Preventive Medicine 76 (2015) 92–102

Contents lists available at ScienceDirect

Preventive Medicine

journal homepage: www.elsevier.com/locate/ypmed

Review

Accelerometer-measured sedentary time and cardiometabolic biomarkers: A systematic review

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ARTICLE INFO

Available online 23 April 2015

Keywords:
Systematic review
Accelerometer
Sedentary time
Breaks in sedentary time
Cardiometabolic risk factors

ABSTRACT

Objective. We conducted a systematic review to investigate the cross-sectional and prospective associations of accelerometer-measured total sedentary time and breaks in sedentary time with individual cardiometabolic biomarkers in adults ≥18 years of age.

Methods. Ovid Medline, Embase, Web of Science and the Cochrane Library were searched for studies meeting the inclusion criteria. Due to inconsistencies in the measurement and analysis of sedentary time, data was synthesised and presented narratively rather than as a meta-analysis.

Results. Twenty-nine studies were included in the review; twenty-eight reported on total sedentary time and six on breaks in sedentary time. There was consistent evidence from cross-sectional data of an unfavourable association between total sedentary time and insulin sensitivity. There was also some evidence that total sedentary time was unfavourably associated with fasting insulin, insulin resistance and triglycerides. Furthermore, there was some evidence from cross-sectional data of a favourable association between breaks in sedentary time and triglycerides.

Conclusion. Total sedentary time was consistently shown to be associated with poorer insulin sensitivity, even after adjusting for time spent in physical activity. This finding supports the proposed association between sedentary time and the development of Type 2 diabetes and reinforces the need to identify interventions to reduce time spent sedentary.

Contents

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http://dx.doi.org/10.1016/j.ypmed.2015.04.013

Introduction

Physical activity is considered to be central to the prevention and management of Type 2 diabetes because of its potential to improve glycaemic control, lipid profiles and blood pressure, and in combination with dietary intervention, to aid weight loss and maintenance (Colberg et al., 2010). However, fewer people with Type 2 diabetes meet physical activity recommendations (at least 150 min of moderate-to-vigorous-intensity physical activity [MVPA] per week) than in the general population (Morrato et al., 2007) and people with Type 2 diabetes often find it difficult to increase their physical activity levels by a sufficient amount to improve cardiometabolic health outcomes (Andrews et al., 2011). Therefore, alternative interventions for improving cardiometabolic health may be required.

Recent interest has focussed on the potential role of sedentary behaviour in the development of chronic diseases. Sedentary behaviour is defined as any waking behaviour characterised by an energy expenditure ≤1.5 metabolic equivalents (METs) whilst in a sitting or reclining posture. Sedentary behaviour is distinct from physical inactivity, which is defined as failure to meet the current physical activity recommendations (Sedentary Behaviour Research, 2012).

In previous systematic reviews, more time spent in sedentary behaviours has been shown to be adversely associated with both risk of chronic diseases and with poorer cardiometabolic health (de Rezende et al., 2014; Edwardson et al., 2012; Wilmot et al., 2012). However, the majority of the studies included in these reviews measured sedentary time with self-report questionnaires, which are susceptible to recall and social desirability bias (Clark et al., 2009; Corder et al., 2007). Therefore, the aim of the current systematic review is to investigate the cross-sectional and prospective associations of accelerometer-measured total sedentary time and breaks in sedentary time with individual cardiometabolic biomarkers in adults ≥18 years of age.

Methods

Search strategy and inclusion criteria

Ovid Medline, Embase, Web of Science and the Cochrane Library were searched for relevant publications (24 June 2014). The search strategy used in Ovid Medline is shown in Supplementary Methods and the same search terms were used in the other databases.

To be included in the systematic review, studies had to meet the following inclusion criteria: (1) written in English; (2) cross-sectional or prospective study design; (3) report data on adults ≥18 years of age; (4) use an accelerometer to measure total sedentary time and/or breaks in sedentary time; (5) measure at least one cardiometabolic biomarker of interest (fasting plasma glucose, fasting insulin, 2-hour plasma glucose, insulin sensitivity, homeostasis model assessment of insulin resistance [HOMA-IR], total cholesterol, high-density lipoprotein cholesterol [HDL-cholesterol], low-density lipoprotein cholesterol [LDL-cholesterol] and triglycerides); and (6) report cross-sectional and/or prospective associations of total sedentary time and/or breaks in sedentary time with at least one cardiometabolic biomarker of interest. Studies were excluded if they defined sedentary behaviour as failure to meet the current physical activity recommendations.

Titles and abstracts were independently reviewed by LB and CF for retrieval of full-text articles meeting the inclusion criteria. If any uncertainty or disagreement existed, the full-text was obtained for discussion with AC. Studies that did not meet the inclusion criteria were disregarded at this stage.

Quality assessment

LB and CF developed a quality assessment tool with reference to the Newcastle-Ottawa Scale (Wells et al., 2014) and the STROBE (Strengthening the Reporting of Observational studies in Epidemiology) Statement (von Elm et al., 2008). The total score available was 7 points: 1 point for reporting a prospective association(s), 1 if analysis adjusted for MVPA (studies reporting on total sedentary time) or MVPA and total sedentary time (studies reporting on breaks in sedentary time), 1 if analysis adjusted for body mass index (BMI) and/or waist circumference (WC), 1 if analysis adjusted for sex (if males and females combined), age and ethnicity, 1 for an objective measure of the health outcome(s), 1 for at least 7 valid days (≥10 h) of accelerometer wear time (Matthews et al., 2002) and 1 for an adequate description of the population, including sex, age, BMI and metabolic health. Two authors (LB and AC) independently assessed all studies for quality and any discrepancies were discussed with CF. A score of 5 to 7 was considered high quality, 3 or 4 moderate quality and 0 to 2 poor quality.

Data extraction and synthesis

Two authors (LB and AC) independently extracted data using a data extraction form developed for this review. The primary outcomes were the cross-sectional and prospective associations of total sedentary time and breaks in sedentary time with individual cardiometabolic biomarkers (Pearson correlation coefficients, regression coefficients and P for trend). Due to inconsistencies in the way in which sedentary time was measured, defined and analysed, data was synthesised and presented narratively rather than as a meta-analysis.

The findings for each cardiometabolic biomarker were interpreted on the following basis: there was no evidence of an association if more than 50% of the cross-sectional and prospective studies reported no association; the evidence for an association was inconclusive if 50% of the studies reported no association and 50% reported a positive or negative association; there was some evidence of an association if more than 50% of the studies reported a positive or negative association; and there was consistent evidence of an association if all of the studies reported a positive or negative association.

Results

The initial search identified 4858 studies (Fig. 1). Twenty-nine studies were included in the systematic review; twenty-eight reported on total