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Socioeconomic status, obesity and lifestyle in men: The Geelong Osteoporosis Study

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Abstract

Background: Although the association between lower socioeconomic status (SES) and obesity in women in developed countries is well-documented, current evidence regarding the relationship between obesity in men and area-based SES (equivalised for advantage and disadvantage) is inconsistent. Therefore, we aimed to examine obesity, lifestyle behaviours, physical activity in different domains and demographics in men using area-based SES.
Methods: We performed a descriptive cross-sectional study of 1467 randomly selected white men (mean age 56 year (inter-quartile range (IQR) = 39–73 year)) recruited from the Barwon Statistical Division, South Western Victoria, Australia between 2001–06.
Results: Age-adjusted BMI, waist circumference, % fat and lean mass and blood pressure were inversely associated with SES, with differences between low and upper SES (*P* for difference <0.05), independent of country of birth. Age-adjusted lifestyle behaviours associated with obesity and/or adverse health (especially cardiovascular disease), were also associated with lower SES.
Conclusions: Subjects from lower SES had greater measures of obesity despite being more physically active at work, but were less likely to be physically active in the domains of sports and/or leisure. These findings suggest the possible influence of lifestyle behaviours and occupation upon obesity in men and should be investigated further.

1. Introduction

The association between socioeconomic status (SES) and adult obesity in women has been well documented[1–3], with a strong inverse association identified among women in developed countries [2,4]. However, evidence regarding obesity and SES in men is much less consistent, as identified in a review of 27 studies published in 1989 [2]. With the exception of three of the reviewed studies, in which no relationship between obesity and SES in men was observed, the remaining 24 studies were equally split between identifying either an inverse or a positive relationship between obesity and SES. Since that review there has been further evidence of a different relationship between SES and obesity depending upon gender [3,5], but no convincing evidence as to the definitive relationship between obesity and SES for men [6–8]. These data are difficult to reconcile with the well-documented suggestion regarding an overall inverse relationship between SES and obesity.

The conflicting data regarding men also suggest that little is known of the underlying lifestyle causal factors for obesity, and differences in obesity across area-based SES. Nevertheless, convincing evidence exists of a relationship between low SES and lifestyle behaviours in men such as inadequate nutritional intake, physical inactivity and prevalence of smoking [2,3,9–13]. These lifestyle behaviours have been shown to increase the risk of preventable diseases, including cardiovascular disease (CVD) [14,15]. Furthermore, there is evidence that policies to reduce health disparities related to obesity, for instance CVD, have been successfully targeted toward socially disadvantaged groups [16]. The worldwide challenge of health inequalities is highlighted within the WHO Social Determinants Commission's 2008 report *Closing the gap in a generation: Health equity through action on the social determinants of health* [17], which identified that reducing disparities in health across the globe would significantly reduce the burden of preventable disease internationally. There is limited, consistent, evidence that a relationship exists between men and obesity across SES, however given the different influences upon the health of men compared to that of women, without further research into this area it will remain unknown whether the same SES gradient that is observed for women also exists for men. Thus, without elucidation of the relationship between obesity in men and SES, any attempt to reduce health inequalities may be limited. We hypothesised that differences in measures of obesity, associated lifestyle behaviours and physical activity in the three domains of work/home, sports and leisure may be identified in men across area-based quintiles of SES.

2. Methods

2.1. Subjects

We examined data derived from a population-based age-stratified random sample of men (n = 1467) enrolled in the Geelong Osteoporosis Study (GOS). Participants had been randomly selected and recruited during 2001–2006 from the Commonwealth electoral rolls for the Barwon Statistical Division (BSD), located in south-eastern Australia. Registration with the Australian Electoral Commission is compulsory in Australia for all persons aged 18 years and over, therefore, the electoral roll provides a comprehensive register of most adult residents. In total, 3,273 men were invited to participate of whom 167 had died, 311 had left the region, 482 were unable to be contacted, 17 were unable to give informed consent and 756 declined to participate. There were 1,540 participants (67% participation) recruited from the Commonwealth electoral rolls from 2001–06 of whom 99% were Caucasian. Of these, 1,467 attended the research centre to each be interviewed by a research assistant, complete a questionnaire of diet and lifestyle and undergo clinical measures including densitometry. The median age for participants included in this analysis was 56 years (inter-quartile range (IQR) = 39–73 years). All participants provided informed written consent and approval was obtained from the Barwon Health Research and Ethics Advisory Committee. We certify that all applicable institutional and governmental regulations concerning the ethical use of human volunteers were followed during this research.

2.2. Body composition

Weight and height were measured to the nearest ±0.1 kg and ±0.1 cm, respectively. Body mass index (BMI) was calculated as weight/height^2 (kg/m^2) and was categorised as normal (<25 kg/m^2), overweight (25–29.9 kg/m^2), or obese (≥30 kg/m^2) [18]. Waist circumference was measured to the nearest 0.5 cm and categorised as ≥102 cm or not; a measure indicating obesity [18]. Subjects underwent a dual-energy X-ray absorptiometry (DXA) scan, GE-Lunar Prodigy system (Prodigy GE Lunar, Madison, WI, USA) and Lunar DPX-L (software version 1.31; Lunar, Madison, WI), from which measures of fat mass and lean mass were obtained. Percentage fat mass was calculated by dividing the fat mass by the sum of body mineral content, fat and lean mass. Percentage lean mass was calculated similarly. Subjects were excluded from analyses of % fat mass and % lean mass if their body size exceeded the 136 kg capacity of the scanner, or if body size did not permit full measurement (n = 90). Systolic and diastolic blood pressures were measured in mmHg using an automated upper arm digital blood pressure monitor (UA-767).

2.3. Lifestyle behaviours

All measures of dietary intake and alcohol consumption were self-reported using a validated food-frequency questionnaire [19]. Fifty-six subjects did not complete the dietary questionnaire or had missing data. Energy intake of foods and alcohol was defined as kilojoules consumed per day and combined to give a total energy intake. Subjects reported their average daily serving sizes of potatoes, vegetables, steak and casserole/other meats, which was calculated as a single Portion Size Factor (PSF). PSF values identified whether, on average, subjects consumed a median size serving (PSF = 1), less than the median (PSF <1) or more than the median (PSF >1). Average fruit consumption (pieces/day), vegetable consumption (servings/day) and takeaway food were self-reported. Takeaway foods included pizza, hamburgers with a bun, or meat pies/pasties/quiches/other savoury pastries and were estimated as how often eaten during the previous 12 months, then calculated as average grams/day. Alcohol consumption was estimated as (1) grams of alcohol consumed per day, (2) consuming on average two or more standard drinks of any alcohol per day [20], and (3) daily consumption of beer, wine or spirits. Smoking status was defined as current at the time of measurement with a further categorisation of smoking >15 cigarettes per day, a level defined as above that of low risk tobacco use [21]. Levels of physical activity, in the three domains of work/home, sports and leisure, were measured by using two separate validated questionnaires; one for subjects aged <60 years [22] and one for those aged ≥60 years [23]. Physical activity scores were identified as above or below the median for each domain and in each age group. Current medication use was classified into taking <3 prescription medications or ≥3 prescription medications.

2.4. Demographics

Country of birth was defined as born in a country other than Australia versus born in Australia. Current occupation type was categorised using the Australian and New Zealand Standard Classification of Occupations (ANZSCO) [24] in six groupings: (1) managers, professionals or paraprofessionals, (2) tradespersons (3) clerks, salespersons or personal service workers, (4) plant or machine operators and drivers, (5) labourers and related workers, and (6) other.

2.5. Socioeconomic status (SES)

The residential address for each subject was matched to the corresponding Australian Bureau of Statistics (ABS) Census Collection District and ABS software was used to determine the Socio-Economic Index For Areas (SEIFA) value from the 2006 census for each subject. It was decided *a priori* to use the Index of Relative Socio-economic Advantage and Disadvantage (IRSAD), which is an aggregate score of area-based measures that represents both advantage and disadvantage and, thus, provides values reflecting the full SES continuum from most disadvantaged to most advantaged. The IRSAD is a composite measure that accounts for high and low income, the type of occupation from unskilled employment to professional positions, educational attainment ranging from no qualifications to a tertiary degree or higher, and some measure of wealth (such as owning a car, or number of bedrooms in a dwelling). A low score, as measured by the IRSAD, represents a more disadvantaged area, while a high score represents a more advantaged area [25,26]. The coding of SES was blinded to the ascertainment of all variables of the study population. After obtaining the SEIFA values, our study population was divided into quintiles of SES based on the BSD reference range data.

2.6. Statistical analysis

Descriptive statistics were tabulated and univariate analyses performed using Chi-square, ANOVA or Kruskal Wallis where relevant. Interaction terms were checked for effect modification. The middle three quintiles were pooled to address a disproportionate spread of ages. Age-adjusted analyses were thus based on three groupings of low (quintile 1), mid (quintiles 2–4) and upper SES (quintile 5). Using multivariate analyses, results were age-adjusted using regression modelling for continuous outcomes and binary or ordinal logistic regression for categorical outcomes. Significance was set at $P < 0.05$. MINITAB (release 15) software was used for statistical analyses.

3. Results

Subject characteristics (n = 1467) are presented in Table 1, by SES quintiles. Although a clear gradient across all SES quintiles was not observed, there were significant differences between SES quintiles for unadjusted measures of obesity, lifestyle behaviours and demographic variables. Subjects in lower SES

Table 1 Unadjusted characteristics across socioeconomic quintiles of Index of Relative Socioeconomic Advantage/Disadvantage (IRSAD) based on the 2006 Australian Bureau of Statistics data for Barwon Statistical Division, Australia

	Total (n = 1467)	**Quintile 1 254 (17.3%)**	**Quintile 2 306 (20.9%)**	**Quintile 3 277 (18.9%)**	**Quintile 4 310 (21.1%)**	**Quintile 5 320 (21.8%)**	***P* for diff**
Age (year)	56.0 (39.0–73.0)	65.0 (42.0–77.0)	56.0 (41.0–73.0)	55.0 (39.0–73.0)	52.0 (36.0–67.0)	53.0 (38.0–71.0)	<**0.001**
Body composition							
Height (cm)	174.5 (169.8–179.5)	172.4 (167.6–176.9)	173.8 (169.6–179.2)	175.6 (170.5–180.1)	175.0 (170.1–179.9)	175.5 (171.7–181.1)	<**0.001**
Weight (kg)	81.4 (73.0–90.7)	79.9 (72.0–90.0)	81.7 (73.4–90.6)	81.6 (73.2–91.4)	82.5 (74.2–91.8)	81.0 (72.0–89.7)	0.48
BMI (kg/m^2)	26.7 (24.2–29.3)	26.8 (24.2–30.2)	26.8 (24.6–29.3)	26.7 (24.0–28.9)	26.9 (24.7–29.5)	26.2 (23.8–28.4)	0.08
BMI groups							<**0.004**
< 25 (kg/m^2)	481 (32.8%)	80 (31.5%)	94 (30.7%)	98 (35.4%)	83 (26.8%)	126 (39.4%)	
25–29.9 (kg/m^2)	737 (50.2%)	117 (46.1%)	158 (51.6%)	143 (51.6%)	170 (54.8%)	149 (46.6%)	
≥ 30 (kg/m^2)	249 (17.0%)	57 (22.4%)	54 (17.6%)	36 (13.0%)	57 (18.4%)	45 (14.1%)	
Waist (cm)	97.3 ± 11.4	99.2 ± 12.1	98.3 ± 11.6	96.6 ± 11.5	97.0 ± 10.6	95.6 ± 11.3	**0.01**
Waist ≥102 (cm)	475 (32.4%)	92 (36.2%)	107 (35.0%)	90 (32.5%)	93 (30.0%)	93 (29.1%)	0.12
% Fat mass	26.0 ± 7.2	26.9 ± 7.4	26.1 ± 6.9	25.7 ± 7.5	26.7 ± 6.8	25.0 ± 7.3	**0.009**
% Lean mass	74.0 ± 7.2	73.1 ± 7.4	73.9 ± 6.9	74.3 ± 7.5	73.3 ± 6.8	75.1 ±± 7.3	**0.009**
Blood pressure (mmHg)							
Systolic	132.5 ± 17.5	135.6 ± 18.0	132.4 ± 18.7	131.7 ± 15.6	132.3 ± 16.6	131.0 ± 18.1	**0.005**
Diastolic	78.7 ± 11.1	80.0 ± 13.2	79.1 ± 10.9	78.3 ± 10.0	78.8 ± 10.4	77.6 ± 11.3	0.75
Lifestyle behaviours							
Energy-foods/alcohol (kJ/day)	8578 (6938–10742)	8578 (6827–10954)	8681 (6911–10921)	8399 (6770–10432)	8876 (7178–10888)	8382 (6983–10660)	0.24
Alcohol (g/day)	12.4 (1.9–28.7)	7.5 (0.5–29.6)	10.1 (1.1–27.3)	12.7 (1.9–26.2)	18.5 (5.8–33.7)	13.7 (3.5–28.1)	<**0.001**
Alcohol av ≥ 2 glasses/day	518 (35.3%)	80 (31.5%)	102 (33.3%)	90 (32.5%)	134 (43.2%)	112 (35.0%)	<**0.001**
Beer – every day	24 (1.6%)	15 (5.9%)	17 (5.6%)	15 (5.4%)	27 (8.7%)	15 (4.7%)	**0.01**
Wine – every day	89 (6.1%)	14 (5.5%)	14 (4.6%)	18 (6.5%)	20 (6.5%)	23 (7.2%)	0.51
Spirits – every day	24 (1.6%)	5 (2.0%)	5 (1.6%)	4 (1.4%)	7 (2.3%)	3 (0.9%)	0.37
Current	784 (53.4%)	153 (60.2%)	167 (54.5%)	149 (53.8%)	170 (54.8%)	145 (45.3%)	**0.001**
smoker ≥ 15 cig/day*	469 (32.0%)	94 (20.0%)	110 (23.5%)	99 (21.1%)	91 (19.4%)	75 (16.0%)	0.23
Physically sedentary (<60 years)							**0.008**
Work	713 (48.6%)	121 (47.6%)	134 (43.8%)	138 (49.8%)	139 (44.8%)	181 (56.6%)	
Sports	658 (44.9%)	130 (51.2%)	143 (46.7%)	117 (42.2%)	140 (45.2%)	128 (40.0%)	
Leisure	705 (48.1%)	138 (54.3%)	155 (50.7%)	136 (49.1%)	144 (46.5%)	132 (41.3%)	
Physically sedentary (≥ 60 years)							**0.04**
Home	281 (19.2%)	63 (24.8%)	59 (19.3%)	51 (18.4%)	56 (18.1%)	52 (16.3%)	
Sports	410 (27.9%)	101 (39.8%)	85 (27.8%)	73 (26.4%)	73 (23.5%)	78 (24.4%)	
Leisure	308 (21.0%)	80 (31.5%)	63 (20.6%)	55 (19.9%)	50 (16.1%)	60 (18.8%)	
Portion Size Factor (PSF)							0.23
PSF <1	348 (23.7%)	68 (26.8%)	73 (23.9%)	67 (24.2%)	57 (18.4%)	83 (25.9%)	
PSF = 1	108 (7.4%)	21 (8.3%)	22 (7.2%)	19 (6.9%)	25 (8.1%)	21 (6.6%)	
PSF >1	932 (63.5%)	152 (59.8%)	200 (65.4%)	174 (62.8%)	207 (66.8%)	199 (62.2%)	
Fruit (pieces/day)	3 (2–4)	3 (2–4)	3 (2–4)	3 (2–4)	3 (2–4)	3 (2–4)	0.45
Vegetables (servings/day)	4 (4–5)	4 (4–5)	4 (4–5)	4 (4–5)	4 (4–5)	4 (4–5)	0.78
Meat pies (g/day)	19.2 ± 27.9	21.23 ± 45.5	18.7 ± 24.1	19.5 ± 26.2	17.8 ± 19.2	19.2 ± 20.7	0.12
Pizza (g/day)	19.7 ± 26.7	21.7 ± 39.4	17.0 ± 23.0	16.6 ± 19.9	20.7 ± 22.7	22.5 ± 26.1	**0.001**

Table 1 (*Continued*)

	Total (n = 1467)	Quintile 1254 (17.3%)	Quintile 2306 (20.9%)	Quintile 3277 (18.9%)	Quintile 4310 (21.1%)	Quintile 5320 (21.8%)	P for diff
Hamburgers (g/day)	8.7 ± 17.4	10.4 ± 19.3	7.5 ± 15.8	7.8 ± 13.4	8.6 ± 17.5	9.1 ± 19.8	0.73
Prescription medications 3+	454 (30.9%)	113 (44.5%)	97 (31.7%)	74 (26.7%)	81 (26.1%)	89 (27.8%)	**0.003**
Demographics							
Born in a country other than Australia	289 (19.7%)	76 (29.9%)	54 (17.6%)	51 (18.4%)	53 (17.1%)	55 (17.2%)	**0.02**
Occupation							<**0.001**
Managers, professionals	316 (21.5%)	25 (9.8%)	47 (15.4%)	60 (21.7%)	74 (23.9%)	110 (34.4%)	
Tradespersons	162 (11.0%)	25 (9.8%)	40 (13.1%)	29 (10.5%)	42 (13.5%)	26 (8.1%)	
Clerks, sales, services	82 (5.6%)	9 (3.5%)	19 (6.2%)	18 (6.5%)	16 (5.2%)	20 (6.3%)	
Plant/machine operators, drivers	100 (6.8%)	26 (10.2%)	22 (7.2%)	17 (6.1%)	25 (8.1%)	10 (3.1%)	
Labourers, related workers	146 (10.%)	17 (6.7%)	38 (12.4%)	34 (12.3%)	32 (10.3%)	25 (7.8%)	
Other	656 (44.7%)	152 (59.8%)	138 (45.1%)	117 (42.2%)	120 (38.7%)	129 (40.3%)	

Data are presented as median (inter-quartile range), mean ± standard deviation(SD) or frequency (%).

* Data represents number of subjects smoking ≥ 15 cigarettes per day (% of current smokers).

quintiles were more likely to be older and shorter and to have greater waist circumference, greater % fat mass, less % lean mass and lower skilled occupations compared to those from upper SES quintiles (P for difference, all $P \leq 0.01$). Subjects in lower SES quintiles were less likely to consume two or more standard alcoholic drinks per day, but were more likely to smoke compared to subjects in upper SES quintiles (P for difference, all $P \leq 0.001$). In lower quintiles, subjects in the younger age group (<60 years), were less likely to be sedentary at work, but were more likely to be sedentary in sports and/or leisure activities compared to those in upper quintiles (P for difference = 0.008). Subjects in the older age group (≥60 years) in lower quintiles were more likely to be sedentary in all three types of leisure-based physical activity compared to those in upper quintiles (P for difference = 0.04). Subjects in lower SES quintiles took more prescription medications (P for difference = 0.003) compared to subjects in upper quintiles. Individuals born in a country other than Australia were more highly represented in the lower SES quintiles than in the upper SES quintiles (P for difference = 0.02).

3.1. Age-adjusted body composition

Age-adjusted results for measures of body composition across three groupings of SES, where significant differences were identified, are presented in Fig. 1. No differences in weight were identified across SES groupings. We identified a positive relationship between height and SES, and an inverse relationship between SES and BMI, waist circumference and blood pressure (all $P < 0.05$). Similarities in %fat and lean mass were observed between subjects in the low and mid SES groups, however, %fat and lean mass of subjects in the upper SES group differed significantly from the two lower groups (both $P < 0.05$). Subjects in the low SES group had an increased risk of being obese (BMI ≥30 kg/m^2) and of having a waist circumference ≥102 cm compared to subjects in the mid or upper groups (Fig. 2).

3.2. Age-adjusted lifestyle behaviours

Age-adjusted results for categorical lifestyle behaviours, where significant differences were identified, are presented in Fig. 3. Data are not shown for continuous lifestyle behaviours. An inverse relationship was observed between SES groupings and age-adjusted daily energy intake from foods and alcohol (combined), with a trend for difference between the low and upper SES groups (P = 0.10). Compared to subjects in the upper SES grouping, subjects in the low SES grouping consumed fewer servings of fruit per day (P = 0.04), although no differences were observed in the consumption of vegetables. Subjects in the low SES grouping consumed the most takeaway foods, with significant

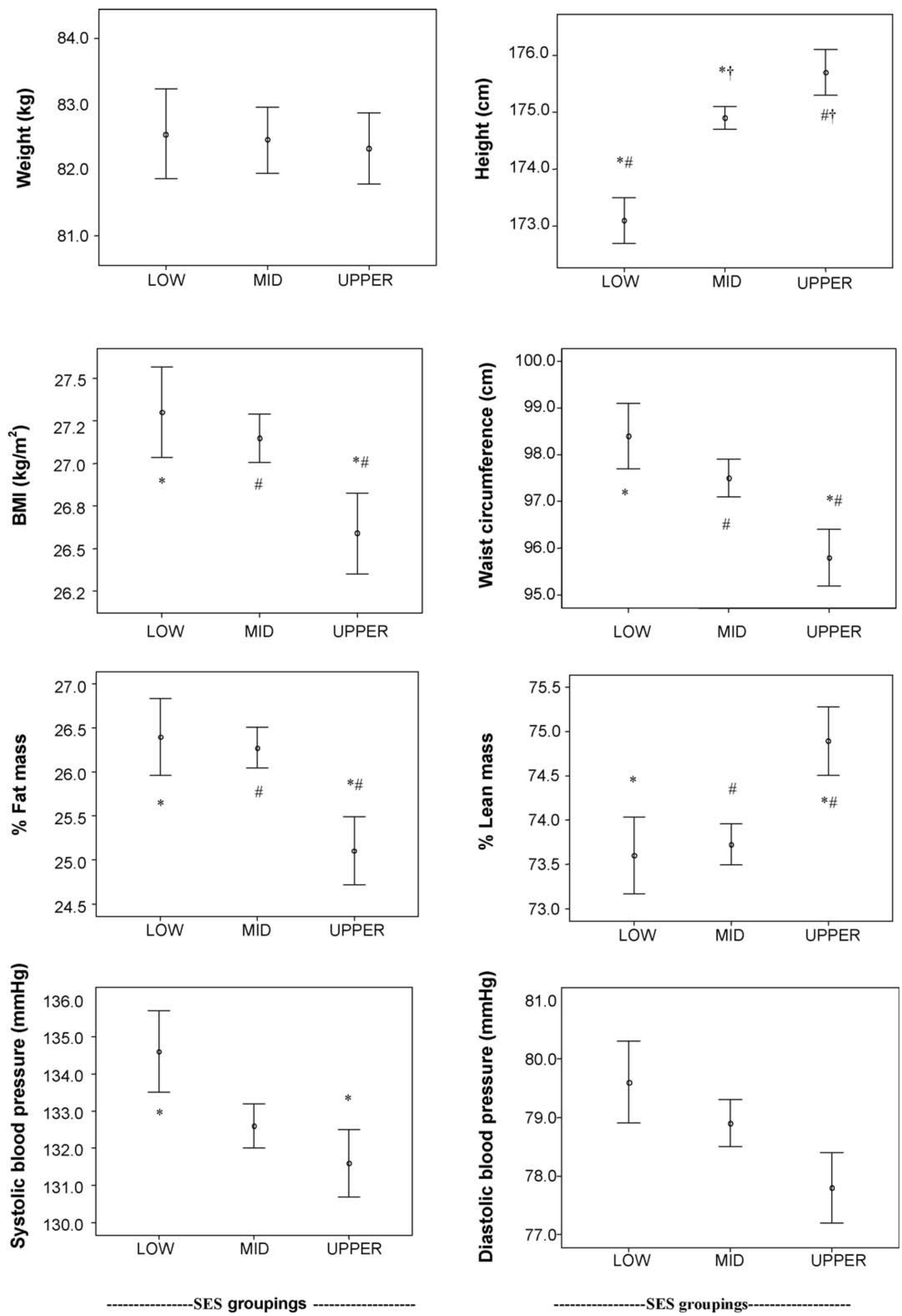

Fig. 1 Age-adjusted (continuous) measures of body composition and blood pressure for low, mid and upper SES groupings based on the 2006 Australian Bureau of Statistics data for Barwon Statistical Division, Australia. Significant differences are indicated by superscript (all $P < 0.05$).

differences observed in the consumption of pizza and hamburgers (both $P < 0.05$).

There were no differences between SES groups for consumption of ≥2 glasses/day alcohol, daily wine consumption or daily spirits consumption. Subjects in the low SES grouping were twice as likely to be current smokers and to smoke more than 15 cigarettes/day,

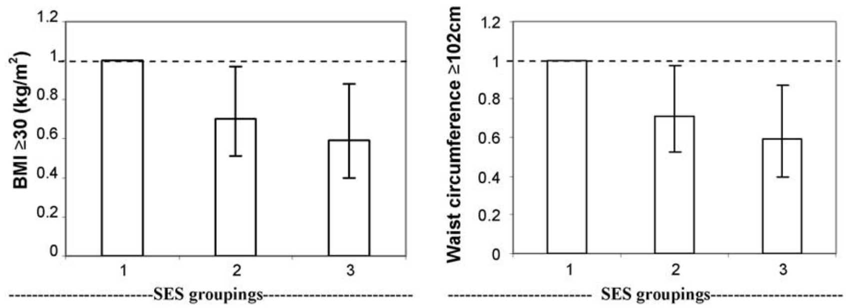

Fig. 2 Age-adjusted odds ratios for body composition across low (1), mid (2) and upper (3) SES groupings based on the 2006 Australian Bureau of Statistics data for Barwon Statistical Division, Australia. Error bars indicate 95% confidence intervals. Lowest SES grouping is held as referent group, with the broken line indicating threshold of significance.

compared to subjects in the upper SES group (Fig. 3). Subjects in the low SES and mid SES grouping, aged <60 years, were 50% less likely to be sedentary at work compared to those in the upper SES group. Subjects in the low SES group were 40% more likely to be involved in sports and/or leisure-based physical activity than subjects in the mid or upper SES groups. No differences in physical activity were observed in those subjects ≥60 years. No differences were observed in portion sizes across SES. Compared to subjects in the mid and upper SES groups, which were both relatively similar, subjects in the low SES group were 40% more likely to take three or more prescription medications.

3.3. Age-adjusted demographic factors

Subjects in the low SES group were twice as likely to be born in a country other than Australia, compared to subjects in the mid and upper SES groups. Subjects in the upper SES group were significantly more likely to be employed as a manager, professional or paraprofessional (odds ratio (OR) = 4.42 (95% confidence interval (CI) = 2.69–7.27)) than subjects in the lower SES group. Employment as a plant/machine operator or driver was least likely for subjects in the upper SES group (OR = 0.21 (95%CI = 0.10–0.46)) compared to subjects in the lower SES group (data not shown).

4. Discussion

This cross-sectional analysis identified an inverse association between all measures of age-adjusted obesity and groupings of area-based SES, with the exception of weight. Age-adjusted lifestyle choices associated with obesity and poorer health, most notably CVD, were observed in the low SES group; including greater levels of smoking, increased consumption of takeaway foods and more sedentary lifestyles. Subjects in the low SES group had greater medication use, suggestive of an increased burden of co-morbidity.

The novel finding of this study was the inverse association between measures of obesity and a more sensitive measure of SES than has previously been applied in examinations of this relationship in men. Our finding that measures of obesity were greater in men from low SES groups is consistent with some [1,2,27], but not all [3,5,6,11], existing literature. Also consistent with current literature was the observed greater level of takeaway food consumption in the lower SES grouping [10], lower level of recreational physical activity (sports and leisure) in this same group [9] and increased levels of smoking [28–31].

Body composition in men may be influenced by dietary patterns associated with employment status and type [3]. Some data suggest employment in lower skilled occupations such as plant/machine operators, drivers or labourers, or those with lower education, may attenuate patterns of lower-cost and convenient, but less healthy, food choices during the working day [7,32]. In contrast, employment in higher skilled occupations such as managers or professionals may increase opportunities for food and alcohol consumption such as corporate functions and/or dining with clients. Patterns of age-adjusted occupations

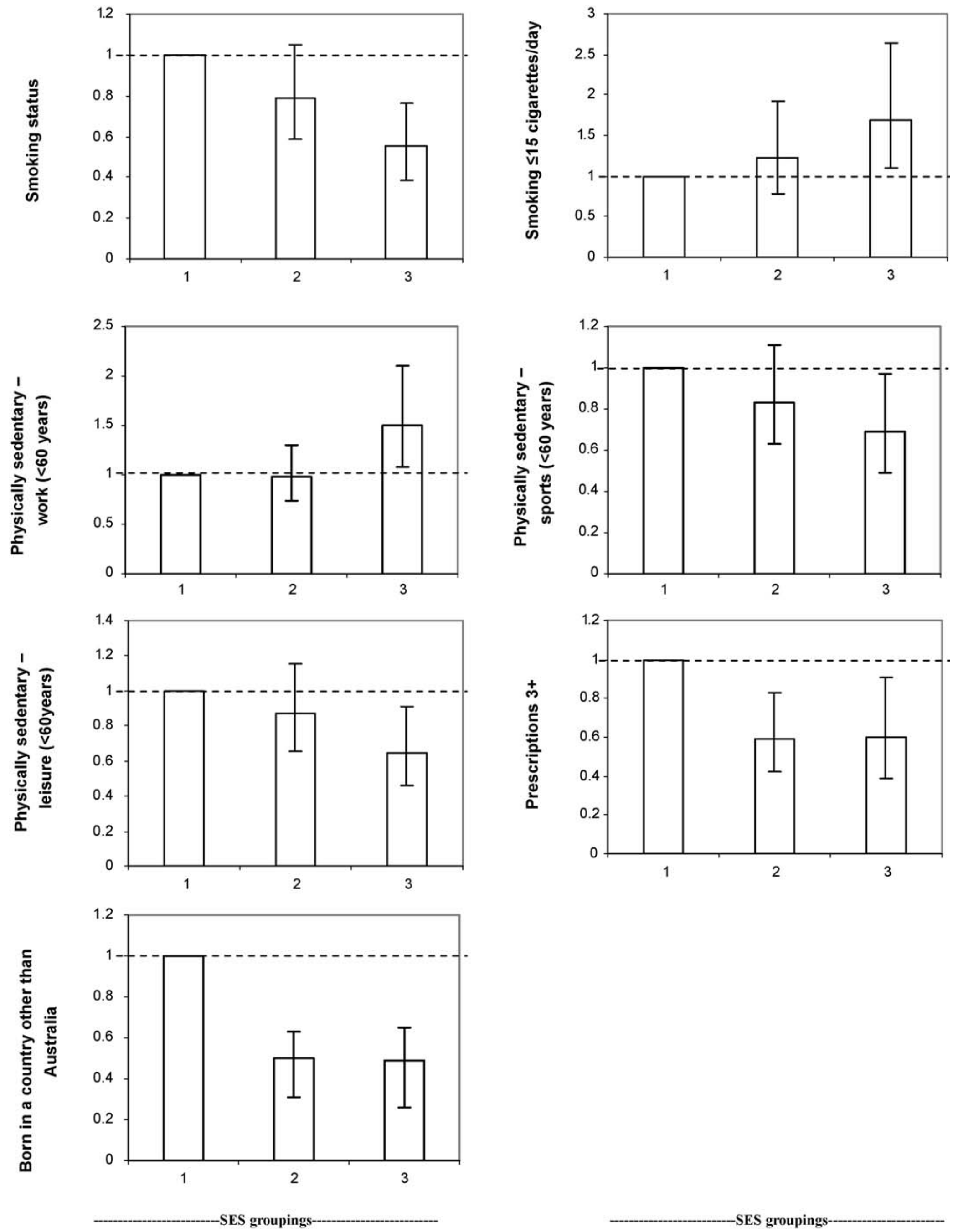

Fig. 3 Age-adjusted odds ratios for lifestyle variables across low (1), mid (2) and upper (3) SES groupings based on the 2006 Australian Bureau of Statistics data for Barwon Statistical Division, Australia. Error bars indicate 95% confidence intervals. Low SES grouping is held as referent group, with the broken line indicating threshold of significance.

across our study population indicated subjects in the upper SES group to be four-times more likely to be employed as managers, professionals or para-professionals compared to subjects in the low SES group. Conversely, subjects in the low SES group were 80% more likely to be employed as a plant/machine operator or driver compared to subjects in the upper SES group (data not shown). After adjusting for age, energy consumption was significantly greater in the higher skilled group of managers, professionals and para-professionals, whereas least energy consumption was observed in the lower skilled group of labourers: a pattern that remained after taking into account alcohol consumption (data not shown). However, the consumption of takeaway food, representing convenient and low-cost choices, was greater in the lower skilled workers than the higher skilled workers. Thus, our data may support the contention that dietary patterns might be influenced by occupation.

The observed differences in physical activity for subjects aged <60 years across SES groupings in each of the domains of work, sports and leisure may hint at possible causal factors for differences in obesity, although we cannot infer this from our cross-sectional study. Subjects in the upper SES group had the lowest measures of obesity, despite being the most occupationally sedentary group. However, the upper SES group was more likely to participate in regular sporting or leisure-based physical activities than the low or mid SES group. Consistent with this argument, the observed greater measures of obesity identified in subjects from lower SES groups may be related to low levels of sports and leisure-based physical activity, rather than work-related physical activity. Thus, regular participation in recreational physical activity (sports and leisure) may partly explain the observed differences between SES groups, more than occupational physical activity.

Fat-free mass may be the single best predictor of energy expenditure over a 24-hour period [33–36] and also the single best determinant of sleeping metabolic rate [33–35], which also influences energy expenditure. The contribution of % fat mass to energy expenditure may further explain body composition measures for subjects in the lower SES group. We identified subjects in the low and mid SES groups to have greater age-adjusted % fat mass than those in the upper SES group, and the low SES group also had significantly less age-adjusted % lean mass than the mid and upper SES groups. We may, therefore, speculate that energy expenditure could be positively associated with SES; influenced by the contribution of fat-free mass. Thus, we might hypothesise that an explanation for greater measures of obesity for subjects in the low SES group may be a combination of food choices rather than energy intake, reduced physical activity and the influence of % fat and lean mass upon energy expenditure. However, inherent in this argument is the notion of causality, which cannot be assumed from this cross-sectional study.

Although the SES group in which greater measures of obesity were observed was the same group that were more likely to have been born in a country other than Australia, the association between obesity and subjects of lower SES was independent of country of birth. Whilst it is beyond the scope of this study, we speculate that the pattern of residency amongst individuals born in a country other than Australia may be related to the significant number of refugee migrants. Given this, many individuals are likely to have a need for cheaper housing, access to multicultural support services that are strategically located where need is greater and/or choice of closer location to lower skilled employment opportunities. That being said, our descriptive characteristics show that individuals born in a country other than Australia are represented within each SES quintile, albeit weighted to lower SES. Given the complex social constructs associated with residing in a country different to that of birth, care should be taken when interpreting our observed pattern of relationship between country of birth and area-based SES.

This study has two major strengths. Our examination of lifestyle choices in a randomly selected population may suggest possible reasons for inequalities in obesity across groupings of SES, and highlight specific populations at greater risk of obesity-related health outcomes, most notably CVD. The ANZSCO has been shown as being comparable to the International Standard Classification of Occupations (ISCO-88); however, the application of skill level criteria in ANZSCO is more rigorous [24]. Our study has some limitations. The level of information collected as part of the Census limits the range of variables forming the SEIFA indexes, thus IRSAD contains limited information regarding accumulated wealth and no information concerning infrastructure such as schools, transport or the cost of living within an area. An assumption is made that subjects within area-based SES groups are socioeconomically homogenous. Similar to all studies that examine self-reported dietary intake and physical activity, recall bias may influence our results. Our findings are based on a cross-sectional study and may not be universally applicable and thus not relevant to populations of other ethnicity or locations. Subjects excluded from % fat mass and % lean mass analyses due to exceeding the capacity of the scanner were disproportionately from the lower SES group, however, the inclusion of these subjects would increase, rather than decrease, the observed relationship between SES and % fat and % lean mass.

Our findings support the well-documented relationship between poorer general health and SES and, whilst raising many questions, the relationships described within this study are likely to contribute to the current debate around approaches to reduce obesity. Our findings suggest that, consistent with current literature, patterns of lifestyle associated with SES may influence obesity in men [3,32]. Despite the cross-sectional nature of this study, our findings suggest that in order to understand why SES and body composition may be related, we need to consider the processes associated with the characteristics and components of occupation and leisure-time activities. These factors may have substantial effects on obesity and related adverse health outcomes and further research into this area of enquiry may help us to understand possible causal factors. The contribution of our analyses is the hypothesis that mechanisms that are influential upon obesity in men may be better understood by further exploring SES in relation to occupational components and domains of physical activity.

Conflict of interest

None of the authors have any conflict of interest.

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