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## Q1 Safety in numbers: Does perceived safety mediate associations between 2 the neighborhood social environment and physical activity among 3 women living in disadvantaged neighborhoods?

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### 6 A R T I C L E I N F O

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10 Physical activity  
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16 Mediation  
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18 Neighborhood  
19 Disadvantage

### A B S T R A C T

*Objective.* The aim of this study is to examine associations between the neighborhood social environment and 20  
leisure-time physical activity (LTPA)<sup>1</sup> and walking among women, and whether these associations are mediated 21  
by perceived personal safety. 22

*Methods.* Women ( $n = 3784$ ) living in disadvantaged urban and rural neighborhoods within Victoria, 23  
Australia completed a self-administered survey on five social environment variables (neighborhood crime, 24  
neighborhood violence, seeing others walking and exercising in the neighborhood, social trust/cohesion), 25  
perceived personal safety, and their physical activity in 2007/8. Linear regression analyses examined associations 26  
between social environment variables and LTPA and walking. Potential mediating pathways were assessed using 27  
the product-of-coefficients test. Moderated mediation by urban/rural residence was examined. 28

*Results.* Each social environment variable was positively associated with engaging in at least 150 min/week of 29  
LTPA (OR = 1.16 to 1.56). Only two social environment variables, seeing others walking (OR = 1.45) and exercis- 30  
ing (OR = 1.31), were associated with  $\geq 150$  min/week of walking. Perceived personal safety mediated all asso- 31  
ciations. Stronger mediation was found in urban areas for crime, violence and social trust/cohesion. 32

*Conclusion.* The neighborhood social environment is an important influence on physical activity among 33  
women living in disadvantaged areas. Feelings of personal safety should not be included in composite or aggreg- 34  
ate scores relating to the social environment. 35

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### 40 Introduction

41 It is well-established that regular physical activity is associated with 42  
reduced mortality and morbidity (US Department of Health and Human 43  
Services, 1996). Globally, it is estimated that 42% of adults are insuffi- 44  
ciently active (World Health Organisation, 2002); in Australia, 57% of 45  
adults are insufficiently active (Australian Bureau of Statistics, 2013). 46  
Particular population groups are less likely to be physically active, 47  
with women consistently shown to be less active in their leisure-time 48  
than men (Trost et al., 2002) and those residing in socioeconomically 49  
disadvantaged areas engaging in less leisure-time physical activity 50  
(LTPA) (Ball et al., 2007; Cerin and Leslie, 2008; Kavanagh et al., 2005) 51  
and being at increased risk of becoming overweight or obese, compared 52  
with those in more advantaged areas (Ball and Crawford, 2005). 53  
54

Key theoretical models, such as social cognitive theory, postulate 55  
that environment may be an important determinant of behavior by pro- 56  
viding conditions that facilitate or constrain behavior (Baranowski et al., 57  
2002; Owen et al., 2004). The neighborhood may be a key setting 58  
for women's physical activity as it provides opportunities for both inex- 59  
pensive, unstructured forms of physical activity, such as walking and 60  
opportunities for organized activity. While the impact of the built envi- 61  
ronment on physical activity has received increasing attention (Humpel 62  
et al., 2002; McCormack and Shiell, 2011), the social environment with- 63  
in neighborhoods has not been widely studied and may also be impor- 64  
tant. Crime and lack of safety, for example, are cited as major barriers to 65  
physical activity in disadvantaged areas (Ball et al., 2006) and neighbor- 66  
hood safety has been shown to moderate associations between some 67  
cognitions and sports participation (Beenackers et al., 2013). A review 68  
by Foster and Giles-Corti suggested that crime-related safety specifically 69  
may constrain physical activity among women, although many of the 70  
studies included crime in a composite measure of safety (Foster and 71  
Giles-Corti, 2008). Further, the role of personal feelings of safety is not 72  
well understood. Studies examining safety tend to include social condi- 73  
tions as well as physical features (e.g. infrastructure such as lighting and 74  
footpaths) and either do not consider perceived personal safety or 75  
include it in a composite measure that lacks specificity (Foster and 76

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<sup>1</sup> LTPA: Leisure-time physical activity.

Giles-Corti, 2008; Kramer et al., 2013). Exploration of how perceived safety mediates associations between aspects of the social environmental and physical activity has been recommended (Foster and Giles-Corti, 2008).

Other elements of the neighborhood social environment that may impact feelings of safety include social norms (e.g. observation of people being physically active in the neighborhood) and levels of social trust or cohesion. Ball et al. (2010) recently showed that social norms were positively associated with tertiles of LTPA and walking among women living in disadvantaged areas. Similar findings were observed for social cohesion (Cleland et al., 2010), though the association was attenuated after adjustment for other social, individual and environmental correlates (Cleland et al., 2010). These elements of the neighborhood social environment may shape perceptions of personal safety, which may encourage or discourage physical activity. However, this has yet to be examined.

This study examined associations between the neighborhood social environment and physical activity among women living in disadvantaged areas, and whether these associations are mediated by perceived personal safety. A conceptual diagram is presented in Fig. 1.

## Methods

Participants were women aged 18–45 years who participated in the Resilience for Eating and Physical Activity Despite Inequality (READI) baseline study. This was a longitudinal cohort study examining health behaviors and obesity among women and children living in socioeconomically disadvantaged neighborhoods. Detailed methods and a cohort profile have been published previously (Ball et al., 2013). Briefly, using the Victorian electoral roll, 4934 women randomly selected from within disadvantaged suburbs in 40 urban and 40 rural areas of Victoria, Australia were recruited (45% response rate). Disadvantaged areas were defined as those suburbs in the bottom tertile of the Australian Bureau of Statistics (ABS) Victorian Socioeconomic Index for Areas (SEIFA) distribution (Australian Bureau of Statistics, 2003). Rural areas were defined as those falling outside metropolitan Melbourne, and outside a 25-km radius of six rural Victorian cities. The women were mailed a self-administered survey with their recruitment pack. Ethical approval was granted by the Deakin University Human Ethics Committee.

## Measures

### Socio-demographic variables

The survey assessed age, marital status (collapsed into: married/defacto relationship; separated/divorced/widowed; never married), and highest level of maternal education (collapsed into: low (did not complete high school); medium (high school, technical or trade certificate); and high (UNIVERSITY or tertiary qualification)). Women reported their employment status (full-time, part-time, or not currently employed), country of birth (Australia or outside Australia) and the number of children under 18 years living in the household. Body mass index (BMI, kg/m<sup>2</sup>) was calculated from self-reported their height and weight and collapsed into acceptable weight, overweight and obese (World Health Organisation, 1997). Urban/rural residence was based on suburb of recruitment.

### Physical activity

Physical activity was assessed using the long version of the self-administered International Physical Activity Questionnaire (IPAQ-L), which

has acceptable reliability and validity (Craig et al., 2003). The IPAQ-L measures total time (h/min) spent in household/yard, leisure time, transport and occupational activity over a usual week and is widely used in population-based research. Total minutes/week of leisure-time physical activity (LTPA) was computed by summing time spent walking and in moderate and vigorous physical activity for leisure, which was then dichotomized consistent with physical activity recommendations (Australian Bureau of Statistics, 2013): <150 min/week; ≥150 min/week. As walking is the most common physical activity undertaken by women (Australian Bureau of Statistics, 2011), leisure and transport walking were also summed and dichotomized using the same criteria (<150 min/week; ≥150 min/week).

### Neighborhood social environment

Women reported agreement with statements about crime ('My neighborhood is safe from crime'), violence ('Violence is not a problem in my neighborhood') and social norms ('I often see other people walking in my neighborhood', 'I often see other people exercising (e.g. jogging, bicycling, playing sports) in my neighborhood') (Mujahid et al., 2007). A five-point response scale was provided and dichotomized as: 0) strongly disagree/disagree/neither agree nor disagree; and 1) agree/strongly agree.

Women reported agreement with five statements related to community trust/cohesion (Sampson et al., 1997): 'People around my neighborhood are willing to help their neighbors'; 'This is a close-knit neighborhood'; 'People in this neighborhood can be trusted'; 'People in this neighborhood generally don't get along (reverse-scored)'; and 'People in this neighborhood do not share the same values (reverse-scored)'. The five-point response scale was scored from 1 to 5 (one representing 'strongly disagree' and five representing 'strongly agree'). The scores were summed and averaged to compute a 'social trust/cohesion' score, with one representing weaker and five representing stronger social trust/cohesion (Cronbach's alpha = 0.83).

### Perceived personal safety (mediator)

Women reported their agreement with one statement about perceived neighborhood safety 'I feel safe walking in my neighborhood, day or night'. The response scale was scored 1–5, with one representing strongly disagree and five representing strongly agree. This item was adapted from Mujahid et al. (2007).

## Data analyses

Analyses were conducted in Stata 12.0 (StataCorp, Texas, 2011) based on 3784 women with no missing data for any variable in the mediation models. Multi-level logistic (xtmelogit) and linear (xtmixed) regressions were used to test whether associations between the social environment and physical activity or walking were mediated by perceived personal safety using the product of coefficients method (MacKinnon et al., 2007), with individual and suburb entered as two levels. All models for LTPA controlled for age, marital status and country of birth, and models for walking controlled only for weight status, as these variables were significantly associated with each dependent variable, respectively.

For each social environment variable and each outcome (i.e. LTPA and walking), the following associations were computed: 1) associations between the neighborhood social environment variables and the outcome variable (*c*-coefficient/total effect); 2) associations between the neighborhood social environment variables and the potential mediator (*a*-coefficient); 3) association between the potential mediator and the outcome variable, adjusting for the social environment variables (*b*-coefficient); and 4) the direct effect of the neighborhood social environment variables on the outcome variable, adjusting for the potential mediator (*c'*-coefficient). The mediated effect is the product of the *a* and *b* coefficient ( $a \times b$ ), an estimate of the relative strength of the mediation effect. The proportion mediated was calculated ( $ab / (c' + ab)$ ) and expressed as a percentage. Coefficients resulting from logistic regression analyses were used to determine mediation; odds ratios are provided for descriptive purposes. Moderation of mediated effects by urban/rural residence was determined by adding interaction terms to each *a*- and *b*-path equation. Where significant interaction was found,

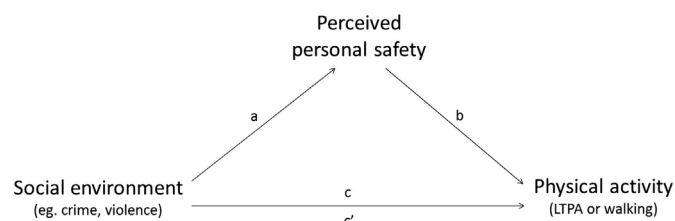


Fig. 1. Conceptual diagram of mediation pathway between the social environment, perceived personal safety and physical activity.

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