


ORIGINAL ARTICLE

Characteristics and effects of physical exercise programs for older adults during the COVID-19 pandemic: an integrative review

Características e efeitos de programas de exercício físico para idosos durante a pandemia de COVID-19: revisão integrativa

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KEYWORDS

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ABSTRACT

Objective: To evaluate the characteristics of physical exercise programs for older adults and their effects during the COVID-19 pandemic.

Methods: An integrative review was conducted between January and March 2022. A search was conducted in MEDLINE via PubMed, Lilacs via BVS, PEDro, and Cochrane Library. Experimental articles (randomized clinical trials, non-randomized trials, or quasi-experimental studies) published from 2019 to 2021, with no language restriction, and that used physical exercise programs for older adults (> 60 years) in their intervention were included. The studies were selected by reading the title, abstract, and full text. The selected articles had their results extracted using an online form, tabulated using an electronic spreadsheet, and analyzed qualitatively and quantitatively.

Results: 113 studies were identified; 7 met the eligibility criteria and were included in the review, all randomized controlled trials. The multi-component exercise programs were more frequent (resistance, balance, flexibility, and aerobic), delivered remotely and performed 2 to 7 times a week, lasting between 30 and 50 minutes. Significant effects were observed on physical function, body composition, blood triglycerides, the incidence of falls, physical activity, and functional capacity.

Conclusions: The physical exercise programs used during the COVID-19 pandemic showed promising results for older adults. The programs proved to be a viable alternative for maintaining the physical, mental, and cognitive functions of older adults in times of public calamity.

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PALAVRAS-CHAVE

COVID-19
Envelhecimento
Exercício
Idoso

RESUMO

Objetivo: Avaliar as características de programas de exercício físico para idosos e seus efeitos durante a pandemia de COVID-19.

Métodos: revisão integrativa, realizada entre os meses de janeiro a março de 2022. As buscas foram realizadas no MEDLINE via PubMed, Lilacs via BVSI, PEDro e Cochrane Library. Foram incluídos artigos experimentais (ensaios clínicos randomizados, ensaios não randomizados ou estudos quase-experimentais) publicados de 2019 a 2021, sem restrição de idioma, e que utilizaram programas de exercício físico para idosos (> 60 anos) em sua intervenção. A seleção dos estudos foi realizada através da leitura de título e resumo, e seguida da leitura do texto completo. Os artigos selecionados tiveram seus resultados extraídos com auxílio de um formulário on-line, tabulados com a utilização de planilha eletrônica e analisados qualitativa e quantitativamente.

Resultados: Foram identificados 113 estudos; 7 preencheram os critérios de elegibilidade e foram incluídos na revisão, todos ensaios clínicos randomizados. Os programas de exercícios foram em maior frequência, multicomponente (resistência, equilíbrio, flexibilidade e aeróbico), entregues de forma *on-line*, sendo realizados de 2 a 7 vezes na semana, com duração entre 30 e 50 min. Efeitos significativos foram observados na função física, composição corporal, triglicérideo sanguíneo, incidência de quedas, atividade física e capacidade funcional.

Conclusões: Os programas de exercício físico utilizados durante a pandemia da COVID-19 apresentaram resultados promissores para a população idosa, se mostrando uma alternativa viável para a manutenção das funções físicas, mentais e cognitivas dos idosos em momentos de calamidade pública.

INTRODUCTION

In March 2020, the World Health Organization (WHO) recognized the COVID-19 crisis, caused by the SARS-CoV-2, as a global pandemic¹. The pandemic was responsible for several deaths worldwide, with older adults being the most affected population group². Various government agencies have implemented restrictive protective measures to combat the spread of the virus and its aggravating effects. Among these measures, isolation or social distancing stood out, which were widely used, especially for more susceptible groups, such as older adults^{3,4}.

Restrictive measures were effective in spreading the virus and protecting older adults⁵. However, some negative consequences were evidenced. For example, social isolation led to mood and mental health changes, increased sedentary lifestyle, and reduced regular physical exercise (PE)⁶. The decrease in the practice of PE can be explained by the reduction in accessibility to public places, the closure of gyms and training centers, and other situations caused by the pandemic. PE, in turn, is related to numerous benefits in the physical, mental, and cognitive health of older adults⁷, and its reduction or restriction is associated with greater chances of developing chronic diseases and changes in physical and cognitive functions⁸.

In Brazil, approximately 60% of older adults are considered sedentary or insufficiently active⁹. With the pandemic and the effects of restrictive measures, an increase of around 20% of inactive older adults was estimated¹⁰. Despite the increase in inactivity among older adults, alternative ways of maintaining the practice of PE were disseminated, aiming at promoting health during the pandemic period. The use of virtual platforms, mobile technologies, and information booklets was disseminated. Its realization was highly recommended during this period to minimize the effects caused by the restrictive measures to combat the virus^{11,12}. With this, research was conducted worldwide to test different ways of implementing PE programs for

older adults during the pandemic.

Given this context, it is crucial to map the studies that used PE programs in their intervention to identify their strengths and weaknesses, their effects on older adults, and the feasibility of implementing them in clinical practice. Therefore, this review evaluated the characteristics of PE programs for older adults and identified their effects during the COVID-19 pandemic.

METHODS**Study design**

This is an integrative literature review, following the steps provided by Mendes et al.¹³ and the writing guidelines from the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR)¹⁴.

Study guiding question

The guiding question was elaborated following the PICO strategy (Population, Intervention, Comparison, and Outcome) for clinical studies¹⁵ (Table 1). Therefore, the guiding question of this review was: What are the characteristics of PE programs for older adults, and what are their effects during the COVID-19 pandemic?

Inclusion and exclusion criteria

The following articles were included: 1) experimental articles (randomized clinical trials, non-randomized trials, or quasi-experimental studies), published between 2019 and 2021, with no language restriction; 2) older adults (age \geq 60 years); and 3) with use of PE programs as an intervention. Original articles and reviews not performed in the context of the COVID-19 pandemic were excluded.

Table 1 – PICO Strategy.

PICO	Information
Population	Older adults (Age ≥ 60 years) in the context of the COVID-19 pandemic
Intervention	Physical Exercise Programs
Comparator	No comparator or control group specificity
Outcome	Characteristics of physical exercise programs and health-related outcomes

Literature search

Literature searches were conducted in January 2022 in the Medical Literature Analysis and Retrieval System Online (MEDLINE) via PubMed, Latin American and Caribbean Literature in Health Sciences (Lilacs) via BVS, Physiotherapy Evidence Database (PEDro), and the Cochrane Library databases.

The search strategy was elaborated using the Medical Subject Headings (MeSH). A matrix search strategy was initially created for MEDLINE (Table 2) and later adapted for other databases (Supplementary File). The combination of search strategy was performed with the Boolean Operators “AND” and “OR”.

Table 2 – Sample MEDLINE search strategy.

Number	Search strategy
#1	Aged [MeSH] OR “Older Adults” OR “Older Adults” OR Elderly OR “Older People”
#2	Pandemics [MeSH] OR COVID-19[MeSH] OR “Social Isolation” [MeSH]OR Pandemic OR “COVID 19” OR “COVID-19” OR “Virus Disease” OR “COVID 19 Virus Disease” OR “COVID-19 Virus Diseases” OR “COVID-19 Virus Infection” OR “COVID 19 Virus Infection” OR “COVID-19 Virus Infections” OR “2019-nCoV Infection” OR “2019 CoVID nfection” OR “2019-nCoV Infections” OR “Coronavirus Disease-19” OR “Coronavirus Disease 19” OR “2019 Novel Coronavirus Disease” OR “2019 Novel Coronavirus Infection” OR “2019-nCoV Disease” OR “2019 -nCoV Disease” OR “2019-nCoV Diseases” OR “Coronavirus Disease2019” OR “SARS Coronavirus 2 Infection” OR “SARS-CoV-2 Infection” OR “SARS CoV 2 Infection” OR “SARS-CoV-2 Infections” OR “COVID-19Pandemic” OR “COVID 19 Pandemic” OR “COVID-19 Pandemics” OR “Social Exclusion” OR “Social Exclusions”
#3	Exercise [MeSH] OR Exercises OR “Physical Activity “OR” Physical Activities “OR” Physical Exercise “OR” Physical Exercises” OR “Acute Exercise” OR “Acute Exercises “OR” Isometric Exercises “OR” Isometric Exercise” OR “Aerobic Exercise” OR “Aerobic Exercises” OR “Exercise Training” OR “Exercise Trainings” OR “Neuromuscular training” OR “Strength training” OR “Resistance training” OR “Plyometric training” OR “Power training” OR “Balance training”
#4	#1 AND #2 AND #3

Selection of articles

After searching the databases, all articles found were imported into the online systematic reviews manager Rayyan QCRI¹⁶. Initially, the duplicated articles were removed, and then the titles and abstracts were read. The selected articles were critically evaluated in full text based on the inclusion and exclusion criteria. Doubts regarding the inclusion and exclusion of articles in the review were clarified in consensus meetings.

Data extraction

Data were extracted using a form prepared and previously tested by the review researchers via *Google Forms*®. Data were collected on study characteristics (title, authors, study site, and year of publication), the study sample, the older adults included, exercise program included (type, parameters, and characteristics), primary outcomes, results, and conclusion.

Summary of the results

The collected data were categorized in a spreadsheet in Microsoft® Excel (version 2207), and the results were analyzed qualitatively. Quantitative data were analyzed using descriptive statistics and were described as mean, standard deviation, and relative and absolute frequency. All information from the articles included in this review was summarized in table.

RESULTS

One hundred thirteen studies were found in the databases; 14 duplicated articles were removed, leaving 99 for the title and abstract reading. After the initial reading, 27 articles were selected for full-text reading, and after critical analysis, 7 articles were included in the review. The entire article selection process is described in a flow diagram (Figure 1).

Information regarding the articles included in the review is briefly shown in Table 3.

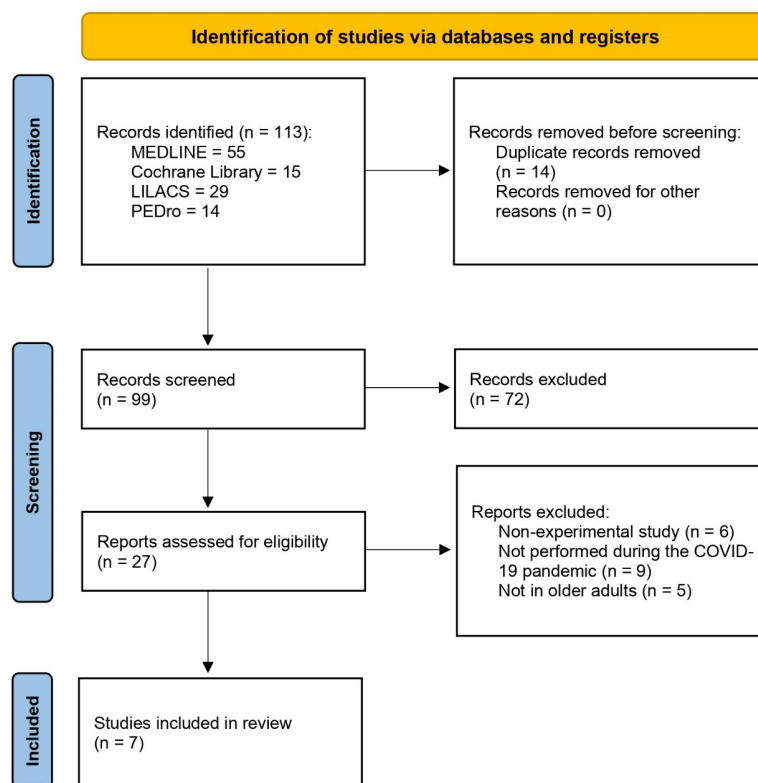


Figure 1 - Flow diagram of articles included in the review.

Characteristics of the studies

All articles included in this review were randomized clinical trials, four of which were published in 2021. As for the primary outcome, physical function had a higher frequency (71.4%), and the other outcomes used were body composition, cardiometabolic markers, psychological aspects, the incidence of falls, physical activity, behavior during exercise, health and well-being, and functional capacity.

Characteristics of the participants

The seven studies included totaled 452 older adults, 82% of whom were from the community. The mean age ranged from 68 ± 7 years to 87.1 ± 7.1 years. More than half (54% to 100%) of those included in each study were female.

Physical exercise programs

Five studies carried out PE programs at home¹⁷⁻²¹; the others were conducted in nursing homes for older adults^{22,23}. PE programs were delivered 1) remotely, supervised, and using virtual platforms (42.85%)¹⁸⁻²⁰, 2) remotely through recommendations (with goals established with participants) (28.57%)^{17,21}, and 3) in-person at nursing homes (28.57%)^{22,23}. The components included in the programs were endurance, balance, flexibility, aerobics, and body and mind. Most studies (57.14%) used more than one component in their

composition^{19,21-23}, mainly employing a combination of resistance, balance, and aerobic exercises.

The total intervention time ranged from 4 to 24 weeks; the sessions were performed 2 to 7 times a week, with the total duration of the exercise session ranging from 20 min to 60 min. Two studies did not carry out the exercise sessions during an established and targeted period, as the characteristic of the intervention was to reach established goals during the whole day, with small exercise practices accounted for until the goal was agreed upon between the researcher and the participant^{17,21}. One study did not report program session time²³. As for the resources used in PE programs, four studies used items available at home, such as sandbags, chairs, balls, and bottles^{18,20,22,23}. Two studies sent materials by mail^{17,19}, and one study sent didactic material virtually²¹.

Effect of physical exercise programs

Five studies included in the review evaluated the effect of PE programs on the physical function of older adults. Of these, 4 showed a significant result over time^{17,18,21,22}. The variables that showed a change in physical function after the PE programs were lower limb strength^{17,18,21,22}, balance^{18,21,22}, mobility^{17,22}, and handgrip strength^{17,21}. When evaluating the effect of PE programs, compared with a comparator or control group, only two found significant differences in physical function^{17,22}.

Other outcomes that showed significant changes over time after participation in PE programs were body

Table 3 – Summary of information from articles included in the review.

Author, year	Study characteristics	Sample characteristics	Intervention group	Comparator group	Main results
Grant et al. ¹⁷ , 2020	Country: United Kingdom Magazine: Front Physiol Type of study: Randomized Clinical Trial Primary outcome: Body composition, cardiometabolic markers, and physical function Older adults included: ≥ 65 years old	N: 28 Average age: 73 ± 5 years Gender, % Female: 100% N, intervention group: 14	Instruction not to perform a sedentary behavior for more than 30 min and that for every 30 min of sedentary behavior, perform 2 min of light-intensity physical activity in the standing position (walking, dragging your feet from one side to the other, washing dishes, etc.). Totaling 48 min of light intensity physical activity (14 sessions of 2 min) throughout the day (from 9 am to 9 pm) for 8 weeks.	Instruction to increase the time in light intensity activities, maintaining the usual routines. Perform a continuous daily session of 45 to 50 min (walking, shuffling from one place to another, washing dishes, etc.) for 8 weeks.	Significant changes were observed in hip circumference (p = 0.02), blood triglyceride (p = 0.045), walking speed (p = 0.005), sitting and standing from 30 s (p = 0.002) and 1 min (p = 0.009) and handgrip strength (p = 0.044) over time. Significant differences between groups were only observed in handgrip strength (p = 0.04) in favor of the group with decreased sedentary behavior.
Vitale et al. ¹⁸ , 2020	Country: Italy Magazine: Int J Environ Res Public Health Type of study: Randomized Clinical Trial Primary outcome: Physical function (Balance, Grip strength, Lower limb strength) Older adults included: ≥ 60 years old	N: 9 Average age: 68 ± 7 years Gender, % Female: 96.7% N, intervention group: 5 participants	Resistance exercises at home for 24 weeks, with 4 sessions per week, for 55 min (5 min of warm-up, 45 min of resistance exercises, and 5 min of cooling down).	No intervention and follow the usual routines.	The intervention group showed significant changes after the intervention, only in the strength of the lower limbs, as assessed by the sit-to-stand test (p = 0.048; ES: 1.0, moderate). No significant differences were observed when comparing the intervention and control groups after 24 weeks of exercise.

Table 3 – Summary of information from articles included in the review (cont.).

Author, year	Study characteristics	Sample characteristics	Intervention group	Comparator group	Main results
Beauchamp et al. ¹⁹ , 2021	Country: Canada Magazine: J Med Internet Res. Type of study: Randomized Clinical Trial Primary outcome: Psychological flourishing Older adults included: ≥ 65 years old	N: 241 Mean age: 73 ± 5.4 years Gender, % Female: 88% N, intervention group: 162 (G1: 80 and G2: 82)	Remote exercise classes (Via Zoom) in groups (G1) or individually (G2), 7 days a week, for 12 weeks, lasting 50 to 60 minutes (strength, flexibility, balance, and aerobic components). All participants were encouraged to attend at least three classes per week.	No intervention and follow the usual routines.	There were no significant differences in psychological flourishing after 12 weeks of remote exercise classes (individual or group). No significant differences were observed when comparing the intervention groups with the control group.
Chen et al. ²² , 2021	Country: China Magazine: J Clin Nurs Type of study: Randomized Clinical Trial Primary outcome: Physical function Older adults included: ≥ 75 years old	No: 59 Mean age: 84.7 ± 4.8 years Gender, % Female: 71.1% N, intervention group: 29	Otago in-person exercise program, for 12 weeks, with a frequency of 3 sessions per week, lasting 30 min (5 min of warm-up, 10 min of resistance training, and 15 min of balance exercise) + Health education on the physical exercise of 30 min.	Health education on physical exercise and information on sleep and diet for 30 min once a month for 12 weeks. The group should also follow the usual routines.	There was a significant improvement in physical function after 6 and 12 weeks of the initial assessment for lower limb strength, balance, and mobility ($p < 0.05$). Furthermore, the Otago exercise group showed significant results after 6 and 12 weeks compared to the control group ($p < 0.05$).
Li et al. ²⁰ , 2021	Country: United States of America Magazine: Clin intervention Aging Type of study: Randomized Clinical Trial Primary outcome: Incidence of falls Older adults included: ≥ 65 years old	N: 30 Mean age: 76.2 ± 6.2 years Gender, % Female: 72% N, intervention group: 15	Chuan remote dual-task training program focusing on balance and fall prevention (10-15 min of preparatory exercises, 45-50 min of core training in an 8-form routine, and 1-2 min of closure). The exercises lasted 1 h per day, performed twice a week for 24 weeks.	Remote stretching exercise program, with most performed in a sitting position. The exercises lasted 1 h per day, performed twice a week for 24 weeks.	Despite a lower incidence of falls in the Tai Chi Chuan group than in the stretching group, there were no significant differences between the groups (incidence = 0.58; 95% CI, 0.32 - 1.03).

Table 3 – Summary of information from articles included in the review (cont.).

Author, year	Study characteristics	Sample characteristics	Intervention group	Comparator group	Main results
Liang et al. ²¹ , 2021	Country: United Kingdom Magazine: J Aging Physical Act Type of study: Randomized Clinical Trial Primary outcome: Feasibility, acceptability and adherence, physical function, physical activity, exercise behaviors, health, and well-being Older adults included: ≥ 65 years old	N: 63 Mean age: 72.2 ± 4.7 years Gender, % Female: 54% N, intervention group: 46 (G1: 15, G2: 16 and G3: 15)	G1: Quick Workouts - 5 resistance exercise moves delivered remotely. Each move lasted 1 min with 1 min of rest in between. G2: Fast Tai Chi - 5 Chen-style Tai Chi moves delivered remotely. Each move lasted 1 min with 1 min of rest in between. G3: Combination: Fast exercises combined with fast Tai Chi. One set of each exercise was performed per day. ***The exercises were performed twice daily, 7 days a week, for 4 weeks.	Received a link to access the Physical Activity Guidelines for Seniors from the National Health Service.	The rapid exercise programs demonstrated good viability, acceptability, and adherence of more than 80% (G1: 90%, G2: 84% and G3: 83%). All groups showed improvement in physical function for the sit and stand tests, and only the G1 and G3 groups for the balance tests. There was an improvement in all groups for physical activity (total, moderate to vigorous physical activity, and sedentary behavior), except for walking time. For behavior during exercise, self-efficacy was reduced for barriers in the 4 groups. Health and wellness scores remained stable.
Courel-Ibañes et al. ²³ , 2022	Country: Spain Magazine: J Am Med Dir Assoc Type of study: Randomized Multicenter Trial Primary outcome: Functional capacity and muscle strength Older adults included: ≥75 years old	N: 22 Mean age: 87.1 ± 7.1 years Gender, % Female: 58.3% N, intervention group: 10	Vivifrail multi-component exercise program (endurance, balance, flexibility, and cardiovascular endurance), adaptable, performed 5 times a week for 24 weeks. The program was delivered in person at a long-term care facility for the older adults.	Vivifrail multi-component exercise program (endurance, balance, flexibility, and cardiovascular endurance), adaptable, performed 5 times a week for 4 weeks. The program was delivered in person at a long-term care facility for older adults.	Both groups after 4 weeks showed improvements in functional capacity and strength (ES from 0.32 to 1.44; p < 0.05), except for handgrip strength in G1. After 20 weeks, G1 showed significant results in all variables except handgrip strength. After detraining, both groups showed similar results, with only SPPB being significantly higher in G1.

N = Sample; % = Percentage; G1 = Group 01; G2 = Group 02; G3 = Group 03; SPPB = Short Physical Performance Battery.

composition (in hip circumference)¹⁷, cardiometabolic markers (in blood triglycerides)¹⁷, physical activity (in total physical activity, moderate to vigorous and sedentary behavior)²¹ and functional capacity²³. No study using outcomes other than physical function found significant differences between groups receiving the PE program and a comparator or control group.

DISCUSSION

Most of the studies included in this review carried out the PE programs remotely, with more than one component in their configuration, with the most used being the resistance component. The programs had a total duration of 4 to 24 weeks, performed 2 to 7 times a week, and with a session time of 20 min to 60 min. Most studies have shown improvement in the outcomes used over time. However, the same was not observed compared with a control group. Physical function was the most used outcome and the one that showed the best results after the PE program and was also the only outcome where significant differences were found compared with a control group.

Even with the difficulties in promoting a PE program for older adults during the COVID-19 pandemic, the remote modality was a viable alternative during this period, which corroborates the findings of this review, where most of the included studies carried out their PE programs remotely¹⁷⁻²¹. Although this modality increased during the pandemic, previous studies have tested this format and shown promising results^{24,25}. Even so, the use of this format was limited, especially among Brazilian older adults, due to low access to technology. With the need for this implementation, mainly because it provides a lower risk of contamination by the COVID-19 virus, in addition to reducing therapist and patient travel time²⁶, this format began to be more accepted, and health agencies implemented measures that make their use possible. Still, Guimarães et al.²⁷ report in their study that this modality can lead to some concerns, such as internet connection problems and the therapist's difficulty with postural corrections while performing the exercises.

Despite the remote modality being a viable method during the pandemic, some older adults have limitations in adapting to this format, such as residents of nursing homes. Thus, 2 studies out of the 7 included carried out their PE programs in person^{22,23}. To make it possible to conduct PE programs safely, measures were used to reduce the risk of contamination by the COVID-19 virus. These measures reflected the recommendations of international health organizations, such as the WHO²⁸ and the US Centers for Disease Control and Prevention²⁹. Pradhan et al.³⁰ also reinforced the indispensability of this care for maintaining the health of older adults and precautions against the spread of the virus.

According to Lima Junior³¹, older adults residing in nursing homes were one of the most vulnerable population groups during the pandemic and had greater difficulties in exercising. Santos et al.³² also reported that most nursing homes do not have services that help in the practice of PE. Even so, recent studies have shown

promising results^{33,34}. These findings reflect the results of studies included in this review, which identified significant effects of PE programs for this population^{22,23}, demonstrating the importance of PE for maintaining the health of these older adults during the pandemic.

As for the characteristics of PE programs, most studies have used more than one component in their configuration. This type of exercise is called "multi-component exercise", which combines two or more components, such as resistance, balance, and aerobics, and may even work on the cognitive aspect^{35,36}. According to Roy et al.³⁷, this exercise modality becomes necessary given exacerbated functional losses during the pandemic. Cadore et al.³⁸ also report that this type of exercise brings numerous benefits as they are highly efficient in improving the characteristics of frailty, working on different aspects of older adults, such as strengthening the musculoskeletal system, improving balance, and reducing falls³⁹.

The parameters used in most of the PE programs in the studies in this review align with the exercise recommendations proposed in the study by Izquierdo et al.⁴⁰ and the WHO recommendations for physical activity for older adults⁴¹. According to these recommendations, PE should be performed at least thrice or more per week, and the training session should last between 30 min and 50 min. Studies that used these parameters in their PE programs have shown positive results in older adults^{40,42,43}.

In the studies included in this review, physical function was the most prominent outcome and consequently presented the best results. For Zhao et al.⁴⁴, PE can reduce cardiovascular risks, falls, in addition to improving motor control, gait, and muscle strength in general. These findings are corroborated by Wade et al.⁴⁵ and Stensvold et al.⁴⁶, who showed significant results in physical function after performing a PE program. Jimenez-Pavón et al.⁴⁷ also reiterate in their study that maintaining physical function was a priority during the pandemic, reducing the consequences of inactivity and maintaining the autonomy and independence of older adults.

The great concern with the physical function of the elderly during the pandemic period can be explained by the fact that this function is closely related to social participation⁴⁸. The pandemic, in turn, brought with it restrictive measures to contain the virus, and these measures drastically reduced the individual's social participation. Dipietro et al.⁴⁹ explained that physical function performance varies according to the individual's age, with the elderly being the population with the most affected performance. The author also argues that PE is paramount for preserving and improving this function, which may explain why most of the studies included in this review have physical function as the primary outcome.

On a smaller scale, other outcomes also showed important results in the studies included in this review. Body composition, blood triglyceride level, physical activity level, and functional capacity showed significant results, especially over time, which corroborates the literature, where previous studies have already shown significant results for these outcomes^{40,50-54}. However, outcomes such as psychological aspects, self-efficacy,

and health and well-being did not show significant results after participating in the PE programs. In contrast, other studies that used PE programs in their intervention showed significant results for these outcomes⁵⁵⁻⁵⁷.

It was possible to observe in this review that the PE programs used in the studies follow the exercise recommendations established in the literature. It was also observed that the remote modality was the most used, and in-person exercises were used only in populations unable to apply restrictive measures against COVID-19 individually, as is the case of older adult residents in nursing homes. The results obtained in the studies were partially favorable, showing significant results for some observed outcomes, with the physical function being the one that presented the best results, which suggests that, even during the pandemic, PE was an essential strategy for the promotion and maintenance of the health of older adults.

Some limitations of this review should be considered, such as the low number of studies included, due to the pandemic context and the time frame of only 2 years. With this, it was already expected a reduced number of experimental studies. The heterogeneity of the results was another limitation of this review, characterized by the scope of the research question, not including a comparator or control group, the lack of definition of one or more outcomes, the characteristics of the PE programs, and the older adults included. This limitation can be explained due to the profile of this review, which mapped the characteristics of studies that used PE programs during the pandemic period and did not systematically analyze the effects of PE programs. Another limitation that must be considered is the failure to evaluate the impact of restrictive measures on the conduct of studies or the behavior of older adults because they did not bring a metric for this context. Additionally, the effect of PE programs obtained in this review should be treated with caution, as they occurred in different countries and contexts of the pandemic,

with restrictive measures being in a more rigorous or flexible moment, thus limiting the generalizability.

As an expansion of the findings of this review, an update is suggested in the future so that there is a general parameter on the PE programs used during the COVID-19 pandemic, as well as identifying their effects on older adults. In addition, it is expected that after the publication of more experimental studies, more reviews will be carried out that systematically and quantitatively assess the effects of PE on older adults, comparing different groups and controlling for the heterogeneity of the studies.

CONCLUSION

PE programs were primarily effective in improving some clinical outcomes of older adults during the COVID-19 pandemic, particularly physical function. In addition, it was observed that PE programs followed the exercise recommendations in the literature and were delivered in in-person and remote formats. It also highlights the need to use measures that reduce the risk of contamination against the COVID-19 virus, especially in institutionalized older adults. Therefore, it is crucial to implement PE programs during the COVID-19 pandemic or in similar contexts in which there is a need for restrictive measures, such as social isolation, aimed at maintaining the physical, mental, and cognitive functions of older adults.

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REFERENCES

- Cucinotta D, Vanelli M. WHO Declares COVID-19 a Pandemic. *Acta Biomed.* 2020;91(1):157-60. <https://doi.org/10.23750/abm.v91i1.9397>
- Richardson DL, Duncan MJ, Clarke ND, Myers TD, Tallis J. The influence of COVID-19 measures in the United Kingdom on physical activity levels, perceived physical function and mood in older adults: A survey-based observational study. *J Sports Sci.* 2021;39(8):887-99. <https://doi.org/10.1080/02640414.2020.1850984>
- Wu B. Social isolation and loneliness among older adults in the context of COVID-19: a global challenge. *Glob Heal Res Policy.* 2020;5(1):27. <https://doi.org/10.1186/s41256-020-00154-3>
- Bezerra GKSD, Sousa ACPA, Araújo MCM, Lucena GA, Fernandes LFQ, Morais PHM, et al. Efeitos do isolamento social para a saúde de pessoas idosas no contexto da pandemia de Covid-19: um estudo de revisão integrativa. *Res Soc Dev.* 2021;10(4):e23010414070. <https://doi.org/10.33448/rsd-v10i4.14070>
- Kucharski AJ, Klepac P, Conlan AJK, Kissler SM, Tang ML, Fry H, et al. Effectiveness of isolation, testing, contact tracing, and physical distancing on reducing transmission of SARS-CoV-2 in different settings: a mathematical modelling study. *Lancet Infect Dis.* 2020;20(10):1151-60. [https://doi.org/10.1016/S1473-3099\(20\)30457-6](https://doi.org/10.1016/S1473-3099(20)30457-6)
- Qin F, Song Y, Nassiss GP, Zhao L, Dong Y, Zhao C, et al. Physical Activity, Screen Time, and Emotional Well-Being during the 2019 Novel Coronavirus Outbreak in China. *Int J Environ Res Public Health.* 2020;17(14):5170. <https://doi.org/10.3390/ijerph17145170>
- Schuch FB, Bulzing RA, Meyer J, Vancampfort D, Firth J, Stubbs B, et al. Associations of moderate to vigorous physical activity and sedentary behavior with depressive and anxiety symptoms in self-isolating people during the COVID-19 pandemic: A cross-sectional survey in Brazil. *Psychiatry Res.* 2020;292:113339. <https://doi.org/10.1016/j.psychres.2020.113339>
- Roschel H, Artioli GG, Gualano B. Risk of Increased Physical Inactivity During COVID-19 Outbreak in Older People: A Call for Actions. *J Am Geriatr Soc.* 2020;68(6):1126-8. <https://doi.org/10.1111/jgs.16550>
- Brasil, Ministério da Saúde. Pesquisa nacional de saúde: 2019: percepção do estado de saúde, estilos de vida, doenças crônicas e saúde bucal: Brasil e grandes regiões. IBGE (ed). Rio de Janeiro; 2020 [cited 2023 Mar 19]. 105 p. Available from: <https://bit.ly/3TH7LeV>

10. Silva DRP, Werneck AO, Malta DC, Souza Júnior PRB, Azevedo LO, Barros MBA, et al. Changes in the prevalence of physical inactivity and sedentary behavior during COVID-19 pandemic: a survey with 39,693 Brazilian adults. *Cad Saude Publica*. 2021;37(3):e00221920. <https://doi.org/10.1590/0102-311x00221920>
11. Jimeno-Almazán A, Pallarés JG, Buendía-Romero Á, Martínez-Cava A, Franco-López F, Sánchez-Alcaraz Martínez BJ, et al. Post-COVID-19 Syndrome and the Potential Benefits of Exercise. *Int J Environ Res Public Health*. 2021;18(10):5329. <https://doi.org/10.3390/ijerph18105329>
12. Silva Filho E, Xavier J, Cezarino L, Sales H, Albuquerque J. Comment on "The importance of physical exercise during the coronavirus (COVID-19) pandemic." *Rev Assoc Med Bras*. 2020;66(9):1311-3. <https://doi.org/10.1590/1806-9282.66.9.1311>
13. Mendes KDS, Silveira RCCP, Galvão CM. Revisão integrativa: método de pesquisa para a incorporação de evidências na saúde e na enfermagem. *Texto Context - Enferm*. 2008;17(4):758-64. <https://doi.org/10.1590/S0104-07072008000400018>
14. Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Ann Intern Med*. 2018;169(7):467-73. <https://doi.org/10.7326/M18-0850>
15. Santos CMC, Pimenta CAM, Nobre MRC. The PICO strategy for the research question construction and evidence search. *Rev Lat Am Enfermagem*. 2007;15(3):508-11. <https://doi.org/10.1590/S0104-11692007000300023>
16. Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan-a web and mobile app for systematic reviews. *Syst Rev*. 2016;5(1):210. <https://doi.org/10.1186/s13643-016-0384-4>
17. Grant D, Tomlinson D, Tsintzas K, Kolić P, Onambele-Pearson GL. The Effects of Displacing Sedentary Behavior With Two Distinct Patterns of Light Activity on Health Outcomes in Older Adults (Implications for COVID-19 Quarantine). *Front Physiol*. 2020;11:574595. <https://doi.org/10.3389/fphys.2020.574595>
18. Vitale JA, Bonato M, Borghi S, Messina C, Albano D, Corbetta S, et al. Home-Based Resistance Training for Older Subjects during the COVID-19 Outbreak in Italy: Preliminary Results of a Six-Months RCT. *Int J Environ Res Public Health*. 2020;17(24):9533. <https://doi.org/10.3390/ijerph17249533>
19. Beauchamp MR, Hulteen RM, Ruissen GR, Liu Y, Rhodes RE, Wierts CM, et al. Online-Delivered Group and Personal Exercise Programs to Support Low Active Older Adults' Mental Health During the COVID-19 Pandemic: Randomized Controlled Trial. *J Med Internet Res*. 2021;23(7):e30709. <https://doi.org/10.2196/30709>
20. Li F, Harmer P, Voit J, Chou L-S. Implementing an Online Virtual Falls Prevention Intervention During a Public Health Pandemic for Older Adults with Mild Cognitive Impairment: A Feasibility Trial. *Clin Interv Aging*. 2021;16:973-83. <https://doi.org/10.2147/CLIA.S306431>
21. Liang IJ, Perkin OJ, McGuigan PM, Thompson D, Western MJ. Feasibility and Acceptability of Home-Based Exercise Snacking and Tai Chi Snacking Delivered Remotely to Self-Isolating Older Adults During COVID-19. *J Aging Phys Act*. 2022;30(1):33-43. <https://doi.org/10.1123/japa.2020-0391>
22. Chen X, Zhao L, Liu Y, Zhou Z, Zhang H, Wei D, et al. Otago exercise programme for physical function and mental health among older adults with cognitive frailty during COVID-19: A randomised controlled trial. *J Clin Nurs*. 2021;10.1111/locn.15964. <https://doi.org/10.1111/locn.15964>
23. Courel-Ibáñez J, Pallarés JG, García-Conesa S, Buendía-Romero Á, Martínez-Cava A, Izquierdo M. Supervised Exercise (Vivifrail) Protects Institutionalized Older Adults Against Severe Functional Decline After 14 Weeks of COVID Confinement. *J Am Med Dir Assoc*. 2021;22(1):217-219.e2. <https://doi.org/10.1016/j.jamda.2020.11.007>
24. Lee K, Jeong G-C, Yim J. Consideration of the Psychological and Mental Health of the Elderly during COVID-19: A Theoretical Review. *Int J Environ Res Public Health*. 2020;17(21):8098. <https://doi.org/10.3390/ijerph17218098>
25. Baez M, Khaghani Far I, Ibarra F, Ferron M, Didino D, Casati F. Effects of online group exercises for older adults on physical, psychological and social wellbeing: a randomized pilot trial. *Peer J*. 2017;5:e3150. <https://doi.org/10.7717/peerj.3150>
26. Yerrakalva D, Yerrakalva D, Hajna S, Griffin S. Effects of Mobile Health App Interventions on Sedentary Time, Physical Activity, and Fitness in Older Adults: Systematic Review and Meta-Analysis. *J Med Internet Res*. 2019;21(11):e14343. <https://doi.org/10.2196/14343>
27. Guimarães JAC, Guerra PH, Ueno DT, Christofolletti AEM, Nakamura PM. Estudo transversal sobre uso de ferramentas virtuais para orientar a atividade física durante a COVID-19. *Rev Bras Ativ Fis Saúde*. 2020;25:1-8. <https://doi.org/10.12820/rbafs.25e0150>
28. World Health Organization. COVID-19 transmission and protective measures [Internet]. 2022 [updated 21 Sep 2022]. Available from: <http://bit.ly/3lvckIV>
29. Centers for Disease Control and Prevention. COVID-19 Risks and Information for Older Adults [Internet]. [updated 22 Feb 2023]. Available from: <http://bit.ly/3n2rrgO>
30. Pradhan D, Biswasroy P, Kumar Naik P, Ghosh G, Rath G. A Review of Current Interventions for COVID-19 Prevention. *Arch Med Res*. 2020;51(5):363-74. <https://doi.org/10.1016/j.arcmed.2020.04.020>
31. Lima Junior LC. Alimentação saudável e exercícios físicos em meio à pandemia da Covid-19. *Bol Conjunt*. 2020;3(9):33-41. Available from: <https://bit.ly/3JR8ZAU>
32. Santos DAS, Fernandes CC, Watanabe LAR. Cinesioterapia em Idosos de Instituições de Longa Permanência. *Amaz Sci Heal*. 2016;4(4):32-6. Available from: <https://bit.ly/3yP2ZIH>
33. Rugbeer N, Ramklass S, Mckune A, van Heerden J. The effect of group exercise frequency on health related quality of life in institutionalized elderly. *Pan Afr Med J*. 2017;26:35. <https://doi.org/10.11604/pamj.2017.26.35.10518>
34. Espejo-Antúnez L, Pérez-Mármol JM, Cardero-Durán MÁ, Toledo-Marhuenda JV, Albornoz-Cabello M. The Effect of Proprioceptive Exercises on Balance and Physical Function in Institutionalized Older Adults: A Randomized Controlled Trial. *Arch Phys Med Rehabil*. 2020;101(10):1780-8. <https://doi.org/10.1016/j.apmr.2020.06.010>
35. Borges-Machado F, Silva N, Farinatti P, Poton R, Ribeiro Ó, Carvalho J. Effectiveness of Multicomponent Exercise Interventions in Older Adults With Dementia: A Meta-Analysis. *Gerontologist*. 2021;61(8):e449-62. <https://doi.org/10.1093/geront/gnaa091>
36. Sadjapong U, Yodkeeree S, Sungkarat S, Siviroj P. Multicomponent Exercise Program Reduces Frailty and Inflammatory Biomarkers and Improves Physical Performance in Community-Dwelling Older Adults: A Randomized Controlled Trial. *Int J Environ Res Public Health*. 2020;17(11):3760. <https://doi.org/10.3390/ijerph17113760>
37. Roy J, Jain R, Golamari R, Vunnam R, Sahu N. COVID-19 in the geriatric population. *Int J Geriatr Psychiatry*. 2020;35(12):1437-41. <https://doi.org/10.1002/gps.5389>
38. Cadore EL, Sáez de Asteasu ML, Izquierdo M. Multicomponent exercise and the hallmarks of frailty: Considerations on cognitive impairment and acute hospitalization. *Exp Gerontol*. 2019;122:10-4. <https://doi.org/10.1016/j.exger.2019.04.007>
39. Freiburger E, Häberle L, Spirduso WW, Rixt Zijlstra GA. Long-Term Effects of Three Multicomponent Exercise Interventions on Physical Performance and Fall-Related Psychological Outcomes in Community-Dwelling Older Adults: A Randomized Controlled Trial. *J Am Geriatr Soc*. 2012;60(3):437-46. <https://doi.org/10.1111/j.1532-5415.2011.03859.x>
40. Izquierdo M, Merchant RA, Morley JE, Anker SD, Aprahamian I, Arai H, et al. International Exercise Recommendations in Older Adults (ICFSR): Expert Consensus Guidelines. *J Nutr Health Aging*. 2021;25(7):824-53. <https://doi.org/10.1007/s12603-021-1665-8>
41. World Health Organization. Guidelines on physical activity and sedentary behaviour: at a glance. World Health Organization: Geneva; 25 Nov 2020 [cited 19 Mar 2023]. Available from: <http://bit.ly/3Ly0P54>

42. Lazarus NR, Izquierdo M, Higginson IJ, Harridge SDR. Exercise Deficiency Diseases of Ageing: The Primacy of Exercise and Muscle Strengthening as First-Line Therapeutic Agents to Combat Frailty. *J Am Med Dir Assoc*. 2018;19(9):741-3. <https://doi.org/10.1016/j.jamda.2018.04.014>
43. Pedersen BK, Saltin B. Exercise as medicine - evidence for prescribing exercise as therapy in 26 different chronic diseases. *Scand J Med Sci Sports*. 2015;25(Suppl 3):1-72. <https://doi.org/10.1111/sms.12581>
44. Zhao M, Veeranki SP, Magnussen CG, Xi B. Recommended physical activity and all cause and cause specific mortality in US adults: prospective cohort study. *BMJ*. 2020;370:m2031. <https://doi.org/10.1136/bmj.m2031>
45. Wade KH, Richmond RC, Davey Smith G. Physical activity and longevity: how to move closer to causal inference. *Br J Sports Med*. 2018;52(14):890-1. <https://doi.org/10.1136/bjsports-2017-098995>
46. Stensvold D, Viken H, Steinshamn SL, Dalen H, Støylen A, Loennechen JP, et al. Effect of exercise training for five years on all-cause mortality in older adults-the Generation 100 study: randomised controlled trial. *BMJ*. 2020;m3485. <https://doi.org/10.1136/bmj.m3485>
47. Jiménez-Pavón D, Carbonell-Baeza A, Lavie CJ. Physical exercise as therapy to fight against the mental and physical consequences of COVID-19 quarantine: Special focus in older people. *Prog Cardiovasc Dis*. 2020;63(3):386-8. <https://doi.org/10.1016/j.pcad.2020.03.009>
48. Sepúlveda-Loyola W, Rodríguez-Sánchez I, Pérez-Rodríguez P, Ganz F, Torralba R, Oliveira D V, et al. Impact of Social Isolation Due to COVID-19 on Health in Older People: Mental and Physical Effects and Recommendations. *J Nutr Health Aging*. 2020;24(9):938-47. <https://doi.org/10.1007/s12603-020-1469-2>
49. Dipietro L, Campbell WW, Buchner DM, Erickson KI, Powell KE, Bloodgood B, et al. Physical Activity, Injurious Falls, and Physical Function in Aging: An Umbrella Review. *Med Sci Sport Exerc*. 2019;51(6):1303-13. <https://doi.org/10.1249/MSS.0000000000001942>
50. Theodorakopoulos C, Jones J, Bannerman E, Greig CA. Effectiveness of nutritional and exercise interventions to improve body composition and muscle strength or function in sarcopenic obese older adults: A systematic review. *Nutr Res*. 2017;43:3-15. <https://doi.org/10.1016/j.nutres.2017.05.002>
51. Chen N, He X, Feng Y, Ainsworth BE, Liu Y. Effects of resistance training in healthy older people with sarcopenia: a systematic review and meta-analysis of randomized controlled trials. *Eur Rev Aging Phys Act*. 2021;18(1):23. <https://doi.org/10.1186/s11556-021-00277-7>
52. Blasco-Lafarga C, Monteagudo P, Roldán A, Cordellat A, Pesce C. Strategies to change body composition in older adults: do type of exercise and dose distribution matter? *J Sports Med Phys Fitness*. 2020;60(4):552-61. <https://doi.org/10.23736/S0022-4707.20.10321-9>
53. da Rosa Orssatto LB, de la Rocha Freitas C, Shield AJ, Silveira Pinto R, Trajano GS. Effects of resistance training concentric velocity on older adults' functional capacity: A systematic review and meta-analysis of randomised trials. *Exp Gerontol*. 2019;127:110731. <https://doi.org/10.1016/j.exger.2019.110731>
54. Liu C, Shiroy DM, Jones LY, Clark DO. Systematic review of functional training on muscle strength, physical functioning, and activities of daily living in older adults. *Eur Rev Aging Phys Act*. 2014;11(2):95-106. <https://doi.org/10.1007/s11556-014-0144-1>
55. Telenius EW, Engedal K, Bergland A. Long-term effects of a 12 weeks high-intensity functional exercise program on physical function and mental health in nursing home residents with dementia: a single blinded randomized controlled trial. *BMC Geriatr*. 2015;15(1):158. <https://doi.org/10.1186/s12877-015-0151-8>
56. Raafs BM, Karssemeijer EGA, Van der Horst L, Aaronson JA, Olde Rikkert MGM, Kessels RPC. Physical Exercise Training Improves Quality of Life in Healthy Older Adults: A Meta-Analysis. *J Aging Phys Act*. 2020;28(1):81-93. <https://doi.org/10.1123/japa.2018-0436>
57. Paluska SA, Schwenk TL. Physical Activity and Mental Health. *Sport Med*. 2000;29(3):167-80. <https://doi.org/10.2165/00007256-200029030-00003>

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