

BMJ Open Effect of physical activity on coronary heart disease risk factors among firefighters: a scoping review protocol

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To cite: Achmat G, Erasmus C, Kanaley J, *et al*. Effect of physical activity on coronary heart disease risk factors among firefighters: a scoping review protocol. *BMJ Open* 2023;**13**:e068353. doi:10.1136/bmjopen-2022-068353

► Prepublication history for this paper is available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2022-068353>).

Received 15 September 2022
Accepted 02 May 2023



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ABSTRACT

Introduction Physical activity interventions have been used for various health conditions, including cardiovascular disease. However, the literature is still limited regarding the effect of physical activity on coronary heart disease among firefighters.

Methods and analysis The review will be conducted according to recommendations from the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) and PRISMA Protocol guidelines. This scoping review will provide a synthesis of current evidence on the effects of physical activity on coronary heart disease among firefighters. Search strategies will be performed in the following databases: Cochrane database, PubMed, Medline, (EbscoHost), Web of Science, Academic Search Complete, CINAHL (EBSCO), SAGE journals, ScienceDirect and Scopus. We will include literature in the English language that are full-text peer-reviewed articles from inception to November 2021. Screening of (titles, abstracts and full text of potential articles) will be done by two independent authors using EndNote V.9 software tool. A standardised data extraction form will be designed for the extraction. Two authors will independently extract the data from the selected articles and all differences will be discussed by an invited third reviewer if a consensus cannot be reached. The primary outcomes will be the impact of physical fitness on firefighters experiencing coronary artery disease. This information can assist policy-makers in decision-making related to the use of physical activity in firefighters experiencing coronary heart disease.

Ethics and dissemination Ethical clearance has been obtained from the University ethics committee and the City of Cape Town. The findings will be disseminated through publications and the physical activity guidelines will be submitted to the Fire Departments within the City of Cape Town. Data analysis will start on 1 April 2023.

INTRODUCTION

Sudden cardiac events such as heart attacks are expected to be a leading cause of death and disability for active-duty firefighters in developed countries.¹ Therefore, health promotion through physical activity (PA) and the prevention of coronary heart disease risk factors (CHDRF) are paramount. Myocardial infarction due to atherosclerotic cardiovascular disease (CVD) significantly

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ The study proposes the use of multiple sources for data collection towards developing a guideline to inform policy on coronary heart disease.
- ⇒ It also proposes a proven methodology, the Delphi technique, to develop the guideline.
- ⇒ This study will be conducted in only one province out of nine provinces of South Africa.
- ⇒ Since the data on this particular topic is novel and unclear, researchers chose a scoping review over a systematic review.
- ⇒ The study will give an in-depth understanding of the current state of coronary artery disease of firefighters.

impairs function and is associated with a history of hypertension, dyslipidaemia, type 2 diabetes mellitus, peripheral artery disease, an increase in age, a family history of CVD, cigarette smoking, a higher body mass index (BMI) and low levels of PA.²⁻³ Indeed, firefighters with increased incidence of CHDRF have significant personal and occupational functioning impairments and are at risk of cardiac disease.³⁻⁴ Given the high prevalence, interventions that promote PA as well as targeting early detection threshold levels of CHDRF are essential.⁴⁻⁵ Access to interventions that promote PA and effective early detection signs of CVD has the potential to impact CHDRF, occupational demands of firefighters, prevent the impact of morbidity, mortality and economic burden of illness in countries.⁵⁻⁷ Smith *et al*⁸ reported physicians lack an understanding of the physiological and psychological strain of the firefighters' job so they can perform their duties in the interest of the public good.⁸ Physicians are reluctant to take firefighters off duty despite the detection of early signs of CVDs such as high blood pressure. Thus, leaving treatment in the hands of firefighters and placing them at greater risk of sudden cardiac death.⁷⁻⁸ Therefore, interventions need to be firefighter-specific and feasible to conduct

appropriate medical evaluations in order to address risk factors and provide fire departments with a comprehensive wellness and fitness programme.^{8 9}

RATIONALE

Evolving evidence shows that PA or exercise is effective in reducing CVD symptoms among firefighters¹⁰⁻¹²; few studies have examined PA or exercise as a physical health promotion strategy for other CHDRF. One single meta-analysis has proved the benefits of PA on health and fitness in firefighters.¹³ Previous reviews on CVD in firefighters focused on the risk of on-duty death and disability among firefighters with coronary heart disease (CHD). The review highlighted that firefighters should be restricted from participating in strenuous emergency duties, such as being placed on light duty work until health concerns are suitably addressed.¹³ Therefore, more active and effective approaches in addressing CHD are needed.^{13 14} A preliminary search of PROSPERO and MEDLINE found no existing or ongoing scoping or systematic reviews focusing on this research study, highlighting the need to conduct a scoping review on PA/exercise for firefighters' with CHDRF.

REVIEW QUESTION

What are the effects of physical activity on CHDRF among firefighters?

AIM

The aim of this scoping review will be to explore the effect of PA on CHDRF among firefighters.

OBJECTIVES

To conduct a scoping review and narrative analysis exploring the effect of PA on CHDRF among firefighters.

METHODS AND ANALYSIS

Patient and public involvement

No patient involved.

The review will be conducted according to recommendations from the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for scoping reviews (PRISMA-ScR) and the six-stage framework outlined in Arksey and O'Malley. The start date of this study is 1 January 2021 and intention to complete by 31 December 2023.

The following steps will be used to conduct the scoping review as recommended by Arksey and O'Malley's six stage framework:

1. Identifying the research question.
2. Identifying relevant studies.
3. Study selection.
4. Charting the data.

5. Collating, summarising and reporting the results.
6. Consultation exercise.

Stage 1: identification of the research question and objectives

The main purpose of undertaking this scoping review was to identify, collate and synthesise the results reported in the studies impacting coronary artery disease and health risk behaviours among firefighters. The principal research question guiding this scoping review is as follows:

- ▶ What is the effect of PA on coronary artery disease among firefighters?

The secondary research questions are the following:

- ▶ What are the strengths and limitations of these exercise and intervention programmes?

The study will use the Population, Exposure and Outcome (PEO) a framework recommended for aetiology and/or risk and lending itself more to qualitative research. The PEO framework to determine our research questions and the search strategy is illustrated below.

Participants

Sedentary firefighters (aged 18 years or older) defined as firefighters not participating in at least 30 min of moderate-intensity PA on at least 3 days/week for at least 3 months. Chronic diseases of lifestyle will be defined as those firefighters with serious injury, long-term physical incapacity, suffering or rehabilitating from chronic conditions and various risk factors that require medication. These studies will be included in the scoping review and classified as inactive firefighters experiencing chronic diseases.

Exposure

Studies involving active firefighters across the globe who have CHD risk and were exposed to PA will be included in the scoping review.

Outcomes

Primary outcomes will be measured in terms of PA and/or sedentary behaviour assessed at baseline and/or postintervention (defined as directly after intervention completion). The primary outcomes will be the impact of physical fitness on firefighters experiencing coronary artery disease. All settings will be included such as leisure centre, primary care and delivery formats of either individual or group settings. Secondary outcomes, such as physiological, psychological, biological and occupational where available, will be recorded.

STAGE 2: IDENTIFYING RELEVANT STUDIES

Study eligibility criteria

In order to be included in this study, literature must report data relating to the effect of PA on CAD risk factors among firefighters. The criteria will be English full-text peer-reviewed articles from any time to November 2021, inclusive of qualitative, quantitative and mixed-method studies. Studies using secondary data, not peer reviewed, not published in the English language and data from

Table 1 Inclusion and Exclusion Criteria

| Inclusion criteria | Exclusion criteria |
|--|--|
| Full text studies | Studies using secondary data |
| English peer reviewed studies | Studies not published in the English language |
| Qualitative, quantitative and mixed-method studies | Studies not peer reviewed |
| CHD articles with firefighters | Employees other than those employed in a fire and rescue setting |
| Articles about physical activity with firefighters | Leisure Studies |
| Inception until November 2021 | Studies not conducted in humans |
| CHD, coronary heart disease. | |

other professionals (eg, police officers), will form part of the exclusion criteria. Studies reporting on intervention will also be included. The inclusion and exclusion criteria are identified in [table 1](#).

PA interventions on firefighters with one or more of the eight CADs will be included into the scoping review. The American College of Sport Medicine stratification; age, a family history of heart disease, cigarette smoking, a sedentary lifestyle, obesity, dyslipidaemia and pre-diabetes will be used as the guideline recommendations.¹⁵ CAD often referred to as atherosclerotic heart disease caused by the build-up of plaque.^{15–17} This causes coronary arteries to narrow, limiting blood flow to the heart and damaging the heart's major blood vessels. Risk factors for coronary artery disease fall into two categories.^{18–20} Modifiable risk factors one can modify and control include smoking, nutrition, alcohol and PA.^{21–23} Non-modifiable risk factors one cannot control include a person's age and gender.^{21–24}

Furthermore, these lifestyle risk factors are related to non-communicable diseases (NCDs) such as CVDs, cancer or chronic respiratory diseases.^{13–15} Health outcomes must report data from studies focusing on the effects of PA on any of the eight coronary artery disease risk factors. The risk stratification with norms is listed in [table 2](#).¹⁵

Awareness of risk factors for coronary artery disease

CVDs, commonly referred to as heart disease or stroke, are the number one cause of death around the world.^{24 25} NCDs are medical conditions or disease which is non-infectious and cannot be passed from person to person.^{26 27} These NCDs may be chronic diseases of long duration and slow progression, which may result in more rapid death such as a sudden stroke.^{28 29}

The four main NCDs are^{23–25}:

1. CVDs, predominantly heart attacks and stroke.
2. Cancers.
3. Respiratory diseases (particularly chronic obstructive pulmonary diseases and asthma).
4. Diabetes.

Table 2 ACSM 8 positive risk factors that are associated with coronary artery disease

| Risk factor | Defining criteria |
|----------------------|--|
| Age | Men ≥ 45 years; women ≥ 55 years |
| Family history | Heart attack, bypass surgery or sudden death before the age of 55 years for father/brother; or before 65 years for mother/sister |
| Cigarette smoking | Current smoker, or have quit < 6 months, or exposure to environmental smoke |
| Sedentary lifestyle | Not participating in at least 30 min of moderate intensity physical activity (40%– $< 60\%$ VO_2R) on at least 3 days/week for 3 months |
| Obesity | Body mass index ≥ 30 kg/m^2 index or waist girth > 102 cm (40in) for men and 88 cm (35in) for women |
| Hypertension | Systolic blood pressure ≥ 140 mm Hg and or diastolic ≥ 90 mm Hg, or taking medication |
| Dyslipidaemia | LDL ≥ 130 mg/dL, or HDL < 40 mg/dL, or taking medication. Or TC > 200 mg/dL |
| Pre-diabetes | IFG ≥ 100 mg/dL or OGTT ≥ 140 and ≤ 199 mg/dL confirmed by two different measurements. |
| Negative risk factor | |
| HDL | ≥ 60 mg/dL |

*ACSM's Guidelines for Exercise Testing and Prescription Lippincott Williams Wilkins, 2014 (p.27).

ACSM, American College of Sport Medicine; HDL, HDL (high-density lipoprotein) cholesterol, sometimes called "good" cholesterol, absorbs cholesterol in the blood and carries it back to the liver. The liver then flushes it from the body. High levels of HDL cholesterol can lower your risk for heart disease and stroke.^{15–17}; IFG, Impaired fasting glycaemia (IFG) is sometimes called pre-diabetes. This is when blood glucose levels in the body are raised, but are not high enough to mean that the person has diabetes. IFG means that the body isn't able to use glucose as efficiently as it should.^{18–20}; LDL, LDL (low-density lipoprotein) cholesterol, sometimes called "bad" cholesterol, makes up most of your body's cholesterol. High levels of LDL cholesterol raise your risk for heart disease and stroke.^{21–24}; OGTT, Oral glucose tolerance tests (OGTT) are used to measure how well the body can process a larger amount of sugar. If the blood sugar measured in the test is above a certain level, this could be a sign that sugar is not being absorbed enough by the body's cells.^{21–24}.

These atherosclerotic plaques in coronary arteries are associated with unhealthy eating habits and poor lifestyle behaviour.³⁰ The interplay between lifestyle habits, medical risk factors and physical fitness indicates that firefighters are subjected to severe physical exertion.^{31–33} Such sympathetic drive increases shear stress on coronary arteries making firefighters more susceptible to acute cardiac events because the cardiovascular system is stressed.^{34–36} Hazardous tactical operations as such, in the presence of endothelial dysfunction and plaque build-up can cause myocardial ischaemia, infarction and mortality.^{37–39} Therefore, a number of CAD risk factors a firefighter possesses combined with their physical fitness

level provide a comprehensive look into the overall health of firefighters tasked with protecting the lives and property of the public.^{40 41}

Study search strategy and selection

The following electronic databases will be searched: Cochrane database, PubMed, Medline, (EbscoHost), Web of Science, Academic Search Complete, CINAHL (EBSCO) Science Direct and Scopus. Searches will include a combination of terms from medical subject headings (MeSH) and keywords in the title, abstract and text. The search shall include multiple terms for population (eg, firefighter), intervention (eg, health promotion, PA), comparator (eg, interventions without PA) and outcome themes (eg, exercise, sedentary behaviour).

All terms within each theme will be combined with 'OR' and then the themes will be combined with 'AND.' Databases will be searched for studies reporting data on firefighters' exercise, fitness and PA using the following search terms:

(physical activity OR exercise OR fitness OR physical exercise AND coronary artery disease OR cad OR coronary heart disease OR chd AND firefighters OR fire fighters OR fire service OR firefighting).

All studies published until 2021 will be searched. Searches will only be limited and inclusive of peer-reviewed journals. Grey literature such as government reports, institutional documents, dissertations (excepting sections published as peer-reviewed articles), books, book chapters, conference abstracts or proceedings, blogs, newsletters or any opinion-based publications and commentaries will be excluded. The scoping review will consider all studies using quantitative, qualitative, mixed-methods studies as well as non-observational studies. The scoping review process is described in [figure 1](#).

IDENTIFICATION OF STUDIES IN THE REGISTERED DATABASES

Stage 3: study selection

The studies retrieved from above-mentioned databases will be combined, and all the duplicates will be removed. A two-step process will be adopted for identifying the relevant studies. In the first step, two reviewers (GA and LL) will screen the titles and abstracts of the studies. Studies not meeting the eligibility criteria will be excluded. After screening of approximately 50 articles, the results will be compared with ensure consistency and resolve any

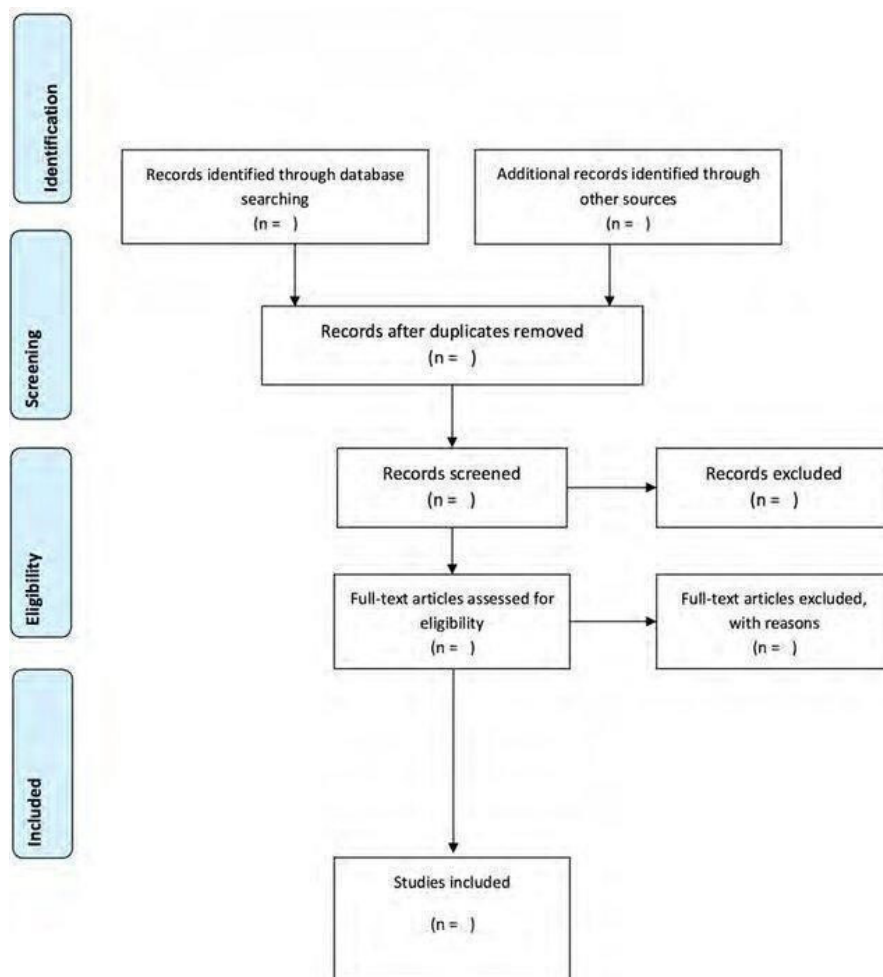


Figure 1 PRISMA flow diagram for the scoping review process. PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

incongruity. During this step, the detected protocols and reviews will also be screened for further potentially relevant articles. First, the abstracts will be screened. Then the reference lists of the remaining reviews will be checked for further articles. Similarly, potential studies that may result from relevant protocols will also be searched.

During the second step, the two authors (GA and LL) will be reading the full-text of the selected articles to check for the eligibility criteria. The reason for exclusion will be recorded. The articles meeting all the eligibility criteria will be used for data extraction. For each of the two steps, if there are disagreements between the reviewers, they will discuss the differences, and a third reviewer (CE or JK) will be invited if GA and LL cannot reach a consensus.

Risk of bias

Critical appraisal of articles is a two-step process that will be performed using the checklist to assess the methodological quality of each article based on its proposed definition. Moreover, the full texts will be appraised by two researchers (GA and LL) separately.

Stage 4: data extraction and charting the data

In order to describe the different methods and outputs, their meaning, strengths and limitations as well as their association with different PA outcomes, the data from selected CHD articles will be extracted by two reviewers (GA and LL) independently by means of a data extraction form. A literature search will be conducted by one reviewer (GA), results will be saved in a reference manager and duplicates will be eliminated using the Covidence provided software tools. Remaining files will be shared with a second reviewer (LL). The two reviewers (GA and LL) will undertake an extensive and comprehensive search to find applicable studies irrespective of publication status or language and assist in the quality checking of the studies. The reviewers (GA and LL) will independently double-check the eligibility of the included studies and extract data by entering details into a predefined data acquisition form. Four main domains: (1) citation information (title, author list, source of publication, year of publication, first author's name and affiliation, country, sponsor), (2) design (design, participants, trial methods, duration, intervention details), (3) results (outcome measures, adverse events) and (4) conclusion will be included in the acquisition form. Any discrepancy noticed in the process of data cross-checking will be resolved through discussion between the two reviewers. If they cannot reach consensus, the suggestion of a third reviewer (CE or JK) will be approached to resolve the issue. Investigators will not be blind to the journal titles, institutions or study authors. The data extraction form will be tested on three different studies to ensure the functionality of the form. Any disagreement will be resolved through discussion and, if required, discussion with a third reviewer (CE or JK). During the data extraction process, the researchers will regularly compare the extracted data

to ensure consistency. The data extraction form may be refined/adapted on the basis of this experience.³⁵

Quality assessment

Depending on the quality of the data included in the studies, critical appraisal tools will independently be adapted to assess the different study designs of qualitative, quantitative and mixed methods. The Critical Appraisal Skill Programme (2014) and the Evaluative Tool for Mixed Method Studies will be adapted for the appraisal of qualitative, quantitative and mixed-methods research along the guidelines proposed by Law *et al.*^{41–43}

These adapted appraisal tools aim to evaluate holistically potential studies according to six domains:

1. Study purpose.
2. Study design.
3. Sampling techniques.
4. Data collection methods.
5. Methods of analysis.
6. Ethical considerations.

Such evaluation ensures both the overall quality and the methodological quality of each subsection.^{42 43} Rating scales of appraisal tools will be adjusted to produce a composite score indicating the quality of studies from weak (0–30), moderate (31–65), strong (66–80) and excellent (81–100).^{43–45} The predetermined threshold score set for this study will be studies within the categories of strong and above. Appraisal tools will be piloted to ascertain the validity and reliability of individual items, resulting in the addition of missing items and the deletion of extraneous items for an improved reviewing process.^{41–45}

Stage 5: collating, summarising and reporting the data

The data will be presented in the form of two tables. The first table will present the study designs, methodology and PA summary variables, while the second table will describe the association of the variables with the studied health outcomes. A synthesis of the results will describe the key characteristics of these studies and how these studies profiled PA and risk factors of CHDs. Further, the tables may be refined or the results may be presented in a graphical format based on the data extracted in order to present the results in a lucid and comprehensible manner.

Stage 6: consulting with stakeholders

The findings of the study provide opportunities for stakeholders to suggest additional recommendations to the PA guidelines, beyond what was discovered in the literature.

Data analysis

A narrative synthesis approach to the scoping review from multiple studies and different methodologies will be applied. This allows for the inclusion of statistical data, distinguishing the characteristics of a textual approach to summarise and describe findings to form a story from the included studies. Data will narratively be synthesised, and the results will be reported according to the objects and

aligned with the PRISMA flow chart. The proposed date to start analysing data for this study is 1 April 2023.

Current study status

At the time of writing this manuscript, prescreening was completed independently by one investigator and data extraction has not started.

ETHICS AND DISSEMINATION

This study involves analysis of data from published literature and does not involve individual-level identifiable data. Given this, there will be no privacy concerns that require ethical approval. Results from this study will be presented at conferences and through publication in a peer-reviewed journal.

Acknowledgements We acknowledge the help and support of our Faculty Librarian, Karen Cook, University of the Western Cape.

Contributors This scoping review protocol was initially conceived and designed by GA and LL. This manuscript was initially drafted by GA, LL, CE and JK. Subsequent drafts were commented on by all members involved in the study and revisions made by the author. All authors have approved submission.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

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