The independent association of overweight and obesity with breathlessness in adults: a cross-sectional, population-based study

To the Editor:

Obesity and overweight are significant health problems worldwide, with a rapidly rising prevalence [1]. Obesity and overweight have serious consequences, including higher rates of metabolic syndrome, diabetes, cardiovascular and cerebrovascular diseases, joint disorders and sleep problems.

Breathlessness is common in the general adult population, with one study showing that nearly one in 10 had experienced breathlessness sufficient to limit exertion for at least 3 months out of the previous 6 months [2]. Factors contributing to the subjective sensation of breathlessness include respiratory, cardiovascular and neuromuscular disorders. The most frequently attributed underlying aetiology is respiratory disease secondary to smoking [3].

Obesity/overweight and breathlessness share important features: lifestyle factors, prevalence, and cycles of decreasing function, leading to deconditioning that creates synergistic detriment. While the physiological mechanisms of breathlessness in overweight obese adults are unclear, the combination of changes in ventilatory drive and pulmonary mechanics are probably contributory [4].

Understanding the relationship between breathlessness and obesity/overweight is the first step to improving clinical management. The aim of this study was to determine whether obesity/overweight were independently associated with breathlessness in community-dwelling adults. The null hypothesis was that there was no relationship between body mass index (BMI) and breathlessness.

We used 2 years of data from the South Australian Health Omnibus Survey (HOS) [5], a multistage, systematic, clustered area sample of households conducted face-to-face annually in spring in participants' homes. Australian Bureau of Statistics (ABS) census collector districts (CCDs) were randomly selected from Adelaide and from country towns with populations of more than 1000 people. Within each CCD, a random starting point was selected, and 10 properties were identified using a fixed skip interval.

One person in each household was interviewed by trained interviewers after an introductory letter was sent. Each respondent was asked if he/she had "experienced breathlessness most days for more than 3 months in the past 6 months". To assess the level of exertion needed to induce breathlessness, the survey used the modified Medical Research Council Scale (mMRC) [6], a tool suitable for assessing breathlessness in obese people [7, 8]. Existing evidence has also established a correlation between mMRC and expiratory reserve volume (ERV), forced expiratory volume in 1 s and 6-min walking test distances [7].

Calculation of BMI was performed using respondents' self-reported height and weight, and coded into four World Health Organization (WHO) categories (normal weight (BMI 20–25 $kg \cdot m^{-2}$); overweight (>25–30 $kg \cdot m^{-2}$); obese (>30–35 $kg \cdot m^{-2}$); and severe (>35–40 $kg \cdot m^{-2}$)/morbid obesity (>40 $kg \cdot m^{-2}$)) [9]. Adults with a BMI of <20 $kg \cdot m^{-2}$ were excluded, given the greater likelihood that other pathologies would account for these levels.

Data were analysed using Statistical Package for Social Sciences (SPSS) Version 23.0 and Stata Version 13. Data were weighted for population estimates (5-year age group, sex, rurality (metropolitan/

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non-metropolitan) and household size to the ABS 2005 Estimated Residential Population for South Australia.

Univariate analyses compared the proportion of respondents by sociodemographic factors in three breathlessness groups (mMRC 0, 1 and ⩾2) and the four WHO weight ranges given above. No data were imputed. Multinomial logistic regression models had mMRC group as the dependent variable exploring BMI groups, and adjusting for age group, sex and smoking status. None of the interaction terms considered (age–sex, BMI–sex and BMI–smoking) was significant and were therefore not included.

Ethical approval was obtained from the South Australian Department of Health's Ethics Committee. Respondents gave verbal informed consent. We used the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines in constructing this report [10].

Participation rate was 65.4% (n=5480) of 8377 people contactable. Of these, 314 people were aged <18 years, 552 did not report their height or weight, 291 had a BMI of <20 kg·m^{-2} and two did not have a breathlessness score. Excluding these left 4321 respondents with a mean±SD age of 47.9±17.4 years (median 47.0, range 18–95 years); 2214 (52.3%) were male and 19.9% were smokers. mMRC grades 2–4 were reported by 109 respondents (2.5%): grade 2 (n=58), grade 3 (n=41) and grade 4 (n=10). BMI classifications were as follows: 20–25 kg·m^{-2}, n=1708; >25–30 kg·m^{-2}, n=1587; >30–35 kg·m^{-2}, n=725; and >35 kg·m^{-2}, n=301 (of whom 101 were morbidly obese). Respondents aged 18 years and over who did not report their height or weight (n=552) were more likely to be female, to be in the youngest and oldest age strata, and to have moderate to severe levels of breathlessness.

Mean±SD BMI was 27.2±5.1 kg·m^{-2} (median 26.1, range 20.0–65.4 kg·m^{-2}); for respondents with mMRC score of 0, mean±SD BMI was 27.1±5.0 kg·m^{-2}, while for those with mMRC score of 1, BMI was 28.6±5.5 kg·m^{-2}, and for those with mMRC score 2–4, BMI was 29.2±7.4 kg·m^{-2}. As BMI increased, so did the prevalence and severity of breathlessness (mMRC ⩾1, BMI >25 kg·m^{-2}; normal weight 6.8%; overweight 11.2%; obesity 12.4% and severe/morbid obesity 16.6%; p<0.0001) (figure 1).

In the adjusted multivariate analysis, people with obesity or severe/morbid obesity were twice as likely as respondents with a normal BMI to have mMRC score of 2–4 (OR 2.05, 95% CI 1.22–3.43; p<0.0001), and for severe/morbid obesity, this rose to OR 3.53 (95% CI 1.87–6.63; p<0.0001).

This population-based study of community-dwelling adults establishes a strong and significant association between increasing BMI and breathlessness related to exertion, and builds on methodologies that have explored this association [11–13]. Rising rates of obesity/overweight may lead to increased absolute numbers of people with breathlessness, and an increasing proportion of people with breathlessness will have obesity/overweight as a contributing factor.

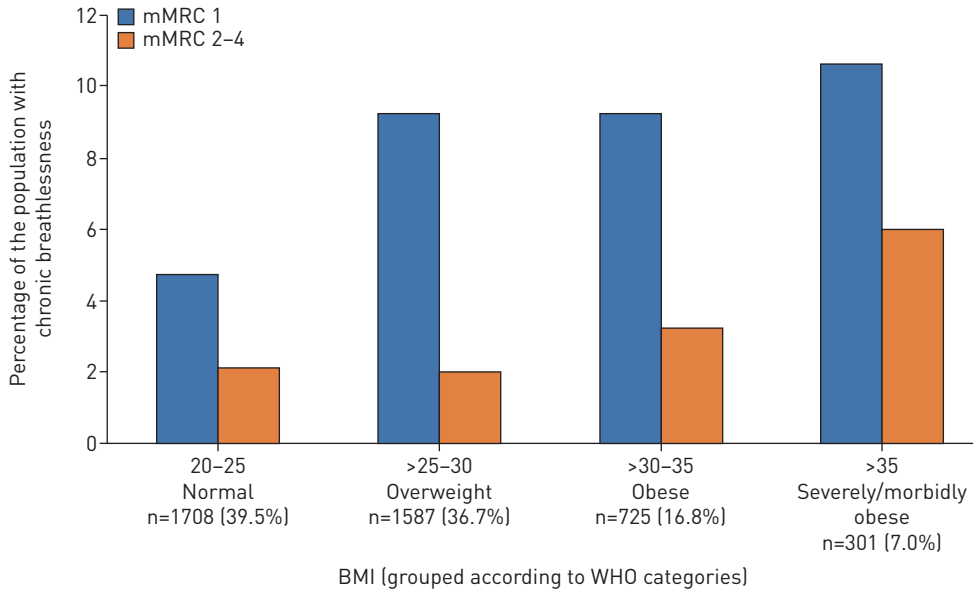

FIGURE 1 The relationship between chronic breathlessness (episode of breathlessness for >3 months during past 6 months measured by the modified Medical Research Council (mMRC) breathlessness scale) and body mass index (BMI) in community-dwelling adults in the general population (n=4321).

The improvements in breathlessness, lung volumes, inspiratory and expiratory muscle strength, and decreased respiratory drive that have often been observed following weight loss confirm the role of obesity/overweight in breathlessness [4, 14]. Uniquely, the current study used a description of breathlessness over a defined time-frame, and included the whole adult population rather than sub-groups limited by age or diagnosis.

Obesity has multiple detrimental effects on the respiratory system, all of which contribute to breathlessness: 1) decreased ERV; 2) decreased functional residual capacity (FRC); 3) greater reliance on intercostal muscles rather than diaphragm; 4) decreased diffusion capacity; 5) reduced lung compliance; 6) a higher likelihood of sleep disordered breathing; 7) decreased total lung capacity (TLC); and 8) increased residual volume (RV) [15–18].

Importantly, weight loss in such patients leads to improved ERV, RV, FRC and TLC, making weight loss a specific therapeutic goal [15].

Breathlessness that persists despite optimal treatment of the underlying pathophysiology and that results in disability has recently been suggested as a clinical syndrome in its own right, termed "chronic breathlessness syndrome" [19]. Any relationship between chronic breathlessness syndrome and obesity-related breathlessness needs to be debated.

Overweight/obesity is an independent risk factor only for the other factors included in the current model. These data probably underestimate the magnitude of the association, given that people with more severe breathlessness were less likely to provide their height and weight when surveyed.

Given the impact of overweight and obesity on other clinical factors such as heart failure, which were not available in this community survey but will contribute to breathlessness, further modelling needs to include physician-diagnosed clinical factors. For some people, breathlessness may lead to less exertion and weight gain, while for others, weight gain leads to increasing breathlessness and less exertion, and for some people, both factors may be at play from the outset.

Given the evidence that breathlessness can be lessened with weight loss in patients with obesity/overweight, further studies to explore how breathlessness changes with weight loss with and without cardiac conditioning would enhance our understanding of the relationship between obesity/overweight and breathlessness.

The rapid rise in the prevalence and disease burden of obesity is concerning [20]. These data on breathlessness provide another reason to reverse these population trends urgently. Obesity and overweight are independently associated with more severe self-reported physical activity-related breathlessness, building on previous population-based evidence [11, 12, 13]. For people with breathlessness, assessment of BMI should be part of good clinical care. Given evidence that weight loss can improve a range of respiratory parameters, it should be considered a therapy for breathlessness in relevant patients, and exertion-induced breathlessness should be addressed as part of exercise and lifestyle programmes [15].

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