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Worldwide prevalence of obesity among firefighters: a systematic review protocol

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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-hour to 24-hour 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 and 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, Cumulative Index of Nursing and Allied Health Literature (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 (eg, structural and 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.

PROSPERO registration number CRD42019129122.

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 USA.

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 US firefighters is sudden cardiac death (SCD). In 2017, SCD accounted for almost half of on-duty deaths in the USA, 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 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 USA ranging from 22%[9] to 60%[10] depending on the region, age and type of firefighter (career or volunteer). Outside of the USA, 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

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fitness,[19] pathological remodelling 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 body mass index (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 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-hour to 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[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 5–15 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 with those in firefighters. These facts raise an interesting question, specifically, do firefighters have a high obesity prevalence because of the population of origin, that is, 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, volunteer firefighters seemed to possess a higher prevalence of obesity compared with 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 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 and military)?
- Does the type of firefighter affect obesity prevalence (structural, wildland and industrial)?
- Does age have an important influence on firefighters prevalence?
- Has firefighters' obesity prevalence changed over the years, that is, 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 PRISMA Protocols (PRISMA-P)[41] statements. This protocol has been registered in the International Prospective Register of Systematic Reviews.

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, that is, studies may have been published in any year. Searches will be limited to peer-reviewed journals. Grey literature will not be included.

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Eligibility criteria

In order to be included in this study, studies must report data from firefighters as a unique group. Data from other professionals (eg, 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-intervention. Data from men and women 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 BMI, BF% or waist circumference. BMI prevalence data that originate 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 BF% will also be recorded to account for possible differences among methods. Although other variables may be used to define obesity, for example, waist-to-height ratio; these indices are probably not often used in firefighter studies; also, their agreement with traditional indices is 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 (online 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 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 DS) 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, eg =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 DS) will be contacted in order to solve the issue

Authors of included or screened articles may be contacted to obtain additional information, that is, 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 1 week.

Data of interest are presented in table 1.

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

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 (eg, 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 and type of firefighter (eg, industrial, hazard material and wildland).
Outcomes	Obesity and overweight prevalence.
Methods used to define obesity	BMI, BF% or waist circumference.

BF%, body fat percentage; BMI, body mass index.

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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 (online supplementary file 2) that evaluate risk of bias in topics such as sampling frame, sample size, data analysis and validity of the methods and response rate that is, 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 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 (eg, industrial, structural material and 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, for example, in the USA, 50% of the studies reported 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 use the WHO's 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] these data will have priority over the WHO data. When possible, we will compare firefighter versus 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-mail to request information if such data are available and could be shared by the authors; a maximum of two attempts will be performed, each one separated by 1 week. In case state or regional data are 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 with national or regional data. Specifically, a 95% CI 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.

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Contributors EMKVKS, LGGP and DS 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, DS and EMKVKS revised the manuscript. LGGP and DS provided oversight for the project. All authors read and approved the final version of this manuscript.

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Competing interests None declared.

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REFERENCES

1 Fahy RF, LeBlanc PR, Molis JL. *Firefighter fatalities in the United States-2017*. Quincy, MA: National Fire Protection Association, 2018. https://www.nfpa.org/-/media/Files/News-and-Research/Fire-statistics/Fire-service/osFFF.pdf
2 Evarts B, Molis JL. *United States Firefighter injuries 2017*. Quincy, MA: NFPA Research, 2018.
3 Soteriades ES, Smith DL, Tsismenakis AJ, *et al*. Cardiovascular disease in US firefighters: a systematic review. *Cardiol Rev* 2011;19:202–15.
4 Smith DL, Barr DA, Kales SN. Extreme sacrifice: sudden cardiac death in the US fire service. *Extrem Physiol Med* 2013;2.
5 Smith DL, DeBlois JP, Kales SN, *et al*. Cardiovascular strain of Firefighting and the risk of sudden cardiac events. *Exerc Sport Sci Rev* 2016;44:90–7.
6 Kales SN, Smith DL. Firefighting and the heart: implications for prevention. *Circulation* 2017;135:1296–9.
7 Kales SN, Soteriades ES, Christoudias SG, *et al*. Firefighters and on-duty deaths from coronary heart disease: a case control study. *Environ Health* 2003;2.

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8 Korre M, Porto LGG, Farioli A, *et al*. Effect of body mass index on left ventricular mass in career male firefighters. *Am J Cardiol* 2016;118:1769–73.
9 Storer TW, Dolezal BA, Abrazado ML, *et al*. Firefighter health and fitness assessment: a call to action. *J Strength Cond Res* 2014;28:661–71.
10 Ode J, Knous J, Schlaff R, *et al*. Accuracy of body mass index in volunteer firefighters. *Occup Med* 2014;64:193–7.
11 Porto LGG, Nogueira RM, Nogueira EC, *et al*. Agreement between BMI and body fat obesity definitions in a physically active population. *Arch. Endocrinol. Metab.* 2016;60:515–25.
12 Strauß M, Foshag P, Przybylek B, *et al*. Occupation and metabolic syndrome: is there correlation? A cross sectional study in different work activity occupations of German firefighters and office workers. *Diabetol Metab Syndr* 2016;8.
13 Jahnke SA, Poston WSC, Haddock CK, *et al*. Obesity and incident injury among career firefighters in the central United States. *Obesity* 2013;21:1505–8.
14 Poston WSC, Jitnarin N, Haddock CK, *et al*. Obesity and injury-related absenteeism in a population-based firefighter cohort. *Obesity* 2011;19:2076–81.
15 Smith DL, Haller JM, Korre M, *et al*. Pathoanatomic findings associated with Duty-Related cardiac death in US firefighters: a Case–Control study. *J Am Heart Assoc* 2018;7:e009446.
16 Fahs CA, Smith DL, Horn GP, *et al*. Impact of excess body weight on arterial structure, function, and blood pressure in firefighters. *Am J Cardiol* 2009;104:1441–5.
17 Kappus RM, Fahs CA, Smith D, *et al*. Obesity and overweight associated with increased carotid diameter and decreased arterial function in young otherwise healthy men. *Am J Hypertens* 2014;27:628–34.
18 Martin-Rodriguez E, Guillen-Grima F, Martí A, *et al*. Comorbidity associated with obesity in a large population: the APNA study. *Obes Res Clin Pract* 2015;9:435–47.
19 Nogueira EC, Porto LGG, Nogueira RM, *et al*. Body composition is strongly associated with cardiorespiratory fitness in a large Brazilian military Firefighter cohort: the Brazilian firefighters study. *J Strength Cond Res* 2016;30:33–8.
20 Lai C-C, Sun D, Cen R, *et al*. Impact of long-term burden of excessive adiposity and elevated blood pressure from childhood on adulthood left ventricular remodeling patterns. *J Am Coll Cardiol* 2014;64:1580–7.
21 De Lorenzo A, Noce A, Moriconi E, *et al*. MOSH syndrome (male obesity secondary hypogonadism): clinical assessment and possible therapeutic approaches. *Nutrients* 2018;10:474.
22 Michalakis K, Mintziori G, Kaprara A, *et al*. The complex interaction between obesity, metabolic syndrome and reproductive axis: a narrative review. *Metabolism* 2013;62:457–78.
23 Aune D, Sen A, Prasad M, *et al*. Bmi and all cause mortality: systematic review and non-linear dose-response meta-analysis of 230 cohort studies with 3.74 million deaths among 30.3 million participants. *BMJ* 2016;353.
24 Cornell DJ, Gnacinski SL, Zamzow A, *et al*. Measures of health, fitness, and functional movement among firefighter recruits. *Int J Occup Saf Ergon* 2017;23:198–204.
25 Roberts MA, O'Dea J, Boyce A, *et al*. Fitness levels of firefighter recruits before and after a supervised exercise training program. *J Strength Cond Res* 2002;16:271–7.
26 Hollerbach BS, Jahnke SA, Poston WSC, *et al*. Examining a novel firefighter exercise training program on simulated fire ground test performance, cardiorespiratory endurance, and strength: a pilot investigation. *J Occup Med Toxicol* 2019;14.
27 Jeong KS, Zhou J, Griffin SC, *et al*. Microrna changes in firefighters. *J Occup Environ Med* 2018;60:469–74.
28 Tsismenakis AJ, Christophi CA, Burress JW, *et al*. The obesity epidemic and future emergency responders. *Obesity* 2009;17:1648–50.
29 Ide CW. Fat future for firefighters? changes in prevalence of obesity in Scottish local authority firefighters. *Scott Med J* 2012;57:1–3.
30 Bonnell E, Huggins C, Huggins C, *et al*. Influences on dietary choices during day versus night shift in shift workers: a mixed methods study. *Nutrients* 2017;9:193.
31 Kim M-J, Son K-H, Park H-Y, *et al*. Association between shift work and obesity among female nurses: Korean nurses' survey. *BMC Public Health* 2013;13:1204.
32 Antunes LC, Levandovski R, Dantas G, *et al*. Obesity and shift work: chronobiological aspects. *Nutr Res Rev* 2010;23:155–68.
33 Sun M, Feng W, Wang F, *et al*. Meta-Analysis on shift work and risks of specific obesity types. *Obesity Reviews* 2018;19:28–40.
34 Soteriades ES, Hauser R, Kawachi I, *et al*. Obesity and cardiovascular disease risk factors in firefighters: a prospective cohort study. *Obes Res* 2005;13:1756–63.
35 Elliot DL, Goldberg L, Kuehl KS, *et al*. The PHLAME (promoting healthy lifestyles: alternative models' effects) firefighter study: outcomes of two models of behavior change. *J Occup Environ Med* 2007;49:204–13.
36 Mozaffarian D, Hao T, Rimm EB, *et al*. Changes in diet and lifestyle and long-term weight gain in women and men. *N Engl J Med* 2011;364:2392–404.
37 Poston WSC, Haddock CK, Jahnke SA, *et al*. The prevalence of overweight, obesity, and substandard fitness in a population-based firefighter cohort. *J Occup Environ Med* 2011;53:266–73.
38 Gurevich KG, Poston WSC, Anders B, *et al*. Obesity prevalence and accuracy of BMI-defined obesity in Russian firefighters. *Occup Med* 2017;67:61–3.
39 Leischik R, Foshag P, Strauß M, *et al*. Aerobic capacity, physical activity and metabolic risk factors in firefighters compared with police officers and sedentary clerks. *PLoS One* 2015;10:e0133113.
40 Liberati A, Altman DG, Tetzlaff J, *et al*. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: explanation and elaboration. *BMJ* 2009;339:b2700.
41 Shamseer L, Moher D, Clarke M, *et al*. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. *BMJ* 2015;349:g7647.
42 Kanter R, Caballero B. Global gender disparities in obesity: a review. *Adv Nutr Bethesda Md* 2012;3:491–8.
43 Garawi F, Devries K, Thorogood N, *et al*. Global differences between women and men in the prevalence of obesity: is there an association with gender inequality? *Eur J Clin Nutr* 2014;68:1101–6.
44 Poston WSC, Jitnarin N, Haddock CK, *et al*. Accuracy of self-reported weight, height and BMI in US firefighters. *Occup Med* 2014;64:246–54.
45 Azabdaftari N, Amani R, Taha Jalali M. Biochemical and nutritional indices as cardiovascular risk factors among Iranian firefighters. *Ann Clin Biochem* 2009;46:385–9.10.1258/acb.2009.009026
46 Boyle MH. Guidelines for evaluating prevalence studies. *Evid Based Ment Health* 1998;1:37–9.
47 Higgins JPT, Altman DG, Gøtzsche PC, *et al*. The Cochrane collaboration's tool for assessing risk of bias in randomised trials. *BMJ* 2011;343:d5928.
48 Stang A. Critical evaluation of the Newcastle-Ottawa scale for the assessment of the quality of nonrandomized studies in meta-analyses. *Eur J Epidemiol* 2010;25:603–5.
49 Jüni P*et al*. The hazards of scoring the quality of clinical trials for meta-analysis. *JAMA* 1999;282:1054–60.
50 Munn Z, Moola S, Lisy K, *et al*. Methodological guidance for systematic reviews of observational epidemiological studies reporting prevalence and cumulative incidence data. *Int J Evid Based Healthc* 2015;13:147–53.
51 Newcombe RG. Two-Sided confidence intervals for the single proportion: comparison of seven methods. *Stat Med* 1998;17:857–72.

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