Socioeconomic differences in associations between living in a 20-min neighbourhood and diet, physical activity and self-rated health : cross-sectional findings from ProjectPLAN

Reference:
Lamb Karen E., Daniel Mark, Chaix Basile, Kestens Yan, Coffee Neil T., Thornton Lukar.- Socioeconomic differences in associations between living in a 20-min neighbourhood and diet, physical activity and self-rated health : cross-sectional findings from ProjectPLAN
Health and place - ISSN 1873-2054 - 84(2023), 103119
Full text (Publisher's DOI): https://doi.org/10.1016/J.HEALTHPLACE.2023.103119
To cite this reference: https://hdl.handle.net/10067/2028150151162165141

TITLE

Socioeconomic differences in associations between living in a 20-minute neighbourhood and diet, physical activity and self-rated health: cross-sectional findings from ProjectPLAN

ABSTRACT

The 20-minute neighbourhood (20MN) concept aims to enable residents to meet daily needs using resources within a 20-minute trip from home noting that there is no single definition of what services and amenities are required for daily needs nor what modes of transport constitute a 20 minute trip. Whether 20MNs promote better health and whether associations differ by socio-economic status (SES) is unknown. Using cross-sectional data from adults randomly sampled in 2018-19 from Melbourne or Adelaide, Australia, we examined whether associations between neighbourhood type (20MN/non-20MN) and diet, physical activity or self-rated health vary according to individual- or area-level SES. We found no consistent patterns of interactions. The results do not consistently support the often assumed belief that 20MNs support more healthful behaviour and that these relationships vary by SES.

KEYWORDS

Built environment, 20-minute neighbourhood, physical activity, eating behaviours

ABBREVIATIONS

ProjectPLAN: Places and Locations for Activity and Nutrition study; 20MN: 20-minute neighbourhood; SES: socioeconomic status; IRSAD: Index of Relative Socio-economic Advantage and Disadvantage; BMI: body mass index; CI: Confidence Interval; IQR: interquartile range.

INTRODUCTION

Diet and physical activity behaviours are key contributors to health and wellbeing (Afshin et al., 2019, Murray et al., 2020, Lee et al., 2012). However, even within high-income countries such as Australia, many people fail to achieve recommended daily levels of fruit and vegetable consumption or physical activity (Leme et al., 2021, Guthold et al., 2018, Australian Institute of Health and Welfare, 2018). Individual-level factors such as age, sex and education are known to be associated with dietary and physical activity behaviours (Marques et al., 2015, Alkerwi et al., 2015, Thorpe et al., 2019, Li et al., 2020). Recognising that individual-choices are influenced by environmental exposures, health-promoting built environments have been a key focus of recent population-level policy responses (Pineo et al., 2018). This includes improving access to facilities that encourage healthful behaviours, such as parks (Sallis et al., 2016) and outlets selling (fresh) healthful food (Trapp et al., 2015, Moore et al., 2008).

A number of systematic reviews have reported links between the built environment and diet and physical activity behaviours, although the underlying evidence is uneven rather than wholly consistent (Ige-Elegbede et al., 2020, Rahmanian et al., 2014, Smith et al., 2017). Findings have also been inconsistent when examining self-rated health, although there is less research on built environment effects on self-rated health (Spring, 2018, McCormack et al., 2019). In the US, long-term exposure to environments with low levels of service provision (low access to supermarkets, recreational facilities, health services, residential care facilities, senior services) or potentially health damaging environments (high access to liquor stores, pawn shops and fast-food outlets) was associated with a higher risk of poor self-rated health (Spring, 2018). However, in Canada, research found little evidence of a relationship between access to community resources and self-rated health (McCormack et al., 2019).

The importance of creating local built environments that support health and well-being, whilst ensuring that underlying socioeconomic disparities do not increase, was a key part of the Victorian Government initiative named 'Plan Melbourne' (State of Victoria Department of Environment, 2017, State of Victoria Department of Transport, 2014, State of Victoria Department of Environment, 2019). The 20-minute neighbourhood (20MN) concept was posited as a key feature of Plan Melbourne, with its aim to provide residents the ability to meet most of their everyday needs within a 20-minute trip from home. Over subsequent, multiple iterations of this document, the definition of how a 20-minute trip ostensibly supports health continued to evolve (c.f. (Thornton et al., 2022)). The 2015 version (State of Victoria Department of Environment, 2015) stated the 20-minute trip was limited to "primarily within a 20-minute walk" with an estimated distance of 1 to 1.5km. In the more resent 2019 update (State of Victoria Department of Environment, 2019), it is stated "within a 20-minute walk from home with access to safe cycling and local transport options" and "this 20-minute journey represents an 800m walk from home to a destination, and back again". These statements highlight that, for Melbourne, whether intentionally or unintentionally, walking retains a core place as the chief envisioned mode of transport and that a 20-minute journey is conceived as reflecting a small service area. Other walkable community planning concepts have been proposed in less populated urban areas in Australia, such as Adelaide. Although not explicitly aiming for 20MNs, Adelaide does recognise the need for infrastructure that supports walkable and connected communities (Government of South Australia Department of Planning and Local Government, 2010).

Importantly, the Plan Melbourne policies and the ongoing narrative related to 20MNs in other locations have implicitly tied the 20MN to better health, largely without supporting evidence. How the field finds itself in such a position reflects the commingling of science, politics, and management in the governance of urban development, confounding the process with tangled motives, expectations and, ultimately, consequences (or lack thereof, of health benefits at the least). Without a clear definition of the 20MN, it is impossible to assess the proposed health benefits of the 20MN, and it is wrong to propagate unsubstantiated health benefits supportive of the 20MN concept without defensible scientific data.

The project from which the current analysis derives, was constructed to evaluate some of the potential health benefits of the 20MN. Doing so was made possible through an explicit operationalisation of the 20MN in the Places and Locations for Activity and Nutrition study (ProjectPLAN) (Thornton et al., 2022), with residents in 20MNs and non-20MNs then being surveyed about their health and behaviour. Findings from this project have shown some benefits to residing in a 20MN, such as more walking for transport (Contardo et al., 2022) and a lower body mass index (Yang et al., 2022) despite a low consistency of findings between Adelaide and Melbourne. Results have also suggested that 20MNs could encourage a greater frequency of out-of-home meal consumption which may potentially be detrimental to health (Oostenbach et al., 2022) as well as no benefit in terms of recreational walking despite more walking for transport (Contardo et al., 2022).

Stepping back from the 20MN *per se*, there is evidence indicating that for local residential areas, the availability of local area resources varies according to socio-economic status (SES) (Daniel et al., 2009, Lamb et al., 2010, Marquet and Miralles-Guasch, 2015), and that relationships between local resources and health-related behaviour vary according to SES. For example, Rummo et al. (2015) found a stronger association between greater access to convenience stores and lower dietary quality among those with lower individual-level income (Rummo et al., 2015). Among adolescents in Spain, Molina-García et al. found that associations between neighbourhood walkability and moderate-to-vigorous physical activity differed by neighbourhood SES, with the highest activity occurring in more walkable neighbourhoods with higher SES (Molina-García et al., 2017). In Japan, associations between street density and proximity to commercial destinations and walking for exercise among adults aged 20-64 years were only observed in high SES areas (Koohsari et al., 2017). In Australia, Turrell et al. found higher levels of walking for transport in more disadvantaged than advantaged neighbourhoods. In their mediation analysis, they found that this relationship was explained to some extent by the disadvantaged neighbourhoods studied having built environment infrastructure more conducive to walking, in addition to residents having lower car access (Turrell et al., 2013). These findings suggest but do not specifically indicate that the effect of residing in a 20MN on health and behaviour has the potential to differ according to individual- or area-level SES.

Although ensuring access to health-promoting facilities is one way of supporting healthful behaviour, less research has explored whether environmental-risk factors and environmental-level health promotion efforts benefit all population segments equally. To address this gap, the aims of this study were to examine whether the effect of living in a 20MN on dietary behaviour, physical activity and self-rated health differed according to individual- or area-level SES.

METHODS

ProjectPLAN examined the influence of living in a 20MN on diet and physical activity behaviours in two Australian cities: Melbourne, Victoria and Adelaide, South Australia.

Neighbourhood characteristics

For this study, 20MNs were defined according to five domains with access to various individual attributes required to meet the requirements for each domain (healthful food [supermarkets and fruit and vegetable stores], recreational resources [gyms], community resources [primary schools, general practitioners, pharmacies, libraries, post offices, cafés,], public open space, and public transport access [bus, tram, train]). This aligns with the broad but largely unspecified 20MN concept presented by Plan Melbourne at the conceptual phase of this study (State of Victoria Department of Environment, 2017). Full details of the 20MN definition used in this study are provided elsewhere (Thornton et al., 2022). In brief, geospatial data for the 20-minute neighbourhood attributes were sourced from a combination of government and commercial sources. A 1.5-kilometre distance pedestrian network service area (to reflect the Plan Melbourne emphasis on walking) was created around each of the geocoded healthful food outlets, recreational resources and community resources, while accessibility to public open space and public transport were guided by Australian planning guidelines recommendations (i.e., access to any public space within a short walk and access to a minimum amount of greenspace within a larger area around homes). Different criteria were set to meet the requirements of each domain. For example, for the healthful food domain, a resident needed to have access to at least one large supermarket or at least one smaller supermarket and a greengrocer. Thus, for this domain, three separate individual attributes were mapped and assessed yet the domain criteria could be met through access to a single attribute (i.e., a large supermarket). For community resources, access was required to all six individual attributes. The final selection of 20MNs were defined as areas that intersected all five domain layers (i.e., healthy food, recreational resources, community resources, public open space and public transport). Non-20MNs were defined as areas with five or fewer of the 11 individual attributes (e.g., library, supermarket, and bus stop only) in Melbourne, otherwise four or fewer individual attributes in Adelaide. This definition of the non-20MN differed slightly between cities due to differences in public transport infrastructure (Thornton et al., 2022). Non-20MNs were defined and sampled to provide a distinct referent for comparing to 20MNs, in the form of an extreme groups contrast. Under this approach, areas with moderate levels of service provision were not sampled and analysed.

Area-SES (low versus high) was defined using the Australian Bureau of Statistics Index of Relative Socio-economic Advantage and Disadvantage (IRSAD) deciles. Deciles 1-3 of the IRSAD at Statistical Areas Level 1 (small census based geographical areas) were classified as low SES if they were also located within Statistical Areas Level 2 (larger census based geographical areas) of deciles 1-3. This approach was adopted to ensure low SES areas considered were small areas with low socioeconomic conditions within a larger community that also had low socioeconomic conditions. The process was repeated for Statistical Areas Level 1 and Statistical Areas Level 2 within deciles 8, 9 and 10 to represent areas with high socioeconomic conditions. The rationale behind only considering deciles 1-3 (low SES) and deciles 8-10 (high) was to ensure clear separation between areas defined as low or high SES. This enables an assessment of participants from distinctly different SES contexts.

Neighbourhood type (20MN/non-20MN) and area-SES (low/high) were used in both the sampling for ProjectPLAN and as covariates of interest in the study.

Recruitment

Stratified recruitment was conducted within 20MNs and non-20MNs in both low and high SES areas from each city in 2018-2019. Household address points, sourced from routinely available government data sources (Department of Environment, 2021, Government of South Australia, 2021), for all study strata (Melbourne/Adelaide; 20MN/non-20MN; low/high SES) were randomly selected, with residents at selected addresses mailed non-personalised invitations to participate in ProjectPLAN. More letters were mailed to address points within low SES areas due to lower anticipated response rates in these areas. To reduce participant burden, half of the randomly selected households were sent an invitation to complete the online food survey and the other half sent a link to complete the physical activity behaviour survey (thus households received either the food or physical activity survey). Food survey respondents were required to be the main household food purchaser while the resident aged ≥18 years with the most recent birthday was invited to participate in the physical activity survey. Self-rated health was solicited for both the food and physical activity surveys as were data reflecting demographic and socioeconomic characteristics. In total, 782 participants (3.7% response rate) from Melbourne and 830 participants (4.2% response rate) from Adelaide completed either the food or PA survey.

Ethics approval was obtained from the Deakin University Human Research Ethics Committee (HEAG-H 168_2017).

Variables

Dietary behaviour outcomes

The three dietary behaviour outcomes were: i) serves of fruit consumed per day (<1 serve/ 1 serve/ ≥2 serves), ii) serves of vegetables consumed per day (<2 serves/ 2 serves/ ≥3 serves), iii) hot takeaway food consumption frequency (never or less than once per month/ more than once per month but less than weekly/ at least once per week).

Physical activity outcomes

The three physical activity outcomes were: i) total transport walking time (minutes), ii) total recreational walking time (minutes), and iii) number of other (non-walking) exercise activities in the past week. Participants reporting no recreational or transport walking were accorded zero minutes for walking outcomes.

For the third physical activity outcome of “other” (non-walking) physical activities, these included recreational- or transport-related jogging/running, recreational- or transport-related cycling, use of exercise/gym equipment, swimming, fitness class/ personal training, yoga/ pilates, and organised or social sport. An "Other" option was provided to account for any activities not included in this list. The count of other activities (rather than time spent doing such activities) was calculated for analysis as this variable aimed to capture the variety of activities in which participants engaged.

Self-rated health outcome

Both food and physical activity survey participants responded to the question "in general, how would you rate your health?", with responses on a 5-point scale ranging from poor to excellent. Response options were coded to three categories, given small cell counts (poor or fair/good/very good or excellent).

All outcome measures were adapted from past studies such as VicLANES (King et al., 2015) and READI (Thornton et al., 2015) which have both examined neighbourhoods and health in the Australian context.

Exposure

Neighbourhood type (20MN/non-20MN).

Moderators

Two SES measures were considered: i) area-SES (low/high) and ii) individual-SES measured by highest educational qualification obtained (up to year 12/certificate or diploma/university).

Other covariates

Potential confounders of apparent relationships between residing in a 20MN or not and each outcome were identified using causal diagrams (see Appendix Figure 1 a-c). Age (years) and gender (male/female) were considered prognostic of the outcomes. Children in the household (no children/ at least one child aged ≤4 years /only child(ren) aged >4 years), relationship status (in a relationship and living with partner, versus not living with partner/single) and neighbourhood self-selection were all identified as potential confounders.

Neighbourhood self-selection included preference to live within a 20-minute walk of: i) a supermarket (fruit and vegetable intake outcomes only), ii) everyday (non-work) needs (all diet outcomes; transport walking; number of physical activities), iii) parks, beaches or open space (recreational walking; number of exercise activities), or iv) recreational facilities, such as gyms (number of activities). These variables were created by combining responses to two survey questions. The first asked about outcomes specific to where a respondent currently lives (e.g., "Within a 20-minute walk, I can reach a grocery store or supermarket"; "Overall, within a 20-minute walk I can meet most of my everyday (non-work) needs", etc.) with response options of 'yes' or 'no'. The second question asked which attributes present within a 20-minute walk (i.e., those for which the response to the first question was 'yes') were core reasons underpinning why the respondent chose to move to or live at their current address (e.g., "Within a 20-minute walk, I can reach a grocery store or supermarket"; "Overall, within a 20-minute walk I can meet most of my everyday (non-work) needs", etc.) with response options 'yes' or 'no'. For each of the four self-selection items, responses to these two questions for each attribute were dichotomised as 'not within a 20-minute walk, or within a 20-minute walk and not an important reason for living here', or 'within a 20-minute walk and an important reason for living here'. Each item was considered separately.

Statistical analysis

Analyses were conducted separately for Melbourne and Adelaide as it was considered *a priori* that the estimated effect of living in a 20MN on outcomes could differ between the two cities due to differences in population density, the density of services and amenities and public transport infrastructure. Ordinal regression was used to assess whether the effect of residing in a 20MN differed by either SES measure for each of the diet outcomes and self-rated health. Two-part models were fitted to each of the walking duration outcomes given the scope of zero-inflation of observations from participants reporting no walking. Poisson regression was used for analysis of the number of activities undertaken. Interactions between neighbourhood type (20MN) and SES (either area-SES or individual-SES) were included in each model. Models adjusted for measured prognostic and confounding variables.

A complete case analysis was conducted in primary analysis. Sample characteristics were compared for the complete case and omitted participants. With a few exceptions, these were comparable (see Appendix Table 1).

Sensitivity analyses

Models were fitted with and without adjustment for neighbourhood self-selection to assess its impact on results. Providing estimates from both models assists understanding how estimated effects differed, dependent on adjustment (Lamb et al., 2020). Additional diet and physical activity outcome models were fitted, accounting for body mass index (BMI) and self-rated health as potential confounders. These were omitted from the primary analyses reported here as they were interpreted to be mediators. To assess sensitivity to missing data assumptions, multiple imputation using chained equations was used to impute missing data. Imputation models included all variables included in the adjusted models, with 20 imputed data sets generated. Adjusted analyses were conducted using the imputed datasets with the findings pooled using Rubin's rules and compared to the complete case analyses.

RESULTS

Complete case sample sizes were 289 (81% of the full sample) and 353 (86%) for Melbourne and Adelaide food samples, and 337 (84%) and 335 (83%) for Melbourne and Adelaide physical activity samples, respectively. Participant characteristics are shown in Table 1.

Diet outcomes

Half of dietary behaviour sample participants consumed ≥2 serves of fruit per day (Melbourne: 52%, Adelaide: 48%) whilst over 40% consumed ≥3 serves of vegetables per day (Melbourne: 46%, Adelaide: 42%). About a third consumed hot takeaway at least once per week (Melbourne: 36%, Adelaide: 31%) (Table 1).

Results from models testing moderation by area-SES (Figure 1) did not indicate an interaction between area-SES and neighbourhood type on diet. The patterns of findings were similar for low and high SES areas in both 20MNs and non-20MNs. An anomalous exception was fruit consumption in Melbourne, where in 20MNs the point estimate for the predicted probability of consuming ≥2 serves of fruit per day was higher (although, the confidence intervals (CIs) overlapped) for participants in low (0.60, 95% CI: 0.46-0.74) compared to high SES areas (0.49, 95% CI: 0.37-0.60). In contrast, the opposite pattern (albeit also with overlapping CIs) was observed in non-20MNs (low: 0.48, 95% CI: 0.37-0.58; high: 0.54, 95% CI: 0.43-0.65). However, CIs for interaction terms were wide and included the null (Appendix Table 2). This finding was not observed in Adelaide (Figure 1).

Similarly, there was no strong support for interactions between individual-SES and neighbourhood type (Figure 2). As with area-SES, the only exception was fruit consumption among Melbourne participants. Within 20MNs, the predicted probability of consuming ≥2 serves of fruit per day was highest for those with a trade/certificate in 20MNs (0.75, 95% CI: 0.54-0.97). However, it was highest among those with university education in non-20MNs

(0.53, 95% CI: 0.42-0.64). Although CIs did not contain the null for some interaction terms (i.e., fruit intake in Melbourne), the estimated CIs were wide (Appendix Table 2).

The predicted probabilities for each outcome within each SES category appeared comparable for 20MN and non-20MNs in both Melbourne and Adelaide (Figures 1 and 2). Therefore, in general it appears that residents of 20MNs did not have better dietary behaviours than those residing in non-20MNs.

Physical activity outcomes

Overall, median transport walking and other non-walking exercise activities were higher for Melbourne (transport walking: 60 mins/week, interquartile range (IQR): 0-85; activities: 3, IQR: 2-4) compared to Adelaide (transport walking: 0 mins/week, IQR: 0-80; activities: 2, IQR: 1-3) (Table 1). In contrast, median recreational walking was higher in Adelaide (120 mins/week, IQR: 60-200) compared to Melbourne (90 mins/week, IQR: 60-180).

Full modelling results are presented in Appendix Table 3, with estimated marginal means from adjusted models shown in Figures 3 and 4. Considering the patterns presented in Figure 3, amongst the physical activity outcomes there is no apparent interaction effect between neighbourhood type and area-SES. Generally, the models show higher estimated marginal means for participants in high SES areas in both 20MN and non-20MN in each city, although with some exceptions. For example, in Adelaide, both the marginal mean minutes of recreational walking and the number of recreation physical activities per week were comparable for participants in low and high SES areas in non-20MNs (low SES: 133 [95% CI: 109-157] mins recreational walking, 2.3 [95% CI: 2.0-2.6] activities; high SES: 132 [95% CI: 108-156] mins, 2.4 [95% CI: 2.0-2.7] activities). This was not so, however, for 20MNs where recreational walking and the number of activities were greater for high SES areas (low

SES: 114 [95% CI: 81-147] mins, 2.1 [95% CI: 1.8-2.5] activities; high SES: 162 [95% CI: 133-191] mins, 3.0 [95% CI: 2.7-3.4] activities).

Comparing the overall patterns of results for 20MNs and non-20MNs within each city, there was no apparent interaction effect between neighbourhood type and individual-SES on transport walking or number of activities (Figure 4). There was some suggestion that patterns for recreational walking differed for 20MN compared to non-20MNs in Melbourne, with mean minutes decreasing with increasing education in 20MNs but roughly the opposite pattern observed in non-20MNs. However, the CI for the lowest qualification category among those with a 20MN was wide (Figure 4). Further, this pattern was not observed in Adelaide.

Although there were no consistent interaction effects, mean transport walking appeared to be higher in 20MNs relative to non-20MNs for Melbourne but not for Adelaide (Figures 3 and 4). There were no other clear differences between 20MNs and non-20MNs.

Self-rated health

The percentages reporting poor/fair health was comparable for both Melbourne samples (19%) and lower than those observed for Adelaide (food: 25%; physical activity: 27%) (Table 1).

There did not appear to be an interaction between neighbourhood type and area-SES on self-rated health (Figure 5). There was some suggestion of an interaction between neighbourhood type and individual-SES. However, this was not consistent across the four samples (Figure 6). For example, in the Melbourne food and the Adelaide physical activity samples, the estimated predicted probability of very good/excellent health decreased with higher educational qualifications in 20MNs, whereas the opposite pattern was observed in non-20MNs. This is shown in the modelling results (Appendix Table 4), where interaction parameters in the Melbourne food and Adelaide physical activity samples do not contain the null. In contrast, the same was not apparent for the Melbourne physical activity or the Adelaide food samples. There did not appear to be a difference in self-rated health by neighbourhood type. However, the estimated odds of better self-rated health was consistently greater for high compared to low SES areas, although such effects were less pronounced for the Adelaide physical activity sample (Appendix Table 4).

Sensitivity analyses

Findings were very similar either with (see Adjustment 2 in Appendix Tables 2-4) or without (Adjustment 1) adjustment for neighbourhood self-selection. In addition, further adjustment for self-rated health and BMI (Adjustment 3 [diet and physical activity models only]) had little impact. Comparisons of missing data approaches are shown in Appendix Tables 5-7. Although the estimated effects differed for some models (e.g., the estimated coefficient for the interaction between 20MN and area-SES was -0.24 from multiple imputation, compared to 0.03 from complete case in the analysis of fruit intake for Adelaide), the study conclusions were not impacted by the approach taken to deal with missing data.

DISCUSSION

Findings from ProjectPLAN provided little evidence to indicate that the effect of living in a 20MN on dietary behaviours, physical activity or self-rated health differed by area-level or individual-SES. The implication is that residing in a 20MN does not help reduce social inequalities in health behaviours and outcomes. ProjectPLAN was the first study to examine the 20MN built environment exposure (noting this measure was tailored to the cities under investigation and was limited to considering access within a 20-minute walk only (to align with the wording in the Melbourne based planning documents) and it is not possible to directly compare the findings from this analysis to other studies. Where built environment and SES interactions have been considered, these have typically examined single aspects of the built environment, such as availability of food outlets or walkability (Mackenbach et al., 2019, Pearce et al., 2008, McInerney et al., 2016, Vogel et al., 2017, Peng and Kaza, 2020, da Silva et al., 2017, Zang et al., 2022, Molina-García et al., 2019, Molina-García and Queralt, 2017, Molina-García et al., 2017, De Meester et al., 2012, Koohsari et al., 2017, Steinmetz-Wood and Kestens, 2015, Cummins et al., 2005), whereas our 20MN measure is multi-dimensional.

In the food environment literature, few studies have found statistically significant interaction effects on dietary behaviour between SES and objectively measured access or proximity to the food resources (Mackenbach et al., 2019, Pearce et al., 2008, McInerney et al., 2016, Vogel et al., 2017, Peng and Kaza, 2020). However, as built environmental effects on behaviour outcomes are typically of small magnitude and detecting interactions with small effects requires large sample sizes, it may be that studies lack power to detect these effects. Of course, previous studies have generally considered just one aspect of the local built environment (i.e., the food environment) and have primarily focussed on outlets deemed unhealthful (e.g., fast food stores). Our 20MN exposure, on the other hand, featuring a healthful food layer consisting of access to at least one large supermarket or at least one smaller supermarket and greengrocer, was not designed to capture unhealthful food environments. It is possible that 20MNs, both in our study and more broadly where 20MNs are considered, encompass both healthful (e.g., greengrocers), and unhealthful food options (e.g., fast food outlets) as found in earlier studies from Melbourne (Thornton and Kavanagh, 2012). This means 20MNs may not have a wholly positive influence on dietary behaviour.

Interactions between SES and a variety of built environment attributes related to walkability including street lighting (da Silva et al., 2017), number of overpasses (Zang et al., 2022), public open space (da Silva et al., 2017), availability of physical activity facilities (da Silva et al., 2017) or other commercial destinations (Koohsari et al., 2017, Steinmetz-Wood and Kestens, 2015) have been considered in the physical activity literature. Street connectivity (da Silva et al., 2017, Zang et al., 2022, Steinmetz-Wood and Kestens, 2015) or walkability (Molina-García et al., 2019, Molina-García and Queralt, 2017, Molina-García et al., 2017, De Meester et al., 2012) have most frequently been considered, and with mixed findings. Some studies found little to indicate an interaction between these characteristics and SES on active transport, leisure time physical activity (Molina-García et al., 2019), or active commuting to school (Molina-García and Queralt, 2017). Others found weaker associations between these characteristics and active transportation among residents of low SES areas (Steinmetz-Wood and Kestens, 2015), as well as negative associations with walking (Zang et al., 2022) and positive associations with moderate-to-vigorous physical activity (De Meester et al., 2012) in low SES areas. Findings from ProjectPLAN provided little indication of interactions between 20MN and SES on walking for recreation, transport or the number of physical activities undertaken. As with the dietary behaviour literature, prior studies of interactions between the built environment and SES on physical activity have tended to examine individual environmental attributes, such as street connectivity. In contrast, our 20MN measure considers local access to services and resources (food outlets, recreational resources, community resources), public open space and public transport. Research considering links between commuting physical activity and multiple attributes of the built environment, albeit considering each attribute individually (e.g., street lighting, paved streets, sidewalks, street connectivity, public open space, distance to gyms/health clubs), has found little evidence of an interaction with SES (da Silva et al., 2017). Therefore, our findings in ProjectPLAN are largely consistent with research to date.

Relative to dietary and physical activity behaviours, fewer studies still have examined built environment and self-rated health relationships. Those that considered the built environment examined community resources (McCormack et al., 2019, Spring, 2018), walkability (Colley et al., 2019), highways and grassland (Nguyen et al., 2019), and housing (Badland et al., 2017). Few studies have considered interactions between the built environment and SES on self-rated health (Schüle and Bolte, 2015). One study from the UK found larger estimated effects between access to health services and self-rated health among those that were not working compared to those who were. However, they did not find that the relationship between other built environment attributes, such as access to public recreational resources (i.e., swimming pools, libraries), and self-rated health differed by this measure of SES (Cummins et al., 2005). Findings from ProjectPLAN were mixed but overall provided little evidence of a consistent or compelling interaction effect. Given the paucity of research in this area, further studies are needed to assess built environment and SES interactive effects on self-rated health.

Findings from this study not only provide little indication of SES interaction effects but also little to suggest any obvious benefit from residing in a 20MN for any of the health outcomes considered, apart from transport walking in Melbourne, discussed elsewhere (Contardo et al., 2022). Therefore, if replicated and found generalisable, any health benefit conveyed by living in a 20MN may be specific to active transportation, a finding supporting efforts to improve transportation outlet availability and access.

For Melbourne, the working definition of the 20MN is problematic given it ties to the idea that a service or amenity must be nearby to be accessible. We note this to highlight that it is not our preference to limit the definition to a time-based accessibility measure that aligns with walking, but one that was necessary to align our 20MN definition to the policy narrative. In Melbourne, the 20MN policy now states a "20-minute journey represents an 800m walk from home to a destination, and back again" (State of Victoria Department of Environment, 2019). Achieving this is unfeasible in cities without a high population density. Further, deemphasising other modes of transport in favour of walking limits the ability to travel further in a short time and makes other areas beyond the immediate neighbourhood less accessible. Thus, these restrictions go against the premise that a 20MN should make accessing everyday needs easier. In Melbourne, this could be best achieved by allowing people to travel further using non-car-based forms of transport (e.g., cycling, or public transport), making the already well-provisioned services and amenities more accessible to both high and low SES residents.

Currently, the proximity-centred focus on access and limitations placed on travel mode (i.e., walking) runs counter to improving accessibility and reducing urban inequalities. This current policy narrative makes it difficult to fully appreciate and assess the benefits of 20MNs, and claims about benefits should be downplayed prior to improvements in defining the 20MN (which should be accompanied by an operationalised measure as without this it is not possible to assess where they exist and the benefits of living in one).

Limitations apply to this study. First, this study was not *a priori* powered to detect interaction effects and thus interpretation was based on examining patterns in the combined effects of neighbourhood type and SES. While there were some indications of interactions, differences were modest and stand to be accounted for as Type 1 errors related to the number of estimates considered. Furthermore, although it would be of interest to examine the combined interactive effects of both individual and area-SES and neighbourhood type on health and behaviour, our modest sample sizes prevented these more complex analyses. Second, as this was a cross-sectional study, it was not possible to determine temporal ordering. It is possible that those who are more physically active, or who have preference for certain foods, choose to live in areas with greater access to these services. Therefore, residing in a 20MN may not be responsible for more healthful behaviours. While attempts were made to account for neighbourhood self-selection, reverse causality remains a possibility. Third, it is often assumed that the relationship between area-SES and health or behaviour may be due to the quantity and quality of services available, as well as perceptions of safety (Schultz et al., 2018, Evans and Kantrowitz, 2002).

While a strength of ProjectPLAN was the stratified sampling of low and high SES areas with and without a 20MN to aid in separating the effect of built and physical environment attributes from area-SES, there was no assessment of the *quality* of the attributes the participants could access in this study. Quality has been shown to be an important determinant of health and behaviour (Sawyer et al., 2017, Francis et al., 2012). Therefore, future studies of the 20MN should aim to examine both availability and quality. Fourth, no information was obtained about how much time participants spent at or near their home address, relevant to determining extent of exposure to the local environment. To understand how the home environment influences health and behaviour, it is important to consider people's activity spaces more broadly to address potential biases introduced by ignoring locations in which activities are undertaken (Perchoux et al., 2015).

In summary, findings from ProjectPLAN do not support the belief that health or health-related behaviours associated with living in a 20MN on differ according to SES. However, we did not find much indication of a difference in these behaviours between 20MN and non-20MN, beyond benefits for transport walking which was equally beneficial for low *and* high SES areas.

REFERENCES

AFSHIN, A., SUR, P. J., FAY, K. A., CORNABY, L., FERRARA, G., SALAMA, J. S., MULLANY, E. C., ABATE, K. H., ABBAFATI, C., ABEBE, Z., AFARIDEH, M., AGGARWAL, A., AGRAWAL, S., AKINYEMIJU, T., ALAHDAB, F., BACHA, U., BACHMAN, V. F., BADALI, H., BADAWI, A., BENSENOR, I. M., BERNABE, E., BIADGILIGN, S. K. K., BIRYUKOV, S. H., CAHILL, L. E., CARRERO, J. J., CERCY, K. M., DANDONA, L., DANDONA, R., DANG, A. K., DEGEFA, M. G., EL SAYED ZAKI, M., ESTEGHAMATI, A., ESTEGHAMATI, S., FANZO, J., FARINHA, C. S. E. S., FARVID, M. S., FARZADFAR, F., FEIGIN, V. L., FERNANDES, J. C., FLOR, L. S., FOIGT, N. A., FOROUZANFAR, M. H., GANJI, M., GELEIJNSE, J. M., GILLUM, R. F., GOULART, A. C., GROSSO, G., GUESSOUS, I., HAMIDI, S., HANKEY, G. J., HARIKRISHNAN, S., HASSEN, H. Y., HAY, S. I., HOANG, C. L., HORINO, M., IKEDA, N., ISLAMI, F., JACKSON, M. D., JAMES, S. L., JOHANSSON, L., JONAS, J. B., KASAEIAN, A., KHADER, Y. S., KHALIL, I. A., KHANG, Y.-H., KIMOKOTI, R. W., KOKUBO, Y., KUMAR, G. A., LALLUKKA, T., LOPEZ, A. D., LORKOWSKI, S., LOTUFO, P. A., LOZANO, R., MALEKZADEH, R., MÄRZ, W., MEIER, T., MELAKU, Y. A., MENDOZA, W., MENSINK, G. B. M., MICHA, R., MILLER, T. R., MIRAREFIN, M., MOHAN, V., MOKDAD, A. H., MOZAFFARIAN, D., NAGEL, G., NAGHAVI, M., NGUYEN, C. T., NIXON, M. R., ONG, K. L., PEREIRA, D. M., POUSTCHI, H., QORBANI, M., RAI, R. K., RAZO-GARCÍA, C., REHM, C. D., RIVERA, J. A., RODRÍGUEZ-RAMÍREZ, S., ROSHANDEL, G., ROTH, G. A., et al. 2019. Health effects of dietary risks in 195 countries, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017. *The Lancet,* 393**,** 1958-1972.

ALKERWI, A., SCHUH, B., SAUVAGEOT, N., ZANNAD, F., OLIVIER, A., GUILLAUME, M., ALBERT, A. & LARSSON, C. A. 2015. Adherence to physical activity recommendations and its associated factors: an interregional population-based study. *Journal of Public Health Research,* 4**,** 406.

AUSTRALIAN INSTITUTE OF HEALTH AND WELFARE 2018. Nutrition across the life stages. Canberra: AIHW.

BADLAND, H., FOSTER, S., BENTLEY, R., HIGGS, C., ROBERTS, R., PETTIT, C. & GILES-CORTI, B. 2017. Examining associations between area-level spatial measures of housing with selected health and wellbeing behaviours and outcomes in an urban context. *Health & Place,* 43**,** 17-24.

COLLEY, R. C., CHRISTIDIS, T., MICHAUD, I., TJEPKEMA, M. & ROSS, N. A. 2019. An examination of the associations between walkable neighbourhoods and obesity and self-rated health in Canadians. *Health Reports,* 30**,** 14-24.

CONTARDO, A. M., LAMB, K. E., LOH, V., DANIEL, M., COFFEE, N., OOSTENBACH, L. H. & THORNTON, L. E. 2022. Do residents living in a 20-minute neighbourhood walk more? Findings from ProjectPLAN. *Health & Place,* 76.

CUMMINS, S., STAFFORD, M., MACINTYRE, S., MARMOT, M. & ELLAWAY, A. 2005. Neighbourhood environment and its association with self rated health: evidence from Scotland and England. *Journal of Epidemiology and Community Health,* 59**,** 207.

DA SILVA, I. C. M., HINO, A. A., LOPES, A., EKELUND, U., BRAGE, S., GONÇALVES, H., MENEZES, A. B., REIS, R. S. & HALLAL, P. C. 2017. Built environment and physical activity: domain- and activity-specific associations among Brazilian adolescents. *BMC Public Health,* 17**,** 616.

DANIEL, M., KESTENS, Y. & PAQUET, C. 2009. Demographic and urban form correlates of healthful and unhealthful food availability in Montréal, Canada. *Canadian Journal of Public Health,* 100**,** 189-93.

DE MEESTER, F., VAN DYCK, D., DE BOURDEAUDHUIJ, I., DEFORCHE, B., SALLIS, J. F. & CARDON, G. 2012. Active living neighborhoods: is neighborhood walkability a key element for Belgian adolescents? *BMC Public Health,* 12**,** 7.

DEPARTMENT OF ENVIRONMENT, LAND, WATER & PLANNING 2021. Vicmap Address Melbourne [last accessed December 2021]. Available from: https://www.land.vic.gov.au/maps-and-spatial/spatial-data/vicmap-catalogue/vicmap-address.

EVANS, G. W. & KANTROWITZ, E. 2002. Socioeconomic status and health: the potential role of environmental risk exposure. *Annual Review of Public Health,* 23**,** 303-331.

FRANCIS, J., WOOD, L. J., KNUIMAN, M. & GILES-CORTI, B. 2012. Quality or quantity? Exploring the relationship between public open space attributes and mental health in Perth, Western Australia. *Social Science & Medicine,* 74**,** 1570-1577.

GOVERNMENT OF SOUTH AUSTRALIA, DEPARTMENT FOR INFRASTRUCTURE AND TRANSPORT 2021. Roads: Government of South Australia [last accessed December 2021]. Available from: https://data.sa.gov.au/data/dataset/roads.

GOVERNMENT OF SOUTH AUSTRALIA DEPARTMENT OF PLANNING AND LOCAL GOVERNMENT 2010. 30-Year Plan for Greater Adelaide. A volume of the South Australian Planning Strategy. ISBN: 978-0-7590-0114-5. https://livingadelaide.sa.gov.au/__data/assets/pdf_file/0007/278332/The_30-Year_Plan_for_Greater_Adelaide_2010_compressed.pdf.

GUTHOLD, R., STEVENS, G. A., RILEY, L. M. & BULL, F. C. 2018. Worldwide trends in insufficient physical activity from 2001 to 2016: a pooled analysis of 358 population-based surveys with 1.9 million participants. *The Lancet Global Health,* 6**,** e1077-e1086.

IGE-ELEGBEDE, J., PILKINGTON, P., ORME, J., WILLIAMS, B., PRESTWOOD, E., BLACK, D. & CARMICHAEL, L. 2020. Designing healthier neighbourhoods: a systematic review of the impact of the neighbourhood design on health and wellbeing. *Cities & Health***,** 1-16.

KING, T. L., BENTLEY, R. J., THORNTON, L. E. & KAVANAGH, A. M. 2015. Does the presence and mix of destinations influence walking and physical activity? . *International Journal of Behavioral Nutrition and Physical Activity,* 12**,** 115.

KOOHSARI, M. J., HANIBUCHI, T., NAKAYA, T., SHIBATA, A., ISHII, K., LIAO, Y., OKA, K. & SUGIYAMA, T. 2017. Associations of neighborhood environmental attributes with walking in Japan: moderating effects of area-level socioeconomic status. *Journal of Urban Health,* 94**,** 847-854.

LAMB, K. E., FERGUSON, N. S., WANG, Y., OGILVIE, D. & ELLAWAY, A. 2010. Distribution of physical activity facilities in Scotland by small area measures of deprivation and urbanicity. *International Journal of Behavioral Nutrition and Physical Activity,* 7**,** 76.

LAMB, K. E., THORNTON, L. E., KING, T. L., BALL, K., WHITE, S. R., BENTLEY, R., COFFEE, N. T. & DANIEL, M. 2020. Methods for accounting for neighbourhood self-selection in physical activity and dietary behaviour research: a systematic review. *International Journal of Behavioral Nutrition and Physical Activity,* 17**,** 45.

LEE, I. M., SHIROMA, E. J., LOBELO, F., PUSKA, P., BLAIR, S. N. & KATZMARZYK, P. T. 2012. Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. *The Lancet,* 380**,** 219-29.

LEME, A. C. B., HOU, S., FISBERG, R. M., FISBERG, M. & HAINES, J. 2021. Adherence to food-based dietary guidelines: a systemic review of high-income and low- and middle-income countries. *Nutrients,* 13.

LI, L., OUYANG, Y., WANG, H., HUANG, F., WANG, Y., ZHANG, J., SU, C., DU, W., JIA, X., JIANG, H., WANG, Z. & ZHANG, B. 2020. Disparities in fresh fruit and vegetable intake by sociodemographic and behavioural factors among adults in China. *Public Health Nutrition***,** 1-8.

MACKENBACH, J. D., NELISSEN, K. G. M., DIJKSTRA, S. C., POELMAN, M. P., DAAMS, J. G., LEIJSSEN, J. B. & NICOLAOU, M. 2019. A systematic review on socioeconomic differences in the association between the food environment and dietary behaviors. *Nutrients,* 11.

MARQUES, A., SARMENTO, H., MARTINS, J. & SABOGA NUNES, L. 2015. Prevalence of physical activity in European adults — Compliance with the World Health Organization's physical activity guidelines. *Preventive Medicine,* 81**,** 333-338.

MARQUET, O. & MIRALLES-GUASCH, C. 2015. The Walkable city and the importance of the proximity environments for Barcelona's everyday mobility. *Cities,* 42**,** 258-266.

MCCORMACK, G. R., CABAJ, J., ORPANA, H., LUKIC, R., BLACKSTAFFE, A., GOOPY, S., HAGEL, B., KEOUGH, N., MARTINSON, R., CHAPMAN, J., LEE, C., TANG, J. & FABREAU, G. 2019. A scoping review on the relations between urban form and health: a focus on Canadian quantitative evidence. *Health Promotion and Chronic Disease Prevention in Canada,* 39**,** 187-200.

MCINERNEY, M., CSIZMADI, I., FRIEDENREICH, C. M., URIBE, F. A., NETTEL-AGUIRRE, A., MCLAREN, L., POTESTIO, M., SANDALACK, B. & MCCORMACK, G. R. 2016. Associations between the neighbourhood food environment, neighbourhood socioeconomic status, and diet quality: An observational study. *BMC Public Health,* 16**,** 984.

MOLINA-GARCÍA, J., MENESCARDI, C., ESTEVAN, I., MARTÍNEZ-BELLO, V. & QUERALT, A. 2019. Neighborhood built environment and socioeconomic status are associated with active commuting and sedentary behavior, but not with leisure-time physical activity, in university students. *International Journal of Environmental Research and Public Health,* 16.

MOLINA-GARCÍA, J. & QUERALT, A. 2017. Neighborhood built environment and socioeconomic status in relation to active commuting to school in children. *Journal of Physical Activity & Health,* 14**,** 761-765.

MOLINA-GARCÍA, J., QUERALT, A., ADAMS, M. A., CONWAY, T. L. & SALLIS, J. F. 2017. Neighborhood built environment and socio-economic status in relation to multiple health outcomes in adolescents. *Preventive Medicine,* 105**,** 88-94.

MOORE, L. V., DIEZ ROUX, A. V., NETTLETON, J. A. & JACOBS, D. R., JR. 2008. Associations of the local food environment with diet quality - a comparison of assessments based on surveys and geographic information systems: the multi-ethnic study of atherosclerosis. *American Journal of Epidemiology,* 167**,** 917-24.

MURRAY, C. J. L., ARAVKIN, A. Y., ZHENG, P., ABBAFATI, C., ABBAS, K. M., ABBASI-KANGEVARI, M., ABD-ALLAH, F., ABDELALIM, A., ABDOLLAHI, M., ABDOLLAHPOUR, I., ABEGAZ, K. H., ABOLHASSANI, H., ABOYANS, V., ABREU, L. G., ABRIGO, M. R. M., ABUALHASAN, A., ABU-RADDAD, L. J., ABUSHOUK, A. I., ADABI, M., ADEKANMBI, V., ADEOYE, A. M., ADETOKUNBOH, O. O., ADHAM, D., ADVANI, S. M., AGARWAL, G., AGHAMIR, S. M. K., AGRAWAL, A., AHMAD, T., AHMADI, K., AHMADI, M., AHMADIEH, H., AHMED, M. B., AKALU, T. Y., AKINYEMI, R. O., AKINYEMIJU, T., AKOMBI, B., AKUNNA, C. J., ALAHDAB, F., AL-ALY, Z., ALAM, K., ALAM, S., ALAM, T., ALANEZI, F. M., ALANZI, T. M., ALEMU, B. W., ALHABIB, K. F., ALI, M., ALI, S., ALICANDRO, G., ALINIA, C., ALIPOUR, V., ALIZADE, H., ALJUNID, S. M., ALLA, F., ALLEBECK, P., ALMASI-HASHIANI, A., AL-MEKHLAFI, H. M., ALONSO, J., ALTIRKAWI, K. A., AMINI-RARANI, M., AMIRI, F., AMUGSI, D. A., ANCUCEANU, R., ANDERLINI, D., ANDERSON, J. A., ANDREI, C. L., ANDREI, T., ANGUS, C., ANJOMSHOA, M., ANSARI, F., ANSARI-MOGHADDAM, A., ANTONAZZO, I. C., ANTONIO, C. A. T., ANTONY, C. M., ANTRIYANDARTI, E., ANVARI, D., ANWER, R., APPIAH, S. C. Y., ARABLOO, J., ARAB-ZOZANI, M., ARIANI, F., ARMOON, B., ÄRNLÖV, J., ARZANI, A., ASADI-ALIABADI, M., ASADI-POOYA, A. A., ASHBAUGH, C., ASSMUS, M., ATAFAR, Z., ATNAFU, D. D., ATOUT, M. M. D. W., AUSLOOS, F., AUSLOOS, M., AYALA QUINTANILLA, B. P., AYANO, G., AYANORE, M. A., AZARI, S., AZARIAN, G., AZENE, Z. N., BADAWI, A., et al. 2020. Global burden of 87 risk factors in 204 countries and territories, 1990-2019: a systematic analysis for the Global Burden of Disease Study 2019. *The Lancet,* 396**,** 1223-1249.

NGUYEN, Q. C., KHANNA, S., DWIVEDI, P., HUANG, D., HUANG, Y., TASDIZEN, T., BRUNISHOLZ, K. D., LI, F., GORMAN, W., NGUYEN, T. T. & JIANG, C. 2019. Using Google Street View to examine

associations between built environment characteristics and U.S. health outcomes. *Preventive Medicine Reports,* 14**,** 100859.
OOSTENBACH, L. H., LAMB, K. E. & THORNTON, L. E. 2022. Is having a 20-minute neighbourhood associated with eating out behaviours and takeaway home delivery? A cross-sectional analysis of ProjectPLAN. *BMC Public Health,* 22**,** 191.
PEARCE, J., HISCOCK, R., BLAKELY, T. & WITTEN, K. 2008. The contextual effects of neighbourhood access to supermarkets and convenience stores on individual fruit and vegetable consumption. *Journal of Epidemiology and Community Health,* 62**,** 198-201.
PENG, K. & KAZA, N. 2020. Association between neighborhood food access, household income, and purchase of snacks and beverages in the United States. *International Journal of Environmental Research and Public Health,* 17**,** 7517.
PERCHOUX, C., KESTENS, Y., BRONDEEL, R. & CHAIX, B. 2015. Accounting for the daily locations visited in the study of the built environment correlates of recreational walking (the RECORD Cohort Study). *Preventive Medicine,* 81**,** 142-149.
PINEO, H., ZIMMERMANN, N., COSGRAVE, E., ALDRIDGE, R. W., ACUTO, M. & RUTTER, H. 2018. Promoting a healthy cities agenda through indicators: development of a global urban environment and health index. *Cities & Health,* 2**,** 27-45.
RAHMANIAN, E., GASEVIC, D., VUKMIROVICH, I. & LEAR, S. A. 2014. The association between the built environment and dietary intake - a systematic review. *Asia Pacific Journal of Clinical Nutrition,* 23**,** 183-96.
RUMMO, P. E., MEYER, K. A., BOONE-HEINONEN, J., JACOBSJR, D. R., KIEFE, C. I., LEWIS, C. E., STEFFEN, L. M. & GORDON-LARSEN, P. 2015. Neighborhood availability of convenience stores and diet quality: findings from 20 years of follow-up in the coronary artery risk development in young adults study. *American Journal of Public Health,* 105**,** e65-e73.
SALLIS, J. F., CERIN, E., CONWAY, T. L., ADAMS, M. A., FRANK, L. D., PRATT, M., SALVO, D., SCHIPPERIJN, J., SMITH, G., CAIN, K. L., DAVEY, R., KERR, J., LAI, P. C., MITÁŠ, J., REIS, R., SARMIENTO, O. L., SCHOFIELD, G., TROELSEN, J., VAN DYCK, D., DE BOURDEAUDHUIJ, I. & OWEN, N. 2016. Physical activity in relation to urban environments in 14 cities worldwide: a cross-sectional study. *The Lancet,* 387**,** 2207-17.
SAWYER, A. D. M., JONES, R., UCCI, M., SMITH, L., KEARNS, A. & FISHER, A. 2017. Cross-sectional interactions between quality of the physical and social environment and self-reported physical activity in adults living in income-deprived communities. *PLoS One,* 12**,** e0188962.
SCHÜLE, S. A. & BOLTE, G. 2015. Interactive and independent associations between the socioeconomic and objective built environment on the neighbourhood level and individual health: a systematic review of multilevel studies. *PLoS One,* 10**,** e0123456.
SCHULTZ, W. M., KELLI, H. M., LISKO, J. C., VARGHESE, T., SHEN, J., SANDESARA, P., QUYYUMI, A. A., TAYLOR, H. A., GULATI, M., HAROLD, J. G., MIERES, J. H., FERDINAND, K. C., MENSAH, G. A. & SPERLING, L. S. 2018. Socioeconomic status and cardiovascular outcomes: challenges and interventions. *Circulation,* 137**,** 2166-2178.
SMITH, M., HOSKING, J., WOODWARD, A., WITTEN, K., MACMILLAN, A., FIELD, A., BAAS, P. & MACKIE, H. 2017. Systematic literature review of built environment effects on physical activity and active transport – an update and new findings on health equity. *International Journal of Behavioral Nutrition and Physical Activity,* 14**,** 158.
SPRING, A. 2018. Short- and long-term impacts of neighborhood built environment on self-rated health of older adults. *The Gerontologist,* 58**,** 36-46.
STATE OF VICTORIA DEPARTMENT OF ENVIRONMENT, LAND, WATER AND PLANNING, 2017. Plan Melbourne 2017-2050. *In:* GOVERNMENT, V. S. (ed.).

STATE OF VICTORIA DEPARTMENT OF ENVIRONMENT, LAND, WATER AND PLANNING, 2019. 20-Minute Neighbourhoods: Creating a more liveable Melbourne.

STATE OF VICTORIA DEPARTMENT OF ENVIRONMENT, LAND, WATER, & PLANNING 2015. Plan Melbourne refresh - discussion paper.

STATE OF VICTORIA DEPARTMENT OF TRANSPORT, PLANNING, AND LOCAL INFRASTRUCTURE, 2014. Plan Melbourne: metropolitan planning strategy.

STEINMETZ-WOOD, M. & KESTENS, Y. 2015. Does the effect of walkable built environments vary by neighborhood socioeconomic status? *Preventive Medicine,* 81**,** 262-7.

THORNTON, L. E., DIETER-SCHROERS, R., LAMB, K. E., DANIEL, M., BALL, K., CHAIX, B., KESTENS, Y., BEST, K., OOSTENBACH, L. & COFFEE, N. 2022. Operationalising the 20-minute neighbourhood. *International Journal of Behavioral Nutrition and Physical Activity,* 19.

THORNTON, L. E. & KAVANAGH, A. M. 2012. Association between fast food purchasing and the local food environment. *Nutrition & Diabetes,* 2**,** e53.

THORNTON, L. E., LAMB, K. E., TSENG, M., CRAWFORD, D. A. & BALL, K. 2015. Does food store access modify associations between intrapersonal factors and fruit and vegetable consumption? *European Journal of Clinical Nutrition,* 69**,** 902-906.

THORPE, M. G., MILTE, C. M., CRAWFORD, D. & MCNAUGHTON, S. A. 2019. Education and lifestyle predict change in dietary patterns and diet quality of adults 55 years and over. *Nutrition Journal,* 18**,** 67.

TRAPP, G. S., HICKLING, S., CHRISTIAN, H. E., BULL, F., TIMPERIO, A. F., BORUFF, B., SHRESTHA, D. & GILES-CORTI, B. 2015. Individual, social, and environmental correlates of healthy and unhealthy eating. *Health Education & Behavior,* 42**,** 759-68.

TURRELL, G., HAYNES, M., WILSON, L. A. & GILES-CORTI, B. 2013. Can the built environment reduce health inequalities? A study of neighbourhood socioeconomic disadvantage and walking for transport. *Health & Place,* 19**,** 89-98.

VOGEL, C., LEWIS, D., NTANI, G., CUMMINS, S., COOPER, C., MOON, G. & BAIRD, J. 2017. The relationship between dietary quality and the local food environment differs according to level of educational attainment: A cross-sectional study. *PLoS One,* 12**,** e0183700.

YANG, G., THORNTON, L. E., DANIEL, M., CHAIX, B. & LAMB, K. E. 2022. Comparison of spatial approaches to assess the effect of residing in a 20-minute neighbourhood on body mass index. *Spatial and Spatio-temporal Epidemiology,* 43.

ZANG, P., XIAN, F., QIU, H., MA, S., GUO, H., WANG, M. & YANG, L. 2022. Differences in the correlation between the built environment and walking, moderate, and vigorous physical activity among the elderly in low- and high-income areas. *International Journal of Environmental Research and Public Health,* 19.

TABLES

Table 1. Descriptive characteristics of ProjectPLAN food and physical activity samples in Melbourne and Adelaide

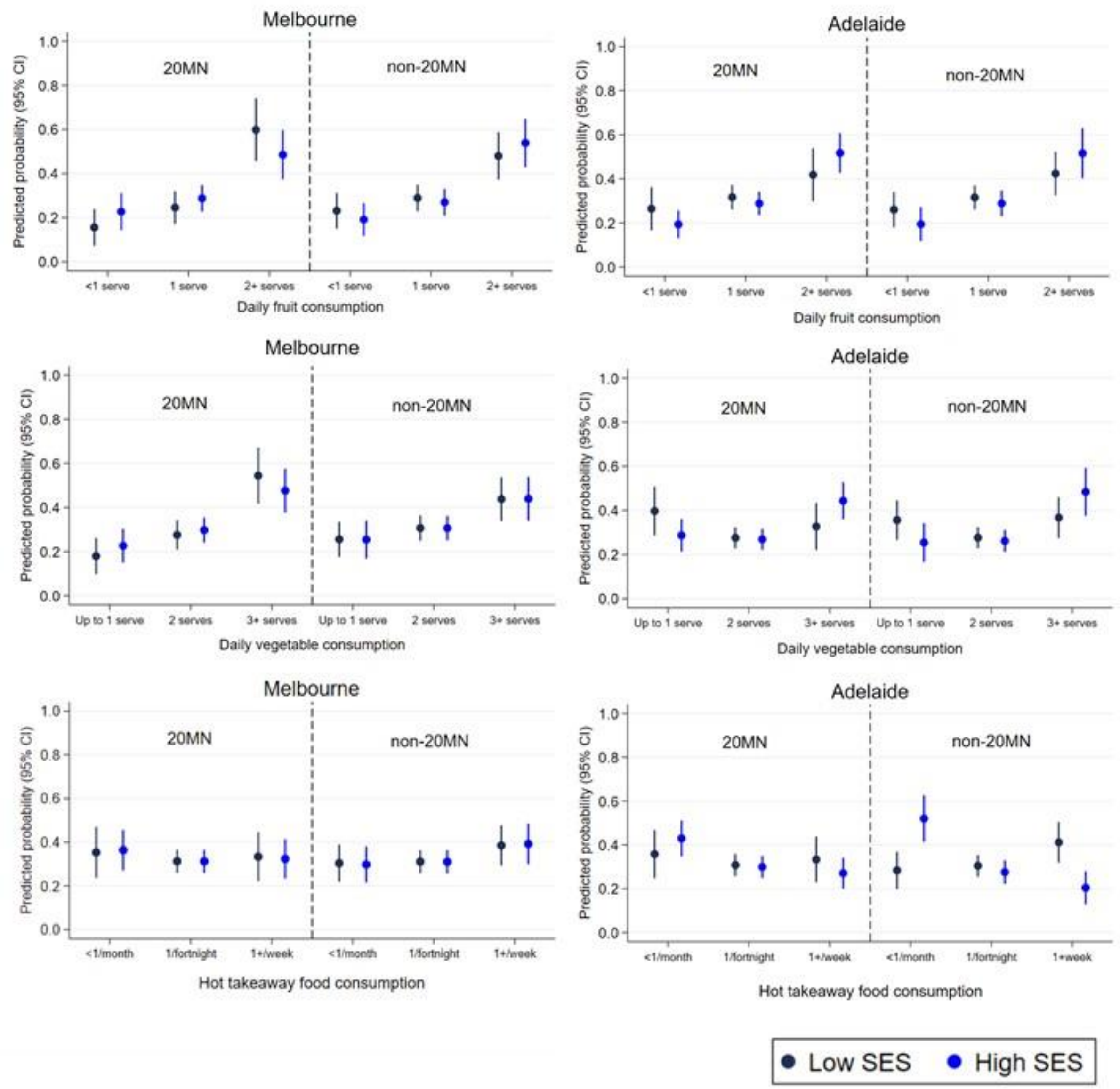
	Melbourne Food N = 289	Adelaide Food N = 353	Melbourne PA N = 337	Adelaide PA N = 335
Outcomes				
Serves of fruit per day				
<1 serve	60 (20.8%)	79 (22.4%)	n.c.	n.c.
1 serve	80 (27.7%)	105 (29.7%)	n.c.	n.c.
≥2 serves	149 (51.6%)	169 (47.9%)	n.c.	n.c.
Serves of vegetables per day				
<2 serves	68 (23.5%)	112 (31.7%)	n.c.	n.c.
2 serves	87 (30.1%)	94 (26.6%)	n.c.	n.c.
≥3 serves	134 (46.4%)	147 (41.6%)	n.c.	n.c.
Frequency of hot takeaway food consumption				
Never/less than once per month	94 (32.6%)	142 (40.2%)	n.c.	n.c.
Once every two weeks	90 (31.3%)	102 (28.9%)	n.c.	n.c.
At least once per week	104 (36.1%)	109 (30.9%)	n.c.	n.c.
Walking for transport (mins/week), median (IQR)	n.c.	n.c.	60 (0, 85)	0 (0, 80)
Walking for exercise/recreation (mins/week), median (Q1, Q3)	n.c.	n.c.	90 (60, 180)	120 (60, 200)
Number of exercise activities in past week, median (Q1, Q3)	n.c.	n.c.	3 (2, 4)	2 (1, 3)
Self-rated health				
Poor/Fair	56 (19.4%)	88 (24.9%)	65 (19.3%)	89 (26.6%)
Good	112 (38.8%)	133 (37.7%)	133 (39.5%)	123 (36.7%)
Very Good/Excellent	121 (41.9%)	132 (37.4%)	139 (41.2%)	123 (36.7%)
Exposure				
20-minute neighbourhood	127 (43.9%)	191 (54.1%)	123 (36.5%)	170 (50.7%)
Moderators				
Area-SES				
Low SES	127 (43.9%)	145 (41.1%)	142 (42.1%)	139 (41.5%)
High SES	162 (56.1%)	208 (58.9%)	195 (57.9%)	196 (58.5%)
Highest qualification				
Up to Year 12	45 (15.6%)	78 (22.1%)	64 (19.0%)	68 (20.3%)
Trade/Certificate	65 (22.5%)	113 (32.0%)	70 (20.8%)	106 (31.6%)
University	179 (61.9%)	162 (45.9%)	203 (60.2%)	161 (48.1%)
Other covariates				
Age (years), mean (SD)	51.7 (15.9)	56.4 (15.7)	48.8 (16.6)	57.4 (15.8)
Gender				
Male	116 (40.1%)	138 (39.1%)	146 (43.3%)	146 (43.6%)
Female	173 (59.9%)	215 (60.9%)	191 (56.7%)	189 (56.4%)
Children in household				
No children	194 (67.1%)	277 (78.5%)	226 (67.1%)	257 (76.7%)
Child(ren) under 4 yrs	52 (18.0%)	37 (10.5%)	58 (17.2%)	37 (11.0%)

Only child(ren) over 4 yrs	43 (14.9%)	39 (11.0%)	53 (15.7%)	41 (12.2%)
Relationship status				
Single/Not living with partner	99 (34.3%)	130 (36.8%)	126 (37.4%)	124 (37.0%)
Living with partner	190 (65.7%)	223 (63.2%)	211 (62.6%)	211 (63.0%)
Supermarket reason for moving/living here				
Not within 20min/not important	120 (41.5%)	149 (42.2%)		
Important	169 (58.5%)	204 (57.8%)	n.c.	n.c.
Everyday needs within 20 minutes reason for moving/living here				
Not within 20min/not important	130 (45.0%)	165 (46.7%)	182 (54.0%)	167 (49.9%)
Important	159 (55.0%)	188 (53.3%)	155 (46.0%)	168 (50.1%)
Park, open space or beach reason for moving/living here				
Not within 20min/not important			131 (38.9%)	124 (37.0%)
Important	n.c.	n.c.	206 (61.1%)	211 (63.0%)
Recreational facilities (e.g., gyms) reason for moving/living here				
Not within 20min/not important			220 (65.3%)	247 (73.7%)
Important	n.c.	n.c.	117 (34.7%)	88 (26.3%)
Body mass index (kg/m^2), mean (SD)	25.3 (4.3)	26.8 (5.0)	25.7 (4.5)	26.8 (5.0)

ProjectPLAN: Places and Locations for Activity and Nutrition study; PA: physical activity; SES: socioeconomic status; n.c. = not collected (indicates covariates that were not measured in the sample).

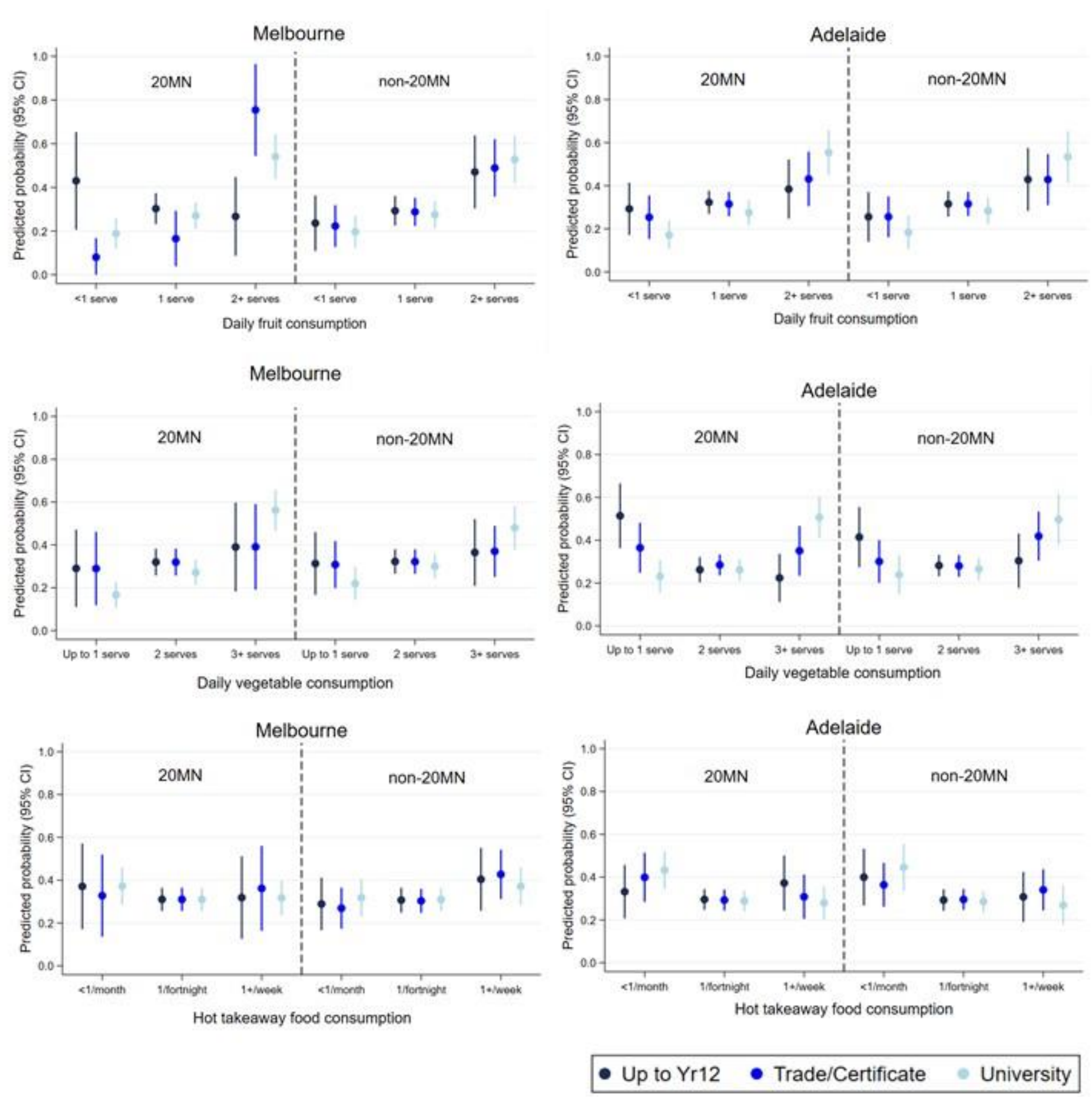
FIGURES

Figure 1. Predicted probability with 95% confidence intervals of each diet outcome by neighbourhood type and area-SES for each city from adjusted ordinal regression models.



*Hot takeaway food consumption: <1/month is Never or <1/month.

Figure 2. Predicted probability with 95% confidence intervals of each diet outcome by neighbourhood type and highest qualification for each city from adjusted ordinal regression models.



*Hot takeaway food consumption: <1/month is Never or <1/month.

Figure 3. Marginal mean with 95% confidence intervals of each physical activity outcome by neighbourhood type and area-SES for each city from adjusted two-part and Poisson regression models.

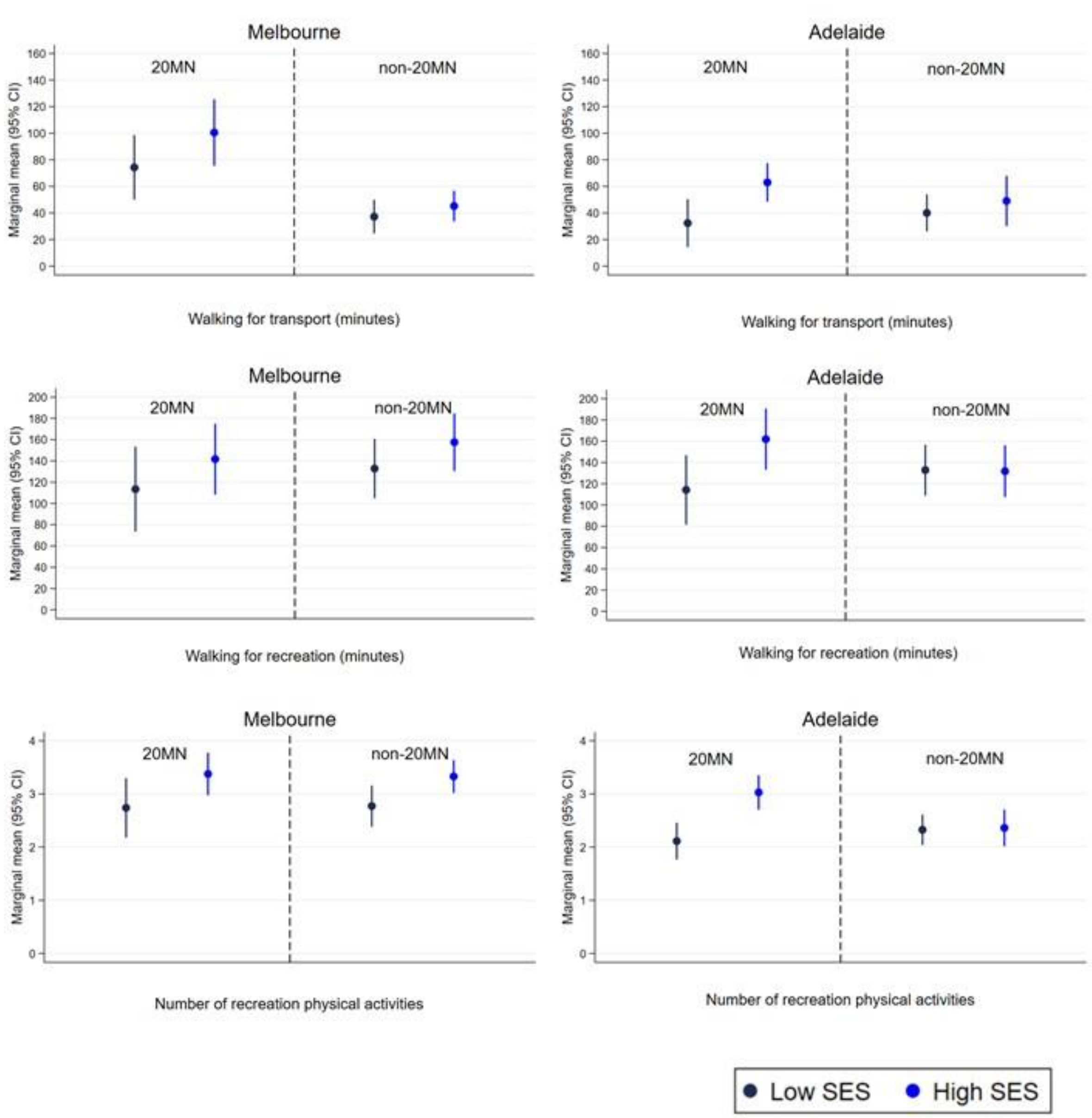


Figure 4. Marginal mean with 95% confidence intervals of each physical activity outcome by neighbourhood type and highest qualification for each city from adjusted two-part and Poisson regression models.

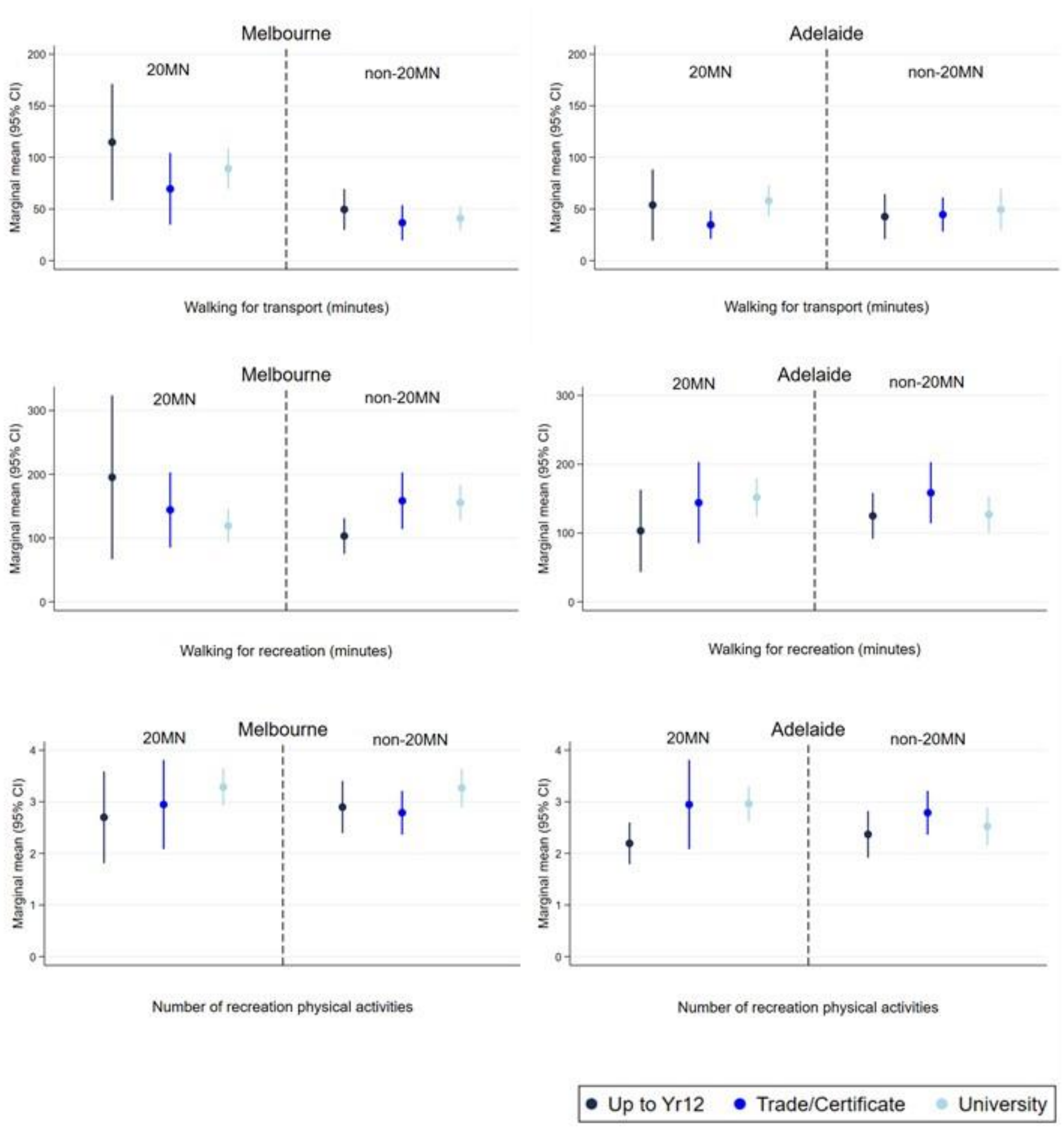


Figure 5. Predicted probability with 95% confidence intervals of self-rated health by neighbourhood type and area-SES for each city and sample from adjusted ordinal regression models.

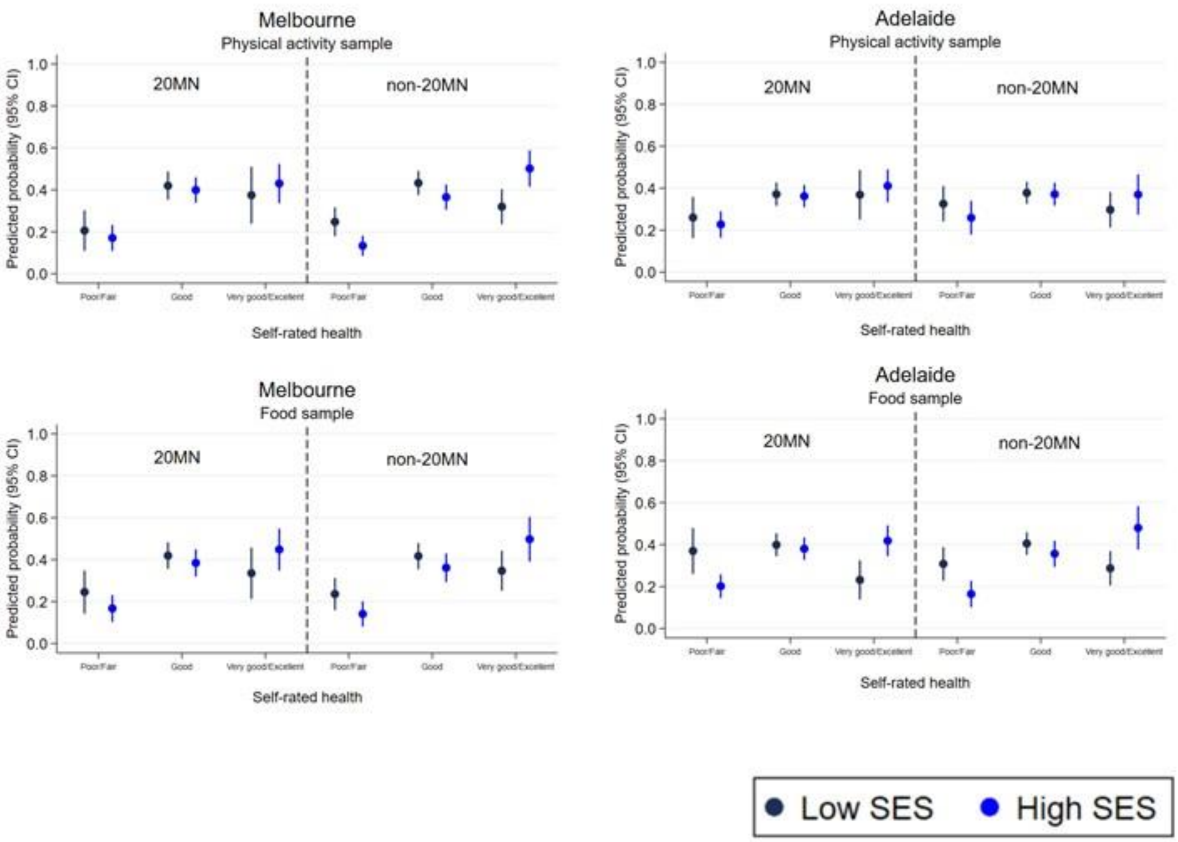


Figure 6. Predicted probability with 95% confidence intervals of self-rated health by neighbourhood type and highest qualification for each city and sample from adjusted ordinal regression models.