



## Commentary

# What is a population-level approach to prevention, and how could we apply it to dementia risk reduction?



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## ABSTRACT

The World Health Organisation's 2022 'blueprint for dementia research' highlights the need for more research into population-level risk reduction. However, definitions of population-level prevention vary, and application to dementia is challenging because of its multi-factorial aetiology and a maturing prevention evidence base. This paper compares and contrasts key concepts of 'population-level prevention' from the literature, explores related theoretical models and policy frameworks, and applies this to dementia risk reduction. We reach a proposed definition of population-level risk reduction of dementia, which focusses on the need to change societal conditions such that the population is less likely to develop modifiable risk factors known to be associated with dementia, without the need for high-agency behaviour change by individuals. This definition, alongside identified policy frameworks, can inform synthesis of existing evidence and help to co-ordinate the generation of new evidence.

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## Background

In the World Health Organization's (WHO) 2022 'blueprint for dementia research',<sup>1</sup> the risk reduction chapter highlights that 'more evidence is necessary for the implementation of whole-population approaches, which ... include investment in green spaces and built infrastructure to promote physical activity, policies to promote access to healthy diets and decrease the salt content in food, age-friendly environments, internet access in rural areas to improve social cohesion and integration, and policies for decreasing air pollution.' The rationale for this call is that the emerging dementia prevention field has, thus far, focussed heavily on individual-level approaches to the exclusion of population-level approaches, despite individual-level approaches lacking the ability to significantly and sustainably reduce population prevalence of dementia and health inequalities.<sup>2</sup>

There is, however, no single, widely accepted definition of what a whole-population approach (also known as a 'population-level

approach') to prevention and risk reduction is. Moreover, existing concepts of population-level prevention have not been applied to dementia risk reduction—a new prevention research agenda. Dementia is a complex syndrome, occurring mostly in older age with multi-factorial aetiologies, for which the prevention evidence base is still maturing—with recent work suggesting many modifiable risk factors, some of which are shared with other non-communicable diseases (NCDs) and some of which are not.<sup>3</sup> In order to address the gap noted by the WHO, a clear and evidence-based definition of population-level dementia risk reduction is required to inform systematic collection of population-level dementia risk reduction evidence and coordinate efforts to produce new evidence.

In this paper, we compare and contrast existing definitions of 'population-level prevention interventions' from the literature, identifying the key epidemiological and public health theories underpinning them. We also summarise examples of population-level policy frameworks, recognising that translation of evidence into policy will require not just understanding what a population-level approach is but also categorisation of the types of interventions it can include. Finally, we apply this evidence base to the emerging dementia prevention field to propose a definition of population-level dementia risk reduction that is operationally informative for future

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systematic review work and can help to coordinate new research efforts to address this research and policy gap.

### What definitions of population-level prevention are used in the literature?

Varying definitions of population-level prevention interventions are offered in relevant literature on this topic. In a 2009 paper entitled ‘What is population health intervention research’, Hawe et al. suggest

*“Population-level health interventions are policies or programs that shift the distribution of health risk by addressing the underlying social, economic, and environmental conditions.”<sup>4</sup>*

This definition introduces the concepts of shifting the population risk distribution, rooted in the work of Geoffrey Rose,<sup>5</sup> and the idea of changing societal living conditions that partly drive health behaviours and risk, from Dahlgren and Whitehead’s<sup>6</sup> socio-ecological model.

Similarly, in a 2008 systematic review summarising population-level interventions to reduce smoking prevalence, Thomas et al. suggest the following definition:

*“Interventions applied to populations, groups, areas, jurisdictions, or institutions with the aim of changing the social, physical, economic, or legislative environment to make them less conducive to smoking.”<sup>7</sup>*

Helpfully, Thomas et al. outline some of their reasoning for their definition, bringing in the concept of agency (the extent to which the exposure to risk is within an individual’s control and to what extent it is beyond their control): ‘These are approaches that mainly rely on state or institutional control, either of a link in the supply chain or of smokers’ behaviour in the presence of others. Such approaches could also form part of wider, multifaceted interventions in schools, workplaces, or communities. We did not include interventions whose main aim was to strengthen the capacity of individuals to stop smoking or to resist taking up smoking, even if these interventions were applied to whole groups or populations (e.g., mass media health education campaigns). These are approaches that mainly rely on individuals engaging voluntarily with measures intended to help them’.<sup>7</sup>

Finally, Hillier-Brown et al.’s systematic review of interventions to reduce inequalities in childhood obesity<sup>8</sup> differentiated between individual-, community-, and societal-level interventions (again invoking the socio-ecological framework). The authors effectively defined community-level interventions as individual-level interventions conducted in a community setting: ‘Group-based health promotion, education, advice, counselling, or subsidy only interventions, or interventions conducted in a community setting (for example, a school, community centre, sports centre and shop)’.<sup>8</sup> The authors split ‘societal-level’ interventions into two sub-groups:

*“Societal-environment-level interventions [were] those that included a change in environment or access to environment. Societal-policy-level interventions as macro-level policies such as taxation, advertising restriction, or subsidies.”<sup>8</sup>*

This distinction is a helpful starting point to think about how we might construct a framework of different types of policies that fall within the ‘population-level’ (or ‘societal-level’) intervention definition.

### Key Points

- No singular definition of ‘population-level prevention’ is ubiquitous.
- Example definitions focus on shifting the distribution of population risk and changing societal conditions.
- Some interventions, such as health education campaigns designed to change individuals’ behaviours, are not considered population-level, even though they may be delivered to large numbers of people.

### What can we learn from the models that underpin these definitions?

#### *Dahlgren and Whitehead’s rainbow model*

Dahlgren and Whitehead’s rainbow model of health determinants<sup>6</sup> describes the various layers that contribute to an individual’s health, with each outer layer interacting with the layers beneath. Starting with individual biological factors in the centre; moving outwards through individual lifestyle factors, neighbourhood and community factors, to upstream factors such as education, housing, and working conditions; and finally high-level societal factors such as wealth inequalities, wealth redistribution, racism, sexism, and gender norms. This model is very helpful to illustrate the idea that individual-level, clinical interventions which operate on the innermost layers will always have a limited impact due to the conditions surrounding the individual, such as their education, housing, employment, and affluence, known as the ‘social determinants of health’ (SDOH) remaining unchanged by the intervention. As an example, an obese person, who is counselled on their weight, but continues to live in a food environment where high-calorie, unhealthy options are more readily available and affordable than healthier options, is likely to remain obese. This demonstrates the need to think about how we change the societal conditions that form the outer layers of the model, which is where ‘population-level’ or ‘societal-level’ interventions operate.

Recently, public health efforts have increasingly included the commercial determinants of health (CDOH), which are defined as ‘strategies and approaches used by the private sector to promote products and choices that are detrimental to health’,<sup>9</sup> alongside the SDOH as key upstream determinants of health. Such strategies include marketing, lobbying, and even casting doubt on academic research about the health hazards of their product. An updated rainbow model could therefore include CDOH in the outer societal-conditions layer.

#### *Geoffrey Rose’s prevention paradox*

A second body of work that the literature definitions draw from is that of Geoffrey Rose.<sup>5</sup> Rose split primary prevention approaches (those which aim to stop risk factors progressing to early disease) into the ‘population strategy of prevention’ and the ‘high-risk individual strategy’. He defined the population strategy as the one which ‘seeks to move the whole distribution of a risk factor, including its low tail, in a favourable direction. Some individuals will stand to benefit much more than others, although ideally everyone would hope to gain something (for example, by control of hazardous environmental pollution)’.<sup>5</sup> Rose’s categorisation of the societal conditions that can be targeted in

a population-level approach is economic, industrial, and political. In contrast, individual-level approaches identify those most at risk and offer treatment or other support to lower their risk. His advocacy for population-level approaches was based on three core principles.

1. Risk of disease exists as a spectrum, with the ‘high risk’ representing the extreme end, rather than a separate entity. Through this lens, prevention poses a society-wide challenge from which everyone stands to benefit.
2. Society exists as a synergistic entity that equates to more than just the sum of the individuals within it. As a result, when social risk factors change, the distribution of those factors tends to shift as a whole, reflecting this cohesive societal nature.
3. The centre point of the distribution contains the greatest proportion of the population and is directly linked to the number of people who are high-risk ones. Therefore, shifting the whole population distribution by a small amount produces a reduction in disease which is much greater than the reduction achieved by a large change in the risk of the small number of people at high-risk.

Rose warns that ‘this ideal (population-level risk reduction by shifting the risk distribution) will not be achieved if the curve relating exposure to risk is not linear, and especially if it is U- or J-shaped’.<sup>5</sup> This could be relevant, for example, to the relationship between blood pressure and dementia in older age.<sup>10</sup>

#### The role of agency

Rose further noted that attempts to shift population risk can be ‘shallow’, such as health education, or ‘radical’, such as those that address the underlying determinants of disease.<sup>5</sup> This idea that all population-level interventions are not equal was explored in more detail by Adams et al., in 2016, with a specific focus on diet and obesity.<sup>11</sup> Echoing the 2008 paper by Thomas et al.,<sup>7</sup> the authors demonstrated that the level of agency required to respond to an intervention could be considered to be on a spectrum, as could the degree to which an intervention is targeted at high-risk groups or the population as a whole. Fig. 1 shows where various diet and obesity prevention interventions might sit on these continuums. Considering the example policies in the bottom-right of the figure (population-level, high-agency), it is clear that these policies would not be included in a population-level definition that is framed around changing societal conditions because these are effectively interventions which maintain the conditions as they are but target individual behaviour change on a big scale. These high-agency interventions require resources (cognitive, financial, psychological, time) that are socioeconomically patterned<sup>12</sup>—this is important for dementia because dementia is also socioeconomically patterned<sup>13</sup>—so these policies are likely to worsen existing health inequalities in dementia.<sup>2,14</sup>

This suggests that definitions of population-level prevention, which describe changing societal conditions, are in fact specifically describing ‘population-level, low-agency, prevention interventions’—thereby excluding interventions which are applied to many people but are high-agency (e.g., health education campaigns). However, mass media health education campaigns which are multi-faceted and include attempts to change the ‘social’ environment (e.g., messaging that passive smoking kills, which could change the social acceptability of smoking) could be considered to include components which meet the definition of a (low-agency) population-level approach.

#### Key Points

- Broad social and commercial factors such as housing, education, and marketing, are determinants of health behaviours in the population.
- Disease risk exists on a spectrum, with most of the population in the centre. As a result, most cases of disease occur in people who are not at high risk.
- Agency (i.e., individuals’ capacity to control their exposure to risk) also exists on a spectrum, with those from low socioeconomic backgrounds typically having fewer financial, time, cognitive, and social resources upon which to draw.

#### Population-level policy/intervention frameworks

Whilst an operational definition of population-level dementia prevention is needed to inform systematic reviews, a policy framework could be a more helpful tool when summarising the interventional evidence curated by such reviews. We therefore identified existing population-level policy or intervention frameworks in order to consider how these might eventually be applied to dementia risk reduction policies.

#### EU Strategic framework and the WHO Best Buys

The 2019 EU Strategic Framework for the Prevention of NCDs<sup>15</sup> is an overarching prevention framework that includes prevention policy recommendations, alongside supporting actions such as data systems and financial support. The policy priorities include ‘creation of health-enabling environments’, ‘addressing the commercial determinants of health’, and ‘tackling health inequalities’, which are all consistent with a definition of population-level prevention that is framed around changing societal conditions and focuses on low-agency interventions.

The framework also refers to the “WHO Best Buys”, a 2017 document<sup>16</sup> that summarises recommended interventions to address NCDs, based on a rolling WHO review of the cost-effectiveness evidence base for what the WHO consider are the key NCD prevention foci: reducing tobacco, alcohol harm, unhealthy diets, and physical inactivity. According to the best buys, the most cost-effective interventions are taxation, bans on advertising and sponsorship, bans/restrictions to reduce availability (such as public smoking bans, reduced after hours alcohol sales), food reformulation, provision of low-salt options, plain tobacco packaging or packaging that includes health warnings, and mass media campaigns for health education. There are several more policies, such as built environment design to encourage active travel, which are included as effective but without sufficient cost-effectiveness evidence for full recommendation. The WHO’s stated aim is to identify the most cost-effective interventions to reduce the global NCD burden—they do not explicitly express an ideological preference for population-level interventions. It is therefore notable that the majority of the interventions and policies they recommend are low-agency, population-level interventions.

#### Interventions to boost healthy life expectancy and reduce inequalities

Marteau et al. responded to a 2018 ambition by the UK government to achieve 5 extra years of healthy life expectancy by 2035

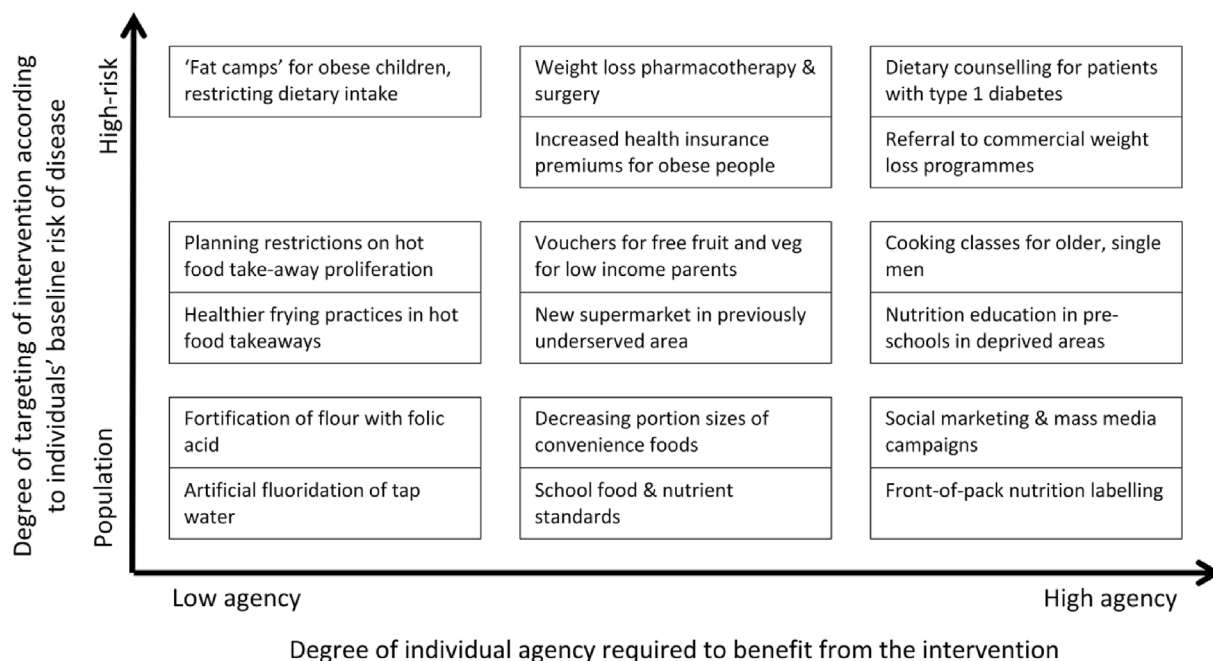


Fig. 1. Two continuums of intervention: population vs. high-risk, low vs. high agency. Adams et al., 2016. Reproduced in accordance with the Creative Commons Attribution License.

whilst reducing health inequalities.<sup>17</sup> Though they doubted that this was truly achievable, they laid out what they felt was the best way to attempt it, via 'structural or policy interventions that create healthier physical, economic, digital, social, and commercial environments'. Their framework was developed by combining the WHO Best Buys,<sup>16</sup> a report on fiscal policies for health by Bloomberg Philanthropies,<sup>18</sup> and a meeting of the UK population health experts. They consider three types of intervention: fiscal and economic (e.g., minimum unit prices for alcohol), marketing (e.g., restricting advertising of unhealthy food to children), and availability (e.g., land use policy to increase walkability of urban areas).

Notably, given the authors' explicit focus on health equity, Marteau et al. include mass media campaigns within marketing.<sup>17</sup> One example given, the 'This Girl Can' campaign was a targeted, evidence-based campaign aimed at changing social gender norms around young women, femininity, and physical activity—therefore, meeting the definition of an intervention aimed at changing 'social' conditions. Other marketing interventions suggested in this framework, such as tobacco pack inserts detailing the benefits of quitting and signposting to cessation services, would not fit a definition focussed on changing societal conditions. This again shows the blurred boundaries of the population-level prevention literature.

**Application to dementia risk reduction**

Age-specific incidence of dementia has declined in high-income countries,<sup>19</sup> likely due to improvements in population health in the latter half of the 20th Century. Reviews of observational and interventional evidence<sup>3,20,21</sup> have identified associations between several biologically plausible, potentially modifiable lifecourse risk factors (Table 1). Advancing the evidence base beyond this point has been limited by an incomplete biological understanding of the disease,<sup>22</sup> the fact that early pathological changes begin decades before symptom onset, and that dementia is often a distal outcome to cardiovascular disease.<sup>23</sup> There is some potential for further work using quasi-experimental designs, though disentangling the effect of one specific policy (e.g., increasing the school leaving age) from other societal changes on dementia incidence many decades

**Table 1**  
Possible modifiable risk factors as indicated by key dementia prevention reviews.

Modifiable risk factor	Livingston et al. <sup>3</sup>	WHO <sup>21</sup>	Lafortune et al. <sup>26</sup>
Poor education	Early life		
Hearing Loss	Midlife		
Traumatic brain injury	Midlife		
Hypertension	Midlife	All ages	
Excess alcohol	Midlife	All ages	Midlife
Obesity	Midlife	Midlife	Midlife
Smoking	Late life	All ages	Midlife
Depression	Late life		
Social isolation	Late life		
Physical inactivity	Late life	All ages	Midlife
Air pollution	Late life		
Diabetes mellitus	Late life	All ages	
Unbalanced diet		All ages	Midlife
Dyslipidaemia		Midlife	
Lack of cognitive stimulation		Late Life	

WHO refers to the World Health Organization.

later is difficult. Mendelian Randomisation studies may also hold some potential, but this evidence-base is in its infancy<sup>24</sup> and is often limited by a lack of allelic variability and representativeness of available data to the general population.<sup>25</sup> As a result, there is likely to be a paucity of high-quality evidence that directly measures the effect of population-level interventions on dementia incidence.

A key unanswered question is – to what extent does dementia constitute 'just another' NCD (i.e., prevention activities would totally overlap with interventions described by documents such as the WHO Best Buys<sup>16</sup> and the Marteau framework<sup>17</sup>) and to what extent it is distinct (and therefore requires dementia-specific interventions)? If causality of the potentially modifiable risk factors in Table 1 is assumed, then dementia is 'half-in-half-out' of the NCD prevention literature. Some of its risk factors are well covered by existing NCD prevention literature, and some are more 'dementia-specific'. This suggests the need for population-level dementia risk reduction to be a standalone agenda that draws from the NCD prevention literature where this overlaps and also considers the population-level prevention evidence for the other proposed modifiable risk factors.

**Table 2**  
The proposed shift in dementia risk reduction approach adapted from Walsh et al., 2022<sup>2</sup> (CCBY 4.0), with permission.

	Individual-level (high-risk) interventions	Group-level, high-agency interventions	Population-level (low-agency) interventions
Obesity, poor diet, and physical inactivity	<ul style="list-style-type: none"> <li>• Individual dietary interventions and advice</li> <li>• Identification of individuals at high risk by primary care-based routine health check-up of all late middle-aged individuals and referral of obese individuals to weight management clinics/exercise clinics</li> </ul>	<ul style="list-style-type: none"> <li>• Mass media health education campaigns to inform of the health risks of physical inactivity and obesity and to encourage healthy eating and exercise</li> </ul>	<ul style="list-style-type: none"> <li>• Investment in walking/cycling infrastructure that makes active travel easier and safer</li> <li>• Subsidised cycling equipment</li> <li>• Investment in better-quality green spaces</li> <li>• Sugar-sweetened-beverages tax levy</li> </ul>
Low education and low cognitive reserve	<ul style="list-style-type: none"> <li>• Counselling of individuals with a registered learning disability on reducing modifiable risk factors of obesity such as physical inactivity and smoking</li> </ul>	<ul style="list-style-type: none"> <li>• Mobile phone applications advertised to older people to provide cognitive stimulation training</li> </ul>	<ul style="list-style-type: none"> <li>• Remove financial barriers to school attendance</li> <li>• Cultural work to address gender inequalities in access to formal education</li> <li>• Improving the quality of work available, and supporting in-work training</li> </ul>
Smoking	<ul style="list-style-type: none"> <li>• Identification of smokers by primary care-based routine health check-up of all late middle-aged individuals and offering smoking cessation advice and support</li> </ul>	<ul style="list-style-type: none"> <li>• Mass media health education campaigns to inform of the dangers of smoking and to encourage cessation attempts</li> </ul>	<ul style="list-style-type: none"> <li>• Banning the advertisement of cigarettes and mandating plain packaging</li> <li>• Legislating smoke-free indoor public spaces</li> </ul>
High blood pressure	<ul style="list-style-type: none"> <li>• Identification of those with high blood pressure by primary care-based routine health check-up of all late middle-aged individuals and offering intensive pharmacological blood pressure management</li> </ul>	<ul style="list-style-type: none"> <li>• Mass media health education campaigns to inform of the health risks of hypertension, and to encourage lower salt consumption</li> </ul>	<ul style="list-style-type: none"> <li>• Legislation to mandate reformulation of food products to reduce salt content</li> </ul>
Depression and social isolation	<ul style="list-style-type: none"> <li>• Offering counselling and pharmacological management to those presenting to primary care with depression</li> </ul>	<ul style="list-style-type: none"> <li>• Social prescribing for those reporting feeling isolated or lonely into community activities or voluntary groups</li> </ul>	<ul style="list-style-type: none"> <li>• Cross-government work to improve social cohesion and integration</li> <li>• Age-friendly town planning</li> <li>• Improving internet access to rural areas</li> </ul>

**Proposed definition of population-level dementia risk reduction**

We propose that the definition of population-level dementia risk reduction should be framed around the modifiable risk factors for dementia, rather than dementia itself, due to constraints of what evidence is available. This requires the assumption that a reduction in the prevalence of a modifiable risk factor for dementia will result in a reduction in the prevalence of dementia.

For simplicity, we propose that the definition should be framed around ‘changing societal conditions’ (rather than any explicit reference to ‘shifting population risk distribution’). This means that the definition will be selective of low-agency interventions only (without needing to specify this explicitly)—which is desirable, given that high-agency interventions tend to widen health inequalities.<sup>12</sup> Accordingly, we propose that the definition should exclude mass media interventions designed exclusively to ‘educate’ the population about a hazard (i.e., health education campaigns), unless these interventions explicitly aim to change the societal conditions of, or commercial exposure to, the risk factor (e.g., plain packaging, advertising bans).

Proposed definition:

***‘Measures applied to populations, groups, areas, jurisdictions, or institutions with the aim of changing the social, cultural, physical, commercial, economic, environmental, occupational, or legislative conditions to make them less conducive to the development or maintenance of the modifiable lifecourse risk factors for dementia and/or more conducive to the development or maintenance of the modifiable lifecourse protective factors for dementia.’***

To consider the step-change in the approach that would be achieved by implementing this definition, Table 2 considers example interventions which could be applied against proposed modifiable lifecourse risk and protective factors for dementia, under the individual-level, and group-level but high-agency approaches and our proposed population-level (low agency) definition.

*Conclusion*

Various definitions of population-level prevention exist in the literature. However, they all generally draw upon Geoffrey’s Rose’s strategy of preventive medicine and Dahlgren and Whitehead’s socioecological model, and call for a change to the societal conditions (e.g., social, environmental, economic conditions) which drive risk exposure across the population. Importantly, this focus on changing societal conditions, as opposed to encouraging individuals to adopt healthier behaviours in spite of such conditions, results in interventions that can achieve health benefits without requiring individuals to exhibit high agency—therefore, avoiding exacerbation of health inequalities.

Evidence demonstrating reductions in dementia prevalence directly in response to interventions and policies that change societal conditions is lacking. However, the evidence bases of many of the modifiable risk factors known to be associated with dementia are more mature, and many of these risk factors are included within the NCD prevention literature, in which, policies to change societal conditions feature prominently. We therefore propose a definition for population-level dementia risk reduction which calls for changes to societal conditions that make them less conducive to the development or maintenance of the modifiable risk factors for

dementia and more conducive to protective factors. This definition will aid development of the evidence base for population-level interventions that could significantly reduce population risk of dementia and reduce health inequalities.

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### Competing interest

The authors declare no interests.

### Author contributions

All authors conceptualised this paper. SW drafted this paper. All authors reviewed and edited this paper.

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