



Validity of self-reported sedentary time differs between Australian rural men engaged in office and farming occupations

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Abstract

Rural Australians have a higher likelihood of chronic disease than urban Australians, particularly male farmers. Chronic disease has been associated with occupational sedentary time. The aim was to validate the self-report of sedentary time in men in contrasting rural occupations. Farmers (n=29) and office workers (n=28), age 30-65y, were recruited from the Riverland region of South Australia. Daily sedentary time and number of breaks in sedentary time were self-reported and measured objectively using body-worn inclinometers. Correlational analyses were conducted between self-reported and objectively measured variables, separately by occupation. There was a significant correlation between self-reported and objectively measured sedentary time in the whole sample ($r=0.44$, $p=0.001$). The correlation among office workers was significant ($r=0.57$, $p=0.003$) but not among farmers ($r=0.08$, $p=0.68$). There were no significant correlations between self-reported and measured number of breaks in sedentary time, for the whole sample ($\rho = -0.03$, $p=0.83$), office workers ($\rho = 0.17$, $p=0.39$) and farmers ($\rho = -0.22$, $p = 0.25$). In conclusion, the validity of self-report of sedentary behaviours by farmers was poor. Further research is needed to develop better performing self-report instruments or more accessible objective measures of sedentary behaviour in this population.

Introduction

There is accumulating evidence for the detrimental health effects of prolonged and uninterrupted sitting, including type 2 diabetes and biomarkers of cardio-metabolic diseases (Healy et al., 2008). Research attention has focused on the workplace as a setting within which daily sitting behaviours are largely determined (Carnethon et al., 2009), motivated by prospective evidence of associations between occupational sitting and type 2 diabetes (van Uffelen et al., 2010).

State and national surveys in Australia consistently report poorer overall health among rural compared with urban adults (Australian Institute of Health and Welfare, 2010). To help narrow this health disparity, patterns of occupational sitting among rural adults warrant attention as a basis for designing and evaluating practices and initiatives that are tailored to different workplace settings. The measurement of sitting is in its infancy, with self-report and objective measures becoming increasingly available. Self-reported sitting is usually assessed with simple questionnaires, either self- or interviewer-administered, while objective measurement is achieved using inclinometers or inferred from established thresholds in accelerometry data.

Self-report of health-related behaviours offers the advantages of low cost and convenience of administration over more expensive and sometimes burdensome objective methods (Dollman et al., 2009). Notably, the validity of self-reported sitting has been reported to vary according to the relative proportions of sitting and standing undertaken in the workplace, with higher validity coefficients observed among desk-based compared with more active occupations (Clark et al., 2011). The aim of this study was to validate questions on sitting behaviours from the South Australian Physical Activity Survey (SAPAC; Gill, Fullerton & Taylor, 2008), an on-going physical activity monitoring survey of adult South Australians, using inclinometer-derived postural information (sitting/lying and standing) as the criterion,

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3 among rural male office workers and male farmers who would be expected to differ
4 markedly in terms of occupational sitting, standing and ambulation. The study was
5 conducted in the Riverland region of South Australia where approximately 57% of
6 the population aged 16 years and over do not meet physical activity guidelines of
7 150 minutes of moderate to vigorous physical activity per week, the highest level of
8 inactivity among all South Australian regions (Population Research and Outcome
9 Studies, 2010). The analysis included total sedentary time (sitting/lying) as well as
10 the number of breaks in sitting time throughout the day.
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22 Methods

23 *The sample*

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26 An Accessibility/Remoteness Index of Australia (ARIA) classifies rural
27 regions as inner regional, outer regional, remote and very remote, using an index
28 derived from quantified access to goods, services and opportunities for social
29 interaction; The Riverland is classified as 'outer regional' or 'moderately accessible'
30 (Australian Bureau of Statistics, 2006b). Participants were recruited via personal
31 contacts, local email lists, print and electronic media. Men were included if they
32 were 30-65 years of age and employed full time as an office worker or farmer. The
33 study excluded women as few women work as full time farmers and those who do
34 undertake active farming tasks often combine these with domestic roles. The
35 analyses reported here are secondary to a study that compared sitting behaviours
36 between farmers and office workers (Pontt, Rowlands & Dollman, 2014). The
37 sample size of 30 farmers and 30 office workers was determined on the basis of this
38 comparison.
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54 Office-based occupations were defined as employment in clerical,
55 administrative or management sectors that are predominantly based in an office.
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3 Farming occupations included farming sectors typical of dominant primary industries
4 in the region i.e. grain and livestock, grape growing and citrus production (Australian
5 Bureau of Statistics, 2006a). Ethics approval was obtained from the Human
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7 Research Ethics Committee of the University of South Australia.
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10 11 12 13 14 *Procedure*

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16 Data were collected over six weeks from mid-August 2012 to mid-September
17 2012, the maintenance phase of the farming calendar between sowing and
18 harvesting. Each participant wore an activPAL[®] monitor (PAL technologies Ltd,
19 Glasgow, UK) for three consecutive full working days, previously reported as
20 sufficient to account for day-to-day variability and thereby characterise habitual
21 physical activity among adults (Tudor-Locke et al., 2005). At an introductory meeting
22 in a convenient community location, occupation was confirmed, demographic data
23 were collected, height and weight were measured, and the activPAL[®] was attached.
24 Thereafter participants were required to wear the monitor continuously for three
25 working days, including when showering/bathing, swimming and sleeping. A log
26 sheet was used to record if the monitor was removed and for what reason, as well
27 as times of going to and getting out of bed. Self-reported sedentary behaviours
28 were recorded in a one-on-one interview when participants returned the activPAL[®]
29 on the day following the three day monitoring period.
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48 *Measurement of sedentary time*

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50 The activPAL[®] is a small, lightweight (15g) uniaxial accelerometer. It was
51 placed in a waterproof finger cot and attached to the mid-anterior right thigh using a
52 porous hypoallergenic tape. Based on postures inferred from the thigh position,
53 activity is classified into episodes of sitting/lying, standing and walking (Grant, Ryan,
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3 Tigbe, & Granat, 2006). The number of sit-to-stand transitions and step counts are
4 also recorded. ActivPAL[®] data are summed over a 15-second epoch with a
5 sampling rate of 10 Hertz. Previous studies have reported 96% (Grant et al. 2006)
6 and 100% (Hart, McClain, & Tudor-Locke, 2011) agreement between postures
7 recorded with activPAL[®] monitors and through direct observation in a laboratory
8 setting, and 94% agreement in a free-living environment (Kozey-Keadle, Libertine,
9 Lyden, Staudenmayer, & Freedson, 2011).
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18 Items on sitting behaviours were taken from the SAPAS: "The following 2
19 questions are about sitting e.g. at work, with friends, travelling, reading, doing
20 hobbies or watching television or reclining at work, at home, getting to and from
21 places, or with friends including time spent [sitting] at a desk, sitting with friends,
22 travelling in car, bus, train, reading, playing cards or watching television; but do not
23 include time spent sleeping. *How much time do you usually spend sitting or reclining*
24 *on a typical day?* (recorded as hours and minutes). *How often do you take regular*
25 *breaks (every 15 -20 minutes) when sitting for long periods?* Response options:
26 *Always; Sometimes; Rarely; Never*" (coded 1 – 4). These items have been included
27 in the 2007, 2010 and 2013 waves of the SAPAS. The first of these questions is
28 from the Global Physical Activity Questionnaire (GPAQ; Bull, Maslin & Armstrong,
29 2009), while the second question was designed specifically for the SAPAS.
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43 Time spent sedentary (classified as sitting/lying) per 24 hour period (midnight
44 to midnight) was determined from the activPAL[®] output, inclusive of time in bed.
45 Time in bed was estimated based on examination of the 'event' files from the
46 activPAL[®] in conjunction with self-report, as reported previously (Healy et al., 2008).
47 In brief, approximate times for 'going to bed' and 'getting up' were identified from
48 self-report; the activPAL[®] 'event' files were used to refine these times based on
49 identification of a change from an upright posture to a prolonged sedentary posture
50 for 'going to bed' time and from a prolonged sedentary posture to an upright posture
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3 for 'getting up' time. For one participant it was not possible to calculate time in bed
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5 from activPAL[®] output; in this case self-reported time in bed was calculated and
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7 used in analyses. As this method of calculating time in bed incorporates a self-
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9 reported component, we decided against compromising the objective 24 h data by
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11 subtracting time in bed. Instead, time in bed was controlled for in correlational
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13 analyses. Sedentary breaks were defined by the number of times a participant
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15 transitioned from a sedentary posture (sitting or lying) to an upright posture (either
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17 standing or walking). Daily averages were calculated for sedentary time and the
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19 number of breaks in sedentary time. As the principal analytical technique was
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21 correlation, a preliminary test, df beta, was performed to identify influential
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23 observations in the dataset, resulting in the removal of one office worker from
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25 analyses ($dfbeta > 2/n^2$).
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30 *Anthropometry*

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33 Weight was measured to the nearest 0.1 kg using electronic scales (Tanita
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35 BF 679W) and standing height was measured to the nearest one millimetre using a
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37 portable stadiometer. Body mass index (BMI) was calculated as weight (kg) divided
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39 by height (m) squared.
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44 *Education*

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46 The highest level of education was reported from the following options: Still
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48 at school; Left after 16 years; Left after 16 years but still studying;
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50 Trade/apprenticeship; Certificate/diploma; University degree or higher.
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55 *Statistical methods*

Analyses were performed in Stata v11 (StataCorp LP, College Station, TX). Descriptive statistics are presented as mean +/- SD or frequencies of categorical responses. Farmers and office workers were compared using t tests for continuous variables and Chi square for categorical variables. The reliability intra-class correlations (ICCs) for the three measurement days were calculated for total sedentary time. As the validity of self-reported physical activity can vary according to weight status (Warner et al., 2012) and the task of recalling previous behaviours is a cognitive challenge (Baranowski, 1988), relationships between self-reported and objectively measured sedentary time were determined using partial correlation analysis, controlling for BMI and level of education as well as time in bed. Spearman correlations were used to describe the relationships between self-reported and objectively measured number of breaks in sedentary time. All correlational analyses were calculated in the whole sample as well as for farmers and office workers separately. Statistical significance was inferred at $P < 0.05$.

Results

Sixty eligible participants volunteered for the study, 30 farmers and 30 office workers. For data to be included in analyses, participants were required to wear the monitor for three complete days (72 hours), and during that time must have engaged in three full days at work. Two participants (one office-worker and one farmer) were excluded from analyses due to non-wear time, resulting in a final sample of 29 farmers and 28 office workers. Reliability ICCs for objectively measured sedentary time were: whole sample, 0.77; farmers, 0.65; and office workers, 0.86.

Eighty nine percent of both office workers and farmers were classified as overweight/obese. Farmers were marginally older than office workers and were significantly less likely to be university educated (see Table 1). Both self-reported and objectively measured sedentary time were significantly lower in farmers;

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3 farmers spent 44% of their total work time being sedentary compared with 67% for
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5 office workers. There were no differences between groups in self-reported frequency
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7 of breaks in sedentary time or objectively measured daily number of breaks (see
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9 Table 1).

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11 A significant correlation between self-reported and objectively measured
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13 sedentary time was observed in the whole sample ($r=0.44$, $p=0.001$). The
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15 correlation among office workers was significant ($r=0.57$, $p=0.003$; see Figure 1) but
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17 not among farmers ($r=-0.08$, $p=0.68$; see Figure 2).

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20 There were no significant correlations between self-reported and measured
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22 number of breaks in sedentary time, for the whole sample ($\rho = -0.03$, $p=0.83$),
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24 office workers ($\rho = 0.17$, $p=0.39$) and farmers ($\rho = -0.22$, $p = 0.25$).

25 26 27 Discussion

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30 This study reports a large correlation, according to the conventions of Cohen
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32 (Cohen, 1988), between self-reported and objectively measured sedentary time
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34 among rural adult males employed in office-based occupations. However, among
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36 farmers in the same rural region, there was no association between self-reported
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38 and objectively measured sedentary behaviour. These observations are consistent
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40 with another recent validation study of self-reported sedentary behaviour in which
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42 accelerometry was used to validate workplace sitting questions adapted from the
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44 IPAQ (Clark et al., 2011). Validity coefficients for workplace sitting were determined
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46 among three occupation subsets: office workers; call centre workers; and customer
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48 service workers. Notably, validity coefficients were significant among those with
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50 essentially desk-based roles (office, $r=0.34$ to 0.44 ; call centre, $r=0.13$ to 0.27), but
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52 non-significant among customer service staff ($r=-0.06$ to -0.02) who typically spend
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54 more time standing and walking in their role (Clark et al., 2011). It is feasible that
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56 desk-based occupations are relatively highly regimented, with scheduled and
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3 predictable breaks such as morning tea and lunch. Accordingly, office workers may
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5 be better equipped to self-report workplace sitting in the previous day as they can
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7 draw upon awareness of their 'typical' work day. On the other hand, farmers' work
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9 days are characterised by a wide range of tasks with less continuity or consistency
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11 between days, perhaps limiting their ability to recall recent daily patterns.
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13 Nevertheless, our results show that farmers' work days still included a substantial
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15 amount of total sedentary time, highlighting the importance of objective measures of
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17 sedentary time in this group.

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19 While the validity of self-reported frequency of breaks in sitting was relatively
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21 poor in the current study, the validity among office workers ($\rho = 0.17$) was higher
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23 than among farmers ($\rho = -0.22$). This is consistent with the observations of Clark
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25 et al. (2011) who found a higher correlation between self-reported and
26
27 accelerometer-derived breaks in workplace sitting among office workers ($\rho = 0.23$)
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29 than customer service workers ($\rho = -0.05$). Again, more frequent and less
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31 predictable transitions from sitting to standing in 'active' occupations may limit the
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33 ability to describe through self-report a 'typical' daily pattern of interrupting sitting
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35 (Clark et al., 2011).

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37 Notably, among office workers but not farmers the three day measurement
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39 period was adequate to achieve the accepted reliability ICC of 0.80 for objectively
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41 measured physical activity in adults (Tudor-Locke et al., 2005). This is perhaps
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43 reflective of the wide variety of often unscheduled work tasks that farmers perform
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45 both indoors and outdoors, unlike the more tightly regimented and monotonous time
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47 use patterns that are typical of the modern office.

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49 A strength of the current study was the use of posture and postural
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51 transitions derived from an inclinometer to validate self-reported sedentary
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53 behaviour. While 100 counts per minute (cpm) has been adopted as a cut-point to
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55 define sedentary behaviour from accelerometry data (Clark et al., 2011), periods of
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57 time ≤ 100 cpm may include standing relatively still which would result in
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3 overestimation of sedentary time. Furthermore, the utility of the 100 cpm cut point
4 has only been tested in relatively few populations (Matthews et al., 2008). A further
5 strength of the study was the adequate statistical power to detect moderate
6 correlation coefficients in occupation sub-samples (Cohen, 1988).
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11 Several limitations of this study should be acknowledged. Data were
12 collected during one phase of the farming year. While an office worker's postural
13 and activity patterns at work may remain relatively consistent throughout a working
14 year, a farmer's activity may be much higher during sowing and harvesting periods.
15 If validity of self-reported sedentary time is influenced by the amount of workplace
16 sitting, as suggested by this study, the difference in validity of sedentary self-
17 reporting between office workers and farmers may be wider if considered across a
18 whole year. In the current study, office workers engaged in sedentary behaviour for
19 67% of their work time, very similar to the proportion of office-based sedentary time
20 (66%) reported by Brown, Ryde, Gilson, Burton and Brown (2013), but substantially
21 lower than 75% reported by Thorpe and Dunstan (2009) and 76% reported by
22 Toomingas, Forsman, Mathiessen, Heiden and Nilsson (2012). If validity of self-
23 reported sitting is associated with the extent to which movement in the workplace is
24 automated and habitual, as the results of this study and the findings of Clark and
25 colleagues (2011) suggest, the validity coefficient for office workers in the current
26 study is limited in its generalizability to other office settings where the proportion of
27 sedentary time is different.
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48 Reactivity may have confounded measurement, whereby participants alter
49 usual sedentary and active patterns as a consequence of being assessed (Dollman
50 et al., 2009). In this study, we attempted to minimise reactivity by fitting the
51 activPAL® on participants the day before recording started. The light weight and
52 unobtrusiveness of the monitor also reduces ongoing awareness of its attachment
53 (Godfrey, Culhane, & Lyons, 2007) as does the absence of the need to remove and
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3 reattach the monitor each day. Social desirability bias may also have led to
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5 underestimation of sedentary behaviour though self-report (Adams et al., 2005) but
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7 it is not possible to quantify the relative impact of these biases on the observed
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9 correlations.

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11 The farmers in this sample study were limited to two main agricultural
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13 industries, grape-growing (n=15) and dryland farming (n=14). A comparison
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15 between these sub-samples showed that the grape-growers spent 48% of their day
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17 being sedentary compared with 41% among dry-land farmers. While sub-sample
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19 sizes are small, this suggests that sedentary behaviours at work may vary with the
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21 type of farming and highlights the need to extend the research to include a wider
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23 range of primary industries. Also, the study was confined to men in full time
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25 employment. Future studies should include women and those in part-time work and
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27 domestic/carer roles as well as unemployed and retirees.

32 Conclusion

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35 While self-reporting of sedentary behaviour is an appealing strategy due to
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37 low cost and very low respondent burden, the results of this study suggest it is of
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39 limited utility in rural Australians. This particularly applies to the self-report of breaks
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41 in sitting time. Among those with irregular work patterns, self-report of sedentary
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43 behaviour seems to be of no value. Given the relevance of sedentary behaviour
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45 measurement to the public health crisis of escalating chronic disease, better
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47 performing self-report instruments need to be developed for population-level
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49 monitoring of the distribution of posture across the day. At the same time,
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51 technological approaches need to be available at lower cost and higher convenience
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53 to support research into patterns and consequences of sedentary behaviour and the
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55 effectiveness of interventions to reduce prolonged sitting.
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Table 1 Demographic and descriptive statistics for the whole sample and separately for office workers and farmers

| Variables | All (n=58) | Office worker (n=29) | Farmer (n=29) |
|---|---------------|-------------------------|-------------------|
| Demographic variables | | | |
| Age (years) | 48.9 (9.0) | 46.9 (8.5) | 50.7 (9.7) |
| BMI (kg.m ⁻²) | 29.13 (3.89) | 28.39 (3.23) | 29.87 (4.38) |
| Highest education (%) | | | |
| <i>Still at school</i> | 0 | 0 | 0 |
| <i>Left school before 16 years</i> | 19.0 | 0 | 37.9 ^a |
| <i>Left after 16 years</i> | 17.2 | 17.2 | 17.2 |
| <i>Left after 16 years but still studying</i> | 0 | 0 | 0 |
| <i>Trade/apprenticeship</i> | 5.2 | 3.4 | 6.9 |
| <i>Certificate/diploma</i> | 37.9 | 37.9 | 37.9 |
| <i>University degree or higher</i> | 20.7 | 41.1 | 0 ^a |
| Self-reported behaviours | | | |
| Time in bed (h) | 8.2 (1.10) | 7.9 (1.1) | 8.3 (0.8) |

| | | | |
|---|-------------|-------------|-------------------------|
| Daily sedentary time (h) | 6.4 (3.3) | 8.7 (2.5) | 4.2 (2.3) ^a |
| Frequency of breaks (%) | | | |
| Always | 12.1 | 20.7 | 3.4 |
| Sometimes | 55.2 | 51.7 | 58.6 |
| Rarely | 27.6 | 20.7 | 34.5 |
| Never | 5.2 | 6.9 | 3.4 |
| Objectively measured behaviours | | | |
| Sitting/lying (h) (including time in bed) | 17.2 (1.7) | 17.9 (1.4) | 16.5 (1.8) ^a |
| Break number (per day) | 71.2 (20.3) | 70.2 (16.7) | 73.9 (23.5) |

Note: data presented as means (SD) or percentages; ^a $P < 0.05$

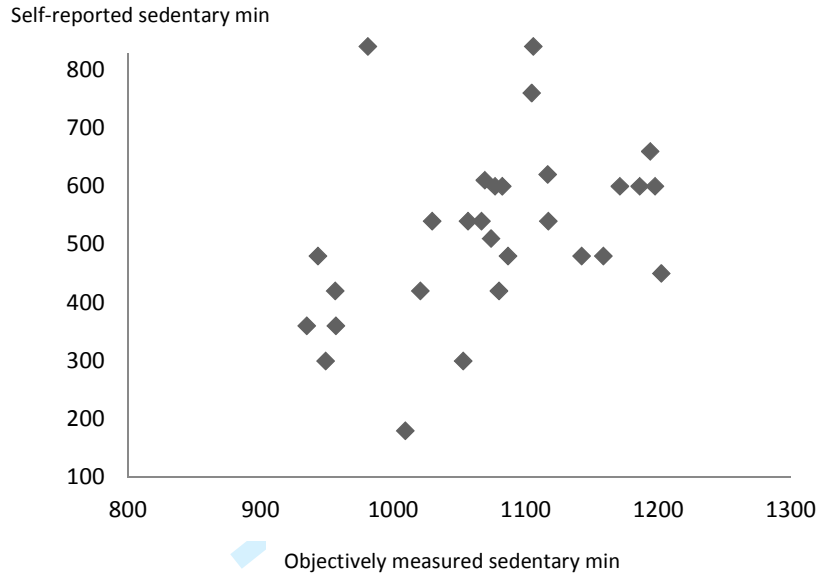


Figure 1: Scattergram of objectively measured and self-reported sedentary time in rural male office workers

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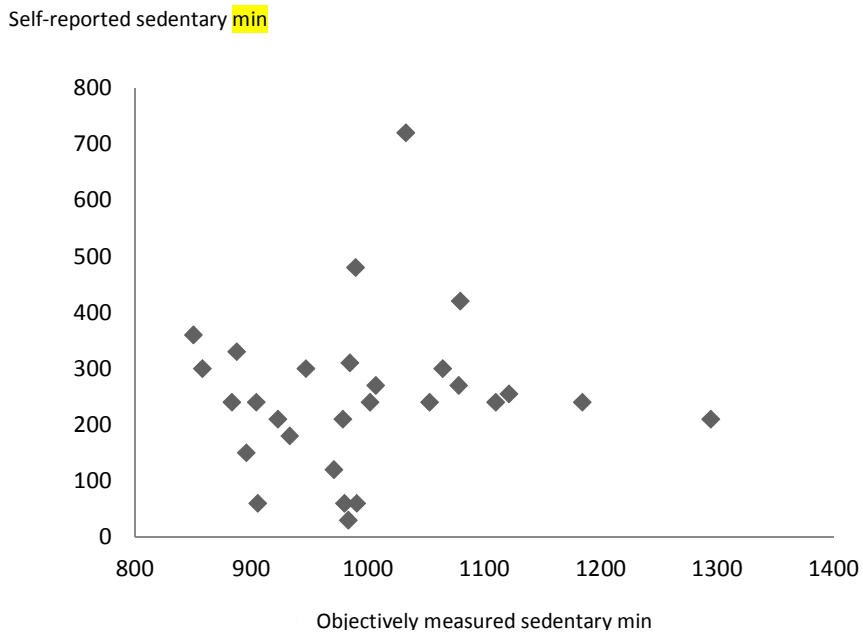


Figure 2: Scattergram of objectively measured and self-reported sedentary time in male farmers