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SHORT REPORT

Physical function and activity among older adults in Jodhpur, India

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Abstract

Background: Physical activity impacts the ageing process; yet, few studies have examined relationships among physical activity, functional abilities and health among older adults in non-Western settings.
Aim: This study tests for associations among measures of physical activity, function and self-report health conditions among 200 older adults (49–50 years old) in Jodhpur, Rajasthan, India.
Methods: Seven consecutive days of accelerometry data were used in measures of physical activity (Total Daily Energy Expenditure [TDEE], Physical Activity Level [PAL], Daily Average Activity Count [AC] and Activity Energy Expenditure [AEE]). Measures of physical function included grip strength, timed walk and daily average sit time. Participants reported if they had been diagnosed with diabetes, hypertension, arthritis and/or depression.
Results: All four measures of physical activity were positively associated with grip strength ($p \leq 0.05$). AC was negatively associated with timed walk ($p \leq 0.05$), and both AC and AEE were negatively associated with daily average sit time ($p \leq 0.05$). Women who reported diagnosis of hypertension had lower PAL and AC ($p \leq 0.05$).
Conclusion: This study provides further evidence for a positive relationship between physical activity and functional ability among older adults and between physical activity and cardiovascular health among women in India.

Keywords

Accelerometry, physical activity, older adults, ageing, SAGE

History

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Introduction

Physical activity has multiple effects on the ageing process, contributing to physical, mental and social well-being in older age (Dogra & Stathokostas, 2012; Bherer et al., 2013). Recent research among older adults (≥50 years old) in high-income countries indicates that higher physical activity levels are associated with greater physical function (Santos et al., 2012), a decreased likelihood of frailty (Peterson et al., 2009), and a lower risk of losing physical independence (Marques et al., 2014). The maintenance of physical function in old age is especially critical in low- and middle-income countries, with rapidly increasing older populations and fewer resources directed to the needs of older adults. A cross-cultural perspective with a concerted focus on low- and middle-income countries is required if a more complete understanding of the relationships among physical activity, function, and health is to be achieved (Hallal et al., 2012); yet, few studies have examined these relationships among ageing populations in such contexts.

Studies investigating population-level physical activity patterns among older adults are further limited by a reliance on self-report data, which often inaccurately capture an individual's full range of active behaviour (Snodgrass, 2012) and have limited validity due to older adults' differing sociocultural perspectives on physical activity (Henderson & Ainsworth, 2000). However, recent technological advances in accelerometry allow for the collection of more reliable data on physical activity variation at the population level. Some studies have also begun utilising accelerometry to examine links between physical activity and health among populations in non-Western settings (Gurven et al., 2013; Wilson et al., 2014), but very few have focused on older adults (but see Peters et al., 2010).

The present study uses accelerometry to test for relationships among measures of physical activity (Total Daily Energy Expenditure [TDEE], Physical Activity Level [PAL], Daily Average Activity Counts [AC], Activity Energy Expenditure [AEE]), measures of physical function (grip strength, timed walk, daily average sit time), and self-report health conditions (diabetes, hypertension, arthritis, depression) among 200 older adults in an urban setting in India. This study tests the following two hypotheses: (H_1) TDEE, PAL, AC and AEE will be positively correlated with grip strength and negatively correlated with timed walk and daily average sit time, while controlling for age, sex and weight; and (H_2) TDEE, PAL, AC and AEE will be lower among participants who report diagnosis of diabetes, hypertension, arthritis and/or depression.

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Methods

Study design and participants

In 2010, the Study on global AGEing and adult health (SAGE)-physical activity and accelerometry (PA) study was conducted in Jodhpur, Rajasthan, India, wherein 200 (72 men, 128 women) urban older adults (49–90 years old) participated in accelerometry data collection and face-to-face interviews. This sample was randomly selected from a 2005 SAGE pilot study conducted in Jodhpur ($n = 492$). SAGE-PA is a sub-study of the World Health Organisation's multi-country SAGE (Kowal et al. 2012).

The World Health Organisation's Ethical Review Board approved SAGE-PA. Further approval was granted by the internal review board of the SAGE-PA partner Organisation in Jodhpur, India (Dr. S.N. Medical College). All participants provided informed written consent.

Physical activity

ActiGraph (Pensacola, FL) GT3X accelerometers were used to collect physical activity data, which were downloaded with ActiLife v.4.1.1 software and processed by two analysts (TJC and AH). Participants wore the accelerometers for 7 consecutive days on the hip. Data were recorded at 60-second epochs for three axes of movement. These data were then used to measure AC and estimate AEE (kcal/day) using ActiLife calculations. AEE was used to estimate TDEE (AEE + Basal Metabolic Rate [BMR; based on Oxford equations, Henry, 2005]). PAL was calculated as TDEE/BMR. Two participants were excluded from the analyses due to corrupt data files.

Physical function and self-report health conditions

Three measures of physical function were gathered during the face-to-face interviews. Grip strength was measured twice in both hands using a Smedley hand dynamometer. Participants also completed a four-metre timed walk at a normal pace on a flat, straight surface. Daily average sit time was self-reported. Interviewers also gathered information regarding diagnosed health conditions including arthritis, depression, diabetes and hypertension. Analyses included a composite health condition measure to test for functional differences between individuals diagnosed with one or more health conditions and those not diagnosed with any of the four health conditions.

Statistical analysis

Pooled partial correlations with men and women combined (controlling for age and sex) were first conducted to test for relationships among measures of physical activity (TDEE, PAL, AC, AEE) and function (grip strength, timed walk, daily average sit time). Pooled partial correlations including grip strength controlled for age, sex and weight. Based on preliminary multiple regression analyses showing a significant interaction between sex and physical activity when predicting health outcomes, additional partial correlations were conducted separately for men and women. T-tests were used to compare the physical activity levels of participants who were diagnosed with one or more of the aforementioned health conditions to participants who were not diagnosed with these conditions; these analyses were conducted separately for men and women. Daily average sit time was filtered to exclude values greater than 16 hours; as a result, one male participant was excluded from analyses. Results were considered statistically significant at $p \leq 0.05$. All analyses used $\log_{10}$-transformed data due to positive skew and were performed using SPSS 21.0.

Table I. Mean age, height, weight and physical function measures for men and women.[a]

	Men		Women	
	n	Mean (SD)	*n*	Mean (SD)
Age	71	62.24 (7.95)	127	59.39 (9.28)
Height (cm)	71	171.90 (6.31)	127	157.81 (6.82)
Weight (kg)	71	68.70 (15.97)	127	63.20 (13.40)
Grip strength (kg)	69	36.85 (8.28)	116	24.66 (9.11)
Timed walk (se	69	6.01 (1.16)	124	6.55 (2.59)
Daily avg. sit time (min)	71	271.90 (197.34)	127	221.34 (120.77)

[a]Values are based on original, non-transformed scales.

Table II. Partial correlations (controlling for age and sex) between measures of activity and function for men and women combined.[a,b]

	Physical activity measures			
Physical function measures	TDEE (kcal/day)	PAL	AC	AEE (kcal/day)
Grip strength	0.147*	0.196**	0.195**	0.187*
Timed walk	−0.007	−0.141	−0.181*	−0.137
Daily average sit time	0.006	−0.129	−0.181*	−0.140*

TDEE, Total Daily Energy Expenditure; PAL, Physical Activity Level; AC, Daily Average Activity Counts; AEE, Activity Energy Expenditure.
[a]Correlations are statistically significant at: $*p \leq 0.05$; $**p \leq 0.01$; $***p \leq 0.001$.
[b]Correlations including grip strength also controlled for weight.

Results

Physical activity and physical function

Descriptive statistics for anthropometrics and functional measures are provided in Table I. Pooled partial correlations with men and women combined (controlling for age and sex) were performed to test H_1.These results are provided in Table II. Accordingly, timed walk showed a negative trend with PAL ($p = 0.052$) and AEE ($p = 0.059$) and was negatively correlated with AC ($p = 0.012$). Daily average sit time was negatively correlated with AC ($p = 0.011$) and AEE ($p = 0.050$). Grip strength was positively correlated with all physical activity measures. When analyses were conducted with sexes separated, daily average sit time was negatively correlated with AC ($r = -0.252$, $p = 0.037$) among men, and timed walk was negatively correlated with PAL ($r = -0.184$, $p = 0.041$) among women. No other correlations were significant in analyses conducted by sex.

Physical activity and self-report health conditions

T-tests were performed to test H_2; that is, physical activity measures will be lower among individuals who report

Table III. Mean physical activity measures for men and women reporting at least one health condition diagnosis and reporting no diagnosis.[a,b]

	No health conditions		One or more health conditions	
Physical activity measures	Men ($n = 39$) Mean (SD)	Women ($n = 56$) Mean (SD)	Men ($n = 32$) Mean (SD)	Women ($n = 71$) Mean (SD)
TDEE (kcal/day)	1 688.1 (299.1)	1 451.8 (209.0)	1 788.2 (360.7)	1 460.8 (216.1)
PAL	1.15 (0.07)	1.17 (0.08)	1.17 (0.11)	1.15 (0.07)
AC	170 039.0 (68 705.8)	186 539.0* (90 455.9)	182 954.0 (114 740.0)	147 878.0 (72 758.0)
AEE (kcal/day)	218.093 (110.4)	212.9 (104.4)	264.1 (194.5)	187.8 (102.3)

TDEE, Total Daily Energy Expenditure; PAL, Physical Activity Level; AC, Daily Average Activity Counts; AEE, Activity Energy Expenditure.
[a]Values are based on original, non-transformed scales.
[b]Differences between those with and without health conditions within the same sex are statistically significant at: *$p \leq 0.05$; **$p \leq 0.01$; ***$p \leq 0.001$.

diagnosis of diabetes, hypertension, arthritis, and/or depression. Mean physical activity measures for men and women diagnosed with at least one health condition and men and women with no diagnosis are reported in Table III. Based on the composite measure, women who reported a diagnosis of one or more health conditions had significantly lower AC ($p = 0.03$). When analyses were conducted with health conditions separated, women diagnosed with hypertension had lower PAL ($p = 0.049$) and AC ($p = 0.021$) than women without hypertension. Physical activity was not significantly associated with health conditions among men.

Discussion

The present study demonstrated a relationship between higher levels of physical activity and greater functional abilities among older adults in Jodhpur, India; these functional abilities are typically used in measures of frailty and are indicative of health and longevity (Fried et al., 2001). In pooled analyses, there were significant relationships between all four measures of physical activity and grip strength; between AC and timed walk; and among AC, AEE and daily average sit time. When stratifying by sex, only the relationship between AC and daily average sit time among men remained significant and the relationship between PAL and timed walk became significant among women. All correlations that were significant for the pooled analyses were still in the predicted directions for both sexes separately. Additional findings demonstrate that women reporting a diagnosis of one or more health conditions have significantly lower AC. When health conditions were further analysed individually, women diagnosed with hypertension were significantly less physically active than those without hypertension.

The loss of significant correlations among measures of physical function and activity in the stratified analyses may have resulted from a lack of statistical power, and additional research is required as none of the four measures of physical activity (TDEE, PAL, AC, AEE) were significantly linked with diabetes, arthritis, or depression, as would be expected based on research conducted in wealthy countries (DiPietro, 2001). It could also be that habitual activity patterns are fundamentally different in lower and higher income countries, with less discretionary physical activity in lower income countries, so those with a condition cannot alter their lifestyles in order to reduce activity. As DiPietro (2001) notes, conditions such as type 2 diabetes as well as those related to bone health are best prevented by active behaviour throughout the life course. The present cross-sectional study only provides a snapshot of activity during a 7-day period and may not capture habitual patterns of energy expenditure. There was also an overall lack of significant relationships among physical activity measures and health among men. While studies often report sex differences in physical activity patterns (Sun et al., 2013), greater active behaviour is typically associated with better health for both sexes (DiPietro, 2001). Therefore, these results indicate the need for a more comprehensive approach to understanding functional decline and health among older men and women in non-Western settings. Despite these limitations, the current study provides further evidence that higher physical activity levels are associated with greater function and a lower incidence of cardiovascular disease among older adults in non-Western settings.

Conclusion

Understanding variation in population-level physical activity patterns and its relation to health is vital to enhancing the well-being of ageing populations. These investigations are especially pertinent to addressing the global burden of chronic disease and are key to informing interventions that attempt to ensure physical independence into old age. While little is known about the impact of physical activity on the ageing process in low- and middle-income countries, accelerometry can be employed in diverse settings to obtain a more complete understanding of active behaviour among ageing populations. The present study documented links among physical activity, functional abilities, and health among older adults in an urban setting in India, contributing to a cross-cultural understanding of the ageing process.

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Declaration of interest

The authors report no conflicts of interest. The Division of Behavioral and Social Research (BSR) 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 World Health Organization and grant NIH R01-AG034479 provided funding for this study.

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