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Is the link between movement and mental health a two-way street? Prospective associations between physical activity, sedentary behaviour and depressive symptoms among women living in socioeconomically disadvantaged neighbourhoods

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ABSTRACT

This study aimed to investigate the bi-directional relationship between different domains of physical activity (PA), sedentary behaviour (SB) and depressive symptoms among women living in socioeconomically disadvantaged neighbourhoods in Victoria, Australia. Women (n = 1033), aged 18–46 years at Wave 1 (2007/08), completed self-report measures of PA (leisure-time, transport, occupational, domestic), SB (TV viewing, computer use, overall sitting time) and depressive symptoms (CES-D 10) at each study time-point (Wave 2: 2010/11, Wave 3: 2012/13). Separate linear mixed models were fitted to examine if change in depressive symptoms differed dependent on each of the baseline PA or SB measures. Similarly, baseline depressive symptoms were used as a predictor of change in PA and SB. In secondary analyses, associations between baseline PA or SB and odds of becoming 'at risk' of depression among those not 'at risk' at baseline were examined using logistic regression. There was no evidence that change in depressive symptoms differed depending on PA or SB at baseline. In general, there was also no evidence that change in PA or SB differed depending on baseline depressive symptoms. One exception was change in leisure-time PA, which declined more among those with heightened depressive symptoms at baseline (Interaction: $\beta = -0.003$, 95% CI = −0.007, −0.0003). Transport-related PA (adjusted OR = 1.06, 95% CI = 1.013, 1.101) and domestic PA (adjusted OR = 1.02, 95% CI = 1.003, 1.040) were associated with greater odds of becoming at risk of depression at wave 3. There was limited evidence of a bi-directional relationship between PA, SB and depressive symptoms in women living in socioeconomically disadvantaged neighbourhoods.

1. Introduction

By 2020, depression is predicted to be the second leading cause of disease burden worldwide (Lopez and Murray, 1998). Current estimates suggest that globally 298 million people (4.4% of the population worldwide) experience major depressive disorder, with almost two thirds of those being women (Ferrari et al., 2013). Considering the physical, social, emotional and financial impact depression has on individuals, families, and the wider community, depressive disorders have become a global health priority (Ferrari et al., 2013). Subsyndromal depressive conditions (i.e. experiencing high levels of depressive symptoms but not clinically meeting the criteria for diagnosis of major depressive disorder) (Ayuso-Mateos et al., 2010) are also common. Approximately 20% of adults in the general population report experiencing depressive symptoms at a given point in time (Judd et al., 1994), which, like clinical depression, are linked to poor health outcomes (Ayuso-Mateos et al., 2010). This has led to a call for more attention to be placed on targeting depressive symptomology in primary and secondary prevention efforts (Ayuso-Mateos et al., 2010).

Intervention studies have shown that physical activity is moderately effective as a treatment for depression (Cooney et al., 2013; Schuch et al., 2016). In addition, observational studies provide evidence that leisure-time physical activity is inversely associated with depressive symptoms (Teychenne et al., 2008a; White et al., 2017). Recently, a review of prospective studies which investigated the link between physical activity and depression concluded that baseline physical activity predicted lower incidence of depression at follow-up (Mammen and Faulkner, 2013), suggesting that physical activity may prevent onset of

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depression. However, several research gaps remain. Firstly, the role of each domain of physical activity (e.g. leisure-time, transport, domestic, occupational) in the prevention of depressive symptoms is unknown. Although leisure-time physical activity has been consistently linked with lower levels of depressive symptoms, findings regarding transport, domestic and work-related physical activity and their relationship with depression risk have been conflicting in the few, predominately cross-sectional studies, that have compared domains (McKercher et al., 2009; Teychenne et al., 2008b; Teychenne et al., 2010; Mutrie and Hannah, 2007). Secondly, most existing prospective studies have examined how physical activity at baseline predicts depressive symptoms at follow-up, and have neglected to examine the potential contribution of reverse causality, that being whether depressive symptoms at baseline predict subsequent physical activity at follow-up. Of the small existing body of evidence, some studies suggest a bi-directional relationship (Gudmundsson et al., 2015; Pinto Pereira et al., 2014; Hiles et al., 2017), while another suggests the relationship is uni-directional (i.e. physical activity was linked to lower subsequent depression, but depression was not linked to subsequent physical activity) (Ku et al., 2012). These are important research gaps to fill as they have significant implications for the direction of mental health and physical activity promotion efforts.

A smaller but growing body of literature has linked sedentary behaviour (i.e. sitting or reclining behaviours requiring minimal energy expenditure) to increased risk of depression (Zhai et al., 2015). It is, however, still unclear as to which types of sedentary behaviour (e.g. computer use, TV viewing, or overall sitting) may be more strongly linked to depressive symptoms. As with the physical activity literature, most prospective studies have only investigated whether sedentary behaviour at baseline predicts subsequent depressive symptoms, and not the reverse relationships. Of the very limited research investigating the bi-directional associations between sedentary behaviour and depressive symptoms (Hiles et al., 2017; Teychenne et al., 2014; van Uffelen et al., 2013), findings have been mixed, with two studies demonstrating a lack of evidence of a relationship in either direction (Hiles et al., 2017; van Uffelen et al., 2013), while another study showed depressive symptoms predicted subsequent sedentary behaviour (i.e. TV viewing) but that sedentary behaviour did not predict subsequent depressive symptoms (Teychenne et al., 2014).

Since women and socioeconomically disadvantaged populations are at high-risk of physical inactivity (Gidlow et al., 2006; Sisson and Katzmarzyk, 2008) and of experiencing depression (Lorant et al., 2003; Wilhelm et al., 2003), with socioeconomically disadvantaged groups also more likely to spend more time engaged in sedentary behaviours such as TV viewing (Stamatakis et al., 2009), it is important to focus research on these vulnerable groups. Therefore, the aim of this study is to investigate the prospective associations between different domains of physical activity (leisure-time, transport, occupational, domestic), sedentary behaviours (TV viewing, computer use, overall sitting time) and depressive symptoms in both directions among women living in socioeconomically disadvantaged neighbourhoods. We also examined whether baseline levels of physical activity or sedentary behaviour were associated with becoming 'at risk' of experiencing depression at waves 2 and 3 among those who were not 'at risk' at baseline.

2. Methods

Prospective data was collected in 2007/2008 (Wave 1), 2010/2011 (Wave 2) and 2012/2013 (Wave 3) as a part of the Resilience for Eating and Activity Despite Inequality (READI) study. The study was approved by the Deakin University Human Research Ethics Committee (HEAG-H 91_2006). Methods have been described previously (Ball et al., 2013).

2.1. Participants and procedures

Participants were randomly recruited from 80 Victorian neighbourhoods (40 urban and 40 rural), randomly selected from all of those neighbourhoods characterised as socioeconomically disadvantaged (being scored in the lowest tertile on the Australian Bureau of Statistics Socioeconomic Index for Areas Index of Relative Socio-Economic Disadvantage (Australian Bureau of Statistics, 2006)). Up to 150 women (aged 18–45 years) from each of the 80 neighbourhoods were randomly selected (based on electoral roll data; voting is compulsory for adults in Australia) and invited to participate. At wave 1, 11,940 women were mailed surveys, and a total of 4934 women completed these (response rate = 45% excluding surveys returned as undeliverable). Of those that responded, 571 women were excluded due to not currently residing in one of the selected study neighbourhoods, nine were excluded since they were outside the valid age range (or had data missing on the variable), and three were excluded since the survey was not completed by the woman it was addressed to. Two women withdrew from the study. This left 4349 women included at wave 1. At wave 2, 1913 women returned a completed survey. Of those, 1560 women completed surveys at wave 3 (36% of the original sample). Only those who completed all three waves were included in the present study. In addition, those who stated that they had a disability which prevented them from conducting physical activity were excluded (n = 383), as were those reporting being pregnant at any wave (n = 179). This left a total of 1033 women included in analyses.

3. Measures

3.1. Physical activity

Physical activity was self-reported at each wave using the long form of the International Physical Activity Questionnaire (IPAQ – L), a reliable and valid 7-day recall of physical activity undertaken across the four domains (leisure-time, transport, occupational and domestic) (Craig et al., 2003). The questionnaire assesses the frequency and duration of time spent being active at various intensities (e.g. walking, moderate and vigorous), in each of the domains, by requiring participants to estimate the days, hours and minutes spent in each of these activities over the past 7 days. Total weekly duration of physical activity in each domain was then calculated by multiplying the frequency (days) by duration (hours and minutes) for each intensity, then summing these across intensities. For leisure and occupational physical activity domains this included walking, moderate and vigorous-intensity. For domestic physical activity this included vigorous and moderate-intensity. For transport-related physical activity, total duration was calculated by summing the duration of weekly walking and cycling for transport.

3.2. Sedentary behaviour

Sedentary behaviour was assessed at each wave using three measures: TV viewing, computer use, and overall sitting time. Time spent sitting watching TV and sitting at the computer were assessed separately using reliable and valid self-report measures (Salmon et al., 2003). The number of hours and minutes spent undertaking those activities on a usual weekday, and weekend day were estimated by participants, and weekly totals were calculated by multiplying the duration of each sitting behaviour on a weekday by five and adding this to the total duration on a weekend day multiplied by two. Overall sitting time in the past week was assessed using the IPAQ-L. Participants estimated the number of hours and minutes spent sitting on a usual weekday, as well as a usual weekend day, and weekly totals were calculated as per above.