Title: Assessment of Indigenous Australians’ functional fitness and sedentary time

Running head: Indigenous Australians’ functional fitness and sedentary time.

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The authors declare that they have no conflicts of interest.
ABSTRACT

Purpose: To examine the utility of field-based techniques to assess functional exercise capacity and sedentary time in Aboriginal, Torres Strait Islander and non-Indigenous regional Australian adults.

Methods: Assessments of physical characteristics and functional exercise capacity were undertaken in 96 adults residing in regional and remote Australian communities (Aboriginal and Torres Strait Islander n=61 and non-Indigenous Australians n=35). Participants wore an accelerometer during waking hours for seven days, provided self-report data on physical activity and sedentary time and rated experiences in regard to the ease of complying with study protocols.

Results: There were high levels of compliance with the study protocol (Indigenous: 91% and non-Indigenous: 97%). Functional exercise capacity was lower in Indigenous Australian’s (p<0.001), and independently associated with advancing age, higher BMI, and indigeneity, with 45% of variability in the 6MWT distance explained by these factors. The relationship between accelerometer and self-report measures of sedentary behaviour was significant (p<0.001) but only explained 17% of the total variation.

Conclusion: This study demonstrated very good compliance for the methods utilised and indicates the procedures have potential for implementation. This study is the first to report reduced functional exercise capacity in Aboriginal and Torres Strait Islander people.

KEY WORDS: sedentary; accelerometer; health
INTRODUCTION

Chronic non-communicable diseases are a major global contributor to premature mortality and disability. Indigenous and non-Indigenous Australians particularly those living in remote and regional areas face an escalating epidemic of chronic non-communicable diseases, including cardiovascular and respiratory disease and diabetes (24). Aboriginal Australian and Torres Strait Islander peoples (13, 31) are particularly at risk and this is likely to be explained by a complex interplay of social, behavioral and environmental factors (14).

The leading causes of premature death and morbidity in Aboriginal and Torres Strait Islander people include diabetes and cardiovascular disease (37). In particular, Torres Strait Islander people are six times more likely to have diabetes with the diagnosis becoming more prevalent in primary school-aged children (29). Despite recognition of sedentary time and obesity playing a contributing role in the development of chronic diseases in Aboriginal and Torres Strait Islander people (20, 22, 23, 28, 34, 37), little research has been undertaken to assess or evaluate interventions to encourage physical activity in these populations. This may be attributable to practical and cultural issues for data collection in rural and remote community settings but it represents a significant omission in the current literature and is problematic for future planning of targeted health promotion and wellness initiatives.

Physical activity is a practical, non-pharmaceutical means of ameliorating obesity and reducing diabetes, cardiorespiratory disease (3) and other obesity related conditions such as obstructive sleep apnoea (11). In general physical activity can be divided into formal and structured exercise at a moderate workload and non-exercise physical activity. Whilst it is currently recommended that adults should undertake 30 minutes per day of moderate to
vigorous exercise (36), addressing sedentary time is also important in preventing the development of chronic diseases such as diabetes (38).

Sedentary time can comprise a disproportionate amount of daily recorded activity. Healy and others (16) found, based on accelerometer data, that individuals without diabetes spent 14.2 hours or 90% of the waking day in sedentary or light intensity behaviors. There are little data regarding the current levels of physical activity in Indigenous Australians and the degree of sedentary time and functional exercise capacity has not been reported. Current self-reported measures for physical activity in Aboriginal and Torres Strait Islanders indicate that one third take part in regular physical activity (1) and only one fifth take part in moderate to high levels of physical activity (2).

Functional capacity refers to the incorporation of tasks and context specific practices with the overall goal of functional independence (25). The six-minute walk test (6MWT) is widely utilized to assess health status and functional exercise capacity across a range of populations in community-based settings (5, 10, 27). However there are currently no published findings regarding functional exercise capacity in Aboriginal and Torres Strait Islander people. Developing valid and reliable methods for monitoring sedentary time in Aboriginal and Torres Strait Islander people is important as there is an urgent need for development and research in this area.

This study examined the utility and outcomes derived from field-based techniques to assess functional exercise capacity and sedentary time in Aboriginal and Torres Strait Islander and non-Indigenous Australians living in regional and remote communities in northern Australia.
METHODS

Participants

Participants were a convenience sample drawn from the local population based at health care and training organisations in far north Queensland in the regional centre of Cairns and adjacent remote communities. Recruitment was facilitated using a combination of presentations to staff, posters, newsletters and direct approaches. Participants provided written informed consent prior to participation and the study was approved by the Human Research Ethics Committee of James Cook University.

Measurements

All evaluations occurred onsite in private and confidential rooms. Baseline assessment included participant demographics and anthropometry (mass, height and hip and waist circumference). Six minute walk test distance was assessed using a standardised technique (10). Participants’ perceived exertion was assessed at the end of the 6MWT using the Borg Rate of Perceived Exhaustion Scale as a relative measure (4). Body mass and body fat was assessed using body impedance assessment (Tanita body fat monitor/scale, BF-522, Tanita Corporation, Tokyo, Japan) which deducted one kilogram for clothes (19).

Following baseline assessment, participants received instructions on the fitting and use of an accelerometer (GT3X+, Actigraph, Florida, USA). They were informed of the need to wear the device over the subsequent seven days. The device was worn on the same side of the hip throughout the week on an adjustable elastic belt which participants were asked to wear during waking hours, with the exception of all water based activities or activities such as contact sports in which the device might otherwise be damaged or cause injury.
At the conclusion of the study period, participants returned the accelerometer and were individually interviewed in private and rated on a scale of one to five (1-5; easy to hard) the ease of using the accelerometer and of participation in the study. Finally participants completed the Past-day Adults’ Sedentary Time (PAST) questionnaire for the previous day’s sedentary behaviors (6).

The PAST Recall tool is a validated self-report questionnaire which identifies participants’ sedentary behaviors across a range of domains (6). Self-reported data from the PAST Recall questionnaire for the 24 hours prior to final assessment was compared with electronic data from the previous day. Face validity and acceptability of the PAST Recall for an Aboriginal and Torres Strait Islander population was confirmed through pilot testing with Aboriginal and Torres Strait Islander people prior to commencement of the study. This piloting suggested minor additional clarifications in the language of the PAST day questionnaire and these were incorporated.

Accelerometer data were downloaded from Actilife version 5 and was then analysed using the Freedson equation (12) for assessing sedentary time. This method organised data cut points using 60 second epoch files. The cut points based on the Freedson method were classified in counts per minute (cpm) with sedentary time being classified as <100 cpm. Participants who wore the device longer than 22 hours in a day (n=2), which would suggest that they slept with the device, had their results truncated to waking hours of 6am to 10pm. Participants who failed to have a single valid day during the seven day period were excluded from the study (n=4). A valid day was based on the criteria employed by Troiano et al (33) and others (8, 15, 35) and was defined as having at least 10 hours or more of monitor wear time. For a data set to be considered complete, participants needed to have initial baseline
measures, wear the device for more than 10 hours a day, complete the PAST recall questionnaire and have a valid day for the PAST recall day.

Statistical analysis

Data were analysed using Stata statistical package, version 12.1 (StataCorp, Texas, USA). Baseline data were analysed using standard univariate and bivariate techniques. A p value less than 0.05 was taken to indicate statistical significance and all tests were two-sided. Demographic and anthropometric data are presented as mean ± SD. Multivariate linear regression models were developed to identify independent factors associated with 6MWT distance, accelerometer and self-reported (PAST) assessed sedentary time and the correlation between accelerometer and PAST-based assessment. These were developed using a backwards stepwise approach, including in the first model all factors associated with outcome variables using bivariate analysis with a p value <0.1. Factors with a p value >0.1 were progressively removed from the models starting with those variables with a regression coefficient closest to 0. Final models were limited to predictive factors with a p value < 0.05.

RESULTS

Participants
The study enrolled 103 participants which comprised Indigenous (n=67) and non-Indigenous (n=36) people. Of these 96 provided sufficient data (three withdrew from the study, four had no valid days ([see methods]). Overall 91% of Aboriginal and Torres Strait Islander participants and 97% of non-Indigenous Australian participants provided sufficient data for analysis.
Complete data, was less likely for Aboriginal and Torres Strait Islander participants (47.5%) compared with non-Indigenous Australian participants (80%) ($\chi^2$, p=0.001). Baseline characteristics of participants are outlined in Table 1. There were no significant differences between Indigenous and non-Indigenous Australian participants for any of these factors.

Bivariate analysis demonstrated the 6MWT distance for Aboriginal and Torres Strait Islander participants was lower (mean 455 metres ± SD 81) compared with non-Indigenous Australians (523 ± 73) (p<0.001). Multivariate analysis highlighted several factors that were independently associated with the 6MWT distance. These included age (1.3m less for every additional year, 95% CI 0.1-2.5), BMI (6.6m less for each increase in BMI of 1kg/m², 95% CI 4.2-9.1), and indigeneity (56.0m less for Aboriginal and/or Torres Strait Islanders compared with non-Indigenous Australian participants, 95% CI 27.8-84.3). Together these factors accounted for 45% of the variability in the 6MWT distance. Of note was the finding that a self-reported diagnosis of chronic disease, tobacco smoking and regular exercise (30 minutes a day) were not independently associated with the 6MWT distance.

Self-reported data from the PAST Recall questionnaire demonstrated no significant differences in the estimated sedentary time between Aboriginal and Torres Strait Islander (526 minutes, SD ±24) and non-Indigenous Australian participants (575 minutes, SD ±86) (p=0.739). A breakdown of types of sedentary time demonstrated that non-Indigenous participants identified a greater amount of sedentary time to sitting at a computer (140
minutes, SD ±136) compared with Aboriginal and Torres Strait Islander participants (58, SD ±96) (p=0.060). Given sitting at a computer and sitting at work were both likely to be work-related they were subsequently combined. In this case the combination of work-computer sitting was also a greater contributor to non-Indigenous sedentary time (296 minutes, SD ±165) compared with Aboriginal and Torres Strait Islander people (224, SD ±153) (p=0.047).

A comparison of time spent in sedentary behaviors between the Indigenous and non-Indigenous participants in our study is shown in Figure 1.

Bivariate analysis of accelerometer data (31) showed Aboriginal and Torres Strait Islander participants (350 mins, SD 51) to have significantly less sedentary time compared to non-Indigenous Australians (390 mins, SD 45) (p<=0.001). Multivariate analysis revealed no other attributes that were significantly associated with accelerometer-assessed sedentary time. The final component of the analysis determined how well objective assessment of sedentary time on the last wear day (derived from accelerometer data using the Freedson sedentary criterion) correlated with self-report based on the PAST Recall questionnaire. After elimination of incomplete data, the sample for this comparison was reduced to 57 participants. Whilst accelerometer and questionnaire data were correlated (p<0.001) the coefficient of determination/R² indicated only 17% of the total variation in these factors was explained by the model. Multivariate analysis demonstrated indigeneity was the only other independent factors which influenced this relationship with more of the variation between
Indigenous Australians’ fitness and sedentary time.

accelerometer and PAST data being explained in non-Indigenous Australians (R² 32%) compared with Aboriginal and Torres Strait Islander participants (R² 9%). In absolute and proportional terms Aboriginal and Torres Strait Islander participants tended to over-estimate sedentary time more on PAST self-report compared with accelerometer data (213 mins SD143) and 63% [SD 45] greater on self-report) in comparison with non-Indigenous participants (189 mins, SD 162) and 48% [SD 39]) but these differences were not significant (p=0.551 and p=0.183 respectively).

DISCUSSION

This study provides new insights into the integrated assessment of functional exercise capacity and sedentary times in a regional population of Australian Indigenous and non-Indigenous adults. It demonstrated that assessment is possible in such settings and, importantly, is feasible for Aboriginal and Torres Strait Islander people. Collecting such field-based data in studies of Indigenous populations can be both culturally sensitive and practically challenging (9). Nonetheless, our high participant retention rate was encouraging and augurs well for using these techniques in future large-scale field-based population-health studies in Aboriginal and Torres Strait Islander people in regional Australia. Adherence to all the protocols within the 7-day test period (Indigenous: 47.5%; non-Indigenous: 80%) nonetheless indicates there remain opportunities for further refinement of the techniques used here and the utilisation of accelerometer and self-report based assessment of sedentary times may be further improved and adapted particularly for Aboriginal and Torres Strait Islander people.
Although adherence to the accelerometer was high, there were issues with self-report which reduced overall adherence. The lower adherence to all protocols in the Aboriginal and Torres Strait Islander participants may be explained by cultural differences. Janca and Bullen (18) investigated Aboriginal Australians concepts of time from a mental health perspective but most of the findings are applicable to the population tested in this study. They highlighted two main factors: Aboriginal Australians have a more traditional ‘here and now’ approach as the future is mainly seen as unimportant and immediate priorities often take precedence over time (21). There are also other factors that can influence self-reported measures such as recall bias (7) and the tendency to give socially desirable (avoidance of criticism) and socially approved (seeking praise) answers (17).

These are the first observations reporting on functional exercise capacity among Indigenous Australian adults and thus provide an important initial contribution. We identified that the Aboriginal and Torres Strait Islander people in our sample had significantly lower functional exercise capacity compared with non-Indigenous Australians. Nonetheless other factors including age and obesity status were also important in explaining such differences. The independent association of BMI with the findings from the 6MWT distance test highlights the importance of preventing excessive gain in body mass as a priority for future interventions in all Australians and particularly in Indigenous Australians as a mechanism for improving functional exercise capacity in addition to its role in addressing chronic disease risk and management.

Whilst we demonstrated it is possible to utilise 6MWT as a time-efficient and minimally-intrusive field test of functional fitness, further study is required to determine the underlying
determinants of a reduced 6MWT distance for Aboriginal and Torres Strait Islander people. This may include language and cultural aspects pertaining to test interpretation, attitudes towards exertion and factors relating to cardiorespiratory and neuromuscular function that may be explained by a differing and more severe burden of chronic diseases. Whilst the explanation for this difference in 6MWT is unlikely to relate to ethnicity alone it nonetheless supports previous self-reported fitness data and is consistent with population-specific health concerns relating to lifestyle-induced susceptibility to premature death among Indigenous Australians (37, 39).

Overall information relating to self-reported sedentary behaviors from the PAST Recall questionnaire was similar between Indigenous and non-Indigenous Australian participants. Our findings suggest domain-specific types of sedentary and physically-active behaviors rather than overall activity levels might be a more important feature when determining functional exercise capacity and elucidating sedentary time. Personal attributes likely to result in participation in structured and non-structured physical activity are well known to vary across ages, gender, socio-economic, and population groups, and may be related to a range of factors including work practices and local accessibility of facilities (14). All forms of physical activity and time spent sitting are likely to be determined by available time and particularly the style of work in which each individual is employed (30). For example, during the working day physical activity among office workers is largely based around sitting time that could be expected to be a necessity of the role.

It is possible there were cultural differences in the perception of ‘sitting at work’ and ‘sitting in front of a computer’ between Aboriginal and Torres Strait Islander and non-Indigenous
Australian participants as collectively these results were similar but when individually assessed they were quite different (Figure 1). Nevertheless, further examination of the categorical data from the PAST Recall questionnaire identified that some of the ‘other’ activities in which Indigenous participants engaged could be classified as either minimally active or sedentary. This would indicate there is a need for self-report questionnaires of sedentary behaviors to be further adapted and validated in particular populations, including Aboriginal and Torres Strait Islander people.

There was a relative disconnect between PAST Recall and accelerometer sedentary time and this was particularly the case in Aboriginal and Torres Strait Islander participants who had equivalent self-reported and significantly less objectively assessed sedentary time compared with non-Indigenous participants. It is likely these measures capture differing aspects of sedentary behavior and a combined approach of accelerometer and self-reported data is likely to provide an optimal approach for future evaluations of sedentary time particularly in populations where cultural and lifestyle factors are important.

In conclusion, we have demonstrated that assessment of functional exercise capacity and sedentary time is possible in a regional Australian setting and with Aboriginal and Torres Strait Islander people. Functional exercise capacity was lower in our Aboriginal and Torres Strait Islander sample and this was independent of other attributes of participants, including advancing age and higher BMI. Self-reported sedentary behavior, as assessed by PAST Recall, was found to be useful and accelerometer data showed that non-Indigenous Australians were more sedentary compared with Aboriginal and Torres Strait Islander people. The correlation between self-report and objective assessment was limited in all participants.
and particularly in Aboriginal and Torres Strait Islander people. It is likely further studies, including the evaluation of future interventions to reduce sedentary time and enhance physical activity in Aboriginal and Torres Strait Islander people, will require a combination of objective and self-reported data and tools such as PAST Recall. These techniques will require ongoing refinement to reflect the culture, language and lifestyle of Aboriginal and Torres Strait Islander people.
ACKNOWLEDGEMENTS

We are grateful to the staff of Apunipima Health Council and research assistants from James Cook University for their assistance in data collection. Graeme Maguire is supported by an NHMRC Practitioner Fellowship and the Margaret Ross Chair in Indigenous Health.
Table 1. Attributes of Indigenous and non-Indigenous study participants.

<table>
<thead>
<tr>
<th></th>
<th>Indigenous (n=61)</th>
<th>Non-Indigenous (n=36)</th>
</tr>
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<tbody>
<tr>
<td><strong>Age (years)</strong></td>
<td>35.6 (10.9)</td>
<td>32.9 (11.5)</td>
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<tr>
<td>(mean, SD)</td>
<td></td>
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<tr>
<td><strong>Ever smoked tobacco</strong></td>
<td>53 (40-66)</td>
<td>40 (23 - 57)</td>
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<tr>
<td>(%, 95% CI)</td>
<td></td>
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<tr>
<td><strong>Height (cm)</strong></td>
<td>165.5 (9.1)</td>
<td>170.1 (10)</td>
</tr>
<tr>
<td>(mean, SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mass (kg)</strong></td>
<td>80.7 (18.3)</td>
<td>75.2 (18.5)</td>
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<tr>
<td>(mean, SD)</td>
<td></td>
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<tr>
<td><strong>Body fat (% total mass)</strong></td>
<td>34.5 (9.6)</td>
<td>27.3 (10.8)</td>
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<tr>
<td>(mean, SD)</td>
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<tr>
<td><strong>BMI (kg/m²)</strong></td>
<td>29.3 (5.9)</td>
<td>25.9 (5.5)</td>
</tr>
<tr>
<td>(mean, SD)</td>
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<tr>
<td><strong>Waist circumference (cm)</strong></td>
<td>93.7 (1.8)</td>
<td>82.2 (2.2)</td>
</tr>
<tr>
<td>(mean, SD)</td>
<td></td>
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<tr>
<td><strong>Hip circumference (cm)</strong></td>
<td>105 (1.3)</td>
<td>100.5 (1.7)</td>
</tr>
<tr>
<td>(mean, SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Waist to hip ratio</strong></td>
<td>0.88 (0.08)</td>
<td>0.81 (0.08)</td>
</tr>
<tr>
<td>(mean, SD)</td>
<td></td>
<td></td>
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<tr>
<td><strong>One or more chronic disease</strong></td>
<td>40 (27 - 53)</td>
<td>26 (10 - 41)</td>
</tr>
<tr>
<td>(%, 95% CI)</td>
<td></td>
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<tr>
<td><strong>Regular exercise</strong></td>
<td>45 (32 - 58)</td>
<td>62 (45 – 79)</td>
</tr>
<tr>
<td>(%, 95% CI)</td>
<td></td>
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</table>

* including chronic heart, lung and musculoskeletal conditions and diabetes mellitus,
Indigenous Australians’ fitness and sedentary time.

# moderate intensity, five times per week for at least 30 minutes)
Table 2. Summary of main outcome variables for functional fitness and sedentary time among Indigenous and Non-Indigenous Australians.

<table>
<thead>
<tr>
<th></th>
<th>Indigenous (n=61)</th>
<th>Non-Indigenous (n=36)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ACCELEROMETER</strong></td>
<td></td>
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<tr>
<td>Sedentary time</td>
<td>350 ±51.4*</td>
<td>390 ±45.3*</td>
</tr>
<tr>
<td>(min per day; mean, SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PAST RECALL QUESTIONNAIRE</strong></td>
<td></td>
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<tr>
<td>Estimated Sedentary time</td>
<td>526 ±23.9</td>
<td>575 ±82.6</td>
</tr>
<tr>
<td>(minutes per day; mean, SD)</td>
<td></td>
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<tr>
<td><strong>FUNCTIONAL FITNESS</strong></td>
<td></td>
<td></td>
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<tr>
<td>Six minute walk test distance</td>
<td>455 ±80.9***</td>
<td>523 ±72.7***</td>
</tr>
<tr>
<td>(meters; mean, SD)</td>
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* = significant difference between variables, p<0.05, ** = significant difference, p<0.01, *** = significant difference, p<0.001
FIGURES

Figure 1  Differences in the time spent in sedentary behaviors for Aboriginal and Torres Strait Islander versus non-Indigenous Australian participants
Indigenous Australians’ fitness and sedentary time.

REFERENCES


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