initial restrictions of the COVID-19.	PA reduced anxiety levels.
Gierc <i>et al.</i> [32]	Before the COVID-19 pandemic, 68.2% of participants reported being sufficiently active for health benefits (ie > 150 min 193 MVPA per week). This decreased to 60.6% of participants during the initial period of the pandemic.	Reports of improved perception of QoL and reduction of symptoms of anxiety and depression for those who did more than 150 min/week of PA.	PA reduced anxiety levels.
Kirmizi <i>et al.</i> [33]	157 (24.3%) [Low (less than 1 day per week)], 318 (49.3%) [Medium (2-4 times per week)], 170 (26.4%) [High (more than 5 times a week)].	In women, SHAI = significant change for anxiety (p = 0.042) was mild to weak (p = 0.387) in relation to TPA.	PA reduced anxiety levels.
Puccinelli <i>et al.</i> [34]	Δ (IPAQ vs. GAD-7).	Δ IPAQ score associated with GAD-7 (General Anxiety) in the pre and post difference = 36.99	PA reduced anxiety levels.
Reigal <i>et al.</i> [35]	Mean min/week of intense PA 234.53 ± 208.04, moderate PA 194.34 ± 223.14, low PA 168.27 ± 161.79.	State-anxiety Intense: -1.11 (p ≤ 0.05), Moderate: -0.19 (p ≤ 0.01), low: -0.15 (p ≤ 0.001)	PA reduced anxiety levels.

PA = physical activity; QoL = quality of life; EuroQol 5D (EQ-5D) = questionnaire to assess health status and the existence of anxiety/depression problems; NA = not applicable; MET = multiples of metabolic equivalents of physical activity; min = duration of physical activity in minutes; HRQoL = health-related quality of life; IPAQ = International Physical Activity Questionnaire; MVPA = moderate- to vigorous-intensity physical activity; SHAI = Short Health Anxiety Inventory; TPA: total amount of physical activity; GAD-7 scale = Generalized Anxiety Disorder, * = significant difference for levels < 0.05

Table IV shows the methodological evaluations, according to STROBE [23].

Tabela IV - Assessment of the report quality of the methods of the studies included in the review

Studies	a	b	c	d	e	f	g	h	i
Antunes <i>et al.</i> [24]	●	●	●●	●	●	○	○	●	●●○○●
Romero-Blanco <i>et al.</i> [25]	●	●	●●	●	●	●	●	●	●●○○●●
Xiang <i>et al.</i> [26]	●	●	●●	●	●	○	○	●	●●●○○●
Zhang <i>et al.</i> [27]	●	●	●●	●	●	●	○	●	●●○○●
Alzahrani <i>et al.</i> [28]	●	●	●●	●	●	●	●	●	●●○○●
Antunes <i>et al.</i> [29]	●	●	●●	●	●	○	○	●	●●○○●
Czenczek-Lewandowska <i>et al.</i> [30]	●	●	●●	●	●	●	●	●	●●○○●
Faulkner <i>et al.</i> [31]	●	●	●●	●	●	○	○	●	●●○○●
Gierc <i>et al.</i> [32]	●	●	●●	●	●	●	●	●	●●●○○●
Kirmizi <i>et al.</i> [33]	●	●	●●	●	●	●	●	●	●●○○●
Puccinelli <i>et al.</i> [34]	●	●	●●	●	●	○	○	●	●●●○○●
Reigal <i>et al.</i> [35]	●	●	●●	●	●	○	○	●	●●○○●

a = Study design: Present key elements of study design early in the manuscript; b = Setting: Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection; c = Participants: 1) give the eligibility criteria, and the sources and methods of selection of participants; 2) matching criteria and number of exposed/unexposed or number of controls per case, where appropriate; d = Variables: Clearly define all outcomes, exposures, predictors, and potential confounders; e = Data sources/measurement: For each variable of interest, give sources of data and details of methods of assessment (measurement); describe comparability of assessment methods if there is more than one group; f = Bias: Describe any efforts to address potential sources of bias; g = Study size: Explain how the study size was arrived at; h = Quantitative variables: Explain how quantitative variables were handled in the analyses; i = Statistical methods: 1) describe all statistical methods, including those used to control for confounding; 2) describe any methods used to examine subgroups and interactions; 3) explain how missing data were addressed; 4) explain of how loss to follow-up, case and control matching, or sampling strategies were handled; 5) describe any sensitivity analyses; ● = met the STROBE recommendation; ○ = did not meet the STROBE recommendation.

Discussion

This integrative review sought to describe the impact of physical activity on anxiety levels during social isolation due to the COVID-19 pandemic. Additionally, observations about physical activity as an alternative to mitigate other emotional disorders were also provided.

To measure the level of physical activity, all studies [24-35] used the International Physical Activity Questionnaire (IPAQ) [36]. To access the levels of anxiety, different instruments were used, such as the State-Trait Anxiety Inventory (STAI) [24,29,35], the EuroQol 5D questionnaire (EQ-5D) [25], the self-rating anxiety scale (SAS) [26], the Depression, Anxiety and Stress Scale (DASS-21) [27], the modified and shortened version of the DASS-21 instrument, that is, the Depression, Anxiety and Stress Scale-9 (DASS-9) [28,31], the Generalized Anxiety Disorder, 7-item (GAD-7) questionnaire [30,32,34], and the Short Health Anxiety Inventory (SHAI) [33]. Some

studies also used instruments to assess depression [26-28,31,32,34], quality of life [28,31], diet [25], sleep [27,30], and aggression [27] of participants.

According to the results presented in this integrative review (Table III), most studies found a significant relationship regarding the benefits of physical activity for the attenuation of participants' perceptions related to anxiety and other factors associated with psychological distress. Taking as a reference the answers obtained with the physical activity questionnaires, it was found that the performance of activities with overloads of moderate to vigorous intensities showed positive results with significant relevance to the aforementioned burdens. However, physical activity levels \geq 600 MET min/week were also able to favor symptom reduction.

Antunes *et al.* [24] indicated that men had higher values for total energy expenditure and satisfaction with competence. However, the group of younger adults, aged between 18 and 34 years, had higher anxiety scores, lower competence satisfaction scores, and lower levels of physical activity [24]. In turn, Romero-Blanco *et al.* [25] showed that individuals spent more time doing physical activities during COVID-19 social isolation. However, when the usual environment was limited, they sat longer. It is worth mentioning the fact that there were no changes in behavior among individuals who were overweight or obese even before social isolation [25].

Samples of included studies ranged from 66 [27] to 8425 [31] participants, with a total of 16,805 subjects analyzed. A high sample number contributes to external validity. This provides for extrapolation of study results to individuals with similar characteristics in a different setting [37]. Hence, the internal and external validity of the analysis of the effect of the systematic practice of physical activity during the COVID-19 pandemic is important to verify if interventions with physical exercises can be adopted and bring benefits to practitioners.

As for the distinction of the participants in this review, it was observed that, during confinement, women became less physically active [25,30-34], while men performed more physical activities and presented lower levels of anxiety [24,31,32,34]. In addition, the higher the physical activity scores, the lower the anxiety symptoms, the higher the feeling of well-being and quality of life [26-29,35].

Regarding gender, the results presented are consistent with most investigations carried out in other countries, which observed that women perform less physical exercise [38-40] and have higher anxiety scores than men during social isolation [41-43].

Puccinelli *et al.* [34] observed a greater presence of symptoms related to anxiety and depression associated with low levels of physical activity, low monthly family income, and younger age. This reinforces the evidence on the importance of regular moderate physical activity during and after the pandemic [44,45].

The results showed that all studies partially met the nine criteria to assess the quality of reporting of the method of the reviewed studies. Most of these criteria, except participants and statistical methods, have an indicator, represented by a closed circle (Table IV). The circle is closed when the information available in the article has been fully reported or described, as recommended in the STROBE statement [23].

The criteria about design/investigation, context/setting, participants (report or description of eligibility, sources and methods of participant selection, and report or description of correspondence, and number of exposed/unexposed or number of controls per case, where appropriate), data source/measurement, and quantitative variables were 100% reported or described in the methods of the studies reviewed. However, reporting or describing any efforts to address potential sources of bias was 50% [25,27,28,30,32,33], and reporting or describing how the study sample size was determined was 41.7% [25,28,30,32,33]. Finally, none of the studies met *all* the indicators pertinent to the criteria on the statistical methods: 25% [26,32,34] of the studies reviewed provided explanations for the management of missing data, and only 8.3% [25] provided explanations of how loss to follow-up, case and control matching, or sampling strategies were handled.

There are some limitations in the research carried out during the COVID-19 pandemic that should be highlighted. Most of the selected studies have a cross-sectional design. Due to the sensitivity to time during the COVID-19 outbreak, researchers have adopted self-report questionnaires to investigate the weekly time spent in physical activities and the psychological and behavioral effects. Nevertheless, the answers provided may not be in line with assessments made by Physical Education professionals and mental health professionals. Another limitation was that the majority of the sample of studies was predominantly female and may not represent the adequate proportion of gender in the general population. Furthermore, data collection was done online, which required individuals to have access to technological devices with an internet connection to answer the questionnaires, therefore, it may not reflect the situation of disadvantaged groups of different socioeconomic levels.

It is recommended, for future research, studies that include samples with different age groups, levels of education, ethnicities, creed, social conditions, and more balanced proportions between genders, so that there is greater consistency with the general population.

As for strengths of this review, relevant data on the frequency and intensity of physical activity and the implications associated with active or sedentary lifestyles stand out, reinforcing the scientific framework regarding the benefits of the daily practice of systematic physical exercises, even in the face of critical and devastating situations such as a pandemic.

Conclusion

Based on the studies included in this integrative review, it was possible to verify a reduction in regular physical activity during social isolation, especially by women. Moreover, individuals who did not engage in or even decreased the amount of daily physical activity during the COVID-19 pandemic had higher anxiety scores. On the other hand, physically active individuals who performed physical activities with moderate and/or vigorous intensities were benefited in the improvement of

immune responses to infections, had lower levels of anxiety, and had positive effects on mental health and physical well-being. We emphasize encouraging the population to start and/or continue the practice of regular physical activities, following the instructions of Physical Education professionals and the guidelines for preventive measures of the relevant Health Organs.

Conflict of interest

No conflict of interest has been reported for this article.

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Author's contributions

Conception and design of the research: Della Corte J, Santos LC, Chrispino RF, Cabral EA, Miarka B, Telles SCC; **Obtaining data:** Della Corte J, Santos LC, Chrispino RF, Cabral EA; **Data analysis and interpretation:** Della Corte J, Santos LC, Chrispino RF, Castro JBP, Miarka B, Telles SCC; **Writing of the manuscript:** Della Corte J, Santos LC, Chrispino RF, Castro JBP, Miarka B, Telles SCC; **Critical review of the manuscript for important intellectual content:** All authors participated equally in the critical review of the manuscript.

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