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Associations between major chain fast-food outlet availability and change in body mass index: a longitudinal observational study of women from Victoria, Australia

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ABSTRACT

Objectives The residential neighbourhood fast-food environment has the potential to lead to increased levels of obesity by providing opportunities for residents to consume energy-dense products. This longitudinal study aimed to examine whether change in body mass index (BMI) differed dependent on major chain fast-food outlet availability among women residing in disadvantaged neighbourhoods.

Setting Eighty disadvantaged neighbourhoods in Victoria, Australia.

Participants Sample of 882 women aged 18–46 years at baseline (wave I: 2007/2008) who remained at the same residential location at all three waves (wave II: 2010/2011; wave III: 2012/2013) of the Resilience for Eating and Activity Despite Inequality study.

Primary outcome BMI based on self-reported height and weight at each wave.

Results There was no evidence of an interaction between time and the number of major chain fast-food outlets within 2 (p=0.88), 3 (p=0.66) or 5 km (p=0.24) in the multilevel models of BMI. Furthermore, there was no evidence of an interaction between time and change in availability at any distance and BMI.

Conclusions Change in BMI was not found to differ by residential major chain fast-food outlet availability among Victorian women residing in disadvantaged neighbourhoods. It may be that exposure to fast-food outlets around other locations regularly visited influence change in BMI. Future research needs to consider what environments are the key sources for accessing and consuming fast food and how these relate to BMI and obesity risk.

Strengths and limitations of this study

- This study is one of very few longitudinal studies of its kind and enables examination of how major chain fast-food outlet availability is associated with change in body mass index (BMI).
- The collection of major chain fast-food outlet data at a follow-up wave enabled examination of associations between change in exposure and change in BMI.
- Loss to follow-up may have limited generalisability of findings beyond the sample. However, descriptive characteristics for major chain fast food availability and BMI at baseline were comparable for those who did and did not participate in all waves of Resilience for Eating and Activity Despite Inequality.
- BMI was based on self-reported height and weight rather than objective measurements.

INTRODUCTION

Obesity is a major public health concern, with WHO reporting that an estimated 35% of adults are classed as overweight and 11% as obese worldwide.[1] In Australia, approximately 60% of adults are now overweight or obese,[2] with higher prevalence among those in socioeconomically disadvantaged and rural communities.[3] As excess of weight is associated with a number of comorbidities, the high prevalence of overweight and obesity in Australian adults poses problems for the long-term health of the nation and places an enormous economic burden on the health system.[4 5]

While individual factors, both behavioural and genetic,[6] have known links to overweight and obesity, there is a growing recognition that the built environment also plays a role.[7 8] As outlined in ecological models of health behaviour,[9 10] the residential neighbourhood food environment has the potential to influence individual dietary behaviours by, for example, offering the opportunity to purchase affordable healthy products in local supermarkets or by providing options for residents to buy inexpensive energy-dense products at fast-food outlets. The proliferation of fast-food outlets has potentially normalised the consumption of energy-dense products which may influence body mass index (BMI).

This may lead to higher levels of obesity, particularly among those residing in disadvantaged neighbourhoods given research showing higher fast-food outlet availability in these neighbourhoods.[11]

In the USA, researchers have proposed zoning laws that restrict the location of fast-food outlets, comparable to those created for alcohol outlets, to help curb the obesity epidemic. These include setting minimum distances for fast-food outlets from youth-orientated facilities or limiting the number of fast-food outlets in an area.[12 13] Similarly, recent consultations with senior representatives in government departments in Australia have highlighted planning measures involving the restriction of fast-food outlets as a potential avenue for promoting healthier eating environments.[14] However, managing fast-food proliferation in Australia is complicated due to Australian planning laws.[15] In addition, it is unclear how successful regulations such as these would be in practice given mixed findings from studies examining associations between the residential fast-food environment and BMI or obesity.[16 17] While studies in the UK,[18] Canada[19] and the USA[20–23] have found evidence that availability of fast-food outlets is positively associated with BMI, others in Australia[24] and the USA[25] have shown no evidence of an association, while some in Australia[26] and New Zealand[27] have found evidence of negative associations.

Although there are several methodological differences across these studies including the definitions of fast food and neighbourhoods, one clear drawback to most studies is their reliance on cross-sectional data. This limits the ability to detect temporal associations or to examine within-individual change in BMI or obesity.[28] This is important as those with higher fast-food outlet availability at baseline may have greater increases in BMI over time than those with lower availability. Furthermore, longitudinal observational studies of the food environment have the benefit of allowing examination of how changes in the environment can influence changes in health outcomes. Those that have a higher increase in fast-food outlets over time may have a larger increase in BMI due to the increased opportunity to purchase and consume energy-dense foods.

The aim of this study was to examine longitudinal associations between the fast-food environment and BMI among women residing in disadvantaged neighbourhoods in Victoria, Australia. As it is commonly hypothesised that fast-food outlet availability is associated with higher BMI, we extended this hypothesis in this longitudinal analysis to assess whether (i) women with higher residential availability of major chain fast-food outlets at baseline would have a greater increase in BMI than those with lower availability and (ii) women who lived in neighbourhoods with a larger increase in availability of major chain fast-food outlets would have a greater increase in BMI than women who lived in neighbourhoods with little or no change in availability.

METHODS

Study participants were from the Resilience for Eating and Activity Despite Inequality (READI) cohort. Full details of the sampling procedures are provided elsewhere.[29] In brief, in 2007, women aged between 18 and 46 years were sampled using the Australian electoral roll (it is compulsory for Australian citizens to register on the electoral roll). Sampling took place within 40 urban and 40 rural randomly selected socioeconomically disadvantaged suburbs. Suburbs were considered disadvantaged if they were in the bottom third of the Australian Bureau of Statistics Index of Relative Socio-economic Disadvantage. In total, 4349 women (39% response rate) were recruited at wave I (2007/2008) and completed a postal survey. Among women eligible to remain in the study (ie, who remained resident of a READI suburb) and who consented to further follow-up (n=3019), 1912 completed the survey at wave II (2010/2011) and 1560 at wave III (2012/2013).

Women were eligible for inclusion in this analysis if they participated in all three waves of READI (n=1560), reported that they were not pregnant at all three waves (n=1341) and had reported weight at more than one time point, meaning that within individual change in BMI could be assessed (n=1302). Participants whose address could not be geocoded at wave I (n=5) were omitted as exposure variables could not be derived for these participants. Due to data errors (inconsistent date of birth and very large change of >80 kg in weight between waves), two further participants were excluded. This resulted in a sample of 1295 participants. Finally, to avoid possible confounding due to changing residential location, only women who remained at the same address during the study duration were examined. Thus, a final sample of 882 participants was considered in this study. Descriptive statistics for the full sample at wave I, those who completed all waves of data and those who only completed wave I are provided in online supplementary table S1.

Body mass index

The weight (kg) and height (m) of participants were self-reported at each wave which enabled BMI (kg/m^2) to be calculated. Research has shown close correspondence between self-reported and objectively measured body weight among Australian women, with no evidence of a difference found between self-report and objectively measured BMI (mean difference=0.12 kg/m^2, 95% CI −0.13 to 0.37 kg/m^2) in the Australian Longitudinal Study of Women's Health.[30]

Major chain fast-food availability

At baseline (2007), the locations of 10 major chain fast-food outlets in Australia were sourced from company websites. The chains considered (Domino's Pizza, Eagle Boys Pizza, Kentucky Fried Chicken (KFC), Hungry Jack's, Nando's, Pizza Haven, Pizza Hut, McDonald's, Red Rooster and Subway) were chosen as each of these chains had >100 outlets across Australia according to the

Table 1 Descriptive characteristics for Resilience for Eating and Activity Despite Inequality participants (n=882)

Variable	Wave I	Wave II	Wave III
Outcome variable			
Body mass index (kg/m^2)			
Mean (SD)	26.1 (6.0)	26.7 (6.4)	26.9 (6.5)
Minimum–maximum	16.0–50.8	15.8–55.4	14.2–55.1
Missing, n (%)	10 (1.1 %)	49 (5.5 %)	26 (2.9 %)
Exposure variables			
Major chain fast-food outlets within 2 km			
Median (Q1–Q3)	0 (0–2)		1 (0–3)
Minimum–maximum	0–33	–	0–40
Major chain fast-food outlets within 3 km			
Median (Q1–Q3)	1 (0–5)	–	3 (0–6)
Minimum–maximum	0–55		0–72
Major chain fast-food outlets within 5 km			
Median (Q1–Q3)	3 (0–12)	–	4 (0–15)
Minimum–maximum	0–84		0–106
Potential confounders			
Age (years)			
Mean (SD)	37.7 (7.1)	40.6 (7.1)	42.7 (7.1)
Minimum–maximum	18.4–49.5	21.3–52.5	23.3–54.4
Education, n (%)			
Low: did not complete high school	236 (26.8%)	212 (24.0%)	186 (21.1%)
Medium: high school/trade/diploma	391 (44.3%)	390 (44.2%)	394 (44.7%)
High: tertiary	253 (28.7%)	281 (31.8%)	299 (33.9%)
Missing	2 (0.2%)	0 (0.0%)	3 (0.3%)
Employment, n (%)			
Full time	317 (35.9%)	348 (39.5%)	356 (40.4%)
Part-time	292 (33.1%)	318 (36.1%)	344 (39.0%)
Not in paid employment	256 (29.0%)	209 (23.7%)	170 (19.3%)
Missing	17 (1.9%)	7 (0.8%)	12 (1.4%)
Weekly household income, n (%)			
<$500	73 (8.3%)	46 (5.2%)	63 (7.1%)
$500 to <$1000	267 (30.3%)	218 (24.7%)	198 (22.5%)
$1000 to <$1500	174 (19.7%)	188 (21.3%)	175 (19.8%)
$1500+	175 (19.8%)	233 (26.4%)	287 (32.5%)
Missing	193 (21.9%)	197 (22.3%)	159 (18.0%)
Children in the household, n (%)			
Yes	596 (67.6%)	594 (67.4%)	568 (64.4%)
No	282 (32.0%)	284 (32.2%)	313 (35.5%)
Missing	4 (0.5%)	4 (0.5%)	1 (0.1%)
Urban/rural classification, n (%)			
Urban	401 (45.5%)	401 (45.5%)	401 (45.5%)
Rural	481 (54.5%)	481 (54.5%)	481 (54.5%)

Q1, quartile 1; Q3, quartile 3.

Table 2 Multilevel linear regression models of the associations between availability of major chain fast-food outlets at baseline and body mass index from wave I to wave III (n=882)

Variable	Model 1 Major chain fast-food outlets within 2 km Coefficient (95% CI)	Model 2 Major chain fast-food outlets within 3 km Coefficient (95% CI)	Model 3 Major chain fast-food outlets within 5 km Coefficient (95% CI)
Intercept	26.68 (25.71 to 27.65)***	26.88 (25.89 to 27.88)***	27.27 (26.32 to 28.21)***
Time (years)	0.17 (0.13 to 0.22)***	0.17 (0.12 to 0.21)***	0.16 (0.11 to 0.21)***
Fast-food availability exposure			
Number of outlets	−0.06 (−0.21 to 0.10)	−0.06 (−0.13 to 0.02)	−0.05 (−0.07 to −0.03)***
Number of outlets and time interaction	−0.001 (−0.011 to 0.010)	0.001 (−0.004 to 0.006)	0.001 (−0.001 to 0.003)
Potential confounders†			
Age at baseline‡	0.08 (0.03 to 0.14)**	0.08 (0.03 to 0.14)**	0.08 (0.03 to 0.14)**
Education			
Medium	−0.36 (−0.98 to 0.27)	−0.35 (−0.97 to 0.28)	−0.32 (−0.95 to 0.31)
High	−0.96 (−1.76 to −0.15)*	−0.94 (−1.74 to −0.14)*	−0.88 (−1.69 to −0.07)*
Employment			
Part-time	−0.22 (−0.51 to 0.08)	−0.22 (−0.51 to 0.08)	−0.22 (−0.51 to 0.08)
Not in employment	−0.06 (−0.42 to 0.30)	−0.06 (−0.42 to 0.30)	−0.06 (−0.42 to 0.31)
Household income			
$500 to <$1000	−0.12 (−0.61 to 0.37)	−0.12 (−0.62 to 0.37)	−0.13 (−0.62 to 0.37)
$1000 to <$1500	−0.04 (−0.53 to 0.44)	−0.04 (−0.52 to 0.44)	−0.04 (−0.52 to 0.44)
$1500+	−0.04 (−0.57 to 0.49)	−0.03 (−0.56 to 0.50)	−0.02 (−0.55 to 0.51)
Children in household			
No	−0.23 (−0.66 to 0.21)	−0.21 (−0.65 to 0.22)	−0.20 (−0.64 to 0.24)
Urban			
Rural	0.34 (−0.52 to 1.20)	0.15 (−0.75 to 1.04)	−0.26 (−1.13 to 0.62)
	Variance	Variance	Variance
Intercept	34.58 (29.81 to 40.11)	34.52 (29.74 to 40.06)	34.34 (29.57 to 39.89)
Slope	0.12 (0.08 to 0.17)	0.12 (0.08 to 0.17)	0.12 (0.08 to 0.17)
Residual	2.17 (1.74 to 2.71)	2.17 (1.74 to 2.71)	2.17 (1.74 to 2.71)
	Covariance	Covariance	Covariance
Intercept, slope§	0.19 (−0.13 to 0.67)	0.19 (−0.13 to 0.68)	0.19 (−0.12 to 0.68)

†Reference categories: low education, full-time employment, <$500, yes children in household, urban.
‡Age was centred at 37 years.
§Considers covariance between these random components.
*p<0.05; **p<0.01; ***p<0.001.

Franchise Council of Australia.[31] The locations of the fast-food outlets in Victoria were geocoded using ArcMap V.9.1, with any unmatched address points geocoded by hand after searching for the nearest address match. Outlet addresses were checked for errors and duplicate records based on trading name, suburb and proximity to another outlet of the same type.

Follow-up fast-food location data were collected in 2014 to approximately correspond with the timing of READI wave III data collection. A commercial data source was purchased from Sensis which included the names and locations of the same chains examined in wave I. Eagle Boys Pizza acquired Pizza Haven mid-2008, meaning only nine chains were considered at follow-up, with Pizza Haven outlets captured as Eagle Boys Pizza at the follow-up time point. These data were validated against company websites, with a high level of agreement between the two sources which reflects the fact that company websites are likely to be a key source of data for companies like Sensis. Geocoding of these data was undertaken in ArcGIS V.10.2.

Participants' home addresses were geocoded and the road network distance between each address and each of the chain fast-food outlets (to a maximum distance of 5 km) was calculated for each time point separately. This enabled the number of fast-food outlets within

Table 3 Multilevel linear regression associations of the change in availability of major chain fast-food outlets and body mass index from wave I to wave III (n=882)

Variable	Model 1 Major chain fast-food outlets within 2 km Coefficient (95% CI)	Model 2 Major chain fast-food outlets within 3 km Coefficient (95% CI)	Model 3 Major chain fast-food outlets within 5 km Coefficient (95% CI)
Intercept	26.84 (25.92 to 27.77)***	27.19 (26.21 to 28.18)***	27.48 (26.54, 28.43)***
Time (years)	0.10 (0.03 to 0.16)**	0.09 (0.01 to 0.16)*	0.08 (0.01 to 0.16)*
Fast-food availability exposure			
Number of outlets	−0.07 (−0.23 to 0.08)	−0.04 (−0.12 to 0.05)	−0.02 (−0.07 to 0.02)
Change in outlets	0.01 (−0.44 to 0.46)	−0.17 (−0.41 to 0.06)	−0.11 (−0.27 to 0.04)
Change in outlets and time interaction	−0.001 (−0.023 to 0.021)	0.008 (−0.013 to 0.029)	0.006 (−0.003 to 0.015)
Potential confounders†			
Age at baseline‡	0.08 (0.02 to 0.13)**	0.08 (0.02 to 0.14)**	0.08 (0.02 to 0.13)**
Education			
Medium	−0.38 (−0.99 to 0.24)	−0.35 (−0.97 to 0.26)	−0.35 (−0.96 to 0.27)
High	−1.12 (−1.88 to −0.36)**	−1.09 (−1.85 to −0.33)**	−1.06 (−1.83 to −0.30)**
Employment			
Part-time	−0.24 (−0.54 to 0.06)	−0.24 (−0.54 to 0.06)	−0.24 (−0.54 to 0.06)
Not in employment	−0.09 (−0.44 to 0.27)	−0.08 (−0.44 to 0.28)	−0.09 (−0.44 to 0.27)
Household income			
$500 to <$1000	−0.11 (−0.60 to 0.39)	−0.11 (−0.61 to 0.38)	−0.11 (−0.61 to 0.38)
$1000 to <$1500	−0.02 (−0.51 to 0.48)	0.01 (−0.50 to 0.48)	−0.01 (−0.50 to 0.48)
$1500+	−0.01 (−0.55 to 0.52)	0.002 (−0.53 to 0.54)	0.01 (−0.53 to 0.55)
Children in household			
No	−0.20 (−0.62 to 0.22)	−0.19 (−0.62 to 0.23)	−0.18 (−0.60 to 0.24)
Urban			
Rural	0.31 (−0.49 to 1.12)	−0.01 (−0.92 to 0.90)	−0.32 (−1.20 to 0.55)
	Variance	Variance	Variance
Intercept	33.91 (29.15 to 39.43)	33.80 (29.10 to 39.27)	33.62 (28.89 to 39.12)
Slope	0.05 (0.02 to 0.10)	0.05 (0.02 to 0.10)	0.05 (0.02 to 0.10)
Residual	2.58 (2.08 to 3.20)	2.57 (2.07 to 3.19)	2.57 (2.08 to 3.19)
	Covariance	Covariance	Covariance
Intercept, slope§	0.24 (−0.06 to 0.87)	0.24 (−0.06 to 0.86)	0.24 (−0.06 to 0.87)

†Reference categories: low education, full-time employment, <$500, yes children in household, urban.
‡Age was centred at 37 years.
§Considers covariance between these random components.
*p<0.05; **p<0.01; ***p<0.001.

2, 3 and 5 km distances, based on distances used elsewhere,[18 26 32–34] to be determined at waves I and III. Although fast-food purchases may be thought to occur at more proximal walking distances to home, a recent study of food purchasing behaviours of Melbourne residents showed that the median distance from home of food purchases was 4.6 km for purchases of hot takeaway items.[35] Therefore, we chose to consider buffer distances of up to 5 km. Three distances were chosen to enable the sensitivity of the findings to the choice of buffer distance to be examined. The availability of fast-food outlets was thus defined as the number of fast-food outlets within 2, 3 or 5 km road network buffers from participants' homes.

Potential confounders

Possible confounders were identified from previous literature. These included the individual-level variables of participant age, children in the household (no/yes), highest educational attainment (low: did not complete high school; medium: completed high school, trade certificate or diploma; high: completed tertiary education), employment status (not employed; employed part-time; employed full time) and weekly household income (<$500; $500 to <$700; $700 to <$1000; $1000 to <$1500; ≥$1500) and the suburb-level variable of urban or rural location. Country of birth was also hypothesised to be a potential confounder. However, as the overall number of non-Australian births was small (n=81) and spread across multiple nations, we did not adjust for country of birth in the analysis but did conduct a sensitivity analysis where only those born in Australia were examined.

Statistical analysis

Under the assumption that the missing covariate data were Missing At Random, we used multiple imputation with chained equations (50 imputations) to impute missing confounder data across all waves using the user-written ice program in Stata V.12.0.[36 37] The amount of missing data for each variable is reported in table 1. Data were imputed in wide format and the imputation model included the outcome variables, exposure variables and all potential confounders described previously, in addition to auxiliary variables (country of birth, and marital status and personal income at waves I, II and III). In sensitivity analyses, a complete case analysis was conducted under the assumption that missing confounder data were Missing Completely At Random.

Multilevel linear regression models were fitted including time (years since baseline) as a predictor of BMI to assess change in BMI over the three waves. As the aim of this study was to examine whether the change in BMI differed dependent on the number of fast-food outlets at baseline, an interaction between each of the fast-food outlet availability measures and time was included in separate multilevel models. This means that the main effects of both time and fast-food outlets should not be interpreted without consideration of their combined effect. The multilevel models included both a random intercept and a random slope for time to allow each participant to have a unique intercept and rate of change. All models adjusted for potential confounders, allowing these to vary over time, and accounted for clustering of participants within suburbs.

To address the second hypothesis, the change in the availability of major chain fast-food outlets within each buffer distance during the study was calculated by subtracting the number of fast-food outlets at wave I from the number at wave III. Change in availability of fast-food outlets was used as an exposure in multilevel models, adjusting for baseline fast-food availability to account for the magnitude of initial availability. An interaction between change in fast-food outlet availability and time was examined to determine if the change in BMI over time differed depending on the change in availability of fast-food outlets.

RESULTS

Average BMI increased from 26.1 kg/m^2 (SD=6.0) at baseline to 26.9 kg/m^2 (SD=6.5) at wave III (table 1). In this sample, the median number of major chain fast-food outlets available at baseline was 0 (IQR=2) within 2 km of participants' homes, 1 (IQR=5) within 3 km and 3 (IQR=12) within 5 km, increasing to 1 (IQR=3) within 2 km, 3 (IQR=6) within 3 km and 4 (IQR=15) within 5 km at wave III.

Availability of major chain fast-food outlets at baseline and change in BMI

On average, BMI was found to increase by approximately 0.17 kg/m^2 each year (table 2). This corresponds to an increase in weight of 0.4 kg (or 0.9 lbs) each year for an Australian woman of average height (161.8 cm). We found no evidence of an interaction between time and the baseline number of major chain fast-food outlets within 2 (p=0.88), 3 (p=0.66) or 5 km (p=0.24). Therefore, there was no evidence to suggest that the change in BMI over time was influenced by the local residential availability of major chain fast-food outlets at baseline.

Change in availability of major chain fast-food outlets and change in BMI

Many participants did not experience a change in the number of major chain fast-food outlets in proximity to their homes between waves I and III: 609 (68%) had the same number within 2 km at both time points, 469 (53%) had the same number within 3 km and 374 (42%) had the same number within 5 km at both time points. Very few participants had a decrease in the number of major chain fast-food outlets within these distances (2 km: 26 (2.9%) participants; 3 km: 18 (2.0%) participants; 5 km: 17 (1.9%) participants). The median change in major chain fast-food outlets was 0 (IQR=1; range from −5 to 10) within 2 km, 0 (IQR=2; range from −5 to 17) within 3 km and 1 (IQR=3; range from −6 to 45) within 5 km.

The results from multilevel models of associations between change in major chain fast-food availability between Waves I and III and BMI are presented in table 3. We found no evidence that the rate of change in BMI differed dependent on the change in the number of major chain fast-food outlets within 2 km (p=0.95), the number of major chain fast-food outlets within 3 km (p=0.46) or the number of major chain fast-food outlets within 5 km (p=0.18).

Sensitivity analyses

Three sensitivity analyses were conducted. The first excluded those born overseas, the second included those who changed address between waves I and III (but remained within a READI suburb) and the third involved a complete case analysis for those who remained at the same address across all three waves. The results from these analyses were consistent with those presented in tables 2 and 3. There was no evidence that the change in BMI differed by either baseline major chain fast-food outlet availability or change in major chain fast-food outlet availability.

DISCUSSION

We hypothesised that increased major chain fast-food outlet availability within the residential environment would be associated with greater increases in BMI over time. However, the results from this longitudinal study of women living in disadvantaged neighbourhoods in Victoria, Australia, found no evidence to support this hypothesis. Furthermore, there was no evidence that the rate of change in BMI differed dependent on the change in the number of major chain fast-food outlets over the study period.

Given that the average change in BMI in this sample over the 5-year study was small (increase of 0.8 kg/m^2) and that studies of adults in the USA and Canada which established associations between fast-food outlets and BMI only identified small effect sizes,[19 20] it is perhaps unsurprising that we did not find evidence of an association. Furthermore, our ability to determine the influence of change in fast-food outlet availability on change in BMI may have been limited by the fact that there was little change in the number of major chain fast-food outlets between waves I and III. Our findings suggesting no evidence of an association between fast-food outlet availability and change in BMI are consistent with cross-sectional findings indicating no evidence of an association between fast-food outlet availability and BMI in a previous analysis of the READI sample.[38] These findings are also consistent with null findings observed in both cross-sectional[25 39] and longitudinal studies[40] of adults from the USA which were not restricted to those residing in disadvantaged neighbourhoods. The present findings contrast that of another longitudinal study from the USA which found evidence that greater distance to fast-food outlets was associated with lower BMI among women.[41] However, the effect sizes in this study were small, with only a 0.19 kg/m^2 decrease in BMI with each additional 1 km to the nearest fast-food outlet.

While the fast-food environment around home was not associated with change in BMI in this sample, it may be that exposure to fast-food outlets in other locations people regularly visit is associated with BMI. Although it has been shown that the number of fast-food outlets around the workplace was not associated with BMI among women in cross-sectional research,[42] recent research exploring individual activity spaces has shown some evidence of a positive association between fast-food outlet availability and overweight status.[43] Furthermore, considering the co-location of fast-food outlets with other types of food outlets, or other built environment characteristics, may be important to gain a better understanding of the range of options available to individuals.[40 44] For example, cross-sectional studies have shown positive associations between availability of fast-food outlets and BMI or obesity when considered relative to other food outlet types.[45 46] Furthermore, in Victoria, research has found that those who reside in areas with unhealthy food outlets also have high access to healthy food outlets, thus residents have choices other than fast food.[47] Therefore, it could be that the participants in our study had a range of both healthy and unhealthy food outlets available to them. This may explain the null associations found since the presence of alternative food outlet options may counteract any influence of the availability of fast-food outlets on BMI. More detailed food environment data would be required on a variety of food outlet types to study this. In addition, it is important to clearly categorise the food outlet types. Without on-the-ground assessment of food outlets, which is often not feasible in studies across a whole state such as this, it can be challenging to clearly identify the types of food provided in independent food outlets to correctly categorise these. Furthermore, defining meaningful relative measures of unhealthy to healthy food outlets can be challenging as, for example, a ratio of one of the number of unhealthy to healthy food outlets does not differentiate between those who have one outlet of each type to those who have 10 of each.[48] Therefore, a ratio measure does not distinguish between individuals with high versus low access to fast-food outlets.

While this study adds to the existing literature by examining prospective associations between the availability of fast-food outlets and change in BMI, it does have some limitations. This study relied on self-reported measures of height and weight. However, self-reported BMI has been shown to correspond closely to objectively measured BMI in Australian women.[30] Furthermore, although this study considered objective measures of the fast-food environment, we were not able to ground truth these outlets across the state of Victoria, although we validated these data against other sources. In addition, this study only considered major chain fast-food outlets. Findings may have differed had we included independent takeaway outlets in our analyses. It may be that other independent takeaway outlets could influence BMI. Finally, there was substantial loss to follow-up in this study with only 36% of recruited participants completing all survey waves. Descriptive characteristics for fast food availability and BMI at baseline were comparable for those who did and did not participate in all waves of READI (supplementary table S1). However, among those who did not complete follow-up, a lower proportion of participants had tertiary education (23.4% compared with 29.9%), a higher proportion were not in paid employment (32.9% compared with 29.2%) and a lower proportion reported income in the highest category (15.1% compared with 21.1%). Thus, the results reported may not be representative of those of lower socioeconomic status residing within disadvantaged neighbourhoods.

Summary

Although this study identified null findings regarding associations between the availability of major chain fast-food outlets and change in BMI, the results are important as they provide an advance on mostly cross-sectional findings in this area and provide insight into associations among women residing in disadvantaged neighbourhoods.

Given that null findings regarding associations between fast-food outlet availability and BMI or overweight and obesity have been identified in the literature,[16] obesity prevention advocacy efforts focused on changes to the built environment that are based on restricting fast-food outlets may not be sufficient. Policies to improve the residential food environment should adopt a more holistic approach rather than focusing on a single outlet type. Future research needs to consider what environments are the key sources for accessing and consuming fast food and how these relate to BMI and obesity risk.

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