



Changes in the mode of travel to work and the severity of depressive symptoms: a longitudinal analysis of UK Biobank

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ABSTRACT

Although commuting provides an opportunity for incorporating physical activity into daily routines, little is known about the effect of active commuting upon depressive symptoms. This study aimed to determine whether changes in commute mode are associated with differences in the severity of depressive symptoms in working adults.

Commuters were selected from the UK Biobank cohort if they completed ≥ 2 assessment centre visits between 2006 and 2016.

Modes of travel to work were self-reported at each visit. Participants were categorised as ‘inactive’ (car only) or ‘active’ commuters (any other mode(s), including walking, cycling and public transport). Transitions between categories were defined between pairs of visits.

The severity of depressive symptoms was defined using the two-item Patient Health Questionnaire (PHQ-2). Scores were derived between zero and six. Higher values indicate more severe symptoms. Separate analyses were conducted in commuters who were asymptomatic (zero score) and symptomatic (non-zero score) at baseline.

The analytical sample comprised 5474 participants aged 40–75 at baseline with a mean follow-up of 4.65 years. Asymptomatic commuters who transitioned from inactive to active commuting reported less severe symptoms at follow-up than those who remained inactive ($\beta -0.10$, 95% CI $[-0.20, 0.00]$; $N = 3145$). A similar but non-significant relationship is evident among commuters with pre-existing symptoms ($\beta -0.60$, 95% CI $[-1.27, 0.08]$; $N = 1078$). After adjusting for transition category, longer commutes at baseline were associated with worse depressive symptoms at follow-up among symptomatic participants.

Shifting from exclusive car use towards more active commuting may help prevent and attenuate depressive symptoms in working adults.

1. Introduction

With an estimated 298 million cases in 2010 (Ferrari et al., 2013a), depression represents the second leading global cause of years lived with disability (YLD) – a burden that is greatest among those of working age (Ferrari et al., 2013b). Alongside pharmacotherapy and psychotherapy (Karyotaki et al., 2016; Khan et al., 2012), exercise is now recommended as an adjunctive therapy for mild-to-moderate depression (Cleare et al., 2015), with the latest Cochrane review of exercise and depression reporting a moderate effect in favour of exercise (Cooney et al., 2013). Subsequent meta-analyses report larger favourable effects (Honey, 2015; Schuch et al., 2016), while evidence from prospective observational studies suggest that physical activity may also help prevent the development of depressive symptoms (Mammen and Faulkner, 2013).

Efforts to promote physical activity have tended to focus upon active leisure pursuits (Dora and Phillips, 2000), but access, cost and time constraints serve as barriers to uptake (Anokye et al., 2014; Brown and Roberts, 2011). As physical activity is more likely to be sustained when incorporated into everyday routines (Hillsdon and Thorogood, 1996), active commuting has attracted attention in public health strategies (Global Advocacy Council for Physical Activity International Society for Physical Activity and Health, 2010; Public Health England, 2014). Though intuitive, a protective relationship between active commuting and the severity of depressive symptoms should not be assumed given the myriad stressors that may be experienced while walking, cycling and using public transport, including crowding, pollution and poor weather (Evans et al., 2002; Gatersleben and Uzzell, 2007; Koslowski et al., 1995; Lyons and Chatterjee, 2008; Wener et al., 2003; Rieger et al., 2017).

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Existing studies have focussed upon the relationship between commuting and various measures of psychological wellbeing and quality-of-life, capturing domains including life satisfaction, anxiety and social dysfunction. Where reported cross-sectionally, these relationships are inconsistent (Gómez et al., 2013; Humphreys et al., 2013; Office for National Statistics, 2014), while prospective studies show positive associations for cycling versus not cycling (Mytton et al., 2016) and walking or public transport use versus car use (Martin et al., 2014), especially over longer distances (Mytton et al., 2016; Martin et al., 2014). Importantly, only one prospective study has examined changes in commute mode (Martin et al., 2014). Here, commuters who switched from car use to walking reported higher subjective wellbeing than those who maintained their car use. These observational results are supported by a randomized controlled trial of a walking intervention for commuters based on a self-help brochure (Mutrie et al., 2002). Elsewhere, several analyses indicate that both physical activity and metabolic energy expenditure are greater when using alternatives to the car, such as public transport, rather than taking car-only trips to work (Rissel et al., 2012; Langlois et al., 2016; Costa et al., 2015).

However, research that pertains specifically to the severity of depressive symptoms is lacking. We therefore build upon studies of more general measures of psychological wellbeing (Mytton et al., 2016; Martin et al., 2014) by reporting differences in the severity of depressive symptoms between groups of commuters who changed or did not change their mode of travel over time. Analyses are reported separately for commuters who were asymptomatic and symptomatic at baseline, allowing a comparison of the contribution of shifts to more active commutes upon both the development and progression of depressive symptoms. Moderating influences of commute distance and frequency are also reported. Based upon the existing literature for physical activity and commuting, it was hypothesised that the severity of depressive symptoms would be lower at follow-up among participants who transitioned from exclusive car use to a more active mode of travel, particularly among those with longer commutes.

2. Methods

2.1. Study population

UK Biobank is a population-based prospective cohort of adults aged 37–73 years at recruitment. Participants were invited if they were registered with the National Health Service and lived ≤ 35 km from one of 22 assessment centres. Of those invited, 502,633 (5.5%) attended an assessment centre between March 2006 and October 2010 to complete a questionnaire concerning their demographic and lifestyle characteristics, medical history and self-rated health. Study design and sampling are detailed elsewhere (Allen et al., 2012; Biobank, 2007).

Participants living ≤ 35 km from the Stockport assessment centre in the north of England were invited to two repeat assessments, one between December 2009 and June 2013 ($n = 20,346$) and the other between April 2014 and November 2016 ($n = 11,923$) (Biobank, 2013).

2.2. Exposure

Participants who reported being self-employed or in paid employment were asked at each assessment about the frequency of trips from home to work (trips/week), the distance travelled (miles), and the mode(s) of transport used ('car or motor vehicle' (hereafter 'car', for simplicity), 'public transport', 'walk' and/or 'cycle').

Modes of travel were first dichotomised as 'inactive' (car only) or 'active' (any other mode or combination of modes), with each pair of consecutive observations then assigned to one of four groups: (i) consistent travel by car only (hereafter 'stable inactive', for simplicity); (ii) consistent use of any other mode or combination of modes ('stable active'); (iii) switch from exclusive use of a car to any other pattern ('inactive to active'); or (iv) switch to the exclusive use of a car ('active

to inactive').

Commuters who participated at all three time points thus provide information for two periods during which a transition could occur (hereafter referred to as 'transition periods'). For any given transition period, the term 'baseline' hereafter refers to the first phase of observation and 'follow-up' to second phase of observation. Adults who commuted less than once a week or 'zero' miles were excluded as home workers.

2.3. Outcome

The severity of depressive symptoms was operationalised using the two-item Patient Health Questionnaire (PHQ-2), which has been validated for the assessment of depressive symptom severity and change in symptom severity (Kroenke et al., 2003; Kroenke et al., 2010; Mitchell et al., 2016; Löwe et al., 2005). The instrument asks participants how often they 'felt down, depressed or hopeless' or 'had little interest or pleasure in doing things' during the preceding two weeks. Response options are: 0 'not at all', 1 'several days', 2 'more than half the days', and 3 'nearly every day'. Scores are summed to derive a value between zero and six, with a higher number indicating more severe symptoms (Kroenke et al., 2003). Symptomatic participants were defined as those who reported any symptoms at baseline (i.e. a score > 0).

2.4. Covariates

Three groups of variables were included: (i) socio-demographic and occupational characteristics (age-squared, education, ethnicity, household income, marital status, occupational grade, sex and working hours); (ii) lifestyle factors (alcohol consumption, body mass index, non-commuting mode(s) of transport, smoking status, vigorous physical activity, walking for pleasure and workplace physical activity); and (iii) health conditions (bone fracture and ever having been diagnosed with (a) a vascular or (b) a non-vascular health complaint). Age-squared was selected owing to the inverse U-shaped relationship between age and major depressive disorder (Ferrari et al., 2013b). Consistent with diagnostic criteria for depression (American Psychiatric Association, 2013), adjustment was also made for: 'serious illness, injury or assault' to the self or a close relative; a death of a close relative, spouse or partner; or financial difficulty in the preceding two years. A continuous variable was also included that accounts for differences in the time elapsed between pairs of observations, denoted by the period of time between two consecutive phases of observation and defined according to the dates of assessment. All other covariates were defined using values reported at the baseline of each pair of observations (Appendix 1).

2.5. Statistical analysis

To determine associations between changes in travel mode and the development or progression of depressive symptoms, models were estimated separately for asymptomatic and symptomatic participants. The `-xtset-` command was used in Stata 14 to declare that the data were longitudinal with repeated observations clustered within individuals (StataCorp, 2015). The within-person relationship between changes in mode of travel and differences in depressive symptomatology were then estimated using a series of linear fixed effects models via the `-xtreg-` package (StataCorp, 2015). Though similar to linear regression, the fixed effects approach has the added benefit of overcoming the potential issue of differences in depression severity being attributable to unobserved time-invariant differences present between individuals.

Relative differences in depressive symptoms at follow-up were estimated by comparing: (i) participants reporting a transition from 'inactive to active' with those in the 'stable inactive' group; (ii) those reporting an 'active to inactive' transition with those in the 'stable active' group; and (iii) those in the 'stable active' group with those in the

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