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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.

78 **METHODS**

79 **Participants**

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

86 **Measurements**

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

94 Following baseline assessment, participants received instructions on the fitting and use of an
95 accelerometer (GT3X +, Actigraph, Florida, USA). They were informed of the need to wear
96 the device over the subsequent seven days. The device was worn on the same side of the hip
97 throughout the week on an adjustable elastic belt which participants were asked to wear
98 during waking hours, with the exception of all water based activities or activities such as
99 contact sports in which the device might otherwise be damaged or cause injury.

100 At the conclusion of the study period, participants returned the accelerometer and were
101 individually interviewed in private and rated on a scale of one to five (*1-5; easy to hard*) the
102 ease of using the accelerometer and of participation in the study. Finally participants
103 completed the Past-day Adults' Sedentary Time (PAST) questionnaire for the previous day's
104 sedentary behaviors (6).

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

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

123 measures, wear the device for more than 10 hours a day, complete the PAST recall
124 questionnaire and have a valid day for the PAST recall day.

125 **Statistical analysis**

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

137

138 **RESULTS**

139 **Participants**

140 The study enrolled 103 participants which comprised Indigenous (n=67) and non-Indigenous
141 (n=36) people. Of these 96 provided sufficient data (three withdrew from the study, four had
142 no valid days ([see methods]). Overall 91% of Aboriginal and Torres Strait Islander
143 participants and 97% of non-Indigenous Australian participants provided sufficient data for
144 analysis.

Complete data, was less likely for Aboriginal and Torres Strait Islander participants (47.5%) compared with non-Indigenous Australian participants (80%) (χ^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.

INSERT TABLE 1 ABOUT HERE

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 (575minutes, 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.

INSERT TABLE 2 ABOUT HERE

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/R^2 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

accelerometer and PAST data being explained in non-Indigenous Australians (R^2 32%) compared with Aboriginal and Torres Strait Islander participants (R^2 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.

211 Although adherence to the accelerometer was high, there were issues with self-report which
212 reduced overall adherence**.** The lower adherence to all protocols in the Aboriginal and Torres
213 Strait Islander participants may be explained by cultural differences. Janca and Bullen (18)
214 investigated Aboriginal Australians concepts of time from a mental health perspective but
215 most of the findings are applicable to the population tested in this study. They highlighted
216 two main factors: Aboriginal Australians have a more traditional 'here and now' approach as
217 the future is mainly seen as unimportant and immediate priorities often take precedence over
218 time (21). There are also other factors that can influence self-reported measures such as recall
219 bias (7) and the tendency to give socially desirable (avoidance of criticism) and socially
220 approved (seeking praise) answers (17).
221
222 These are the first observations reporting on functional exercise capacity among Indigenous
223 Australian adults and thus provide an important initial contribution. We identified that the
224 Aboriginal and Torres Strait Islander people in our sample had significantly lower functional
225 exercise capacity compared with non-Indigenous Australians. Nonetheless other factors
226 including age and obesity status were also important in explaining such differences. The
227 independent association of BMI with the findings from the 6MWT distance test highlights the
228 importance of preventing excessive gain in body mass as a priority for future interventions in
229 all Australians and particularly in Indigenous Australians as a mechanism for improving
230 functional exercise capacity in addition to its role in addressing chronic disease risk and
231 management.
232
233 Whilst we demonstrated it is possible to utilise 6MWT as a time-efficient and minimally-
234 intrusive field test of functional fitness, further study is required to determine the underlying

235 determinants of a reduced 6MWT distance for Aboriginal and Torres Strait Islander people.
236 This may include language and cultural aspects pertaining to test interpretation, attitudes
237 towards exertion and factors relating to cardiorespiratory and neuromuscular function that
238 may be explained by a differing and more severe burden of chronic diseases. Whilst the
239 explanation for this difference in 6MWT is unlikely to relate to ethnicity alone it nonetheless
240 supports previous self-reported fitness data and is consistent with population-specific health
241 concerns relating to lifestyle-induced susceptibility to premature death among Indigenous
242 Australians (37, 39).
243
244 Overall information relating to self-reported sedentary behaviors from the PAST Recall
245 questionnaire was similar between Indigenous and non-Indigenous Australian participants.
246 Our findings suggest domain-specific types of sedentary and physically-active behaviors
247 rather than overall activity levels might be a more important feature when determining
248 functional exercise capacity and elucidating sedentary time. Personal attributes likely to result
249 in participation in structured and non-structured physical activity are well known to vary
250 across ages, gender, socio-economic, and population groups, and may be related to a range of
251 factors including work practices and local accessibility of facilities (14). All forms of physical
252 activity and time spent sitting are likely to be determined by available time and particularly
253 the style of work in which each individual is employed (30). For example, during the working
254 day physical activity among office workers is largely based around sitting time that could be
255 expected to be a necessity of the role.
256
257 It is possible there were cultural differences in the perception of 'sitting at work' and 'sitting
258 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

283 and particularly in Aboriginal and Torres Strait Islander people. It is likely further studies,
284 including the evaluation of future interventions to reduce sedentary time and enhance
285 physical activity in Aboriginal and Torres Strait Islander people, will require a combination of
286 objective and self-reported data and tools such as PAST Recall. These techniques will require
287 ongoing refinement to reflect the culture, language and lifestyle of Aboriginal and Torres
288 Strait Islander people.

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291 University for their assistance in data collection. Graeme Maguire is supported by an NHMRC
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308 **TABLES**

309 Table 1. Attributes of Indigenous and non-Indigenous study participants.

	Indigenous (n=61)	**Non-Indigenous (n=36)**
Age (years) (mean, **SD**)	35.6 (10.9)	32.9 (11.5)
Ever smoked tobacco (%, 95% CI)	53 (40-66)	40 (23 - 57)
Height (cm) (mean, **SD**)	165.5 (9.1)	170.1 (10)
Mass (kg) (mean, **SD**)	80.7 (18.3)	75.2 (18.5)
Body fat (% total mass) (mean, **SD**)	34.5 (9.6)	27.3 (10.8)
BMI (kg/m^2) (mean, **SD**)	29.3 (5.9)	25.9 (5.5)
Waist circumference (cm) (mean, **SD**)	93.7 (1.8)	82.2 (2.2)
Hip circumference (cm) (mean, **SD**)	105 (1.3)	100.5 (1.7)
Waist to hip ratio (mean, **SD**)	0.88 (0.08)	0.81 (0.08)
One or more chronic disease* (%, 95% CI)	40 (27 - 53)	26 (10 - 41
Regular exercise[#] (%, 95% CI)	45 (32 - 58)	62 (45 – 79)

310

311 * including chronic heart, lung and musculoskeletal conditions and diabetes mellitus,

312 # 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.

	Indigenous (n=61)	**Non-Indigenous (n=36)**
ACCELEROMETER		
Sedentary time (min per day; mean, SD)	350 ±51.4*	390 ±45.3*
PAST RECALL QUESTIONNAIRE		
Estimated Sedentary time (minutes per day; mean, SD)	526 ±23.9	575 ±82.6
FUNCTIONAL FITNESS		
Six minute walk test distance (meters; mean, SD)	455 ±80.9***	523 ± 72.7***

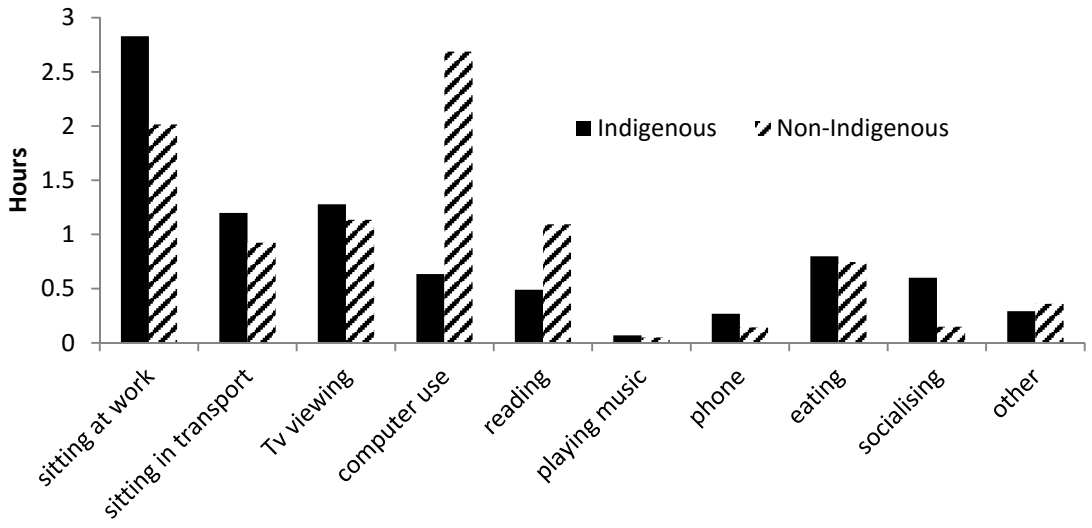
* = significant difference between variables, $p<0.05$, ** = significant difference, $p<0.01$, *** = significant difference, $p<0.001$

333

334 **FIGURES**

335 Figure 1 Differences in the time spent in sedentary behaviors for Aboriginal and Torres

336 Strait Islander versus non-Indigenous Australian participants



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REFERENCES

1. Australian Bureau of Statistics. National Aboriginal and Torres Strait Islander Social Survey. Canberra: *Australian Bureau of Statistics*; 2001.
2. Australian Institute of Health and Welfare. Aboriginal and Torres Strait Islander health performance framework 2010: detailed analysis. Canberra: Australian Institute of Health and Welfare; 2011. *AIHW Catalogue no IHW* 53.
3. Bassuk SS, Manson JE. Epidemiological evidence for the role of physical activity in reducing risk of type 2 diabetes and cardiovascular disease. *J Appl Physiol.* 1985;99(3):1193-1204.
4. Borg G. Borg's perceived exertion and pain scales. Champaign (IL): Human Kinetics; 1998.
5. Casanova C, Cote CG, Marin JM, et al. The 6-min walking distance: long-term follow up in patients with COPD. *Eur Respir J.* 2007;29(3):535-40.
6. Clark B. Measurement of Adults' Sedentary Behaviour by Questionnaire [dissertation]. Brisbane: The University of Queensland; 2011.
7. Clark BK, Sugiyama T, Healy GN, Salmon J, Dunstan DW, Owen N. Validity and reliability of measures of television viewing time and other non-occupational sedentary behaviours of adults: a review. *Obes Rev.* 2009;10(1);7-16.
8. Colley RC, Garriguet D, Janssen I, Wong SL, Saunders TJ, Carson V, Tremblay MS. The association between accelerometer-measured patterns of sedentary time and health risk in children and youth: results from the Canadian Health Measures Survey. *BMC Public Health.* 2013;13(100).

9. Dunbar T, Schrimgeour M. Ethics in Indigenous Research-Connecting with Community. *J Bioeth Inq.* 2006;3(3):179-85.

10. Enright PL, Sherrill DL. Reference equations for the six-minute walk in healthy adults. *Am J Respir Crit Care Med.* 1998;158:1384-1385.

11. Foster G, Borradaile K, Sanders, M, Millman R, Zammit, G, Newman A, Kuna ST. A randomized study on the effects of weight loss on obstructive sleep apnea among obese patients with type 2 diabetes. *Arch Int Med.* 2009;169(17):1619-1626.

12. Freedson PS, Melanson E, Sirard J. Calibration of the Computer Science and Applications, Inc. Accelerometer. *Med Sci Sport Exerc.* 1997;30(5):777-781.

13. Gill JM, Cooper AR. Physical activity and prevention of type 2 diabetes mellitus. *Sports Med.* 2008;38(10):807-824.

14. Gracey M, King M. Indigenous health part 1: determinants and disease patterns. *Lancet.* 2009;374(9683):65-75.

15. Healy GH, Dunstan DW, Salmon J, Cerin E, Shaw J E, Zimmer PZ., Owen N. Breaks in sedentary time. Beneficial associations with metabolic risk. *Diabetes Care.* 2008;31:661-666.

16. Healy GN, Dunstan DW, Salmon J, Cerin E, Shaw JE, Zimmet PZ, Owen N. Objectively measured light-intensity physical activity is independently associated with 2-h plasma glucose. *Diabetes Care.* 2007;30:1384-1389.

17. Herbert JR, Yunsheng M, Clemow L, Ockene IS, Saperia G, Stanek EJ, Ockene J K. Gender Differences in Social Desirability and Social Approval Bias in Dietary Self-report. *Am J Epodemiol.* 1997;146(12):1045-1055.

18. Janca A, Bullen C. The Aboriginal concept of time and its mental health implications. *Australasian Psychiatry*. 2003;11:40-44.

19. Jartti L, Hakanen M, Paakkunainen U, Raittinen P, Rönnemaa T. Comparison of hand-to-leg and leg-to-leg bioelectric impedance devices in the assessment of bodyadiposity in prepubertal children. The STRIP study. *Acta Paediatrica*. 2009;89(7):781-786.

20. Leonard D, McDermott R, O'Dea K, et al. Measuring Prevalence: Obesity, diabetes and associated cardiovascular risk factors among Torres Strait Islander people. *Aust N Z J Public Health*. 2008;26(2):144-149.

21. Madafferi R. Aboriginal cultural handbook: resources of non-Aboriginal people caring for Aboriginal children. Peth: Aboriginal and Islander Women's Congress of WA; 1998.

22. McDermott R, Tulip F, Schmidt B, Sinha A. Sustaining better diabetes care in remote indigenous Australian communities. *Br Med J*. 2003;327(7412):428-430.

23. O'Dea K. Preventable Chronic Disease Among Indigenous Australians: The Need for a Comprehensive National Approach. *Heart Lung Circ*. 2005;14(3):167-171.

24. O'Neil A, Stevenson CE, Williams ED, Mortimer D, Oldenburg B, Sanderson K. The health-related quality of life burden of co-morbid cardiovascular disease and major depressive disorder in Australia: findings from a population-based, cross-sectional study. *Qual Life Res*. 2013;22:37-44.

25. O'Sullivan SB. Physical Therapy glossary. 5th ed. Philadelphia: F. A. Davis Company; 2007. 1335. 365 p.

405 26. Owen N, Healy GN, Matthews CE, Dunstan DW. Too much sitting: the population
406 health science of sedentary behaviour. *Exer Sport Sci Rev*. 2010;38(3):105-113.
407 27. Rasekaba T, Lee LE, Naughton MT, Williams TJ, Holland AE. The six-minute walk
408 test: a useful metric for the cardiopulmonary patient. *Intern Med J*. 2009;39(8):495-
409 501.
410 28. Shilton TR, Brown WJ. Physical activity among Aboriginal and Torres Strait
411 Islander people and communities. *J Sci Med Sport.* 2004;7(1):39-42.
412 29. Sinha AK, O'Rourke S, Yanker J, Leonard D. Type 2 Diabetes in Children and
413 Adolescents in the Indigenous communities of Far North Queensland. Proceedings of
414 the 17th International Diabetes Federation Congress. *Diabetes Res Clin Pract*.
415 2007;50(1):113-135.
416 30. Swinburn BA, Eggar GJ, Raza F. Dissecting obesogenic environments: the
417 development and application of a framework for identifying and prioritising
418 environmental interventions for obesity. *Prev Med.* 1999;29:563-570.
419 31. Thompson P D. Exercise and physical activity in the prevention and treatment of
420 atherosclerotic cardiovascular disease. *Arteriosclerosis Thromb Vas Bio*. 2003;23(8):
421 1319-1321.
422 32. Thorp AA, Owen N, Neuhaus M, Dunstan DW. Sedentary behaviours and
423 subsequent health outcomes in adults a systemic review of longitudinal studies, 1996-
424 2011. *Am J Prev Med.* 2011;41(2):207-2015.
425 33. Troiano RP, Berrigan D, Dodd KW, Masse LC, Tilert T, McDowell M. Physical
426 activity in the United States measured by accelerometer. *J Sci Med Sport.*2008;
427 40(6):181–188.

34. Trewin D, Madden R. The Health and Welfare of Australia's Aboriginal and TorresStrait Islander Peoples. Australian Institute of Health and Welfare.2005. Catalogue no IHW14.

35. Trost SG, McIver KL, Pate RP. Conducting accelerometer-based activity assessments in field-based research. *Med. Sci. Sports Exerc*. 2005;37(11):531-543.

36. U.S Department of Health and Human Services. Physical Activity Guidelines for Americans. Washington: U.S Department of Health and Human Services, Office of Disease Prevention and Health Promotion; 2008. Available at http://www.health.gov/paguidelines.

37. Vos T, Barker B, Begg S, Stanley L, Lopez AD. Burden of disease and injury in Aboriginal and Torres Strait Islander Peoples: The Indigenous health gap. *Int. J. Epidemiol*. 2009;38:470-477.

38. Willett WC, Koplan JP, Nugent R, Dusenbury C, Puska P, Gaziano TA. Prevention of Chronic Diseases by Means of Diet and Lifestyle Changes. 2nd ed. Washington (DC): World Bank; 2006. Chapter 44.

39. Willis E, Reynolds L, Keleher H. Understanding the Australian Health Care System. Sydney: Elsevier; 2009. 57 p.