Comparability of Accelerometer- and IPAQ-Derived Physical Activity and Sedentary Time in South Asian Women: A Cross-Sectional Study

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Abstract

Background: There is limited research documenting objectively measured physical activity (PA) and sedentary (ST) in South Asian (SA) women, with no published evidence of the validity of self-report methods for assessment of PA/ST in SA. The purpose of this study was to compare accelerometer- and IPAQ-derived PA/ST among SA women in the United Kingdom (UK) via a mixed methods approach. **Methods:** 140 SA women wore an accelerometer for 7 consecutive days; a sub-sample (n=50) completed the IPAQ-Short form (IPAQ-SF) and a brief structured interview. **Results:** Accelerometer-derived MET.min.wk^{-1} MVPA (mean+/-SD) for the full sample was 793.94(+/-519.44) and mean accelerometer-derived STwk was 530.20(+/-81.76). IPAQ-SF derived MVPA (MET.min.wk^{-1}) was 636.80(+/-2113.56) and mean STwk was 315.31(+/-266.98). Pearson correlations were not significant between accelerometer- and IPAQ-SF-assessed MVPA (r=-.119, p=.579), and ST (r=-.140, p=.229). Major themes synthesized from interviews included inability to recall sitting time, and limited general knowledge of real-life examples of MVPA. **Conclusions:** These results suggest that the IPAQ-SF may not accurately measure PA/ST in UK SA women. These findings are supported by qualitative evidence indicating several issues with interpretation and recall of PA/ST as assessed via this questionnaire.

Background

The health benefits of physical activity (PA) are well documented, and the potential negative consequences of increased sedentary time (ST) are being recognized (Davies, Blake, & Dhana, 2011). Major health organizations agree that 150 minutes of moderate intensity PA or 75 minutes of vigorous activity per week are needed to reduce risks for chronic disease morbidities and premature mortality (UKDH, 2011). There are currently no guidelines for ST; however it is suggested that reducing ST as much as possible and breaking up bouts of ST are important strategies to promote health (USDHHS, 2011; UKDH, 2011). Those who are physically active can reduce their risk for cardiovascular disease by up to 50% (Williams, Stamatakis, Chandola, & Hamer, 2010a), and reducing ST may improve metabolic profiles of adults with type 2 diabetes (Cooper, Sebire, & Montgomery, 2012).

Self-report data from the Health Survey for England indicate that Bangladeshi and Pakistani women in the UK are less likely to meet PA guidelines than their white counterparts (Higgins & Dale, 2009). Limited data suggest that South Asian (SA) women are also more sedentary than the general population (Babakus & Thompson, 2012). As such, increasing PA and reducing ST in this population are important public health priorities, as SA are at higher risk than the general population for morbidity and premature mortality resulting from various chronic diseases (Williams *et al.*, 2010a). As in all populations, it is important to accurately assess PA/ST in SA to enhance surveillance and examine trends, and develop and evaluate appropriate and effective prevention and intervention strategies to increase PA and reduce ST (Lee, Macfarlane, & Lam, 2011).

There is currently no generally accepted standardised method of accurately assessing PA/ST, although self-report questionnaires and objective methods such as accelerometry are now widely used (Kurtze, Rangul, & Hustvedt, 2008). A recent mixed-methods systematic review examining PA/ST among SA women (aged 16 to 90yrs) found that there is limited

published research documenting objectively measured PA/ST levels in SA women. Further, this review revealed no published evidence of the validity of self-report methods of PA assessment in this group, and indicated that findings published to date on PA/ST in SA women is of relatively low quality (Babakus & Thompson, 2012). Moreover, only two studies used objective measurements of PA and only two studies assessed self-reported ST (Babakus & Thompson, 2012).

Accelerometry is a popular method of objectively measuring PA/ST due to small device size and ease of use (Lee *et al.*, 2011). These devices are lightweight motion sensors that record frequency, intensity and duration of PA and can detect ST; they monitor activity in a free-living environment and are practical for measuring PA/ST in large groups (Mathie, Coster, & Lovell, 2004). However, due to their relatively high cost, accelerometers are not always an option for large-scale studies. Therefore questionnaires are commonly used to assess PA/ST. There are over 85 self-administered questionnaires available to measure PA/ST for adults, children and the elderly (Williams, Nazroo, Kooner, & Steptoe, 2010). Among these, the International Physical Activity Questionnaire (IPAQ) has become a widely used self-report tool to assess PA/ST (Williams *et al.*, 2010a). The IPAQ is designed to provide data on PA/ST that can be compared nationally and internationally and validated using accelerometry (IPAQ, 2013). This questionnaire is intended to be translated and culturally adapted as needed, although to date, there appear to be no published studies examining how it may need to be adapted for use within groups with a range of English literacy (such as SA women living in the UK).

To our knowledge, no studies have explored the validity of using the IPAQ to assess PA and ST in SA women (Babakus & Thompson 2012). Thus, the aims of this mixed-method study were to: 1) assess the comparability of accelerometer and IPAQ derived PA/ST in SA women (specifically Bangladeshi and Pakistani); and 2) provide a description of SA women's

understanding of the terminology, content and context of the IPAQ-SF using brief structured interviews.

Methods

Participants

A convenience sample of Bangladeshi and Pakistani women aged 18-72 years living in Cardiff, Wales were recruited from January 2012 through March 2013. Recruitment was initiated with contacts from a previous study conducted within the Bangladeshi community (Project MINA, 2013), with additional recruitment conducted via referral from those contacts, and various community groups in Cardiff. Women were eligible to participate if they were 18 years or older, born in Bangladesh or Pakistan and now living in the UK, or born in the UK with Bangladeshi or Pakistani parents, healthy enough to participate, and able to give full informed consent. Translators fluent in Punjabi, Urdu, Bengali and Sylheti were available during all phases of recruitment and data collection for women who were not fully fluent in English. All participants were invited to wear an accelerometer and have demographic and anthropometric measurements taken. On the day of measurement, a sub-sample of women was purposively selected based on age range and levels of English literacy and invited to complete the IPAQ-Short Form (IPAQ- SF). Written and verbal consent was obtained from participants; ethical approval was granted by the University Ethical Review Committee of the University of Birmingham (reference # ERN_12-1316).

Descriptive Characteristics

Descriptive data included height (to the nearest mm with a SECA Leicester Stadiometer), weight (to the nearest 0.1 kg using a SECA 899 digital scale), and waist circumference (to the nearest cm) using standard protocols. Age, current health/disease status,

medications, place of birth and years in the UK were self-reported. Body fat percentage was estimated (to the nearest 0.1%) using bioelectrical impedance (BodyStat Quadscan 4000 unit, BodyStat Ltd, Douglas, Isle of Man, British Isles) and an equation validated among SA women (Kolt, Schofiel, Rush, Oliver, & Chadha, 2007). Body mass index (BMI) was calculated by dividing weight in kilograms by the square of height in meters.

IPAQ-Short Form

The IPAQ-SF is a 9-question self-report tool that documents PA/ST performed over the previous 7 days (IPAQ, 2013). English literacy levels of participants were as follows: 1) 38.6% were fully fluent in written and spoken English, and completed the English version of the IPAQ-SF in the presence of a researcher (WBC); 2) 34.2% had some written and spoken English literacy, but preferred to complete the IPAQ-SF in their native language in the presence of the researcher and a trained translator; and 3) 26.3% had little or no English literacy skills and thus completed the IPAQ-SF in their native language in the presence of the researcher and a trained translator.

Data were converted into MET-minutes per week based on the IPAQ scoring protocol (IPAQ, 2013). One MET (Metabolic Equivalent) is equivalent to resting energy expenditure. Total minutes over the 7 days spent in moderate- and vigorous-intensity PA were multiplied by 4.0 and 8.0, respectively, to obtain a MET score for each intensity level.

Accelerometer

The Actigraph GT1M and GT3X were used to collect objective measures of PA/ST. These models are widely employed and data obtained from them are reported to be valid and reliable in adults, children and the elderly (Lee *et al.*, 2011). A recent study (Vanhelst, Mikulovic, & Bui-Xuan, 2012) comparing the GT1M and the GT3X models found no significant difference in measurement of PA/ST between the models, therefore no additional calibration or validation between the two models was undertaken. Participants were instructed to wear the accelerometer around their waist for 7 consecutive days during waking hours, and to remove it for sleeping, swimming, or bathing.

Data Reduction

Accelerometer data were downloaded using Actilife 6 data analysis software (Actigraph, LLC, Pensacola, Florida). The epoch for analysis was 60 seconds (Dinesh *et al*, 2012). A valid day of accelerometry measurement was defined as a recording of at least 600 minutes of registered time (Dinesh, Tyo, & Bassett, 2012). Participants with a minimum of 3 valid days of activity that included one weekend day were included in analyses (Gemmill, Bayles, & McTigue, 2011). Non-wear time was defined as more than 60 successive minutes of zero counts. Data were reduced using Kinesoft software (v3.3.75; Kinesoft, Saskatchewan, Canada) to provide counts per minute (CPM) of activity, minutes of moderate-to-vigorous physical activity (MVPA), and minutes spent in ST. Cut points used to determine minutes spent at intensity levels were: sedentary = <50counts/min.; light activity = 51-500 counts/min.; moderate activity = 501-1400 counts/min; vigorous activity = 1401-2300/min; and very vigorous activity = 2301- ∞ /min (Freedson, Melanson, & Sirard, 1998). These cut points were chosen because they are widely used in adult populations therefore making our

study comparable to other populations, and known to reflect different intensities of activity. All activity and ST variables were not normally distributed therefore they were log transformed for statistical analyses.

Comparison Variable

The IPAQ-SF calculates and reports physical activity in MET minutes per week (MET.min.wk^{-1}). For comparison purposes, accelerometer data were converted into MET.min.wk^{-1}. Moderate intensity PA was calculated at (4 x minutes of moderate PA), vigorous intensity PA was calculated as (8 x minutes of vigorous PA) and MVPA was calculated as [(8 x minutes of vigorous PA) + (4 x minutes of moderate PA)] (Freedson *et al.*, 1998). ST is reported as mean minutes per week (STwk) for both accelerometer and IPAQ-SF data.

Brief Structured Interview

Following the administration of the IPAQ-SF, participants were invited to participate in a brief interview to determine ease of use, understanding of terms used in the IPAQ-SF, and cultural contextualisations of PA/ST in daily life. The interview consisted of 12 questions based on a review of the literature and guided by the research aims of the study. A trained translator was available for women with limited or no fluency in English. Interviews were audio recorded and transcribed verbatim.

Data Analysis

Descriptive statistics (means, SDs, percentages) were calculated for all variables (Table 1). T-tests were conducted to determine whether there were any significant differences between the full and sub-sample for age, BMI, or accelerometer and IPAQ-SF

derived PA and ST. Pearson correlations were determined to examine the relationship between accelerometer and IPAQ-SF by PA intensity level. Additionally, Bland-Altman plots were used to explore the differences in the two methods of measurement. All statistical analyses were conducted using PASW 18.0 (Quarry Bay, Hong Kong). Transcripts from the brief interviews were coded independently by two researchers (WBC and JLT). Data from the interview transcripts were coded using directed content analysis (Ferriday & Muir-Cochrane, 2006).

Results

140 (84%) of the 167 participants recruited into the study, had a minimum of 3-days of valid accelerometry data and were included in analyses. A sub-sample of 50 participants (36% of the 140 with valid accelerometer data) provided complete self-reported data from the IPAQ-SF. As reported in Table 1, the mean age and BMI for the full sample were 46.3+/-15.12 yr and 27.8+/-5.5 kg/m^2, respectively; 22.9% and 65.7% were categorized as overweight and obese, respectively, according to the World Health Organization's definition for SA BMI (WHO, 2004) (Table 1). Mean age and BMI for the sub-sample were 45.76+/-13.6 and 28.0+/-6.3 kg/m^2 respectively; 22.1% and 65.7% were categorized as overweight and obese, respectively (Table 1).

Accelerometer-derived mean CPM was 2194.01+/-828.66 count/min/wk, mean moderate intensity PA min/wk was 213.50+/-135.24, mean vigorous intensity PA min/wk was 32.83+/-11.48, and mean MPVA min/wk was 242.62+/-150.64 min/day for the full sample. Accelerometer derived MET.min.wk^{-1} for moderate PA, vigorous PA and MVPA for the full sample were 668.81+/-460.21, 20.12+/-60.88, and 793.94+/-519.44 respectively. Accelerometer derived MET.min.wk^{-1} for moderate PA, vigorous PA and MVPA for the subsample was 680.38+/370.34, 21.47+/-34.11, and 738.41+/-393.07 respectively. Mean

accelerometer derived ST (min/wk) for the full and sub-sample was 3711.40+/- 572.32 and 3474.94+/- 508.06, respectively. IPAQ-SF derived moderate PA (MET.min.wk^{-1}), vigorous PA (MET.min.wk^{-1}), and MVPA (MET.min.wk^{-1}) were 462.56+/-678.44, 34.87+/-181.69, and 636.80+/-2113.55. IPAQ-SF derived mean ST (min/wk) was 2207.17+/-1868.86 (Table 2). T-tests indicate no significant difference ($p>0.05$) between the full and sub-sample in age, BMI, waist circumference or accelerometer derived moderate PA, vigorous PA, MVPA and ST.

There were significant differences between accelerometer MET.min.wk^{-1} MVPA and IPAQ-SF MET.min.wk^{-1} MVPA ($p<.001$), and between accelerometer ST (min/day) and IPAQ-SF ST (min/day) ($p<.001$), with the values lower for the IPAQ-SF in both instances. Pearson correlations indicated no significant associations between accelerometer- and IPAQ-SF-derived MET.min.wk^{-1} for moderate PA (r=-.309, p=.133), vigorous PA (r=-.168, p=.423), MVPA (r=-.119, p=.579), or ST (r=-.140, p=.229). When controlling for literacy ability significant correlations emerged for moderate PA and MVPA (English literate: Moderate PA, r=-.940, p=.002; MVPA, r=.886, p=.003; Some literacy: Moderate PA, r=.856, p=.007; MVPA, r=.844, p=.008; Little or no literacy: Moderate PA, r=.838, p=.009, MVPA, r=-.950, p=.001) Bland-Altman plots showing the difference between accelerometer and IPAQ derived activity and ST can be seen in Figures 1 and 2. For MVPA, the mean difference between the methods was .75 ($p<.001$) (532.75 MET.min.wk^{-1} not log transformed) and the 95% limits of agreement were relatively wide (-1.43 to 2.89), indicating the two methods are not likely to be measuring MVPA similarly (Figure 1a). When MVPA was separated into moderate and vigorous activity, Bland-Altman plots show that for moderate PA the mean difference in the methods was -.04 (not significant) (138.05 MET.min.wk^{-1} not log transformed) and with similarly large 95% limits of agreement (-.83 to 3.09) (Figure 1b). The mean difference for vigorous PA was .004 (not significant) (14.82

MET.min.wk^{-1} not log transformed) but with smaller 95% limits of agreement (-1.57 to 2.35) (Figure 2a). Importantly, only 42% of participants who completed the IPAQ reported engaging in any vigorous PA. The mean difference for ST was -.26 (not significant) (223.83 min/wk not log transformed) with much smaller 95% limits of agreement of -1.79 to 1.35 (Figure 2b), suggesting that the two methods are likely to be measuring ST similarly.

Major themes emerging from the brief structured interview included: (1) lack of cultural context and terminology for participation in leisure-based PA; (2) inability of participants to equate their own PA with examples of intensity levels from the IPAQ-SF; (3) inability of participants to recall sitting time; and (4) limited general knowledge of real-life examples of activities that are of moderate or vigorous intensity. Table 3 provides exemplar quotes for each major theme. These themes were identified as the most salient issues affecting participants' ability to self-report PA/ST among this sample, with theme (1) reported in 68% of interviews, theme (2) in reported in 53% of interviews, theme (3) reported in 83% of interviews, and theme (4) reported in 57% of interviews.

Discussion & Conclusions

This study assessed the comparability of objectively measured PA/ST using accelerometry with self-reported PA/ST using the IPAQ-SF in a sample of UK-residing SA women. Results indicate that the IPAQ-SF may not accurately measure PA/ST in women of Bangladeshi and Pakistani descent. There were no significant correlations between accelerometer derived PA/ST and IPAQ-SF derived PA/ST before controlling for literacy level. However when literacy was controlled for, significant correlations were found for moderate PA and MVPA. This indicates that there may be differences between accelerometer and IPAQ measurement of vigorous PA and ST but not moderate PA and MVPA. In both the

measurement of PA and ST, the IPAQ-SF underestimated the level of activity of participants when compared to accelerometer-derived data.

Further exploration of this measurement difference can be seen in the Bland-Altman plots of activity and ST. The mean difference between accelerometry and IPAQ measurement of MVPA and wide limits of agreement indicate a low level of agreement between the two methods. This is also the case when moderate and vigorous activity are investigated separately. This may be accounted for by the qualitative evidence indicating several issues with interpretation and recall of PA/ST. Specifically the underestimation of MVPA may have been affected by the lack of cultural context and terminology of leisure-based PA, the inability of participants to relate PA examples given in the IPAQ-SF to their own PA, as well as their difficulty in recalling sitting time. These results are consistent with those from similar studies conducted with predominantly white participants and indicate an inherent recall bias (Gemmill *et al.*, 2011). Recall bias may be compounded in the present study by the respondents' lack of knowledge and cultural contextualisations related to participating in PA for leisure, and to defining and describing their own PA/ST. Furthermore, the results point to a possible discrepancy in the way that the IPAQ and the SA women conceptualise moderate and vigorous PA. A more extensive exploration of how SA women recall or conceptualise moderate and vigorous activity may be needed to improve the validity of the IPAQ among SA women.

A recent systematic review highlights the difficulties in comparing levels the PA/ST among SA due to the lack of standardized measurement, though some comparisons can be made with studies using the IPAQ and accelerometer data (Babakus & Thompson, 2012). Using the IPAQ, Williams et al. (2010) found that 45.6% of SA men and women in the study were sedentary (using the benchmark of more than 3 hours/day of sedentary time) and

another study found 40% of SA women were sedentary (according to IPAQ-SF data) (Yates, Davies, & Gray, 2010). Our study found a much higher percentage of participants to be sedentary according to the IPAQ-SF (86%). A possible explanation for this difference may be, as the qualitative interviews identify, an inability for participants' to accurately recall sitting time as well as a possible relationship between high levels of overweight/obesity and increased time spent being sedentary. Kolt et al. (2007), in one of only 2 published studies reporting PA from accelerometer data in SAs, and the only one to report ST, reported 48% of SA men and women were sedentary when measured by accelerometer. Similarly, accelerometer-derived data from our study showed 47.7% of our sample to be sedentary. These findings are unique and important, as to date most conclusions drawn about PA amongst SA women are based on self-report data and assume that they are substantially less active than the general White population.

There are some limitations to this study. Firstly, the study sample is a relatively small convenience sample, and is not representative of all SA women living in the UK. Therefore our findings cannot be generalised to the wider population of SA women in the UK. A larger validation study is necessary to provide definitive data on the comparability of accelerometer and IPAQ methods in SA women. Another limitation of this study is the use of the IPAQ-SF instead of the Long Form version, which is reported to provide more in depth and detailed activity data. Although the Long Form may have yielded more detailed data on activity levels, the IPAQ-SF was deemed appropriate for this study due to it's ease of use, rapid translation, and ability to collect overall activity data in a limited amount of time. In addition, based on the participants' limited cultural contextualization related to PA and ST, we are not convinced that using the IPAQ Long Form would have necessarily provided more accurate information. Strengths of this study include this being the largest reported sample of SA women measured by accelerometer to date, the recruitment of individuals who are

traditionally defined as “hard-to-reach”, inclusion of SA women across the range of age, activity levels, and English literacy levels, and triangulation of quantitative data with qualitative interview data.

To our knowledge, there have been no other studies published to date that have assessed the comparability of accelerometer- and IPAQ-SF-derived PA/ST among SA women in the UK. Our data suggest that further validation of the IPAQ-SF with a larger sample of SA women is needed to determine its suitability within this population. These results strengthen the argument for the development of more culturally tailored and contextualized self-report tools for the assessment of PA/ST among SA women, and emphasize the need for the wider use of accelerometers to objectively measure PA/ST and use these to validate self-report tools in multi-cultural populations. Moreover, the amount of ST and daily patterns of sedentary behaviours among SAs should be explored further, as our accelerometer data indicate a less sedentary group that might have been expected based on published self-report data.

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References

1. Babakus, W.S., Thompson, J.L. (2012). Physical activity among South Asian women: a systematic, mixed-methods review. *International Journal of Behavioral Nutrition and Physical Activity*, 9,150-167. doi: 10.1186/1479-5868-9-150
2. Chaudhury, M., & Esliger, D. (2009). Accelerometry in adults. *Health Survey for England 2008*. 1,59-78.
3. Cooper, A.R., Sebire, S., Montgomery, A.A., Peters, T.J., Sharp, D.J., Jackson, N., Fizsimons, K., Dayan, C.M., & Andrews, R.C. (2012). Sedentary time, breaks in sedentary time and metabolic variables in people with newly diagnosed type 2 diabetes. *Diabetologia*, 55,589-99. doi: 10.1007/s00125-011-2408-x
4. Davies, A. A., Blake, C., & Dhana, P. (2011). Social determinants and risk factors for non-communicable diseases (NCDs) in South Asian migrant populations in Europe. *Asia Europe Journal*, 8, 461-473. doi:10.1007/s10308-011-0291-1
5. Dinesh, J., Tyo, B., & Bassett, D.R. (2010). Comparison of four Actigraph accelerometers during walking and running. *Medicine & Science in Sports & Exercise,* 42(2), 368-374. doi: 10.1249/MSS.0b013e3181b3af49
6. Ferriday, J., & Muir-Cochrane, E. (2006). Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. *International Journal of Qualitative Methods*, 5(1),1-11. doi: 10.1177/1049732311400431
7. Freedson, P.S., Melanson, E., & Sirard, J. (1998). Calibration of the Computer Science and Applications, Inc. *Medicine & Science in Sports & Exercise,* 30(5), 777-781. doi: 10.1097/00005768-199805000-00021

8. Gemmill, E., Bayles C.M., McTigue K., Satariano W., Sharma R., & Wilson J.W. (2011). Factors associated with adherence to an accelerometer protocol in older adults. *Journal of Physical Activity and Health*, 8,1152-1159.
9. Higgins & Dale (2009). This is a chapter. In Stillwell & van Ham (Eds.), Ethnicity and Integration: Understanding Population Trends and Processes: Ethnic differences in physical activity and obesity (pp. 20-31). New York: Springer.
10. International Physical Activity Questionnaire website[http://www.ipaq.ki.se/ipaq.htm]. (Accessed April 23, 2011).
11. Kolt, G.S., Schofiel, G.M., Rush, E.C., Oliver, M., & Chadha, N.K. (2007). Body fatness, physical activity, and nutritional behaviours in Asian Indian immigrants to New Zealand. *Asia Pacific Journal of Clinical Nutrition*, 16(4),663-670.
12. Kurtze, N., Rangul, V., &Hustvedt, B. (2008). Reliability and validity of the international physical activity questionnaire in the Nord-Trondelag health study(HUNT) population of men. *BMC Medical Research Methodology*, 8,63-71. doi: 10.1186/1471-2288-8-63
13. Landman J. & Cruickshank J.K. (2001). A review of ethnicity, health and nutrition-related diseases in relation to migration in the United Kingdom. *Public Health Nutrition*, 4, 647-657.
14. Lee, P.H., Macfarlane, J., Lam, T.H., & Stewart S.M. (2001). Validity of the international physical activity questionnaire short form (IPAQ-SF): A systematic review. *International Journal of Behavioral Nutrition and Physical Activity*, 8,115-125. doi: 10.1186/1479-5868-8-115

15. Mathie, M.J., Coster, A.C.F., Lovell, N.H., & Celler, B.G. (2004). Accelerometry: providing an integrated, practical method for long-term, ambulatory monitoring of human movement. *Physiological Measurement*, 25, R1–R20.
16. Project MINA Web site (Internet): http://projectmina.org/. [Accessed May 11,2013].
17. Roth, M. (2009). Self-reported physical activity in adults. *Health Survey for England 2008*, 1,21-43.
18. UK Department of Health. (2011). Physical activity guideline for adults (19-64 years), 1.
19. Vanhelst, J., Mikulovic, J., Bui-Xuan, G., Dieu, O., Blondeau T, Fardy P, Beghin L: Comparison of two ActiGraph accelerometer generations in the assessment of physical activity in free living conditions. *BMC Research Notes* 2012; 5:187-190. doi: 10.1186/1756-0500-5-187
20. World Health Organization. (2004). Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet*, 13,157-163.
21. Williams, E.D., Nazroo, J.Y., Kooner, J.S., & Steptoe, A. (2010). Subgroup differences in psychosocial factors relating to coronary heart disease in the UK South Asian population. *Journal of Psychosomatic Research*, 69, 379-387. doi: 10.1016/j.jpsychores.2010.03.015
22. Williams, E.D., Stamatakis, E., Chandola, T., Hamer, M. (2010a). Physical activity behaviour and coronary heart disease mortality among South Asian people in the UK: an observational longitudinal study. *Heart*, 97, 655-659. doi: 10.1136/hrt.2010.201012

23. Yates, T., Davies, M.J., & Gray, L.J. (2010). Levels of physical activity and relationship with markers of diabetes and cardiovascular disease risk in 5474 white European and South Asian adults screened for type 2 diabetes. *Preventative Medicine,* 51, 290-294. doi: 10.1016/j.ypmed.2010.06.011

Tables

Table 1: Participant Characteristics

	All (n=123)	**Subsample (n=50)**	**P value**
Age (yrs)	46.3+/- 15.12	40.1+/- 10.5	*p*=.236
BMI kg/m^2 *	27.8+/- 5.5	28.2+/- 5.3	*p*=.458
% Underweight <18.5	0.80	0.50	
% Normal Weight 18.5-23	10.60	14.70	
% Overweight 23.1-27.5	22.90	22.10	
% Obese >27.5	65.70	62.70	
% Body fat	53.9+/- 3.9	50.6+/-4.1	*p*= .212
Waist circumference (cm)	92.4+/- 9.3	91.9+/- 6.3	*p=.602*

***BMI Categories as defined for South Asians by WHO (2004) Lancet 363:157-163**

Table 2: Summary Variables

Variables	All [A]	Subsample		P-differences between A and B	P-values differences between methods
		Accelerometer[B]	IPAQ SF		
Moderate PA (min/wk)	213.50+/- 135.24	185.64+/- 279.58		*p=.59*	
Vigorous PA (min/wk)	32.83+/- 11.48	18.13+/- 13.09		*p=.07*	
MVPA (min/wk)	242.62+/- 150.64	216.30+/- 147.00		*p=.169*	
ST (min/wk)	3711.40+/- 572.32	3474.94+/- 508.06	2207.17+/- 1868.86	*p=*.251	*P<.001*
MET.min.wk[1] Moderate	668.81+/- 460.21	680.38+/- 370.34	462.56+/- 678.44	*p=.130*	*P<.001*
MET.min.wk[1] Vigorous	20.21+/- 60.88	21.47+/- 34.11	34.87+/- 181.69	*p=.109*	*P<.001*
MET.min.wk[1] MVPA	793.94+/- 519.44	738.41+/- 393.07	636.80+/-2133.55	*p=.159*	*P<.001*

* For illustration purposes the activity data represented in table are original values. Data were log transformed for analysis.

Table 3: Major themes from brief structured interviews

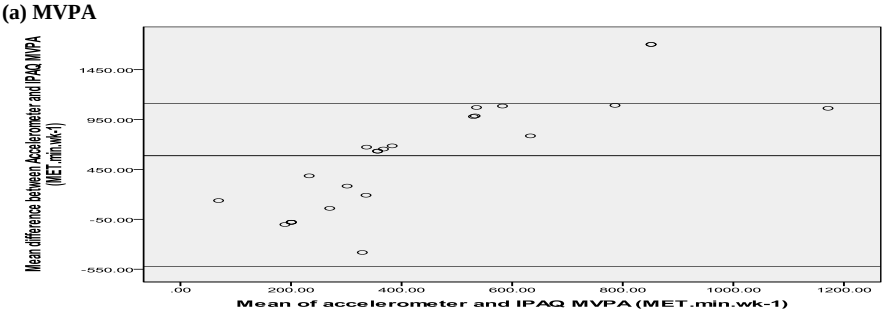
Major Theme	Participant Quotes
(1) Lack of Cultural Context and Terminology	“I don’t know this word very well, vigorous. I work hard to make my home. Is this the same?” * 59 year old Bangladeshi woman "Vigorous is not easy to understand for me. I need explanation and examples." * 62 year old Pakistani woman
(2) Inability to equate own PA with IPAQ-SF examples	“ During the questions I don’t understand, you see, what is this moderate level. I do carry loads like washing but I never do tennis or bicycle. So I don’t do any of this moderate [physical activity]?” * 47 year old Pakistani woman "Is it [moderate physical activity] when I sweat a lot or only just like walking?" * 32 year old Bangladeshi woman
(3) Inability to recall sitting time	“ I don’t think I do sit much. I get up and pray, make the breakfast, and food for the day. I think I sit sometimes but for how long I don’t know this.” * 64 year old Pakistani woman "I don't really keep time of how much sitting. I sit after cooking and taking tea but for how long I don't know." * 53 year old Bangladeshi woman
(4) Limited general knowledge of real-life examples of PA intensity	“I do my prayer during the day and this is, I think is moderate [physical activity]. It is enough.” * 72 year old Pakistani woman "I do walking sometimes so this is vigorous, isn't it? I'm not sure." * 35 year old Bangladeshi woman

Figures

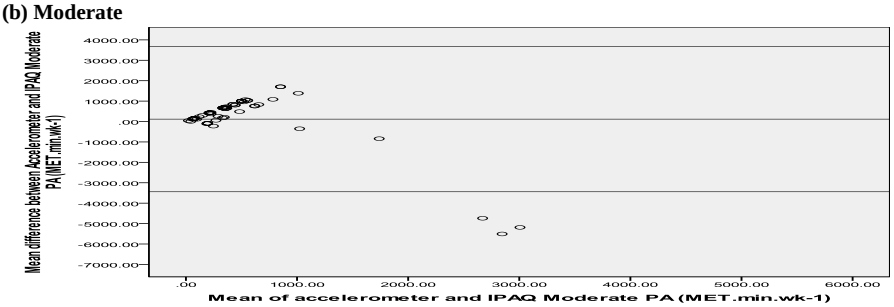
Figure 1. (a) The difference between accelerometer measured time spent in MVPA and IPAQ measured time spent in MVPA (y-axis) plotted against the mean of accelerometer and IPAQ time spent in MVPA (x-axis) with 95% limits of agreement. Overall mean difference was 532.75 MET.min.wk^{-1} and limits of agreement were –520.72 to 1109.54 (n=50). (b)The difference between accelerometer measured time spent in moderate PA and IPAQ measured time spent in moderate PA (y-axis) plotted against the mean of accelerometer and IPAQ time spent in moderate PA (x-axis) with 95% limits of agreement. Overall mean difference was 138.05 MET.min.wk^{-1} data and limits of agreement were -3441.33 to 3675.27 (n=50). Data reported here are original data, not log transformed for clarity of reporting. (c) The difference between accelerometer measured time spent in vigorous PA and IPAQ measured time spent in vigorous PA (y-axis) plotted against the mean of accelerometer and IPAQ time spent in vigorous PA (x-axis) with 95% limits of agreement. Overall mean difference 14.82 MET.min.wk^{-1} and limits of agreement were -399.36 to 350.38 (n=50). (d) The difference between accelerometer measured time spent in ST and IPAQ measured time spent in ST (y-axis) plotted against the mean of accelerometer and IPAQ time spent in ST (x-axis) with 95% limits of agreement. Overall mean difference was 223.83 min/wk and limits of agreement were -337.24 to 785.66 (n=50). Data reported here are original data, not log transformed for clarity of reporting.

Figure 1 a-d

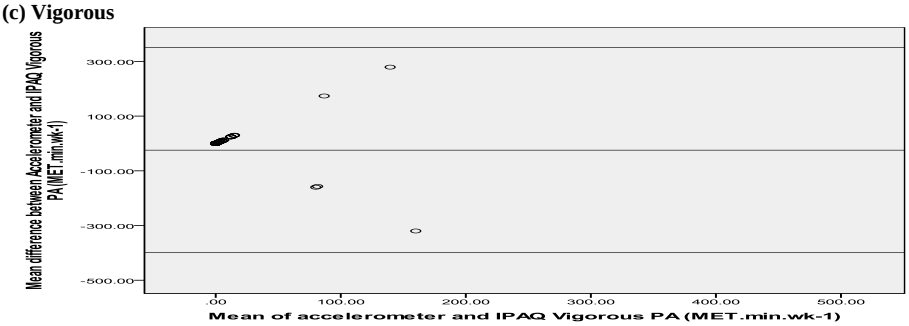
(a) MVPA



(b) Moderate



(c) Vigorous



(d) Sedentary