1.a. **Full Title**: A descriptive study of accelerometer-determined physical activity and sedentary behavior in older adults: The ARIC Physical Activity and Falls Study

   b. **Abbreviated Title (Length 26 characters)**: Physical activity and sedentary behavior correlates in older adults.

2. **Writing Group**:

   Writing group members: Lisa Pompeii, Mike Griswold, Sadie Conway, Wanmei Wang, Priya Palta, Kelly Evenson, Jennifer Schrack, Eric Boerwinkle

I, the first author, confirm that all the coauthors have given their approval for this manuscript proposal. _KPG_ [please confirm with your initials electronically or in writing]

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3. **Timeline**:

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4. **Rationale:**

Regular aerobic physical activity has numerous health benefits for older adults, including reduced risk of premature mortality and chronic diseases, including cardiovascular disease, type 2 diabetes mellitus, and some cancers. Further, there is strong evidence to support the benefits of physical activity for improved physical and cognitive functioning. For older adults (aged ≥65 years), current aerobic 2008 Physical Activity Guidelines for Americans recommend: ≥ 150 minutes per week of moderate-intensity physical activity (e.g., brisk walk), ≥ 75 minutes per week of vigorous intensity physical activity (e.g., jog), or an equivalent combination of moderate-to-vigorous intensity physical activity (MVPA) for general health benefit.

Based on 2011 Behavioral Risk Factor Surveillance System (BRFSS) data, 52.7% of U.S. adults aged ≥65 years met aerobic physical activity guidelines, which is a slightly higher prevalence estimate than midlife age groups (45-54 years: 51.1% and 55-64 years: 50.9%). However, in stark contrast, accelerometer data from U.S. surveillance systems and epidemiological research studies consistently show that older adults are the least active subgroup. More specifically, using 2003-06 National Health and Nutrition Examination Study (NHANES) accelerometer data (the most recent publicly-available data released by the U.S. Department of Health and Human Services), the prevalence of U.S. adults reporting sufficient physical activity to meet guidelines was lowest [15.9% and 8.7% in men and women, respectively] among adults aged ≥ 65 years.

Older adults participate in a variety of activity types (e.g., walking, gardening), across multiple domains (e.g., leisure-time or domestic/self-care) and intensity levels. Previous research also suggests that physical activity among older adults is often irregular and performed at a lower intensity level than younger adult populations. Self-report methods (e.g., recall questionnaires) have been primarily used to assess physical activity in epidemiologic studies of older adults. However, exclusive use of self-report methods may not be appropriate given recall questionnaires are most accurate (i.e., reliable and valid) when quantifying higher intensity, structured physical activity or exercise. Over the past decade emerging technology has advanced our ability to objectively measure physical activity through the use of accelerometers in population-based studies. Use of accelerometers in studies of older adults has several advantages over traditional self-report methods, including: (1) direct quantification of physical activity across multiple domains, contexts, and intensity levels, including detection of sedentary and light intensity activities and (2) accuracy not dependent on participants’ cognitive ability.

To date, very few epidemiologic studies have included accelerometers to assess physical activity in older adult populations. Further, the targeted study populations of previous research studies were quite homogeneous. For example, a recent study by Jefferis examined adherence to physical activity guidelines (United Kingdom (U.K.) Physical Activity Guidelines) among 2,540 men and women enrolled in the British Regional Heart Study (men) and British Women’s Heart Health Study (women). Yet, the race/ethnic characteristics of the study population were not reported. Regardless, authors reported that only 7% of men and 3% of women aged 70-93 years met the U.K. physical activity recommendations, which are similar to the 2008 Physical Activity Guidelines for Americans. Further, in men, characteristics including physical health (no chronic conditions and/or mobility limitations), no depression, and behaviors, including leaving the house at least 5 times per week, active transport, and regularly walking a dog were statistically
significantly related to meeting physical activity guidelines. Unfortunately, the authors were not able to conduct this analysis in women given the very low prevalence (3%) meeting physical activity guidelines.

In a subsequent analysis among the male participants, only, Jefferis and colleagues examined accelerometer-derived sedentary patterns and found that on average approximately 72% of waking hours (618 ± 83 minutes per day) were spent engaging in sedentary behaviors (e.g., sitting, standing, reclining or lying down). Men who were older, obese, current smokers, depressed, and ≥3 chronic conditions had statistically significantly higher mean levels of sedentary time than individuals who were younger, had a healthy body weight, non-smokers, non-depressed, and no chronic conditions (all p<0.05). In 2013, Shiroma et al. reported on accelerometer-derived indicators of sedentary behavior in the U.S. based Women’s Health Study cohort (n=7,247; aged ≥65 years) and found that approximately 65.5% of waking hours (or an average of 9.7 hours per day) were spent sedentary. Women who were older, obese, and current smokers had statistically significantly higher mean sedentary time per day than those who were younger, had a healthy body weight, and were non-smokers (all p<0.001). However, similar to the studies by Jefferis and colleagues, the Women’s Health Study cohort was homogeneous, consisting primarily of white, well-educated women. Further, the set of possible correlates included in these studies was quite limited.

While previous work in this area provides important descriptive data related to physical activity and sedentary behaviors patterns of older adults, additional studies are needed on a more diverse study sample. Further, to adequately inform future studies testing physical activity interventions in older adults, ample available data that comprehensively examine possible correlates of higher physical activity levels, and lower time spent sedentary are greatly needed. Therefore, the overall purpose of this proposed analysis is to (1) describe the physical activity and sedentary behaviors of a sub-sample of participants enrolled in the ARIC Physical Activity and Falls Study (n=513) and (2) examine differences in these behaviors by a variety of socio-demographic and behavioral factors, and indicators of chronic disease and disability).

ARIC can contribute to the existing knowledge base in several ways, including:

1. The ARIC Physical Activity and Falls Study, an ancillary study to the parent NCS Visit 6 exam included accelerometer-based measures in a sub-sample of older adult black and white men and women, recruited from all four ARIC Field Centers.

2. Sufficient sample size (n=513) to describe and explore differences in accelerometer-determined physical activity and sedentary behavior levels by socio-demographic characteristics (e.g., age, sex, race, field center, education level, marital status, etc.), behaviors (e.g., self-reported physical activity, smoking status), and co-morbidities (e.g., obesity, self-rated health, chronic disease and disability indicators).

5. Main Hypothesis/Study Questions:

1. To describe accelerometer-determined physical activity and sedentary behaviors in ARIC Physical Activity and Falls Study participants.

   Primary hypothesis is:
a) Mean daily average accelerometer counts and time spent in physical activity (light- and moderate- to vigorous- intensity (MVPA) and sedentary behaviors (derived using vertical axis and vector magnitude counts) of ARIC participants will be consistent with results in previous accelerometer-based studies of older adults.

2. To examine differences in accelerometer-determined physical activity and sedentary behaviors by socio-demographic and behavioral factors, geographical location, and co-morbidities.

Primary hypotheses are:

a) Participants that are (i) younger, (ii) male, (iii) white, (iv) bachelor’s degree or higher, (v) married or living as married, (vi) non-smokers, (vii) normal body weight, (viii) no depression, (ix) higher self-rated health, (x) no chronic conditions, and (xi) no disability will have statistically significantly higher physical activity (across intensity categories) and lower sedentary time than their relevant counterparts.

*For this analysis, primary estimates from vertical axis counts will include average accelerometer counts (per minute per day), MVPA (accumulated and bouted ≥760 counts per minute and ≥1952 counts per minute), and sedentary estimates (<100 counts per minute). Primary estimates from the vector magnitude counts will include: sedentary (0-18 counts per minute) and (MVPA: ≥519 counts per minute. The vector magnitude cutpoint threshold values will be multiplied by 4 to convert these values, created for 15-second epochs, to 60-second epochs.

Differences in mean time spent in light-intensity physical activity (from both the vertical axis and vector magnitude count data) will also be explored.

3. To evaluate the convergent validity (linear correlation and agreement) of the ARIC/Baecke Physical Activity versus accelerometer.

Primary hypothesis is: The linear correlation and agreement between physical activity measurement methods will be moderate, demonstrating that they are quantifying related but different aspects of physical activity (i.e., physical activity behavior vs. ambulatory movement).

6. Design and analysis (study design, inclusion/exclusion, outcome and other variables of interest with specific reference to the time of their collection, summary of data analysis, and any anticipated methodologic limitations or challenges if present).

Data Preparation / Study Question #1: The distributions of all related variables will be described. This descriptive analysis will include frequency distributions, as well as measures of central tendency (means and medians) and measures of variability (standard deviations and ranges). The assumption of normality will be tested for all variables. Box-Cox transformations will be used for variables where the assumption of normality was not met.

Study Question #2: First, depending on the distribution of relevant variables, Pearson’s or Spearman’s correlations will be used to examine the linear relations of socio-demographic and behavioral factors, and co-morbidities with accelerometer-derived physical activity and sedentary behavior estimates. Then, linear least squares regression will be used to test for differences in mean values among sub-groups using 2-sided tests with a significance level of
p<0.05. All models will be adjusted for accelerometer wear time and other relevant covariates, depending on the individual independent variable. For example, when examining differences in mean sedentary time by marital status, results will be additionally adjusted for age, sex, and race.

Study Question #3: Spearman rank order correlation coefficients will be used to examine the linear correlation between the self-reported and accelerometer-derived estimates, with emphasis on accelerometer measures of moderate- to vigorous- intensity physical activity (primary construct ascertained via self-report). Interclass correlation coefficients will be used to evaluate agreement between measures. Also, continuous physical activity estimates (both self-report and accelerometer) will be categorized based on quartiles and agreement will be examined using kappa statistics.

7.a. Will the data be used for non-CVD analysis in this manuscript? ____ Yes  __x__ No

b. If Yes, is the author aware that the file ICTDER03 must be used to exclude persons with a value RES_OTH = “CVD Research” for non-DNA analysis, and for DNA analysis RES_DNA = “CVD Research” would be used? ____ Yes  ____ No
(This file ICTDER has been distributed to ARIC PIs, and contains the responses to consent updates related to stored sample use for research.)

8.a. Will the DNA data be used in this manuscript? ____ Yes  __x__ No

8.b. If yes, is the author aware that either DNA data distributed by the Coordinating Center must be used, or the file ICTDER03 must be used to exclude those with value RES_DNA = “No use/storage DNA”? ____ Yes  ____ No

9. The lead author of this manuscript proposal has reviewed the list of existing ARIC Study manuscript proposals and has found no overlap between this proposal and previously approved manuscript proposals either published or still in active status. ARIC Investigators have access to the publications lists under the Study Members Area of the web site at: http://www.cscc.unc.edu/ARIC/search.php

____x____ Yes  _______ No

10. What are the most related manuscript proposals in ARIC (authors are encouraged to contact lead authors of these proposals for comments on the new proposal or collaboration)?

| MS #333B | Patterns of change in physical activity: six-year follow-up of the ARIC cohort | K. Evenson |
| MS #2310 | Physical activity and cognitive decline | P. Palta |
| MS #2450 | Physical Activity Patterns and Predictors of Change from Midlife to Older Adulthood: the Atherosclerosis Risk in Communities (ARIC) Study | P. Palta |
| MS #2548 | Changes in Physical Activity and the Risk of Incident Heart Failure: The Atherosclerosis Risk in Communities | R. Florido |
11.a. Is this manuscript proposal associated with any ARIC ancillary studies or use any ancillary study data? __x__ Yes  ____ No

11.b. If yes, is the proposal
   _x_ A. primarily the result of an ancillary study (list number* 2013.10)
   ___ B. primarily based on ARIC data with ancillary data playing a minor role (usually control variables; list number(s)* __________ __________ __________)

*ancillary studies are listed by number at http://www.cscc.unc.edu/aric/forms/

12a. Manuscript preparation is expected to be completed in one to three years. If a manuscript is not submitted for ARIC review at the end of the 3-years from the date of the approval, the manuscript proposal will expire.

12b. The NIH instituted a Public Access Policy in April, 2008 which ensures that the public has access to the published results of NIH funded research. It is your responsibility to upload manuscripts to PubMed Central whenever the journal does not and be in compliance with this policy. Four files about the public access policy from http://publicaccess.nih.gov/ are posted in http://www.cscc.unc.edu/aric/index.php, under Publications, Policies & Forms. http://publicaccess.nih.gov/submit_process_journals.htm shows you which journals automatically upload articles to PubMed central.

13. Per Data Use Agreement Addendum, approved manuscripts using CMS data shall be submitted by the Coordinating Center to CMS for informational purposes prior to publication. Approved manuscripts should be sent to Pingping Wu at CC, at pingping_wu@unc.edu. I will be using CMS data in my manuscript ____ Yes __x__ No.

References Cited


