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Original article

## Ethnicity, length of residence, and prospective trends in body mass index in a national sample of Australian adults (2006–2014)



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### ABSTRACT

**Purpose:** Increasing global migration, high obesity in developed countries, and ethnic health inequalities are compelling reasons to monitor immigrant obesity trends. Longitudinal studies of ethnicity, length of residence, and adiposity in contexts outside of the United States are lacking.

**Methods:** Nine waves (2006–2014) of the Household Income and Labour Dynamics in Australia survey were analyzed ( $n = 20,934$ ; 52% women; 101,717 person-year observations) using random effects modeling to assess average annual change in body mass index (BMI) by ethnic group. A second analysis used an immigrant only cohort ( $n = 4583$ ; 52% women; 22,301 person-year observations) to examine BMI change by length of residence.

**Results:** Over 9 years, mean BMI increased significantly in all ethnic and Australian-born groups, and by the final wave, mean BMI exceeded  $25 \text{ kg m}^{-2}$  for all groups. Trajectories of change did not vary between groups, with the exception of slower BMI increases for North-West European men compared with Australian born. Immigrants residing in Australia for 10–19 years had significantly faster annual increases in BMI compared with long-term immigrants ( $\geq 30$  years).

**Conclusions:** Immigrants to Australia, regardless of ethnicity, are at risk of obesity over time. Obesity prevention policy should prioritize immigrants in the early-mid settlement period.

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### Introduction

Large and persistent inequalities in overweight and obesity prevalence have been observed for some ethnic minority groups in developed countries [1–4]. The past 15 years has also seen rapid rises in international migration, with 240 million people now living outside their country of origin [5]. Together, ethnic health inequalities and rising population proportions of immigrants underscore the importance of understanding immigrant bodyweight trends for predicting future burden of disease and shaping effective health policy.

Ethnic inequalities in adult obesity have been documented extensively in the United States [1,4,6]; however, in other countries, there has been patchy coverage, often relying on cross-sectional data [2,3,7–10]. The reasons for ethnic differences in obesity risk are likely to be context- and ethnic group-specific, given that they are influenced by the dynamic interplay of biological/genetic, behavioral, cultural, contextual, and systemic factors [11]. Cross-sectional methods offer only limited insight into these processes and must be interpreted with caution as associations between obesity and ethnicity may be conflated with age, calendar period, and birth cohort effects [6,12–14]. Longitudinal studies of immigrant bodyweight trends in contexts outside of the United States are therefore needed.

Acculturation has often been used to explain obesity progression in immigrants, with acculturation typically defined as the process of individual adaptation to the host country's lifestyle, environment, and culture [15]. Cross-sectional studies have shown that proxy measures for acculturation, including generational

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status (second and subsequent immigrant generations) [7,16,17], younger age at migration [3,18], and longer residence in the host country [3,10,19,20], are associated with higher body mass index (BMI), overweight, or obesity. Acculturation, however, has been criticized as an overly-simplistic concept when based on individual cultural change [15,21–23], and theorists have asserted the need to consider social determinants of health [22,24] and the interplay with other power dimensions such as gender and class [21,22]. Length of residence has the benefit of being an easy to collect, comparable measure and can respond to the criticisms of acculturation by being interpreted more broadly, as reflecting the sum total of an immigrant's experiences and exposures in their host society that impact health. Given the dynamic nature of social processes, longitudinal research on length of residence and obesity is beneficial to not only identify vulnerable periods postmigration but also understand contemporary obesity trends and predict future burden of disease in increasingly diverse societies.

In the past 10 years, five longitudinal studies from the United States examined BMI, weight, or waist circumference change among immigrants [6,25–28] and three studies examined the role of length of residence [25–27]. Four other U.S. studies compared patterns of weight change using a repeated cross-sectional design [12,14,29,30]. Generalizing findings from these methodologically different studies is problematic, and evidence for differences in the rate of bodyweight change comparing immigrant ethnic groups to native-born is inconclusive. There has been greater consistency in the findings of the studies, which examined the effect of length of residence on bodyweight change. That is, although groups with longer length of residence are heavier at baseline, more recently arrived immigrants appear to have faster increases in waist circumference and BMI compared with those who have lived in the host country for longer periods (although increases can be context- and ethnic-group specific) [12,25–27].

It remains unknown whether relationships between ethnicity, length of residence, and BMI are observed outside the United States. Australia has a large, growing immigrant population, [31,32] and immigrants to Australia are likely to be different from immigrants to the United States in several ways. Australia is ethnically diverse with 28.1% of the population born overseas [31] (vs. 12.5% in the United States [33]), and positive net migration represents 55% of the country's population growth [32]. Australia's ethnic composition also differs from the dominant Hispanic, non-Hispanic black, non-Hispanic white, and Asian groups typical in U.S. research. Australia's ethnic groups have a different socioeconomic profile due to the large intake of skilled migrants. Over the past decade, Australian population studies exploring the bodyweight profile of immigrant ethnic groups have been cross-sectional; longitudinal studies are needed [3]. The aims of this study are to investigate BMI trends of immigrant ethnic groups compared with native-born Australians; and using an immigrant-only cohort, examine whether BMI trends differ by length of residence in Australia.

## Methods

The Household Income and Labor Dynamics in Australia (HILDA) survey is a national household panel survey, which began in 2001. The reference population is all Australian residents who live in private households excluding remote areas. Study methods are published elsewhere [34]. In brief, the panel began with a national probability sample of 7682 households and 19,914 individuals. Data are collected annually from interviews with each household member aged  $\geq 15$  years, followed by a self-completed questionnaire. The sample has expanded over time to include new members of original households. Attrition analyses showed that those more likely to be lost to follow-up were aged 15–24 years, born in a non-

English speaking country, unemployed, or in low-skilled occupations, single, and indigenous [35]. In wave 11 (2011), the sample was replenished using a similar recruitment methodology as the first wave [36], resulting in an additional 2153 households and 5477 individuals. Inclusion of the top-up sample has improved the representativeness of the data, particularly for country of birth and length of residence in Australia [37], and improved comparability of estimates when benchmarked to the Australian Bureau of Statistics' (ABS) Labour Force Survey [37].

This study used the nine waves of data (waves 6–14), in which BMI was available. Women (at any wave) who were pregnant in the previous year and respondents aged  $< 18$  years were excluded.

## Variables

BMI ( $\text{kg}/\text{m}^2$ ) was calculated from height and weight data reported through the self-completed questionnaire. BMI was treated as a continuous variable so that interpreting the results was not influenced by different ethnic cut-off points for overweight and obesity.

Ethnicity was defined from responses to the interview question, "In which country were you born?" Responses were categorized into regions using the ABS Standard Australian Classification of Countries, which is based on geographic proximity and economic, social, and political similarities [38]. Length of residence was calculated by subtracting the year the person first came to live in Australia from the survey year and then grouped into 10-year categories, consistent with other research [27,39]. Sensitivity analyses confirmed that 10-year categories produced the strongest results in detecting differences while ensuring appropriate statistical power and reasonable estimates of uncertainty.

As immigrant ethnic groups vary in socioeconomic characteristics [40] and socioeconomic status also predicts BMI [41], the following variables were included as confounders in the modeling: education, occupation, household income, neighborhood disadvantage, and area remoteness, as well as age in 2006 (mean-centered). The highest education level achieved was derived from interview questions that progressed from asking about school attendance, to questions on the highest educational qualification achieved. Occupation was derived from interview responses to the question: "What kind of work do you do in this job? That is, what is your occupation called and what are the main tasks and duties you undertake in this job? Please describe fully." Responses were coded using the ABS' 4-digit Australian and New Zealand Standard Classification of Occupations (ANZSCO 2006). Annual household disposable income was assessed from self-reported total regular household income from all sources minus estimated income tax. Neighborhood disadvantage was based on the household's residential address and categorized into quintiles of disadvantage based on the area's Index of Relative Socioeconomic Disadvantage score, which is a ranking produced by the ABS from combining socioeconomic indicators into a single index [42]. Area remoteness was defined using the Australian Standard Geographical Classification [43].

## Statistical analysis

Analyses were conducted in two stages using STATA/SE Release 13 (StataCorp LP, College Station, TX) and MLwiN [44]: the first examined associations between ethnicity and prospective trends in BMI, and the second examined length of residence in Australia and prospective trends in BMI. The gender interaction with ethnicity was significant ( $P < .001$ ), therefore, analyses were stratified by gender.

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