Physical activity and health among older adults in India: Results of a Study on Global AGEing and adult health sub-study using accelerometry

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Recent technological advances in accelerometry have provided researchers with a useful tool for accurately measuring energy expenditure and documenting physical activity patterns in population-level studies (Troiano et al., 2008). However, this technology has been underutilized in the study of physical activity patterns among non-Western groups and relatively few studies have examined older adults (>50 years old) in these populations. This is unfortunate given the utility of accelerometry in accurately and reliably distinguishing activity levels between older adult individuals (Copeland & Esliger, 2009).

Most data on physical activity among older adults is based on self-report, yet these activity calculations can underestimate energy expenditure because they often fail to record the complexity and multidimensional nature of active behavior that occurs during normal daily life (Snodgrass, 2012). In addition, studies of older adults have shown that memory recall and cognitive challenges can affect measurements. Also, light and moderate intensity activities are the most difficult to recall, yet these are the most common activities among older adults (Taraldsen et al., 2012).

Among older adults, higher levels of physical activity are associated with increased survival, better physical functioning, lower frailty risk, and better mental health (Santos et al. 2012). Several studies have documented a significant decline in physical activity levels with age (e.g., Hansen et al., 2012); however, most studies have used self-report data and those that use objective measures such as accelerometry or doubly labeled water (DLW) have been conducted exclusively among populations in high income countries such as the United States. Because of the lack of objectively measured activity data, it is unclear whether the marked age-related decline in physical activity seen in the United States and Europe is as pronounced among older adults in low and middle income countries, who may have radically different lifestyles with dissimilar transportation options, occupations, and leisure-time behaviors. This is an important topic given that many populations are currently experiencing rapid economic development and adopting Western diets and lifestyles, which are increasing the burden of chronic conditions such as obesity, cardiovascular disease, and type 2 diabetes.

The present study was conducted among older adults in urban India with the following three objectives: 1) to compare average activity levels obtained through different durations of monitoring (1, 3, and 7 days); 2) to evaluate links between measures of physical activity and anthropometrics (e.g., body mass index [BMI]), as well as between activity parameters and measures of household size, work status, and social cohesion; and 3) to consider links between activity and measures of health and fitness.

METHODS

Study on global AGEing and adult health (SAGE). SAGE is a longitudinal, multi-country project designed to collect comprehensive information on the health and well-being of adult populations and the aging process (Kowal et al., 2012). The core SAGE study focuses on older adults (>50 years) from nationally representative samples in six countries (China, Ghana, India, Mexico, Russian Federation, and South Africa). The present study reports data from a physical activity sub-study (SAGE-PA) in India.

Study Location and Participants. The SAGE-PA sub-study was implemented in 2010 as a household interview among urban adults in Jodhpur, India. Data were collected from 200 adults (72M, 128F) between the ages of 49 and 90 years old. 113 participants (33M, 80F) were young older adults (49-60 years old), while 87 (39M, 48F) were considered old older adults (>60 years old).

Survey Measures, Anthropometrics, and Health Information. The SAGE-PA sub-study combined accelerometry as a measure of physical activity with a short interview on economic well-being and work history, health state and functioning, and social cohesion. In this preliminary study, measures of household size (number of individuals living in household) and work status (whether worked for at least 2 days within the past 7 days) were used to get an indication of household composition and employment. Furthermore, a social cohesion measure was utilized based on an evaluation with nine items examining community involvement and social engagements over the past 12 months; scores were summed to create an overall social cohesion score, with higher scores indicating more social cohesion.

Anthropometric dimensions (height, weight, body mass index [BMI; kg/m^2]) were measured following standard practices.

Performance tests were conducted to measure average grip strength (using a hand dynamometer, repeated twice for each hand) and a timed walk (over 4 meters). The questionnaire also asked participants to report whether they have been diagnosed with the following conditions: arthritis, stroke, angina, diabetes, chronic lung disease, asthma, depression, or hypertension.

Accelerometry Data. Participants wore ActiGraph GT3X accelerometers at the hip for 7 consecutive days. Daily average activity counts (ACs) were provided by ActiLife v.4.1.1. Calorie counts were determined using ActiLife v.4.1.1 through a combination of the Freedson and Work Energy Theorem equations. In addition to AC, three activity variables were calculated and used in analyses: 1) activity energy expenditure (AEE; kcal/day); 2) total daily energy expenditure (TDEE; kcal/day), and 3) physical activity level (PAL). To estimate TDEE and PAL, basal metabolic rate (BMR) was estimated from the age- and sex-specific Oxford equations (Henry, 2005). Results here focus on AEE and TDEE.

SELECTED RESULTS

Two participants (1 male, 1 female) were excluded due to corrupt data files. The mean age for men (n=71) was 62.2 (8.0) years and 59.4 (9.3) years for females (n=127).

Duration of Monitoring. No significant differences were identified between 1, 3, and 7 days of activity monitoring for AEE [$F(1.37, 223.83)=2.71$, $P=0.089$] and all other activity variables.

Physical Activity Patterns by Age and Sex. Age was negatively correlated with AEE in men ($r=-0.31$, $P=0.008$) and women ($r=-0.43$, $P<0.001$). A series of two-way independent ANOVA tests were conducted to compare the physical activity levels of young older (49-60 years old) and old older (>60 years old) males and females over 7 days of monitoring. The ANOVA for TDEE revealed that males had significantly higher levels than females ($F(1, 194)=67.49$, $P<0.001$), while young older participants had significantly higher levels than old older adults ($F(1, 194)=39.96$, $P<0.001$). For AEE, males had significantly higher levels than females ($F(1, 194)=6.31$, $P=0.013$), and young older adults demonstrated higher levels than old older adults ($F(1, 194)=16.28$, $P<0.001$). Additional tests showed that old older males had higher AEE levels than old older females ($t(194)=2.24$, $P=0.027$).

Anthropometrics, Lifestyle Measures, and Activity. With young older and old older males combined, partial correlations (controlling for age) were conducted among the physical activity measures, anthropometrics (height, weight, and BMI), household size, and social cohesion scores. TDEE was positively correlated with height ($r=0.354$; $P=0.003$), weight ($r=0.878$; $P<0.001$), and BMI ($r=0.817$; $P<0.001$). Similarly, AEE was positively correlated with height ($r=0.265$; $P=0.027$), weight ($r=0.357$; $P=0.002$), and BMI ($r=0.299$; $P=0.012$). Correlations between physical activity measures and household size and social cohesion scores were non-significant for males. For females, TDEE was positively correlated with height ($r=0.230$; $P=0.009$), weight ($r=0.815$; $P<0.001$), and BMI ($r=0.750$; $P<0.001$). AEE was also positively correlated with weight ($r=0.227$; $P=0.011$) and BMI ($r=0.188$; $P=0.035$). Social cohesion score was positively correlated with AEE ($r=0.244$; $P=0.006$) for females.

PRELIMINARY DISCUSSION POINTS

Physical Activity Levels. The present study used accelerometry to examine physical activity patterns among older adults in Jodhpur, India. Our findings reveal that activity levels for both males and females in this sample are extremely low (PAL averages of 1.14-1.17). The overall low activity levels in the present study are almost certainly attributable, at least in part, to the underestimates of activity due to limitations of accelerometry. Accelerometers do not detect many upper body movements and cannot estimate load-carrying effort and miss entirely certain activities such as swimming that generally require the accelerometer to be removed. Despite the limitations inherent with accelerometry, the current study provides a robust measure of activity, which allows comparisons between individuals.

Duration of Monitoring. An important question in population-based physical activity research is the number of days of monitoring necessary to assess habitual energy levels. Although this topic has been debated for years, studies with accelerometry have helped clarify this issue (Baranowski et al., 2008). Most work among adults in the United States and other high income countries has shown that 3 to 7 days of accelerometry data are needed to reliably document habitual activity patterns (i.e., to capture typical intraindividual variation) (Matthews et al., 2001). However, few studies have been conducted among older adults. An exception is a study in the United States among older adults (aged 55-86 years) that demonstrated that three days of accelerometer monitoring was adequate for the accurate capture of habitual physical activity data in older adults (Hart et al., 2011). No studies to date have addressed this issue in low or middle income countries. The present study did not find significant differences in AEE or TDEE between 1, 3, and 7 days of monitoring. This is likely a result of an extremely sedentary population with relatively low activity levels throughout and little day-to-day variability.

Physical Activity Patterns by Age. Studies in the United States and several European countries have shown a pattern of decreasing physical activity levels with advancing age; in many studies this decline begins in the seventh decade and then accelerates with increasing age (Troiano et al., 2008; Hansen et al., 2012; Sun et al., 2013). Almost no information on population-level trends in activity using objective measures is available for older adults in low or middle income countries. The present study identified significant differences in physical activity levels by age, with the younger group of participants having higher AEE and TDEE compared to the group of older participants. The results reported here are consistent with studies in high income nations showing lower activity levels in more advanced age groups, as well as with the minimal accelerometry data collected in non-Western populations (Peters et al., 2010) and self-report data from low and middle income nations (Hallal et al., 2012).

Physical Activity Patterns by Sex. Another area of intense interest is the extent of sex differences in physical activity and the question of whether these differences show similar patterns across different age groups. The present study identified modest sex differences, with men having higher TDEEs and AEEs than women, and is consistent with the majority of findings from other studies (but see Peters et al., 2010). Some of these energetic differences, such as in TDEE, are partially attributable to larger body sizes in males compared to females; however, AEE is significantly higher in males compared to females, which appears largely attributable to the particularly low AEEs among the oldest group of females.

Anthropometric Correlates of Activity. A number of studies have examined links between anthropometric dimensions and physical activity, many with a focus on delineating the contribution of low activity levels to the risk of obesity (e.g., Prentice et al., 1996). Several studies using objective measures such as accelerometry have shown higher TDEEs among obese adults compared to normal weight individuals, yet when AEE or PAL are examined the results become far more variable. Studies have not consistently found the expected negative associations between BMI and activity measures, and several population-based studies have documented no or positive associations between activity measures and BMI (Dugas et al., 2011). Some have concluded that low activity levels are not a major contributor to recent increases in obesity prevalence. This topic has not been extensively studied in older adults or among individuals in low and middle income nations. The findings from the present study document significant links between physical activity levels and anthropometric dimensions. Among both men and women, BMI and body weight are positively correlated with TDEE and AEE. These results suggest that elevated BMI is not being driven primarily by low activity levels.

Lifestyle Correlates of Activity. The present study obtained information on economic well-being, work history, and social cohesion in order to examine associations between these lifestyle variables and activity measures. Results indicate that none of the household or lifestyle characteristics were significantly related to activity measures among men. Among women, household size and recent work history were also not associated with any of the activity measures, yet those women most socially integrated had higher AEE. This domain should be further investigated as a possible target of intervention for increasing physical activity. More detailed questionnaire data and ethnographic information are needed to understand why this same relationship was not seen among men.

Conclusion. This study demonstrates the utility of accelerometry for quantifying physical activity levels among older adults in non-Western settings. In addition to documenting patterns of physical activity, objectively measured energy expenditure data provide valuable public health information with which policymakers can target interventions that increase physical activity and minimize sedentary time. Interventions informed by objectively measured activity data, which utilize diverse approaches such as behavioral self-monitoring and modifications to the built environment, show promise for minimizing risk for frailty and reducing chronic disease. The potential for identifying new targets of intervention and testing their efficacy will only increase as accelerometers continue to drop in cost and grow in accuracy.

SUPPORT

SAGE and SAGE sub-studies are supported by the Division of Behavioral and Social Research at the National Institute on Aging, US National Institutes of Health, through Interagency Agreements (OGHA 04034785; YA1323-08-CN-0020; Y1-AG-1005-01) with WHO and NIH R01-AG034479. Additional support for data analyses was provided by the University of Oregon.

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