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Wrist Accelerometry in the Health, Functional, and Social Assessment of Older Adults

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To the Editor

The importance of accelerometry as an indicator of older adult health is increasingly recognized. Hip accelerometry is associated with disability, cardiovascular risk, and poor health outcomes and is considered a more precise measure of activity and sedentary behavior than wrist.[1] However, wrist accelerometers have become ubiquitous commercially and are being used increasingly in research as a result of new activity monitor protocols (e.g, National Health and Nutrition Examination Study). Currently, we lack data relating wrist accelerometry to older adult health. In this analysis, we associate wrist accelerometry with an extensive set of health outcomes essential to older adults' well-being using a nationally-representative community sample.

METHODS

We analyzed data from the wrist accelerometry sub-study (n=738) in Wave 2 of the National Social Life, Health, and Aging Project (NSHAP).[2] The ActiWatch® Spectrum (Philips

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Authors' Contributions.

Huisingh-Scheetz M – concept, design, analysis, interpretation, drafting, revising/writing, approval of final draft.
Kocherginsky M – concept, design, analysis, revising, approval of final draft.
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Respironics[3]), worn on the non-dominant wrist, continuously measured activity and sleep over 72 hours (not removed for water activities).[4] Activity "counts" were recorded every 15 seconds (epoch). A galvanic sensor excluded non-wear time. Wake time was determined using Actiware® software protocols and investigator adjustment to align event markers, ambient light, and activity data.[5] Only days with ≥10 hours of wake time were included. Average daily activity was calculated as the sum of the wake time counts divided by the total number of epochs. Valid hours worn, number of weekend days worn (categorical, reference: no weekend days), and month of wear (categorical, reference: January) to approximate season were calculated.

Outcomes

Self-rated physical and mental health (excellent, very good, good, fair, poor) were assessed. Systolic and diastolic blood pressure, non-fasting glycosylated hemoglobin (HbA1C, %), C-reactive protein (CRP, mg/L) (blood spots), and body mass index (BMI, kg/m^2) were measured.[2] Obesity was identified as BMI ≥30 kg/m^2. Study participants reported any diagnoses of heart problems, diabetes, stroke, cancer (other than skin), or asthma/chronic obstructive pulmonary disease (COPD)/emphysema.[6] Respondents performed a 3-meter timed walk twice and 5 timed serial chair stands.[4] The fastest walk and chair stands times were recorded. Difficulty performing any activity of daily living (ADL) or instrumental activity of daily living (IADL) was self-reported.[4] Frequency of 11 depressive symptoms and 7 anxiety symptoms "during the past week,"[7] frequency of attending meetings of organized groups and socializing with friends or family at least once per month, and current alcohol or tobacco use were self-reported.

Covariates

Age at the time of survey; gender; education; race; Hispanic ethnicity; household assets; and current working status were self-reported. Cognitive function was determined using the survey-adapted Montreal Cognitive Assessment (MoCA-SA).[8]

Statistical Analysis

Association of average daily activity with each outcome was assessed using survey-adjusted regression models controlling for covariates, wear time, weekend days, and wear month. Effects per 10 activity counts are reported. Analyses were conducted using Stata 14 (NSHAP data release v2.2:d34186f4ce5f).

RESULTS

Of the 738 participants, 631 had complete accelerometer and covariate data. Age ranged from 71.2–72.4 years, 52.8% were female, and 83.6% were White/Caucasian. The average daytime activity count was 54.2 (95% CI: 52.1–56.4), mean number of valid wake hours was 36.4 (95% CI: 35.4–37.3), and 59.6% of participants did not wear the accelerometer on a weekend day (95% CI: 55.6%–63.4%).

Multivariate regression models demonstrated that all accelerometry-health outcome relationships were in the expected direction. Higher physical activity was significantly

associated with better reported physical (p<0.001) and mental health (p=0.009), lower DBP (p=0.01), lower BMI (p<0.001), lower CRP (p=0.02), less obesity (p<0.001), lower HgbA1c (p=0.01), less reported heart problems (p=0.01) and diabetes (p< 0.001), faster 3-meter walk (p< 0.001), faster chair stands (p=0.002), and less reported ADL (p=0.002) and IADL difficulty (p=0.006). For example, a 10 point increase in mean activity count was associated with a 0.98 (=exp(−0.02)) seconds faster walk, and a 20% lower risk of reporting an ADL disability.

DISCUSSION

Similar to hip devices, wrist accelerometry-measured average daily activity was significantly associated with many physical and functional older adult health outcomes but with few mental health and social engagement outcomes. To our knowledge, this is the first report showing significant associations between wrist accelerometry and a wide range of health outcomes in a nationally-representative older adult sample.[9] In this study, accelerometry was assessed over three days, and our findings of strong associations with this brief wear duration suggest that accelerometry may be feasible in clinic settings. Longer durations (e.g., ≥5 days[10]) may more fully represent habitual activity, increase reliability and therefore strengthen the accelerometry associations found with health outcomes. With newer wrist devices and algorithms for interpreting output, ease of wear, and low battery requirements, wrist accelerometers may become clinically useful moving forward.

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TABLE

WRIST ACCELEROMETRY AND OLDER ADULT HEALTH OUTCOMES (N=631)

HEALTH OUTCOMES	AVERAGE DAILY ACTIVITY[b]	
Self-Rated Health		
Linear Regression Outcomes	*β* (p-value)	n
Self-Rated Health (Range Poor = 1 to Excellent = 5)	**0.11 (<0.001)**	631
Self-Rated Mental Health (Range Poor = 1 to Excellent = 5)	**0.08 (0.009)**	631
Biomarkers		
Linear Regression Outcomes	*β* (p-value)	n
Systolic Blood Pressure (mmHg)	0.04 (0.94)	615
Diastolic Blood Pressure (mmHg)	**−0.80 (0.01)**	615
Body Mass Index (kg/m^2)[a]	**−0.01 (<0.001)**	613
HgbA1C	**−0.05 (0.01)**	587
C-Reactive Protein (mg/L)	**−0.25 (0.02)**	588
Comorbidities		
Logistic Regression Outcomes	*OR* (p-value)	n
Obese (yes vs. no)	**0.74 (<0.001)**	611
Heart Problems (yes vs. no)	**0.85 (0.01)**	627
Diabetes (yes vs. no)	**0.72 (<0.001)**	628
Stroke (yes vs. no)	1.03 (0.81)	553
Cancer - Non-Skin (yes vs. no)	0.86 (0.13)	630
Asthma/COPD/Emphasema (yes vs. no)	0.92 (0.20)	628
Function		
Linear Regression Outcomes	*β* (p-value)	n
3-meter walk[a] (seconds)	**−0.02 (<0.001)**	610
Chair stands[a] (seconds)	**−0.02 (0.002)**	554
Logistic Regression Outcomes	*OR* (p-value)	n
Activities of Daily Living Difficulty (Any difficulty vs. No difficulty)	**0.80 (0.002)**	629
Instrumental Activities of Daily Living Difficulty (Any difficulty vs. No difficulty)	**0.87 (0.006)**	555
Health Behaviors		
Logistic Regression Outcomes	*OR* (p-value)	n
Consume Alcohol (yes vs. no)	1.01 (0.80)	631
Smoke Cigarettes (yes vs. no)	0.87 (0.07)[d]	629

HEALTH OUTCOMES	AVERAGE DAILY ACTIVITY[b]	
Mental Health		
Logistic Regression Outcomes	*OR* (p-value)	n
Depressive Symptoms 0–22 (Depressive Symptoms vs. None)	0.88 (0.08)	603
Anxiety Symptoms 0–21 (Anxious Symptoms vs. None)	0.87 (0.10)	517
Social Engagement		
Logistic Regression Outcomes	*OR* (p-value)	n
Socialize with Friends (≤ Several times/year vs. ≥ Once/month)	0.85 (0.08)	568
Attend Meetings (≤ Several times/year vs. ≥ Once/month)	0.89 (0.05)	568

[a] Log transformed

[b] Effect size for a change of 10 counts