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Worldwide prevalence of obesity among firefighters: a systematic review protocol

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TITLE: Worldwide prevalence of obesity among firefighters: a systematic review protocol

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Word count: 1,848

Number of Figures:1

Number of Tables: 0

Number of References: 44

Number of Supplementary Files: 2

ABSTRACT

Introduction

Obesity may interfere with job performance and increase the risk of injury during firefighting activity. Obesity also has many deleterious effects on health indices and is associated with higher all-cause mortality. Several studies have reported a high prevalence of obesity in the fire service. Possibly, this could be a reflection of the obesity prevalence in their original population. Also, firefighter's work routine (12-24 hour shifts) and food availability during night shifts may be related to weight gain during career. Studies in American firefighters have shown annual weight gain between 0.5-1.5 kg. This study aims to report the obesity prevalence in the fire service to describe how it varies based on country and region, job status, type of firefighter and gender.

Methods and analysis

We will systematically search the literature databases PubMed, Medline, Web of Science and Sportdiscus. Two independent reviewers will search, screen, select studies and evaluate their methodological and reporting quality. One reviewer will extract data from eligible studies. The main outcome measured will be obesity prevalence. The results will be reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement. We plan to produce a narrative summary of our findings. Evidence tables will be generated to descriptively summarize the included studies and results.

Ethics and dissemination

The systematic review does not require ethics clearance since published studies with non-identifiable data will be used. The results of the systematic review will be disseminated via publication in a peer-reviewed journal as well as through conference presentations

Registration

This systematic review protocol has been registered at PROSPERO (CRD42019129122)

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Keywords

Fire and Rescue Personnel, Abdominal Fat, Overweight

ARTICLE SUMMARY

Strengths and limitations of this study

- The first systematic review of worldwide obesity prevalence in firefighters.

- A comprehensive synthesis of worldwide obesity prevalence, including a narrative comparison with the country of origin of the study using a standardized risk of bias tool.

- Search, study selection and risk of bias assessment will be performed independently by two researchers, which will ensure that all relevant studies are included without personal biases.

- A potential limitation of this review may be a small number of studies available for countries other than United States.

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INTRODUCTION

Firefighters perform critical public safety work public. Considering all the different occupational hazards firefighters face, it is surprising to many that the leading cause of duty-related death among United States (US) firefighters is sudden cardiac death (SCD). In 2017, SCD accounted for almost half of on-duty deaths in the US, and SCD has been responsible for about 43% of on duty fatalities for the last 10 years [1]. Furthermore, for every fatal on-duty cardiac event, there are an estimated 20 nonfatal on-duty cardiovascular events [2]. Theoretical models have been proposed in order to conceptualize how firefighters activities can result in a SCD [3–6].

Clearly, the underlying health of the firefighters is one of the important aspects associated with cardiovascular death in the fire service. Also, individual risk factors are critical factors in determining risk of SCD. Research has consistently found a highly prevalence of cardiovascular disease risk among FFs. Obesity increases the odds of a fatal on-duty coronary heart disease event by 1.5-6.6 times [7], and is highly associated with cardiomegaly in firefighters [8]. Studies report obesity prevalence in the US ranging from 22% [9] to 60% [10] depending on the region, time and type of firefighter (career or volunteer). Outside of the US, lower estimates of obesity have been reported. In Brazil, obesity rates of less than 15% have been reported for firefighters (who are members of the military)[11,12].

Obesity may interfere with job performance and increase the risk of injury during firefighting activity [13–15]. Obesity also has many deleterious effects on health indices, including: reduced arterial function [16,17], glucose intolerance, dyslipidemia, type 2 diabetes, hypertension, osteoarthritis [18], low cardiorespiratory fitness [19], pathological remodeling of the heart [20], endocrine disorders [21,22] and is associated with higher all-cause mortality [23].

Several studies in the US have reported that firefighter recruits begin their career with an elevated BMI [24,25]. In one study, conducted in Massachusetts, 33% of the recruits were obese [26]. Research has also shown that a significant weight gain occurs during a firefighters careers

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[26,27]. A recent case-control study which retrospectively examined all available autopsy records of US fire fighters between 1999 and 2014 has shown obesity prevalence estimates as high as 59.2% among cardiac cases and 47.7% among noncardiac trauma control cases [15].

Firefighter's work routine (12-24 hour work shifts) added to lower availability of healthy food during night shifts may have an important contribution to weight gain [28] as shift-working by itself is considered an independent risk factor for obesity [29–31]. Some US cohort studies report firefighters annual weight gain ranging from 0.5 kg [32] to 1.5 kg [33]. Ide [27] reports similar values for Scottish Firefighters, with a mean gain of 1.5 kg/year. This could represent a gain of 5 kg to 15 kg of weight in 10 years of service. Data from the Health Professionals Follow-Up Study show a significant weight gain of 0.2 kg every year [34], a considerably lower value compared to those in firefighters. These facts raise an interesting question, do firefighters have a high obesity prevalence because of the population of origin i.e. those who become firefighters (US population) have a large proportion of men with obesity, or does firefighting lead to obesity, or is it associated with the burden of their type of service.

Poston et al., [35] analyzed the obesity prevalence in 677 firefighters and compared them to the US adults. While prevalence was similar, in a separate analysis, volunteers seemed to possess a higher prevalence of obesity compared to US adults and career firefighters. Others studies show similarities between the firefighters and their original population [19,36], in contrast, German firefighters seem to be more fit than sedentary clerks and police officers from the same region [37]. Thus, this study aims to (1) report the obesity prevalence in the fire service (2) to describe how it varies based on country and region, job status, type of firefighter and gender.

Objectives

The present studies intends to address the following issues:

- What is the prevalence of obesity among firefighters around the world?
- Is the obesity prevalence among FF different from their own original population?

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- Does the job status affect FF's obesity prevalence (volunteer, career, military)?

- Does the type of firefighter affect obesity prevalence (structural, wildland, industrial)?

- Does age have an important influence on obesity prevalence (recruits vs experienced)?

- Has obesity prevalence changed along the years in the Fire Service i.e. do older studies report an obesity prevalence different than the most recent ones?

METHODS AND ANALYSIS

Protocol and registration

The methods for this systematic review have been developed according to recommendations from the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)[38] and Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P)[39] statements. This protocol has been registered in the International Prospective Register of Systematic Reviews (PROSPERO) under the registration number CRD42019129122.

Search strategy

The following electronic databases will be searched:

- PubMed

- Medline

- Web of Science

- Sportdiscus

We will search for studies reporting data on firefighter's BMI, BF% and obesity prevalence using the following terms:

- (Firefighter OR Firefighting) AND (obesity OR overweight OR weight OR excess weight OR adiposity or waist)

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- (Firefighter OR Firefighting) AND (body and mass and index)

- (Firefighter OR Firefighting) AND (body and fat)

The only limit on the search will be time i.e. the day of the search. The search will be repeated before submitting the paper to a journal.

Eligibility criteria

In order to be included this analysis, studies must report data from firefighters (FF) as a unique group. Data from other professionals (e.g. police officers) should constitute a different, separate group. Studies may have a cross-sectional or longitudinal design. If a study has multiple time points in the same cohort, we will use the most recent time point for the prevalence report, but will use other time points in order to address our last objective. Although we are not interested in interventions, interventions studies will also be included and pre-intervention data will be used instead of post. Data from men and women will be analyzed separately. We will include studies written in English, Portuguese and Spanish, from any year. Prevalence data must be calculated from body mass index, percentage body fat or waist circumference. The method employed to measure body fat percentage will also be recorded in order to account for possible differences among methods. Prevalence of obesity based on other variables will not be eligible for this analysis. To increase objectivity, reviewers will use a simple form to assess eligibility (Supplementary File 1).

Data extraction

Two reviewers will independently perform the literature search and screen titles and abstracts for eligibility. Search results will be saved into a reference manager, duplicates will be eliminated using the provided software tools. Full texts will then be obtained for those who meet inclusion criteria or are uncertain. The full text will then be screened and reviewers will decide whether the paper meets all requirements for inclusion in the study. In order to avoid double

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counting, when there are multiple studies from the same cohort, the study with the largest sample size will be used. If the sample size does not vary, the most recent paper will be used. We will also look for similarities (sample size, firefighter headquarter and mean age) between studies of the same author or group in order to ensure they are not the same sample. Authors will not be contacted in to obtain additional information, all necessary information should be reported in the manuscript. Reviewers will record the reasons for excluding studies. At the end of the independent assessment, results from the two reviewers will be shared. If discrepancies occur, they will be discussed between the two reviewers. If they cannot reach consensus, a senior author will resolve the differences. Investigators will not be blind to the journal titles or institutions or study authors.

One reviewer (EMKVKS) will use a standardized excel spreadsheet to extract and store data from the studies selected by the independent reviewers. In the remote possibility of any difficulties related to data extraction or storage, one of the senior authors (LGGP or DLS) will be contacted in order to solve the issue

Data of interest are presented in Table 1.

Table 1. Data of interest that will be sought from eligible studies

Author details:	Name of first author, journal where the article was published, language and publication year.
Study characteristics:	Study design, sampling method, data collection period, and time of data collection (e.g. a 2016 study may have data from 2009).
Participants' characteristics:	Age, body mass index, body fat percentage and waist circumference.
Firefighters' characteristics:	Job status (volunteer, career or military), years of service, type of firefighter (e.g. industrial, hazard material, wildland)
Outcomes:	Obesity and overweight prevalence based on BMI, body fat percentage or waist circumference.

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Quality assessment

Quality assessment will be performed independently by two reviewers. Considering various recommendations of not arbitrarily scoring the quality of studies, we will focus our analysis on the source of bias, instead of a general classification of low or high quality based on score [38,40–42]. Juni et al.,[43] compared low-quality and high quality studies in a meta-analysis according to different scoring scales, and found that the scale used could change the result completely.

Since it is not our aim to create a new scale or checklist, we will perform a risk of bias assessment as suggested by Munn et al.,[44] with nine simple questions (Supplementary File 2) that will help us maintain objectivity and reproducibility for updates and new reviews on a similar topic. We will perform a training with the reviewers before the study in order to ensure agreement between then. In case of disagreement the two reviewers will discuss their opinions. If they are not able to reach a consensus the senior authors (LGGP or DLS) will resolve this difference.

Data analysis

Data will be narratively synthesized. Results will be reported according to the PRISMA statement. Evidence tables will be generated to descriptively summarize the included studies and results according to our objectives. We will compare obesity prevalence between countries and regions, job status (volunteer, career or military), type of firefighter (e.g. industrial, hazard material, wildland) and gender. Confidence intervals for the prevalence will be computed using the data extracted from the articles [45]. We will also evaluate how frequent a certain prevalence values are reported by studies in a worldwide and country analysis e.g. in the US 50% of the studies report an obesity prevalence greater than 33%. Depending on the heterogeneity of risk of bias in the studies, a secondary comparison will be made between those with lower and higher risk.

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In order to compare firefighter's data with the general population, we will utilize national and international databases. In the US, we will use NHANES data, in Brazil we will use VIGITEL's data. Whenever it is not possible to have a non-firefighter representative data set from the population, data from WHO will be sought. In case a study already provide a similar comparison to the general population [36,37], this data will be used as representative for their own country. If possible, we will compare the US data in regard to the region of the country that the data came from.

In order to determine if a prevalence is significantly different, we will adopt a conservative approach. Specifically, a 95% confidence interval will be calculated and data will be considered different when confidence intervals do not overlap.

ETHICS AND DISSEMINATION

The systematic review does not require ethics clearance since published studies with non-identifiable data will be used. The results of the systematic review will be disseminated via publication in a peer-reviewed journal as well as through conference presentations.

AUTHOR CONTRIBUTIONS

EMKVKS, LGGP and DLS contributed to the concept of this project, creating the search strategy, refining the inclusion and exclusion criteria and producing this manuscript. EMKVKS drafted the protocol. LGGP, DLS and EMKVKS revised the manuscript. LGGP and DLS provided oversight to the project. All authors read and approved the final version of this manuscript.

FUNDING

No institution, funder or sponsor contributed to the development of the protocol. The authors have not declared a specific grant for this research from any funding agency in the public, commercial

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COMPETING INTERESTS

The authors have no competing interests.

PATIENT CONSENT

Not required.

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SUPPLEMENTARY FILE 1

Eligibility Form – Please cross "yes" or "no" considering the content of the paper		
	YES	NO
Does the study possess the main outcome of interest? (Obesity prevalence using BMI, %BF or WC)		
Does the study possess at least one group that may be analyzed or provide outcome of interest in which there are only firefighters in?		
Are men and women in separate groups in the reported data?		

If all answers are yes, then the study is eligible.

SUPPLEMENTARY FILE 2

Risk of bias assesment scale

	Yes	No	Unclear	Not applicable
A. Was the sample frame appropriate to address the target population?	☐	☐	☐	☐
B. Were study participants sampled in an appropriate way?	☐	☐	☐	☐
C. Was the sample size adequate?	☐	☐	☐	☐
D. Were the study subjects and the setting described in detail?	☐	☐	☐	☐
E. Was the data analysis conducted with sufficient coverage of the identified sample?	☐	☐	☐	☐
F. Were valid methods used for the identification of the condition?	☐	☐	☐	☐
G. Was the condition measure in a standard, reliable way for all participants?	☐	☐	☐	☐
H. Was there appropriate statistical analysis?	☐	☐	☐	☐
I. Was the response rate adequate, and if not, was the low response rate managed appropriately?	☐	☐	☐	☐

REPORTING CHECKLIST FOR PROTOCOL OF A SYSTEMATIC REVIEW.

PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis Protocols) 2015 checklist: recommended items to address in a systematic review protocol

		Reporting Item	Page Number
Identification	#1a	Identify the report as a protocol of a systematic review	1
Update	#1b	If the protocol is for an update of a previous systematic review, identify as such	N/A
	#2	If registered, provide the name of the registry (such as PROSPERO) and registration number	N/A
Contact	#3a	Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author	1
Contribution	#3b	Describe contributions of protocol authors and identify the guarantor of the review	10
	#4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments	N/A
Sources	#5a	Indicate sources of financial or other support for the review	10-11

Sponsor	#5b	Provide name for the review funder and / or sponsor	10-11
Role of sponsor or funder	#5c	Describe roles of funder(s), sponsor(s), and / or institution(s), if any, in developing the protocol	N/A
Rationale	#6	Describe the rationale for the review in the context of what is already known	4-5
Objectives	#7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO)	5-6
Eligibility criteria	#8	Specify the study characteristics (such as PICO, study design, setting, time frame) and report characteristics (such as years considered, language, publication status) to be used as criteria for eligibility for the review	7
Information sources	#9	Describe all intended information sources (such as electronic databases, contact with study authors, trial registers or other grey literature sources) with planned dates of coverage	8
Search strategy	#10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated	6-7
Study records - data management	#11a	Describe the mechanism(s) that will be used to manage records and data throughout the review	7-8
Study records - selection process	#11b	State the process that will be used for selecting studies (such as two independent reviewers) through each phase of the review (that is, screening, eligibility and inclusion in meta-	7-8

analysis)

Study records - data collection process	#11c	Describe planned method of extracting data from reports (such as piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators	7-8
Data items	#12	List and define all variables for which data will be sought (such as PICO items, funding sources), any pre-planned data assumptions and simplifications	8
Outcomes and prioritization	#13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale	8
Risk of bias in individual studies	#14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis	8
Data synthesis	#15a	Describe criteria under which study data will be quantitatively synthesised	9
	#15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data and methods of combining data from studies, including any planned exploration of consistency (such as I2, Kendall's т)	N/A
	#15c	Describe any proposed additional analyses (such as sensitivity or subgroup analyses, meta-regression)	N/A
	#15d	If quantitative synthesis is not appropriate, describe the type	9

of summary planned

Meta-bias(es)	#16	Specify any planned assessment of meta-bias(es) (such as publication bias across studies, selective reporting within studies)	N/A
Confidence in cumulative evidence	#17	Describe how the strength of the body of evidence will be assessed (such as GRADE)	N/A

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Worldwide prevalence of obesity among firefighters: a systematic review protocol

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Manuscripts

TITLE: Worldwide prevalence of obesity among firefighters: a systematic review protocol

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Word count: 2,350

Number of Figures:0

Number of Tables: 1

Number of References: 50

Number of Supplementary Files: 2

ABSTRACT

Introduction

Obesity may interfere with job performance and increase the risk of injury during firefighting activity. Obesity also has many deleterious effects on health indices and is associated with higher all-cause mortality. Studies report a high prevalence of obesity in the Fire Service. Also, firefighters' work schedule (12-24h shifts) and food availability during night shifts may be related to weight gain. Studies in American firefighters have shown annual weight gain between 0.5-1.5 kg. This study aims to report the obesity prevalence in the Fire Service to describe how it varies based on country and region, job status, type of firefighter and gender.

Methods and analysis

The main outcome evaluated will be obesity prevalence. We will systematically search the literature databases PubMed, Medline, Web of Science, Sportdiscus, Academic Search Premier, CINAHL, SciTech Premium Collection, Sports Medicine & Education Index, Research Library, and Scopus. One reviewer will perform the search. Two independent reviewers will select studies, extract data from eligible studies, and evaluate their methodological and reporting quality. Agreement between reviewers will be measured using Cohen's Kappa. Other data of interest will include age, body mass index, body fat percentage, job status (career, volunteer or military), years of service and type of firefighter (e.g., structural, wildland firefighter). We will produce a narrative summary of our findings. Tables will be generated to summarise data.

Ethics and dissemination

This systematic review does not require ethics clearance since published studies with non-identifiable data will be used. The results of the systematic review will be disseminated via publication in a peer-reviewed journal and through conference presentations

Registration and review status

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This systematic review protocol has been registered at PROSPERO (CRD42019129122).

The systematic review process will start once the protocol has gone through full external peer

review at the BMJ Open (estimated date: 12 January 2020).

Keywords

Fire and Rescue Personnel, Abdominal Fat, Overweight, Public Health

ARTICLE SUMMARY

Strengths and limitations of this study

- The first systematic review of worldwide obesity prevalence among firefighters.

- A comprehensive synthesis of worldwide obesity prevalence, including a narrative comparison with the country of origin of the study using a standardised risk of bias tool.

- Study selection and risk of bias assessment will be performed independently by two researchers, which will ensure that all relevant studies are included without personal biases.

- A potential limitation of this review may be a small number of studies available for countries other than the United States.

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INTRODUCTION

Firefighters perform critical public safety work. Considering all the different occupational hazards firefighters face, it is surprising to many that the leading cause of duty-related death among United States (US) firefighters is sudden cardiac death (SCD). In 2017, SCD accounted for almost half of on-duty deaths in the US, and SCD has been responsible for about 43% of on-duty fatalities for the last ten years [1]. Furthermore, for every fatal on-duty cardiac event, there are an estimated 20 nonfatal on-duty cardiovascular events [2]. Theoretical models have been proposed in order to conceptualise how firefighting interacts with individual risk factors like obesity to increase the risk of SCD [3–6].

Clearly, the underlying health of firefighters is one of the important aspects associated with cardiovascular death in the Fire Service. Also, individual risk factors are critical factors in determining the risk of SCD. Research has consistently found a high prevalence of cardiovascular disease risk factors among firefighters. Obesity increases the odds of a fatal on-duty coronary heart disease event by 1.5-6.6 times [7] and is highly associated with cardiomegaly in firefighters [8]. Studies report obesity prevalence in the US ranging from 22% [9] to 60% [10] depending on the region, age and type of firefighter (career or volunteer). Outside of the US, lower estimates of obesity have been reported. In Brazil, obesity rates of less than 15% have been reported for military based firefighters [11,12].

Obesity may interfere with job performance and increase the risk of injury during firefighting activity [13–15]. Obesity also has many deleterious effects on health indices, including: reduced arterial function [16,17], glucose intolerance, dyslipidemia, type 2 diabetes, hypertension, osteoarthritis [18], low cardiorespiratory fitness [19], pathological remodeling of the heart [20], endocrine disorders [21,22], and is associated with higher all-cause mortality [23].

Several studies have reported that US firefighter recruits begin their career with an elevated BMI [24–26]. Few studies report the actual obesity prevalence within firefighter recruits. One study performed in Tucson, Arizona reported an obesity prevalence of 15.6% in firefighter

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recruits [27]. A separate study from Massachusetts that included both firefighter and ambulance personnel recruits found a prevalence of 33%[28]. Research has also shown that a significant weight gain occurs during a firefighter's career [28,29]. A recent case-control study which retrospectively examined all available autopsy records of US firefighters between 1999 and 2014 has shown obesity prevalence estimates as high as 59.2% among firefighters who died due to cardiac issues (cardiac cases) and 47.7% among noncardiac trauma controls [15].

Firefighters' work schedule (12-24 hour work shifts) and lower availability of healthy food during night shifts may be an important contribution to weight gain [30] as shift-working by itself is considered an independent risk factor for obesity [31–33]. Some US cohort studies report firefighters' annual weight gain ranging from 0.5 kg [34] to 1.5 kg [35]. Ide [29] reports similar values for Scottish firefighters, with a mean gain of 1.5 kg/year. This could represent a gain of 5 kg to 15 kg of weight in 10 years of service. Data from the Health Professionals Follow-Up Study show a significant weight gain of 0.2 kg every year [36], a considerably lower value compared to those in firefighters. These facts raise an interesting question, specifically, do firefighters have a high obesity prevalence because of the population of origin, i.e. those who become firefighters (US population) have a large proportion of men with obesity, or does firefighting lead to obesity, or is it associated with the burden of their type of service.

Poston et al., [37] analysed the obesity prevalence in 677 firefighters and compared them to the national obesity prevalence (US adults). While prevalence was similar, in a separate analysis, volunteers seemed to possess a higher prevalence of obesity compared to US adults and career firefighters. Other studies show similarities between the firefighters and their original population [19,38]. In contrast, German firefighters seem to be more fit than sedentary clerks and police officers from the same region [39].

There is an important need to understand the obesity prevalence in the Fire Service due to its relation to health and job performance. Understanding if this is a phenomenon isolated to US firefighters or occurring globally. It is also important to understand potential factors that could

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be associated with such phenomenon, from ageing to job status. An increased understanding of obesity would be important for fire service leaders and policymakers in order to create effective strategies to decrease obesity and lead to better health and job performance in the Fire Service. Thus, this study aims to (1) report the obesity prevalence in the Fire Service (2) to describe how it varies based on country and region, job status, type of firefighter and gender.

Objectives

The present study intends to address the following questions:

- What is the prevalence of obesity among firefighters around the world?
- Is the obesity prevalence among firefighters different from their own original population?
- Does the job status affect firefighters' obesity prevalence (volunteer, career, military)?
- Does the type of firefighter affect obesity prevalence (structural, wildland, industrial)?
- Does age have an important influence on obesity prevalence?
- Has firefighters' obesity prevalence changed over the years, i.e. do older studies report an obesity prevalence different from more recent ones?

METHODS AND ANALYSIS

The systematic review process will start once the protocol has been through full external peer review at the BMJ Open (estimated date: 12 January 2020).

Protocol and registration

The methods for this systematic review have been developed according to recommendations from the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)[40] and Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols

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(PRISMA-P)[41] statements. This protocol has been registered in the International Prospective

Register of Systematic Reviews (PROSPERO) under the registration number CRD42019129122.

Search strategy

The following electronic databases will be searched:

- PubMed

- Medline

- Web of Science

- Academic Search Premier (EBSCO)

- Sportdiscus (EBSCO)

- CINAHL (EBSCO)

- SciTech Premium Collection (ProQuest)

- Sports Medicine & Education Index (ProQuest)

- Research Library (ProQuest)

- Scopus

We will search for studies reporting data on firefighters' BMI, body fat percentage (BF%)

and obesity prevalence using the following search term:

- ((Firefighter OR Firefighting OR Firefighters OR Firefighter's OR

Firefighters') AND (obesity OR overweight OR "excess weight" OR adiposity OR waist OR

"body mass index" OR bmi OR "body fat"))

There will be no time limit, i.e. studies may have been published in any year. Searches

will be limited to peer-reviewed journals. Grey literature will not be included.

Eligibility criteria

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In order to be included in this study, studies must report data from firefighters as a unique group. Data from other professionals (e.g. police officers) should constitute a different, separate group. Studies may have a cross-sectional or longitudinal design. If a study has multiple time points in the same cohort, we will use the most recent time point for the prevalence report but will use other time points to address our last objective. Although we are not interested in interventions, intervention studies will also be included, and pre-intervention data will be used instead of post. Data from males and females will be analysed separately due to a sex-related difference in obesity prevalence[42,43]. Although the search will be performed in English, we will include studies written in any language; which will be translated when necessary to ensure eligibility, and for data extraction when eligibility is confirmed. In cases where it is impossible to translate the studies, it will be noted, and we will report the number of studies in this situation.

Prevalence data must be calculated from body mass index (BMI), per cent body fat (%BF) or waist circumference. The method employed to measure body fat percentage will also be recorded to account for possible differences among methods. Although other variables may be used to define obesity, e.g., waist-to-height ratio; these indices are probably not often used in firefighter studies; also, their agreement with traditional indices are unknown and may overestimate obesity in the Fire Service[44]. Thus, the authors decided to include only obesity prevalence data that used BMI, %BF and waist circumference. To increase objectivity, reviewers will use a simple form to assess eligibility (Supplementary File 1).

Data extraction

One reviewer will perform the literature search; results will be saved in a reference manager; duplicates will be eliminated using the provided software tools. Remaining files will be shared with the second reviewer. The two reviewers will independently screen titles and abstracts for eligibility. Full texts will then be obtained for those that meet inclusion criteria or are uncertain. The full text will then be screened, and reviewers will independently decide whether the paper

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meets all requirements for inclusion in the study. Reviewers will record the reasons for excluding studies. At the end of the independent assessment, results from the two reviewers will be shared, and the agreement between the two reviewers will be assessed using kappa statistics. If discrepancies occur, they will be discussed between the two reviewers. If they cannot reach consensus, one of the senior authors (LGGP or DLS) will resolve the issue. Investigators will not be blind to the journal titles or institutions or study authors.

In order to avoid double-counting, when there are multiple studies from the same cohort, the study with the largest sample size will be used. If the sample size does not vary, the most recent paper will be used. We will also look for similarities (sample size, firefighter headquarter and mean age) between studies of the same author or group to ensure they are not the same sample.

Both reviewers will independently use a standardised excel spreadsheet to extract and store data of interest (Table 1) from the studies chosen to be included in the review. An agreement analysis will be performed between reviewers for each data of interest using kappa statistics to evaluate if both reviewers have the same data present in the spreadsheet. Both spreadsheets will be united in one excel file, and data of interest will be compared between spreadsheets using an IF function, e.g. =IF(A1=B1;"0";"1"). Reviewers will discuss differences until spreadsheets contain the same information. In the remote possibility of any difficulties in this process, one of the senior authors (LGGP or DLS) will be contacted in order to solve the issue

Authors of included or screened articles may be contacted to obtain additional information, i.e., in case important information is missing from the manuscript, but authors are likely to have it. One reviewer will send an e-mail to the corresponding author's e-mail address, based on information in the article; a maximum of two attempts will be made, each separated by one week.

Data of interest are presented in Table 1.

Table 1. Data of interest that will be sought from eligible studies

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Author details:	Name of first author, journal where the article was published, language and publication year.
Study characteristics:	Study design, sampling method, data collection period, and time of data collection (e.g. a 2016 study may have data from 2009).
Participants' characteristics:	Age, BMI, %BF and waist circumference.
Firefighters' characteristics:	Job status (volunteer, career or military), years of service, type of firefighter (e.g. industrial, hazard material, wildland)
Outcomes:	Obesity and overweight prevalence
Methods used to define obesity:	BMI, %BF or waist circumference.

Quality assessment

Quality assessments will be performed independently by both reviewers. We will focus our analysis on the risk of bias since manuscript "quality" may be an ambiguous term and different interpretations of it can significantly impact reviews and meta-analysis results [40,45–48].

We will perform a risk of bias assessment using the Joanna Briggs Institute's critical appraisal checklist for studies reporting prevalence data as suggested by Munn et al.,[49] which contains nine simple questions (Supplementary File 2) that evaluate risk of bias in topics such as: sampling frame, sample size, data analysis, validity of the methods and response rate i.e. the proportion of individuals who agreed to participate from all who were invited.

In order to improve agreement, objectivity and reproducibility of the reviewers, we will perform training with the reviewers before the study is initiated. In case of disagreement, the two

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reviewers will discuss their opinions. If they are not able to reach a consensus, the senior authors

(LGGP or DLS) will resolve this difference.

Data analysis

Data will be narratively synthesised. Results will be reported according to the PRISMA

statement[40]. Evidence tables will be generated to descriptively summarise the included studies

and results according to our objectives. We will compare obesity prevalence based on countries

and regions, job status (volunteer, career or military), type of firefighter (e.g. industrial, structural

material, wildland) and gender. Confidence intervals for the prevalence will be computed using

the data extracted from the articles [50]. We will also evaluate how frequently a specific

prevalence value is reported by studies in a worldwide and country analysis, e.g. in the US, 50%

of the studies report an obesity prevalence greater than 33%. Depending on the heterogeneity of

risk of bias in the studies, a secondary comparison will be made between those with lower and

higher risk.

In order to compare firefighter data with the general population, we will utilise the World

Health Organization's (WHO) age-standardised obesity prevalence that is available for almost all

countries. In case a study already provides an age-standardised obesity prevalence of its country

of origin[38,39], this data will have priority over the WHO data. When possible, we will compare

firefighter vs general population-based obesity using a table or figure.

Since obesity is a multidimensional issue, its prevalence may vary significantly from region

to region, particularly in large countries. Thus, we will attempt to perform a comparison between

the general adult population from the region or state from which study participants belong. US

state data will be retrieved from the Centers for Disease Control and Prevention database

(Behavioral Risk Factor Surveillance System). Brazil's regional comparison will be performed

using information from the "*Vigilância de Doenças Crônicas por Inquérito Telefônico*" database.

For state or regional data from other countries, researchers will attempt to contact authors via e-

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mail to request information if such data is available and could be shared by the authors; a maximum of two attempts will be performed, each one separated by one week. In case state or regional data is already available in a manuscript from the same country, it will be used for comparison.

We will adopt a conservative approach to determine if prevalences are significantly different between countries or when compared to national or regional data. Specifically, a 95% confidence interval will be calculated, and data will be considered different when confidence intervals do not overlap.

Patient and Public Involvement

Patient and public were not involved directly in this study.

ETHICS AND DISSEMINATION

The systematic review does not require ethics clearance since published studies with non-identifiable data will be used. The results of the systematic review will be disseminated via publication in a peer-reviewed journal as well as through conference presentations.

AUTHOR CONTRIBUTIONS

EMKVKS, LGGP and DLS contributed to the concept of this project, creating the search strategy, refining the inclusion and exclusion criteria and producing this manuscript. EMKVKS drafted the protocol. LGGP, DLS and EMKVKS revised the manuscript. LGGP and DLS provided oversight for the project. All authors read and approved the final version of this manuscript.

FUNDING

No institution, funder or sponsor contributed to the development of the protocol. The authors have not declared a specific grant for this research from any funding agency in the public, commercial

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ACKNOWLEDGEMENTS

COMPETING INTERESTS

The authors have no competing interests.

PATIENT CONSENT

Not required.

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SUPPLEMENTARY FILE 1

Eligibility Form – Please cross "yes" or "no" considering the content of the paper		
	YES	NO
Does the study possess the main outcome of interest? (Obesity prevalence using BMI, %BF or WC)		
Does the study possess at least one group that may be analyzed or provide outcome of interest in which there are only firefighters in?		
Are men and women in separate groups in the reported data?		

If all answers are yes, then the study is eligible.

SUPPLEMENTARY FILE 2

Risk of bias assesment scale

	Yes	No	Unclear	Not applicable
A. Was the sample frame appropriate to address the target population?	☐	☐	☐	☐
B. Were study participants sampled in an appropriate way?	☐	☐	☐	☐
C. Was the sample size adequate?	☐	☐	☐	☐
D. Were the study subjects and the setting described in detail?	☐	☐	☐	☐
E. Was the data analysis conducted with sufficient coverage of the identified sample?	☐	☐	☐	☐
F. Were valid methods used for the identification of the condition?	☐	☐	☐	☐
G. Was the condition measure in a standard, reliable way for all participants?	☐	☐	☐	☐
H. Was there appropriate statistical analysis?	☐	☐	☐	☐
I. Was the response rate adequate, and if not, was the low response rate managed appropriately?	☐	☐	☐	☐

REPORTING CHECKLIST FOR PROTOCOL OF A SYSTEMATIC REVIEW.

PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis Protocols) 2015 checklist: recommended items to address in a systematic review protocol

		Reporting Item	Page Number
Identification	#1a	Identify the report as a protocol of a systematic review	1
Update	#1b	If the protocol is for an update of a previous systematic review, identify as such	N/A
	#2	If registered, provide the name of the registry (such as PROSPERO) and registration number	3
Contact	#3a	Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author	3
Contribution	#3b	Describe contributions of protocol authors and identify the guarantor of the review	3
	#4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments	N/A
Sources	#5a	Indicate sources of financial or other support for the review	13-14
Sponsor	#5b	Provide name for the review funder and / or sponsor	13-14
Role of sponsor or funder	#5c	Describe roles of funder(s), sponsor(s), and / or institution(s), if any, in developing the protocol	N/A
Rationale	#6	Describe the rationale for the review in the context of what is already known	5-7
Objectives	#7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO)	7

Eligibility criteria	#8	Specify the study characteristics (such as PICO, study design, setting, time frame) and report characteristics (such as years considered, language, publication status) to be used as criteria for eligibility for the review	9,11
Information sources	#9	Describe all intended information sources (such as electronic databases, contact with study authors, trial registers or other grey literature sources) with planned dates of coverage	8-10
Search strategy	#10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated	8
Study records - data management	#11a	Describe the mechanism(s) that will be used to manage records and data throughout the review	9,10
Study records - selection process	#11b	State the process that will be used for selecting studies (such as two independent reviewers) through each phase of the review (that is, screening, eligibility and inclusion in meta-analysis)	9,10
Study records - data collection process	#11c	Describe planned method of extracting data from reports (such as piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators	9
Data items	#12	List and define all variables for which data will be sought (such as PICO items, funding sources), any pre-planned data assumptions and simplifications	10,11
Outcomes and prioritization	#13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale	10,11
Risk of bias in individual studies	#14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis	11,12
Data synthesis	#15a	Describe criteria under which study data will be quantitatively synthesised	12-13
	#15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data and methods of combining data from studies, including any	N/A

planned exploration of consistency (such as I2, Kendall's т)

	#15c	Describe any proposed additional analyses (such as sensitivity or subgroup analyses, meta-regression)	N/A
	#15d	If quantitative synthesis is not appropriate, describe the type of summary planned	12-13
Meta-bias(es)	#16	Specify any planned assessment of meta-bias(es) (such as publication bias across studies, selective reporting within studies)	N/A
Confidence in cumulative evidence	#17	Describe how the strength of the body of evidence will be assessed (such as GRADE)	N/A

The PRISMA-P checklist is distributed under the terms of the Creative Commons Attribution License CC-BY 4.0. This checklist was completed on 20. March 2019 using https://www.goodreports.org/, a tool made by the EQUATOR Network in collaboration with Penelope.ai

BMJ Open

Worldwide prevalence of obesity among firefighters: a systematic review protocol

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TITLE: Worldwide prevalence of obesity among firefighters: a systematic review protocol

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Word count: 2,350

Number of Figures:0

Number of Tables: 1

Number of References: 51

Number of Supplementary Files: 2

ABSTRACT

Introduction

Obesity may interfere with job performance and increase the risk of injury during firefighting activity. Obesity also has many deleterious effects on health indices and is associated with higher all-cause mortality. Studies report a high prevalence of obesity in the Fire Service. Also, firefighters' work schedule (12-24h shifts) and food availability during night shifts may be related to weight gain. Studies in American firefighters have shown annual weight gain between 0.5-1.5 kg. This study aims to report the obesity prevalence in the Fire Service to describe how it varies based on country and region, job status, type of firefighter and gender.

Methods and analysis

The main outcome evaluated will be obesity prevalence. We will systematically search the literature databases PubMed, Medline, Web of Science, Sportdiscus, Academic Search Premier, CINAHL, SciTech Premium Collection, Sports Medicine & Education Index, Research Library, and Scopus. One reviewer will perform the search. Two independent reviewers will select studies, extract data from eligible studies, and evaluate their methodological and reporting quality. Agreement between reviewers will be measured using Cohen's Kappa. Other data of interest will include age, body mass index, body fat percentage, job status (career, volunteer or military), years of service and type of firefighter (e.g., structural, wildland firefighter). We will produce a narrative summary of our findings. Tables will be generated to summarise data.

Ethics and dissemination

This systematic review does not require ethics clearance since published studies with non-identifiable data will be used. The results of the systematic review will be disseminated via publication in a peer-reviewed journal and through conference presentations

Registration and review status

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This systematic review protocol has been registered at PROSPERO (CRD42019129122).

The systematic review process will start once the protocol has gone through full external peer

review at the BMJ Open (estimated date: 12 January 2020).

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Keywords

Fire and Rescue Personnel, Abdominal Fat, Overweight, Public Health

ARTICLE SUMMARY

Strengths and limitations of this study

- The first systematic review of worldwide obesity prevalence among firefighters.

- A comprehensive synthesis of worldwide obesity prevalence, including a narrative comparison with the country of origin of the study using a standardised risk of bias tool.

- Study selection and risk of bias assessment will be performed independently by two researchers, which will ensure that all relevant studies are included without personal biases.

- A potential limitation of this review may be a small number of studies available for countries other than the United States.

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INTRODUCTION

Firefighters perform critical public safety work. Considering all the different occupational hazards firefighters face, it is surprising to many that the leading cause of duty-related death among United States (US) firefighters is sudden cardiac death (SCD). In 2017, SCD accounted for almost half of on-duty deaths in the US, and SCD has been responsible for about 43% of on-duty fatalities for the last ten years [1]. Furthermore, for every fatal on-duty cardiac event, there are an estimated 20 nonfatal on-duty cardiovascular events [2]. Theoretical models have been proposed in order to conceptualise how firefighting interacts with individual risk factors like obesity to increase the risk of SCD [3–6].

Clearly, the underlying health of firefighters is one of the important aspects associated with cardiovascular death in the Fire Service. Also, individual risk factors are critical factors in determining the risk of SCD. Research has consistently found a high prevalence of cardiovascular disease risk factors among firefighters. Obesity increases the odds of a fatal on-duty coronary heart disease event by 1.5-6.6 times [7] and is highly associated with cardiomegaly in firefighters [8]. Studies report obesity prevalence in the US ranging from 22% [9] to 60% [10] depending on the region, age and type of firefighter (career or volunteer). Outside of the US, lower estimates of obesity have been reported. In Brazil, obesity rates of less than 15% have been reported for military based firefighters [11,12].

Obesity may interfere with job performance and increase the risk of injury during firefighting activity [13–15]. Obesity also has many deleterious effects on health indices, including: reduced arterial function [16,17], glucose intolerance, dyslipidemia, type 2 diabetes, hypertension, osteoarthritis [18], low cardiorespiratory fitness [19], pathological remodeling of the heart [20], endocrine disorders [21,22], and is associated with higher all-cause mortality [23].

Several studies have reported that US firefighter recruits begin their career with an elevated BMI [24–26]. Few studies report the actual obesity prevalence within firefighter recruits. One study performed in Tucson, Arizona reported an obesity prevalence of 15.6% in firefighter

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recruits [27]. A separate study from Massachusetts that included both firefighter and ambulance personnel recruits found a prevalence of 33%[28]. Research has also shown that a significant weight gain occurs during a firefighter's career [28,29]. A recent case-control study which retrospectively examined all available autopsy records of US firefighters between 1999 and 2014 has shown obesity prevalence estimates as high as 59.2% among firefighters who died due to cardiac issues (cardiac cases) and 47.7% among noncardiac trauma controls [15].

Firefighters' work schedule (12-24 hour work shifts) and lower availability of healthy food during night shifts may be an important contribution to weight gain [30] as shift-working by itself is considered an independent risk factor for obesity [31–33]. Some US cohort studies report firefighters' annual weight gain ranging from 0.5 kg [34] to 1.5 kg [35]. Ide [29] reports similar values for Scottish firefighters, with a mean gain of 1.5 kg/year. This could represent a gain of 5 kg to 15 kg of weight in 10 years of service. Data from the Health Professionals Follow-Up Study show a significant weight gain of 0.2 kg every year [36], a considerably lower value compared to those in firefighters. These facts raise an interesting question, specifically, do firefighters have a high obesity prevalence because of the population of origin, i.e. those who become firefighters (US population) have a large proportion of men with obesity, or does firefighting lead to obesity, or is it associated with the burden of their type of service.

Poston et al., [37] analysed the obesity prevalence in 677 firefighters and compared them to the national obesity prevalence (US adults). While prevalence was similar, in a separate analysis, volunteers seemed to possess a higher prevalence of obesity compared to US adults and career firefighters. Other studies show similarities between the firefighters and their original population [19,38]. In contrast, German firefighters seem to be more fit than sedentary clerks and police officers from the same region [39].

There is an important need to understand the obesity prevalence in the Fire Service due to its relation to health and job performance. Understanding if this is a phenomenon isolated to US firefighters or occurring globally. It is also important to understand potential factors that could

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be associated with such phenomenon, from ageing to job status. An increased understanding of obesity would be important for fire service leaders and policymakers in order to create effective strategies to decrease obesity and lead to better health and job performance in the Fire Service. Thus, this study aims to (1) report the obesity prevalence in the Fire Service (2) to describe how it varies based on country and region, job status, type of firefighter and gender.

Objectives

The present study intends to address the following questions:

- What is the prevalence of obesity among firefighters around the world?
- Is the obesity prevalence among firefighters different from their own original population?
- Does the job status affect firefighters' obesity prevalence (volunteer, career, military)?
- Does the type of firefighter affect obesity prevalence (structural, wildland, industrial)?
- Does age have an important influence on obesity prevalence?
- Has firefighters' obesity prevalence changed over the years, i.e. do older studies report an obesity prevalence different from more recent ones?

METHODS AND ANALYSIS

The systematic review process will start once the protocol has been through full external peer review at the BMJ Open (estimated date: 12 January 2020).

Protocol and registration

The methods for this systematic review have been developed according to recommendations from the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)[40] and Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols

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(PRISMA-P)[41] statements. This protocol has been registered in the International Prospective Register of Systematic Reviews (PROSPERO) under the registration number CRD42019129122.

Search strategy

The following electronic databases will be searched:

- PubMed

- Medline

- Web of Science

- Academic Search Premier (EBSCO)

- Sportdiscus (EBSCO)

- CINAHL (EBSCO)

- SciTech Premium Collection (ProQuest)

- Sports Medicine & Education Index (ProQuest)

- Research Library (ProQuest)

- Scopus

We will search for studies reporting data on firefighters' BMI, body fat percentage (BF%) and obesity prevalence using the following search term:

- ((Firefighter OR Firefighting OR Firefighters OR Firefighter's OR Firefighters') AND (obesity OR overweight OR "excess weight" OR adiposity OR waist OR "body mass index" OR bmi OR "body fat"))

There will be no time limit, i.e. studies may have been published in any year. Searches will be limited to peer-reviewed journals. Grey literature will not be included.

Eligibility criteria

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In order to be included in this study, studies must report data from firefighters as a unique group. Data from other professionals (e.g. police officers) should constitute a different, separate group. Studies may have a cross-sectional or longitudinal design. If a study has multiple time points in the same cohort, we will use the most recent time point for the prevalence report but will use other time points to address our last objective. Although we are not interested in interventions, intervention studies will also be included, and pre-intervention data will be used instead of post. Data from males and females will be analysed separately due to a sex-related difference in obesity prevalence[42,43]. Although the search will be performed in English, we will include studies written in any language; which will be translated when necessary to ensure eligibility, and for data extraction when eligibility is confirmed. In cases where it is impossible to translate the studies, it will be noted, and we will report the number of studies in this situation.

Prevalence data must be calculated from body mass index (BMI), per cent body fat (%BF) or waist circumference. BMI prevalence data that originates from self-reported height and weight will also be included since they are reasonably accurate reflections of their measured values [44]. The method employed to measure body fat percentage will also be recorded to account for possible differences among methods. Although other variables may be used to define obesity, e.g., waist-to-height ratio; these indices are probably not often used in firefighter studies; also, their agreement with traditional indices are unknown and may overestimate obesity in the Fire Service[45]. Thus, the authors decided to include only obesity prevalence data that used BMI, %BF and waist circumference. To increase objectivity, reviewers will use a simple form to assess eligibility (Supplementary File 1).

Data extraction

One reviewer will perform the literature search; results will be saved in a reference manager; duplicates will be eliminated using the provided software tools. Remaining files will be shared with the second reviewer. The two reviewers will independently screen titles and abstracts

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for eligibility. Full texts will then be obtained for those that meet inclusion criteria or are uncertain. The full text will then be screened, and reviewers will independently decide whether the paper meets all requirements for inclusion in the study. Reviewers will record the reasons for excluding studies. At the end of the independent assessment, results from the two reviewers will be shared, and the agreement between the two reviewers will be assessed using kappa statistics. If discrepancies occur, they will be discussed between the two reviewers. If they cannot reach consensus, one of the senior authors (LGGP or DLS) will resolve the issue. Investigators will not be blind to the journal titles or institutions or study authors.

In order to avoid double-counting, when there are multiple studies from the same cohort, the study with the largest sample size will be used. If the sample size does not vary, the most recent paper will be used. We will also look for similarities (sample size, firefighter headquarter and mean age) between studies of the same author or group to ensure they are not the same sample.

Both reviewers will independently use a standardised excel spreadsheet to extract and store data of interest (Table 1) from the studies chosen to be included in the review. An agreement analysis will be performed between reviewers for each data of interest using kappa statistics to evaluate if both reviewers have the same data present in the spreadsheet. Both spreadsheets will be united in one excel file, and data of interest will be compared between spreadsheets using an IF function, e.g. =IF(A1=B1;"0";"1"). Reviewers will discuss differences until spreadsheets contain the same information. In the remote possibility of any difficulties in this process, one of the senior authors (LGGP or DLS) will be contacted in order to solve the issue

Authors of included or screened articles may be contacted to obtain additional information, i.e., in case important information is missing from the manuscript, but authors are likely to have it. One reviewer will send an e-mail to the corresponding author's e-mail address, based on information in the article; a maximum of two attempts will be made, each separated by one week.

Data of interest are presented in Table 1.

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Table 1. Data of interest that will be sought from eligible studies

Author details:	Name of first author, journal where the article was published, language and publication year.
Study characteristics:	Study design, sampling method, data collection period, and time of data collection (e.g. a 2016 study may have data from 2009).
Participants' characteristics:	Age, BMI, %BF and waist circumference.
Firefighters' characteristics:	Job status (volunteer, career or military), years of service, type of firefighter (e.g. industrial, hazard material, wildland)
Outcomes:	Obesity and overweight prevalence
Methods used to define obesity:	BMI, %BF or waist circumference.

Quality assessment

Quality assessments will be performed independently by both reviewers. We will focus our analysis on the risk of bias since manuscript "quality" may be an ambiguous term and different interpretations of it can significantly impact reviews and meta-analysis results [40,46–49].

We will perform a risk of bias assessment using the Joanna Briggs Institute's critical appraisal checklist for studies reporting prevalence data as suggested by Munn et al.,[50] which contains nine simple questions (Supplementary File 2) that evaluate risk of bias in topics such as: sampling frame, sample size, data analysis, validity of the methods and response rate i.e. the proportion of individuals who agreed to participate from all who were invited.

In order to improve agreement, objectivity and reproducibility of the reviewers, we will perform training with the reviewers before the study is initiated. In case of disagreement, the two

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reviewers will discuss their opinions. If they are not able to reach a consensus, the senior authors (LGGP or DLS) will resolve this difference.

Data analysis

Data will be narratively synthesised. Results will be reported according to the PRISMA statement[40]. Evidence tables will be generated to descriptively summarise the included studies and results according to our objectives. We will compare obesity prevalence based on countries and regions, job status (volunteer, career or military), type of firefighter (e.g. industrial, structural material, wildland) and gender. Confidence intervals for the prevalence will be computed using the data extracted from the articles [51]. We will also evaluate how frequently a specific prevalence value is reported by studies in a worldwide and country analysis, e.g. in the US, 50% of the studies report an obesity prevalence greater than 33%. Depending on the heterogeneity of risk of bias in the studies, a secondary comparison will be made between those with lower and higher risk.

In order to compare firefighter data with the general population, we will utilise the World Health Organization's (WHO) age-standardised obesity prevalence that is available for almost all countries. In case a study already provides an age-standardised obesity prevalence of its country of origin[38,39], this data will have priority over the WHO data. When possible, we will compare firefighter vs general population-based obesity using a table or figure.

Since obesity is a multidimensional issue, its prevalence may vary significantly from region to region, particularly in large countries. Thus, we will attempt to perform a comparison between the general adult population from the region or state from which study participants belong. US state data will be retrieved from the Centers for Disease Control and Prevention database (Behavioral Risk Factor Surveillance System). Brazil's regional comparison will be performed using information from the "*Vigilância de Doenças Crônicas por Inquérito Telefônico*" database. For state or regional data from other countries, researchers will attempt to contact authors via e-

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mail to request information if such data is available and could be shared by the authors; a maximum of two attempts will be performed, each one separated by one week. In case state or regional data is already available in a manuscript from the same country, it will be used for comparison.

We will adopt a conservative approach to determine if prevalences are significantly different between countries or when compared to national or regional data. Specifically, a 95% confidence interval will be calculated, and data will be considered different when confidence intervals do not overlap.

Patient and Public Involvement

Patient and public were not involved directly in this study.

ETHICS AND DISSEMINATION

The systematic review does not require ethics clearance since published studies with non-identifiable data will be used. The results of the systematic review will be disseminated via publication in a peer-reviewed journal as well as through conference presentations.

AUTHOR CONTRIBUTIONS

EMKVKS, LGGP and DLS contributed to the concept of this project, creating the search strategy, refining the inclusion and exclusion criteria and producing this manuscript. EMKVKS drafted the protocol. LGGP, DLS and EMKVKS revised the manuscript. LGGP and DLS provided oversight for the project. All authors read and approved the final version of this manuscript.

FUNDING

No institution, funder or sponsor contributed to the development of the protocol. The authors have not declared a specific grant for this research from any funding agency in the public, commercial

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ACKNOWLEDGEMENTS

COMPETING INTERESTS

The authors have no competing interests.

PATIENT CONSENT

Not required.

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SUPPLEMENTARY FILE 1

Eligibility Form – Please cross "yes" or "no" considering the content of the paper		
	YES	NO
Does the study possess the main outcome of interest? (Obesity prevalence using BMI, %BF or WC)		
Does the study possess at least one group that may be analyzed or provide outcome of interest in which there are only firefighters in?		
Are men and women in separate groups in the reported data?		

If all answers are yes, then the study is eligible.

SUPPLEMENTARY FILE 2

Risk of bias assesment scale

	Yes	No	Unclear	Not applicable
A. Was the sample frame appropriate to address the target population?	☐	☐	☐	☐
B. Were study participants sampled in an appropriate way?	☐	☐	☐	☐
C. Was the sample size adequate?	☐	☐	☐	☐
D. Were the study subjects and the setting described in detail?	☐	☐	☐	☐
E. Was the data analysis conducted with sufficient coverage of the identified sample?	☐	☐	☐	☐
F. Were valid methods used for the identification of the condition?	☐	☐	☐	☐
G. Was the condition measure in a standard, reliable way for all participants?	☐	☐	☐	☐
H. Was there appropriate statistical analysis?	☐	☐	☐	☐
I. Was the response rate adequate, and if not, was the low response rate managed appropriately?	☐	☐	☐	☐

REPORTING CHECKLIST FOR PROTOCOL OF A SYSTEMATIC REVIEW.

PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis Protocols) 2015 checklist: recommended items to address in a systematic review protocol

		Reporting Item	Page Number
Identification	#1a	Identify the report as a protocol of a systematic review	1
Update	#1b	If the protocol is for an update of a previous systematic review, identify as such	N/A
	#2	If registered, provide the name of the registry (such as PROSPERO) and registration number	3
Contact	#3a	Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author	1
Contribution	#3b	Describe contributions of protocol authors and identify the guarantor of the review	3
	#4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments	N/A
Sources	#5a	Indicate sources of financial or other support for the review	13-14
Sponsor	#5b	Provide name for the review funder and / or sponsor	13-14
Role of sponsor or funder	#5c	Describe roles of funder(s), sponsor(s), and / or institution(s), if any, in developing the protocol	N/A
Rationale	#6	Describe the rationale for the review in the context of what is already known	5-7
Objectives	#7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO)	7

Eligibility criteria	#8	Specify the study characteristics (such as PICO, study design, setting, time frame) and report characteristics (such as years considered, language, publication status) to be used as criteria for eligibility for the review	9,11
Information sources	#9	Describe all intended information sources (such as electronic databases, contact with study authors, trial registers or other grey literature sources) with planned dates of coverage	8-10
Search strategy	#10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated	8
Study records - data management	#11a	Describe the mechanism(s) that will be used to manage records and data throughout the review	9-10
Study records - selection process	#11b	State the process that will be used for selecting studies (such as two independent reviewers) through each phase of the review (that is, screening, eligibility and inclusion in meta-analysis)	9-10
Study records - data collection process	#11c	Describe planned method of extracting data from reports (such as piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators	9
Data items	#12	List and define all variables for which data will be sought (such as PICO items, funding sources), any pre-planned data assumptions and simplifications	10-11
Outcomes and prioritization	#13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale	10-11
Risk of bias in individual studies	#14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis	11-12
Data synthesis	#15a	Describe criteria under which study data will be quantitatively synthesised	12-13
	#15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data and methods of combining data from studies, including any	N/A

		planned exploration of consistency (such as I2, Kendall's τ)	
	#15c	Describe any proposed additional analyses (such as sensitivity or subgroup analyses, meta-regression)	N/A
	#15d	If quantitative synthesis is not appropriate, describe the type of summary planned	12-13
Meta-bias(es)	#16	Specify any planned assessment of meta-bias(es) (such as publication bias across studies, selective reporting within studies)	N/A
Confidence in cumulative evidence	#17	Describe how the strength of the body of evidence will be assessed (such as GRADE)	N/A

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