




# BMJ Open Global mapping of exercise interventions among COVID-19 survivors: protocol for a scoping review

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## ABSTRACT

**Introduction** The COVID-19 pandemic has posed an unparalleled threat to all dimensions of human health and well-being. The Pan American Health Organization has acknowledged the crucial role of rehabilitation therapies for COVID-19 and emphasised the importance of exercise programmes for COVID-19 survivors. This scoping review outlines our strategy for systematically reviewing published and unpublished literature to investigate the volume of evidence for exercise interventions for COVID-19 survivors.

**Methods and analysis** This scoping review will be conducted based on the framework developed by Arksey and O'Malley. Six databases (PubMed/Medline, Scopus, Web of Science, Cochrane Central, ProQuest and CINAHL) will be searched in August 2022 and articles will be considered for inclusion published till July 2022. Studies will be screened by two independent reviewers at the title/abstract and full-text screening stages, as well as data extraction and critical assessment. Data will be extracted in a data extraction form and presented as figures and tables with narratives. This scoping review will give a thorough understanding of the current literature on exercise interventions for COVID-19 survivors, as well as identify knowledge gaps that will guide future research. Preliminary searches will be conducted after the publication of this scoping review protocol.

**Ethics and dissemination** No human or animal participants were involved in this review. Therefore, ethical committee approval is not required. Transparency will be followed at every review stage. Review findings will be disseminated through peer-review publications or through conference presentations.

## STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ This is the first scoping review to map the existing exercise intervention literature among COVID-19 survivors.
- ⇒ This scoping review focused on effectiveness studies only.
- ⇒ Only English language studies will be considered for inclusion.

presentation of the illness are known to have underlying comorbidities and hospitalised patients require long durations of stay (around 4–53 days) or treatment in ICUs (around 4–19 days).<sup>3–5</sup> Many patients are at risk of losing pulmonary functions and eventually having a poor health-related quality of life on discharge from hospitals.<sup>1,2</sup>

As the number of people recovering with COVID-19 rises, it is more important than ever to have a greater understanding of the healthcare challenges they confront. Previous research has shown that post-COVID-19 has an impact on multiple organs. Early data suggest that SARS-CoV-2 infection has left persistent effects such as fatigue, dyspnoea, myalgia, arthralgia, reduced cardio respiratory endurance, decreased functional exercise capacity and exercise tolerance, thereby limiting quality of life.<sup>6–15</sup> All of these require long-term care and rehabilitation to regain functionality. Post-acute COVID-19 (Long COVID-19) is defined as persistent symptoms and/or delayed or long-term complications beyond 4 weeks from the onset of symptoms.<sup>6</sup>

Prior research has indicated that COVID-19 survivors suffer long-term functional limitations following discharge.<sup>8–12, 16</sup> A first case series undertaken by Carfi *et al* among the Italian population in 2020 reported the incidence of post-COVID-19 symptoms stands at 71.4% among post-COVID-19 survivors.<sup>17</sup> Another cohort study conducted by Huang *et*

## INTRODUCTION

The novel human COVID-19 is the fifth known pandemic since the 1918 influenza pandemic.<sup>1</sup> The WHO designated the COVID-19 outbreak as a public health emergency of international concern on 30 January 2020.<sup>2</sup> A recent report indicates that 26% of COVID-19 patients needed to be admitted to the hospital, with 14% requiring intensive care unit (ICU) admission and/or respiratory assistance.<sup>1, 2</sup> Individuals with a severe



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al among discharged COVID-19 patients in 2021 reported that 63% COVID-19 survivors were having musculoskeletal related symptoms with reduced 6 min walk distance.<sup>18</sup> Impaired pulmonary diffusion capacities and abnormal radiographic features were evident among patients who were seriously ill during their hospital admissions. As a result, they were the major target group for long-term recovery interventions.<sup>18</sup>

COVID-19 rehabilitation research framework has been developed by the WHO Rehabilitation Programme and Cochrane Rehabilitation team to inform best practices and ensure that the health system offers its best to serve the COVID-19 survivors.<sup>19</sup> The rehabilitation community has recently issued a 'call to action' to overcome multi-domain impairments among COVID-19 survivors.<sup>8 20</sup>

Exercise has been found to offer short and long-term health benefits in preventing, mitigating and even reversal of a wide range of metabolic, pulmonary, cardiovascular, neuropsychological, inflammatory and musculoskeletal illnesses. The benefits of exercise-induced immune response, including increased antipathogen activity, enhanced recirculation of anti-inflammatory cytokines and leucocytosis are relevant for fighting viral infections such as COVID-19.<sup>21</sup>

Rehabilitation professionals such as physiotherapists play a vital role in assessing and providing comprehensive pulmonary rehabilitation programme in long COVID-19 to restore functionality (cardiorespiratory, musculoskeletal).<sup>22 23</sup> A preliminary report suggested the positive impact of pulmonary rehabilitation programme on dyspnoea and fatigue<sup>24</sup> among long COVID-19. However, the effectiveness of Pulmonary rehabilitation for long COVID-19 remains unclear.

Against this background, this scoping review will be conducted with an objective of mapping and collating the published literature on the exercise interventions among COVID-19 survivors.

## METHODS

The present scoping review will be conducted in accordance with the Arksey and O'Malley's<sup>25</sup> framework which was further methodologically enhanced by the Levac *et al*<sup>26</sup> and Joanna Briggs Institute.<sup>27</sup> According to this framework, there are five main stages in undertaking a scoping review: (1) identification of research question; (2) identification of relevant studies; (3) study selection; (4) charting the data and (5) collate, summarise, and report the findings.

### Stage 1: identify the research question

The research question for this scoping study was established by the team members after extensive brainstorming and further refinement of ideas. Based on the terminologies, preliminary literature search and current trends addressing long COVID-19 and exercises intervention, the research questions are presented in [table 1](#). Also, narrative synthesis of change in outcome such as fatigue,

**Table 1** Scoping review research questions

Aspect	Research questions
Descriptive	How many studies published (year wise) on exercise intervention among COVID-19 survivors or long COVID? What is the region wise distribution (as per WHO classification) of published literature?
Methods	What type of study designs used in published literature? What are the research methods employed in published literature? What are the population characteristics available in published literature?
Exercise regimen	What is the type of exercise evaluated in published literature? What is the dose of exercise being reported in published literature?
Exercise and COVID-19 survivor or Long COVID	What is the impact of exercise on physical health among COVID-19 survivors as reported in published literature? What are the adverse events reported following exercise intervention (if any)?

dyspnoea, myalgia, arthralgia, reduced cardio respiratory endurance, decreased functional exercise capacity, exercise tolerance, health-related quality of life, quality of life, anxiety, stress, depression, self-esteem, mental health and mental well-being following intervention will be reported.

### Stage 2: identifying relevant studies

Based on Arksey and O'Malley's framework,<sup>25</sup> this stage entails the identification of the available literature. The search will be based on the Medical Subject Heading (MeSH) terms ([table 2](#)) and the associated keywords identified through MeSH library.<sup>28</sup> Drawing the help of an evidence specialist and a subject-matter expert, the search strategy ([table 3](#)) will be developed, which is likely to include a wide range of keywords and controlled vocabulary. Without using any time frames, a search query will be developed in PubMed/Medline and this will be reciprocated for additional specified databases such as Scopus, Web of Science, Cochrane Central, ProQuest and CINAHL. These databases have been included based on the authors' accessibility to them through their respective institutions and because they are comprehensive in terms of culminating information on exercise interventions. Studies will be screened for inclusion based on the Population, Concept and Context ([table 4](#)). Handsearch of the reference list of all included studies will be performed to ensure the inclusion of eligible and relevant studies.

**Table 2** Search theme and terms

Domain	Search terms
Population	Covid19 survivors, long COVID, post-acute COVID, COVID19, coronavirus survivors, COVID-19 patients, Coronavirus positive patients, Novel Coronavirus patients, 2019 Novel Coronavirus, 2019-nCoV, SARS-CoV-2
Physical activity intervention	Exercise, fitness, physical activity, physical education, physical fitness, aerobic exercise, resistance training, movement, physical excursion, exercise, mobility, walking, brisk walking, running, cycling, swimming, activity, basic activities, essential activities
Outcomes	Fatigue, dyspnea, myalgia, arthralgia, reduced cardio respiratory endurance, decreased functional exercise capacity, exercise tolerance, Health related Quality of Life, quality of life, anxiety, stress, depression, self-esteem, mental health and mental wellbeing
Study design	Randomized control trial, quasi experimental studies, before vs after studies, other matching designs

Eligibility criteria for the inclusion of the studies are given below.

#### Inclusion criteria

All research articles eligible for selection must meet the following inclusion criteria:

1. Effectiveness studies (randomised control trials, quasi-experimental studies, other matching studies, before vs after study) were published in peer-reviewed journals.
2. Studies must be conducted among survivors of COVID-19 (Long COVID-19) after 4 weeks of recovery.
3. Must assess the exercise interventions (aerobic, resistance and concurrent exercise).
4. Studies conducted in the English language.

#### Exclusion criteria

1. Studies other than effectiveness studies will be excluded.
2. Reviews, reports, commentary and editorials will also be excluded.
3. Studies will be excluded where participants are cognitively not fit.

**Table 3** Search strategy for PubMed/Medline

Sl. no.	Search strategy
#1	“Covid19 patients” OR “Long Covid19” OR “post-acute Covid19” OR “Covid19 survivors” OR “Covid19” OR “coronavirus survivors” OR “coronavirus positive patients” OR “novel coronavirus patients” OR “2019 novel coronavirus” OR “2019-nCoV” OR “SARS-CoV-2”
#2	Exercise OR fitness OR “physical activity” OR “physical education” OR “physical fitness” OR “aerobic exercise” OR “resistance training” OR movement OR “physical excursion” OR exercise OR mobility OR walking OR “brisk walking” OR running OR cycling OR swimming OR activity OR “basic activities” OR “essential activities”
#3	“Health related Quality of Life” OR “quality of life” OR “physical health” OR tiredness OR fatigue OR pain OR myalgia OR “musculoskeletal pain” OR “exercise tolerance” OR rehabilitation OR “cardio respiratory endurance” OR “functional exercise capacity” OR anxiety OR stress OR depression OR “self-esteem” OR “mental health” OR “mental wellbeing”
#4	RCT OR Randomized control trial or quasi experimental study OR pre post study OR before vs after study OR experimental study OR effectiveness study
#5	#1 AND #2
#6	#4 AND #5
#7	#3 AND #5 AND #6

**Table 4** Eligibility criteria for the studies

Population	COVID-19 survivors (Long COVID following 4 weeks recovery) aged above 18 years will be included.
Concept	Any exercise interventions (aerobic, resistance and concurrent exercise). Exercise dose must be reported as per frequency, intensity, type, time, volume and progression.  Health-related quality of life, fatigue, musculoskeletal pain, exercise tolerance, cardiorespiratory fitness, mental health and well-being, emotional instability
Context	All studies will be screened and reported based on: 1. WHO regional classification for countries. 2. At community level—both home based and centre based 3. Healthcare facilities

### Patient and public involvement

No patients were involved in this review.

### Stage 3: study selection

This scoping review will follow a two-stage article selection process: (1) Title and abstract screening and (2) full-text screening using Rayyan.qcri.org software.<sup>29</sup> Inter-rater reliability will be calculated for the above two stages using Cohen's kappa statistics.<sup>30</sup> Searches will be conducted on the mentioned databases and duplicates will be removed making use of the Rayyan software. Both title and abstract screening, as well as full-text screening will be conducted independently by two reviewers (RA and RKK). Any discrepancy related to the inclusion or exclusion of the study among the reviewers will be resolved by discussion and mutual consensus. In the case of a disagreement among the reviewers, a third reviewer (MKS) will resolve it. Reporting guidelines and criteria set in Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews checklist will be used.<sup>31</sup>

### Stage 4: charting the data

Arksey and O'Malley<sup>25</sup> demonstrated the fourth stage of the framework in charting the data from selected studies. To extract relevant data from the included studies, the study team (VK, MKS and AS) will design a data extraction tool in collaboration with subject knowledge experts with more than 7 years of experience in exercise prescription. These data collecting tool will be piloted for 5% of the studies to ensure that it captures the information needed for this scoping review by two independent authors (AV and MN). Two authors will extract data independently, and discrepancies will be solved by mutual consensus (RA and RKK). Data will be extracted on the following characteristics: (1) Bibliometric information (study title, authors, journal name, publication year, country, research setting, population characteristics like age, gender, body mass index, duration of hospitalisation if any); (2) Methodological characteristics (method of randomisation if applicable, sampling technique and sample size); (3) Intervention (type of exercise, method of delivery, the dose of exercise in terms of warm-up, cool down, frequency, intensity, type, time, volume and progression and type of comparator and (4) outcomes related to the quality of life, physical health, cardiorespiratory fitness and musculoskeletal pain.

### Critical appraisal

All included studies will be critically appraised using Joanna Briggs's critical appraisal tool.<sup>32</sup> Two authors (AV and MN) will independently assess the study quality and resolve disagreements through discussion and mutual consensus. The overall risk assessment will be presented in a tabular or graphical manner and will be described through systematic narrative synthesis.

### Stage 5: collating, summarising and reporting the results

The descriptive and narrative summaries developed based on the findings of this scoping review will be documented in a report format that follows the Joanna Briggs Institute Reviewer's manual recommendation.<sup>27</sup> The key components of the domains in the included studies, such as study area, exercise dosage in the form of warm-up, cool down, frequency, intensity, type, time, volume and progression, sample size, and research outcomes, will be visualised using summary tables. Other relevant findings will be presented in a tabular manner with appropriate charts (bar and pie).

## DISCUSSION

Residual changes in affected lungs and reduced quality of life (physical, health related) are evident among COVID-19 survivors.<sup>33</sup> Due to these clinical manifestations, exercise interventions play a significant role in the rehabilitation of COVID-19 survivors. This scoping review will map and collate the available literature on exercise interventions among COVID-19 survivors.

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