

Urban–rural comparison of weight status among women and children living in socioeconomically disadvantaged neighbourhoods

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Obesity poses a major threat to population health because it significantly increases the risk of all-cause mortality, stroke, type 2 diabetes and coronary heart disease.¹ Recent Australian estimates suggest that over two-thirds of men, over 50% of women and about 25% of children are overweight or obese.^{2–4} Long-term weight loss strategies are of limited success, and the costs associated with obesity treatment are high.^{5,6} Obesity prevention is therefore an important public health priority.

Socioeconomically disadvantaged people are at increased risk of overweight and obesity compared with the general population. Higher levels of obesity are associated with lower income, lower education level, unemployment, employment in low-status occupations, and living in disadvantaged neighbourhoods.^{7,8} Living in a rural area may also be associated with greater risk of overweight or obesity, although evidence is equivocal. Estimates of the proportion of Australian adults who are overweight or obese range from 45% to 74% in rural areas^{9,10} and from 45% to 61% in predominantly urban areas.^{2,4} However, it is not known whether the higher levels of overweight and obesity observed among rural-dwelling adults in the few existing studies are attributable to compositional effects (eg, rural residents having a higher risk of socioeconomic disadvantage, which is associated with obesity risk)¹¹ or contextual effects (eg, rural residents having different social norms relating to body weight, or poorer access to healthy foods or physical activity facilities).

Other groups at increased risk of obesity include women of childbearing age and children. Substantially greater weight gains were observed between the periods 1990–1994 and 1995–1999 in Australian women compared with men, and in younger women compared with older women.¹² Among children, overweight doubled and obesity trebled between 1985 and 1995,¹³ and further increases in obesity have been observed over the past decade.⁴ Plausibly, women and children living in socioeconomically disadvantaged rural areas are especially at risk of obesity, but these population groups remain

ABSTRACT

Objective: To compare the weight status of women and children living in socioeconomically disadvantaged rural and urban neighbourhoods in Victoria.

Design, setting and participants: Cross-sectional study of data collected between August 2007 and July 2008 as part of the Resilience for Eating and Activity Despite Inequality (READI) study. Women aged 18–45 years living in 40 rural and 40 urban socioeconomically disadvantaged Victorian areas were surveyed by postal questionnaire. Data from a subset of their children aged 5–12 years were also analysed. Weight and height were self-reported for women and measured for children.

Main outcome measures: Women's weight status based on body mass index (BMI): underweight; healthy; overweight; or obese Class I, II or III; children's weight status based on International Obesity Taskforce BMI cut-off points.

Results: Of 11 940 women randomly selected, 4934 (41%) replied to a postal invitation to participate. After exclusions for various reasons, data were available on 3879 women and 636 of their children. Twenty-four per cent of urban and 26% of rural women were classified as overweight; a further 19% of urban and 23% of rural women were classified as obese. Twenty per cent of both urban and rural children were classified as overweight; a further 10% of urban and rural children were classified as obese. In crude analyses, rural women had higher odds of Class I and II obesity (odds ratio [OR], 1.34 and 1.72, respectively) compared with urban women. After adjusting for sociodemographic factors (age, number of children, country of birth, education level, employment status and marital status), there was no difference between urban and rural women in odds of overweight or obesity Class I, II or III. No significant urban–rural difference in odds of overweight/obesity was evident among children.

Conclusions: The higher prevalence of obesity in rural women compared with urban women was largely explained by individual-level sociodemographic factors, such as age, number of children, country of birth, education level, employment status and marital status. This suggests that higher obesity levels among women in rural areas may be attributable to the sociodemographic composition of these areas.

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largely unstudied. Our study aimed to describe and compare the weight status of women of childbearing age and their children living in socioeconomically disadvantaged rural and urban areas of Victoria.

METHODS

Data were collected between August 2007 and July 2008 as part of the Resilience for Eating and Activity Despite Inequality (READI) study.

Sampling and participants

Forty urban and 40 rural areas in Victoria were randomly selected using a sampling frame based on the Australian Bureau of Statistics' 2001 Socio-Economic Indexes for

Areas (SEIFA).¹⁴ Disadvantaged areas were defined as those within the bottom third of the Victorian SEIFA distribution.

Urban areas included (a) metropolitan Melbourne; (b) rural cities (defined by the *Regional Infrastructure Development Fund Act 1999* [Vic] as Geelong, Traralgon, Ballarat and Bendigo) and all suburbs completely within a 10 km radius of the centroid of these rural cities; and (c) all suburbs completely within a 10 km radius of the centroid of other cities in Victoria with a population of 20 000 or more (Warrnambool and Wodonga).

Rural areas were classified as areas falling outside metropolitan Melbourne and outside a 25 km radius of the rural cities (Geelong, Traralgon, Ballarat, Bendigo, Warrnambool and Wodonga).

Within each of the 80 urban and rural areas, 150 women aged 18–45 years were randomly selected from the Australian electoral roll. In areas with less than 150 eligible women, all eligible women were sampled. Of 11 940 women selected, 4934 (41%) responded to a postal invitation to complete a written questionnaire, with the response rate being slightly higher among rural than urban women (39% v 34%). Data were excluded for 585 respondents (571 who had moved from the sampled suburb before survey completion, three who completed the survey but were not the intended participants, two who withdrew their data after completing the survey, and nine who were aged under 17 or over 46 years). Of the 4349 remaining eligible women, those with a child aged 5–12 years ($n=1457$) were invited to participate in an additional study. Of these, 771 (53%) agreed to provide information on the 5–12-year-old child in their family with the next birthday. Data collected from women and children were excluded if the woman was pregnant ($n=210$) or had missing data for pregnancy ($n=40$) or body mass index (BMI) ($n=220$). This left a total of 3879 women and 636 children to be included in our analyses.

Measures

Women self-reported their height and weight ($n=4229$), from which BMI (kg/m^2) was calculated. Based on BMI, respondents were classified as underweight (BMI $<18.5 \text{ kg/m}^2$), healthy weight (BMI $18.5\text{--}24.9 \text{ kg/m}^2$), overweight (BMI $25.0\text{--}29.9 \text{ kg/m}^2$), or obese Class I, II or III (BMI $30.0\text{--}34.9 \text{ kg/m}^2$, $35.0\text{--}39.9 \text{ kg/m}^2$ or $\geq 40.0 \text{ kg/m}^2$, respectively).⁵

Children's height (to the nearest 0.1 cm) and weight (to the nearest 0.1 kg) were measured without shoes in light clothing using a portable stadiometer and digital scales ($n=636$). Inter- and intra-rater reliability (intra-class correlations) were both 0.99. Based on International Obesity Taskforce cut-off points for BMI, children were classified as underweight, healthy weight, overweight or obese.¹⁵

Women self-reported their highest qualification, which was classified as low (no formal qualifications/Year 10 or equivalent), medium (Year 12 or equivalent, trade, apprenticeship, certificate or diploma), or high (university undergraduate or postgraduate degree). They also reported their employment status (working full-time, working part-time, or not currently employed); marital status (married/living as

| Characteristic [†] | Overall ($n=3879$) | Urban ($n=1801$) | Rural ($n=2078$) | P^{\ddagger} |
|-----------------------------------|----------------------|--------------------|--------------------|----------------|
| Mean age (years) (SD) | 34.7 (8.2) | 33.6 (8.2) | 35.6 (8.1) | <0.001 |
| Mean BMI (kg/m^2) (SD) | 26.0 (6.1) | 25.5 (6.0) | 26.4 (6.1) | <0.001 |
| Number of children under 18 years | | | | <0.001 |
| 0 | 1500 (39.3%) | 48.9% | 31.2% | |
| 1 | 665 (17.4%) | 18.1% | 17.0% | |
| 2 | 993 (26.0%) | 21.4% | 30.1% | |
| ≥ 3 | 654 (17.2%) | 11.6% | 21.8% | |
| Born in Australia | 3432 (88.8%) | 80.0% | 96.3% | <0.001 |
| Level of education | | | | <0.001 |
| Low | 841 (22.0%) | 17.5% | 25.8% | |
| Medium | 1974 (51.5%) | 49.9% | 52.9% | |
| High | 1016 (26.5%) | 32.6% | 21.2% | |
| Employment status | | | | <0.001 |
| Working part-time | 1125 (29.7%) | 23.4% | 35.2% | |
| Working full-time | 1469 (38.8%) | 45.5% | 33.1% | |
| Not currently employed | 1188 (31.4%) | 31.1% | 31.7% | |
| Marital status | | | | <0.001 |
| Not married | 1010 (26.2%) | 33.7% | 19.7% | |
| Married/living as married | 2508 (65.0%) | 57.2% | 71.8% | |
| Previously married | 339 (8.8%) | 9.1% | 8.6% | |
| Weight status | | | | <0.001 |
| Underweight | 143 (3.7%) | 4.9% | 2.7% | |
| Healthy weight | 1933 (49.8%) | 52.2% | 47.8% | |
| Overweight | 972 (25.1%) | 23.8% | 26.1% | |
| Obese Class I | 471 (12.1%) | 10.9% | 13.2% | |
| Obese Class II | 229 (5.9%) | 4.6% | 7.1% | |
| Obese Class III | 131 (3.4%) | 3.7% | 3.1% | |

BMI = body mass index. READI = Resilience for Eating and Activity Despite Inequality.
 * For all categories except mean age and BMI, figures represent number (%) or %.
 † Denominators varied between categories because data were incomplete for some questions.
 ‡ P values were calculated from independent t tests (continuous variables) or χ^2 tests (categorical variables). ◆

married, previously married [separated, divorced or widowed], or never married); country of birth (Australia or outside Australia); pregnancy status (yes, no, or don't know); and the number of children under 18 years in the household (0, 1, 2 or ≥ 3).

Statistical analyses

Independent t tests and χ^2 tests were used to compare differences in continuous and categorical variables, respectively, according to area of residence (urban or rural). Demographic characteristics that were significantly associated with weight status (women's age, education, employment status, number of children, country of birth, marital status, illness/injury, and, additionally in children,

maternal BMI, child's age and sex) were selected a priori and were included in regression analyses as covariates.

Multinomial logistic regression was used to determine crude and adjusted odds ratios (ORs) for weight status (reference group: healthy weight) according to area of residence (reference group: urban) for women and children separately. Because of small cell sizes, the "overweight" and "obese" categories for children were combined into one (referred to hereafter as "overweight"), and one child participant classified as "underweight" was included in the "healthy weight" category (renamed "not overweight").

Analyses were conducted using Stata software, version 10.2 (StataCorp, College Sta-

2 Characteristics of children aged 5–12 years in the READI study, by area of residence

| | Overall (n = 636) | Urban (n = 209) | Rural (n = 427) | P* |
|------------------------------------|-------------------|-----------------|-----------------|------|
| Boys (n = 295) | | | | |
| Mean age (years) (SD) | 9.3 (2.2) | 9.2 (2.1) | 9.3 (2.2) | 0.52 |
| Mean BMI (kg/m ²) (SD) | 18.5 (3.3) | 18.5 (3.5) | 18.4 (3.2) | 0.88 |
| Weight status [†] | | | | 0.79 |
| Not overweight | 211 (71.5%) | 73.5% | 70.6% | |
| Overweight | 61 (20.7%) | 18.4% | 21.8% | |
| Obese | 23 (7.8%) | 8.2% | 7.6% | |
| Girls (n = 341) | | | | |
| Mean age (years) (SD) | 9.5 (2.2) | 9.4 (2.2) | 9.5 (2.2) | 0.69 |
| Mean BMI (kg/m ²) (SD) | 18.8 (3.7) | 18.7 (3.6) | 18.8 (3.7) | 0.78 |
| Weight status [†] | | | | 0.89 |
| Not overweight | 236 (69.2%) | 68.5% | 69.6% | |
| Overweight | 66 (19.4%) | 20.7% | 18.7% | |
| Obese | 39 (11.4%) | 10.8% | 11.7% | |

BMI = body mass index. READI = Resilience for Eating and Activity Despite Inequality.

* P values were calculated from independent t tests (continuous variables) or χ^2 tests (categorical variables).

† Figures for weight status represent number (%) or %.

3 Odds of underweight, overweight and obesity for women aged 18–45 years living in rural areas* in the READI study[†]

| Weight status (BMI [kg/m ²]) | Unadjusted OR (95% CI) | P | Adjusted OR [‡] (95% CI) | P |
|--|------------------------|---------|-----------------------------------|------|
| Underweight (< 18.5) | 0.52 (0.36–0.75) | < 0.001 | 0.73 (0.51–1.04) | 0.08 |
| Healthy weight (18.5–24.9) | 1.0 | | 1.0 | |
| Overweight (25.0–29.9) | 1.18 (1.00–1.40) | 0.06 | 1.02 (0.87–1.19) | 0.84 |
| Obese Class I (30.0–34.9) | 1.34 (1.06–1.71) | < 0.05 | 1.16 (0.91–1.47) | 0.23 |
| Obese Class II (35.0–39.9) | 1.72 (1.22–2.40) | < 0.01 | 1.33 (0.96–1.82) | 0.08 |
| Obese Class III (\geq 40.0) | 0.90 (0.60–1.36) | 0.62 | 0.73 (0.47–1.12) | 0.15 |

BMI = body mass index. OR = odds ratio. READI = Resilience for Eating and Activity Despite Inequality.

* Reference group: women of healthy weight living in urban areas.

† Based on multinomial logistic regression analysis.

‡ Odds ratios were adjusted for age, number of children, country of birth, education level, employment status, marital status, and clustering within neighbourhoods.

tion, Tex, USA), and regression models were adjusted for clustering within areas (the unit of sampling).

Ethics approval

Our study was approved by the Deakin University Human Research Ethics Committee, the Catholic Education Office and the Victorian Department of Education and Early Childhood Development.

RESULTS

Characteristics of the sample

Compared with urban women, rural women were on average 2 years older and had a BMI

0.9 kg/m² higher (Box 1). More rural than urban women had lower education levels, were born in Australia, had three or more children, were employed part-time, were married or living as married, and were overweight or obese Class I or II. There were no significant differences between urban and rural children in age, BMI or weight status (Box 2).

Weight status among women

In the crude analyses, women living in rural areas had significantly lower odds of being underweight and higher odds of being obese Class I or II than women living in urban areas (Box 3). Once adjusted for age,

number of children, country of birth, education, employment status and marital status, these associations were no longer significant.

Weight status among children

Rural children had no greater odds of being overweight than urban children in the crude analyses (OR, 1.03 [95% CI, 0.71–1.49]) or in analyses adjusted for child age, maternal education level, maternal marital status and maternal BMI (adjusted OR, 1.11 [95% CI, 0.74–1.68]).

Interactions between age, sex and area of residence

Interactions between age (and sex among children) and area of residence (urban and rural) were assessed, with no significant interactions identified.

DISCUSSION

Although overweight and obesity were more common in rural than urban women, the differences were mostly explained by individual-level sociodemographic characteristics, such as age, number of children, country of birth, education level, employment status and marital status. Among children, there were no significant differences between urban and rural dwellers in the proportion classified as overweight.

The finding of higher levels of obesity in rural women may reflect the fact that these women are more likely to have a lower education level, to be Australian-born, to be married and to have a greater number of children¹¹ — all of which predispose women to increased risk of obesity.^{7,8,16} Further research could examine whether living in rural areas also has an impact on behavioural risk factors for obesity, such as poor eating habits and sedentary lifestyle. Our findings also do not rule out the possibility of contextual effects of area of residence (such as varying social norms related to body weight) or differences in access to healthy foods or physical activity facilities in urban and rural neighbourhoods, which may also contribute to variations in obesity risk.

Previous Australian studies have reported higher obesity rates among rural women than urban women. One study of rural Victorians found that 31% of women aged 25–44 years were overweight and 26% were obese.⁹ Another study of rural Victorians aged 25–52 years found a 23%–33% obesity rate among men and women combined.¹⁷ The proportion of children classified as overweight in

our study (30%) was higher than that for similarly aged children in 2004 estimates from a New South Wales study (25%),³ from the 2007 *Australian National Children's Nutrition and Physical Activity Survey* (24%),¹⁸ and from the 2007–08 National Health Survey (23%).⁴ The higher rates of overweight and obesity in our study could be attributable to temporal changes in obesity,^{4,13} or to an increased risk of obesity among people living in socioeconomically disadvantaged areas. Although evidence is equivocal,¹⁹ Australian and international studies have identified inverse relationships between area-level socioeconomic status and obesity among adults, independently of individual-level factors.^{16,20} However, these studies were predominantly in urban samples and did not compare urban and rural samples using temporally matched data and matching methods.

Self-reported measurement of women's height and weight could result in weight status misclassification, although the tendency for women to under-report their weight²¹ would likely result in underestimates of overweight and obesity. Some differences in self-reported height and weight have been found among different socioeconomic groups,²² but it is unknown whether estimates would be differentially distributed according to urban/rural location. Furthermore, classification of rurality is difficult and contentious,²³ and our approach may have resulted in misclassification. Given the relatively low response rate to our survey (41%), it is possible that there was a selection bias, but no information was available on non-participants. Although the response was higher in rural than urban women (39% v 34%), the effect on study findings is unknown. Strengths of our study included the large sample size, objective measurement of children's height and weight, and the focus on population groups at high risk of obesity.

In conclusion, there were no significant differences in the proportion of urban or rural women and children living in socioeconomically disadvantaged areas classified as overweight or obese once adjustment had been made for sociodemographic factors. Acknowledging the cross-sectional study design, our findings suggest that living in socioeconomically disadvantaged areas of rural Victoria does not of itself increase the risk of overweight and obesity. Rather, individual-level factors more common in rural women (such as lower levels of education, being Australian-born, being married and having more children) may predispose women to obesity and help explain the higher

levels of obesity observed among women in rural areas. Our study has been one of few to explore urban–rural comparisons among Australian women and children. Despite their heightened risk of having poor health,¹¹ rural women and children remain significantly understudied population groups.

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COMPETING INTERESTS

None identified.

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