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Original article

Accumulated exposure to rural areas of residence over the life course is associated with overweight and obesity in adulthood: a 25-year prospective cohort study

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ABSTRACT

Purpose: This prospective cohort study investigated whether body mass index (BMI) and weight status in mid-adulthood were predicted by trajectories of urban-rural residence from childhood to adulthood.
Methods: Participants aged 7–15 years in 1985 ($n = 8498$) were followed up in 2004–2006 ($n = 3999$, aged 26–36 years) and 2009–2011 ($n = 3049$, aged 31–41 years). Area of residence (AOR) was classified as urban or rural at each time point. BMI and/or weight status was calculated from self-reported weight and height (2009–2011). We tested which of three life-course models ("accumulation," "sensitive period," "mobility") best explained the AOR-BMI and/or weight status association using a novel life-course modeling framework.
Results: Accumulation and sensitive period models best described the effect of AOR on mid-adulthood BMI and weight status. Those with greater accumulated exposure to rural areas had a higher BMI ($\beta = 0.29$ kg/m^2 per time in a rural area, $P = .005$) and were more likely obese (relative risk = 1.13 per time in a rural area, $P = .002$). Living in rural areas at ages 26–30 years was also associated with a higher BMI and obesity in mid-adulthood.
Conclusions: Greater cumulative exposure to rurality and exposure during the "sensitive period" of young adulthood is associated with obesity in middle-aged adults. This study highlights the important contribution of context to the development of obesity over the life course.

Introduction

Obesity significantly increases the risk of all-cause mortality, stroke, type-2 diabetes, and cardiovascular disease [1–3]. People living in regional and rural areas are more often overweight or obese than those living in urban areas [4–7]. Although those living outside of urban areas tend to be of lower socioeconomic position (SEP) [8,9], rurality increases the risk of being overweight or obese, independent of compositional factors such as age, education, income, race and/or ethnicity, and marital status [5,6]. This suggests that the rural context has an important role to play in obesity development. However, because most studies investigating the effects of rural areas on body mass index (BMI) and weight status rely on cross-sectional data [4–7], it is currently unclear how exposure to rural areas across the life course affects the development of obesity longitudinally.

Using an exposure measured at a single point in time and ignoring a persons' exposure of geographic residence over the life course may underestimate the effects that urban-rural area of residence may have on BMI. There are various models describing how exposures such as SEP may operate across the life course [10]. The accumulation of risk model, which is the most common model within the literature, suggests that exposures across the life course accumulate having adverse effects on health in the longer term [11]. A sensitive period model suggests that an exposure has a stronger effect at one time period than at other time periods (e.g., both childhood and adulthood have independent effects, but the effect of the exposure in childhood may be greater) [10,11]. Some researchers have also highlighted the possible importance of a mobility model, which focuses on the importance of change of an exposure to adult health [11–13]. A systematic review of models on life-course socioeconomic factors

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recommended that future analyses should examine multiple life-course models within the same study, to identify all possible patterns of association in the data [13].

Mishra et al. [14] described a statistical model selection approach to delineate the different life-course models by comparing a set of nested life-course models, each corresponding to a life-course hypothesis, to an all-inclusive (saturated) model. Most of the current literature comparing different life-course models (critical period, accumulation) has primarily investigated the relationship between SEP and health outcomes such as BMI or mortality. However, there have been no reports of studies applying these theoretical life-course models to understand the impact of urban-rural area of residence on BMI, and no research to date has sought to establish statistically which of these theoretical life-course models best explain geographic influences on weight and obesity.

This study therefore aimed to investigate whether BMI and weight status in midadulthood was predicted by trajectories of urban-rural area of residence from childhood to adulthood.

Methods

The Childhood Determinants of Adult Health (CDAH) study is the 20- and 25-year follow-ups of a nationally representative sample of Australian school children (7–15 years) who participated in the 1985 Australian Schools Health and Fitness Survey (n = 8498) [15]. Details of the response proportions and loss of data are included in Figure 1, and on the study sample in Appendix S1.

Ethics

At baseline, the Directors of Education in each state and territory granted ethical approval, and consent was obtained from children and parents. At follow-up, ethical clearance was obtained from the Southern Tasmanian Health and Medical Ethics Committee, and participants provided informed consent.

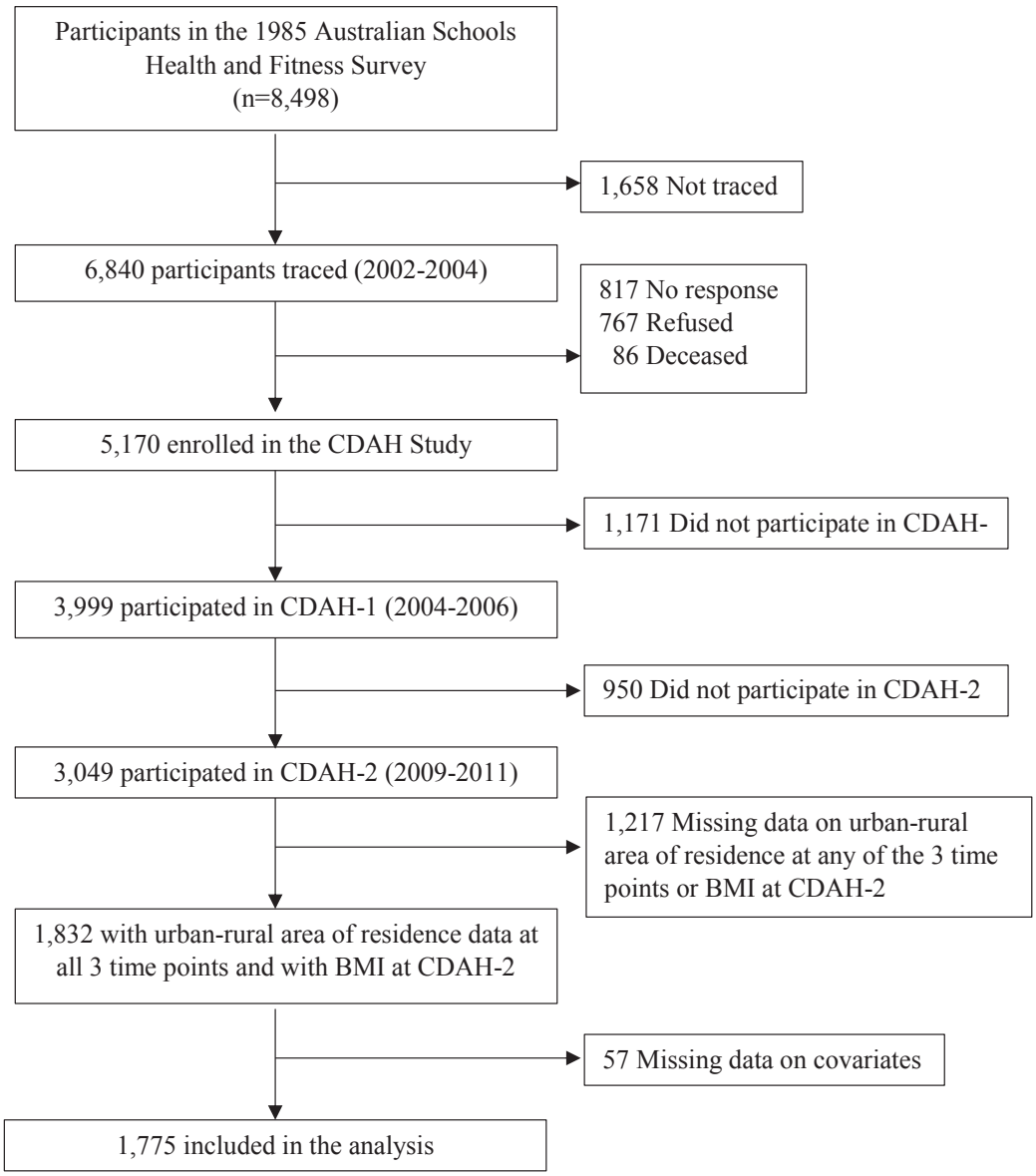

Fig. 1. Flowchart of participants in the Childhood Determinants of Adult Health (CDAH) study, Australia, 1985–2009/2011, detailing loss to follow-up and final participant sample used in this study (n = 1775).