Title: Validation of objective measures of sedentary and light intensity physical activity

SECTION A: PRELIMINARY PROPOSAL

1. Brief Rationale and Specific Aims

The majority of occupational, transportation, and discretionary time is spent in sedentary behavior (SB) (27), defined as energy expenditure (EE) between 1-1.5 METs while sitting or reclining (2,31). Specifically, in the National Health and Nutrition Examination Survey (NHANES) Matthews et al. reported that 54% (7.7 hrs) of waking hours are spent in sedentary activities (28). Simultaneously, an impressive body of literature has emerged showing that SB is associated with an increased risk of obesity, elevated blood glucose following an oral glucose tolerance test, chronic disease and mortality (16, 18, 30). Although the physical and social structure of modern society fosters inactivity, researchers have identified potential areas of intervention including reduction of discretionary sedentary time (such as watching television), utilizing active workstations, and promoting active transportation to reduce SB (6, 26, 37).

However, a critical knowledge gap remains in the measurement of SB (7, 32). Existing self-report measures often use surrogate measures of SB (such as TV viewing time) (32), which may not be sensitive to changes in behavior. For example an individual may replace TV time with other sedentary pursuits. Surrogate self-report measures do not capture breaks in sedentary time, which are associated with an improved metabolic profile independent of total sedentary time (17). Other investigations define sedentary individuals as those who are not meeting physical activity (PA) guidelines, which is problematic because evidence suggests that PA and SB are independently associated with risk for disease (9, 15, 18, 38). Using an objective measure, SB is defined as an ActiGraph (Pensacola, FL) accelerometer count value of less than 100 cts/min (20, 28). However, this pragmatic cut-point was not empirically derived and does not provide information about the type of SB. A promising tool engineered to quantify low intensity activity and different types of behavior (e.g. sitting, standing) is the activPAL (PAL Technologies, Glasgow, Scotland). This accelerometer has been validated in the laboratory to measure steps and time in various postures (14, 35). The device has not been evaluated in a free-living setting nor has it been shown to be sensitive to changes in time spent in sedentary activities in a natural setting. Thus, we propose a study to examine the following specific aims.

Primary Aims

1a. To identify and compare the features and sensitivity of two commonly used activity monitors to quantify sedentary and light intensity activity in a free-living setting using direct observation as the criterion measure. It is hypothesized that the activPal will more accurately quantify sedentary and light intensity activity levels compared to the ActiGraph (Model GT1M).

1b. To compare the activPAL and ActiGraph in differentiating between patterns of sedentary and light intensity behavior. It is hypothesized that the activPAL will more accurately quantify changes in activity patterns compared to the ActiGraph.
2. Background and Significance (TO BE COMPLETE FOR FINAL PROPOSAL)

3. Experimental Design and Methodology (TO BE EXPANDED FOR FINAL PROPOSAL)

3a. Participants

This study is an exploratory investigation to examine the efficacy of existing technology to measure sedentary and light intensity activity in a free-living situation. Twenty individuals will be recruited for this study. (Power Analysis in Section 3f) Eligibility criteria are as follows and are set to ensure a representative sample of individuals who would be targeted for future intervention studies:

1. Age 30-60 years.
2. Overweight/Obese: Body mass index (BMI) between 25 and 39.9 kg m$^{-2}$
3. Sedentary: Report exercising less than 3 days per week for less than 20 minutes per session over preceding 6 months and a score less than 2 on the Physical Activity Status questionnaire (34).
4. Ambulatory: no major medical conditions that would invalidate our objective measures (e.g., no major orthopedic limitations, no wheelchair users)
5. Healthy: free of life threatening illness (e.g., terminal cancer), debilitating chronic diseases (e.g., heart failure, severe claudication)
6. Inactive Employment: Not employed in an occupation requiring light intensity activity (e.g. mail carrier, retail, and carpenter). Must be able to complete employment duties while seated for long periods of time.

Participants will be recruited from the University of Massachusetts, Amherst and local communities via the University’s web site, flyers, and word of mouth. Interested individuals will complete a telephone screening to determine eligibility. All participants will come to the University of Massachusetts for an Informed Consent Visit, which will include written Informed Consent, completion of a physical activity readiness questionnaire (PAR-Q), a health history questionnaire and a Physical Activity Status questionnaire (Appendix 1-3). Following the consenting process, blood pressure, height, and weight will be measured.

3b.1 Study Design Aim 1a

The first aim is to validate the ActiGraph and the activPAL as tools to differentiate between SB and light intensity activity in a free-living environment. The criterion method for measuring free-living activity is a direct observation system. Details about the direct observation are in 3c.1. All participants will be observed by a trained observer for a continuous 12 hour period. During the observation period they will simultaneously wear the ActiGraph model GT1M and the activPAL. Data from this protocol will be used to address aim 1a validation of the monitor. The observation day will be randomly selected to take place during either the sedentary condition or the light intensity activity condition (detailed below 3b.2). A total of 10 subjects will be observed during the light intensity condition and 10 subjects during the sedentary condition.

3b.2. Study Design Aim 1b

To compare monitor sensitivity in detecting changes in patterns of behavior (Aim 1b), the participant’s daily sedentary and light intensity activity levels will be experimentally manipulated. In contrast to an intervention study where a participant receives materials to facilitate independent behavior change, this study will included a detailed daily prescription, very specific goals and follow up procedures to ensure the participant complies with behavior recommendations for each condition. The details of the recommendations are provided below.
1. Sedentary condition

All participants will be provided with an activPAL, ActiGraph accelerometer and an Omron Pedometer following the Informed Consent visit. They will be instructed to wear the monitors during all waking hours for a one week period, and to maintain or reduce their current level of activity. They will be specifically instructed not to initiate any exercise programs or change their habitual activity levels over the week long baseline period. Participants will be instructed to avoid stairs and to remain seated as much as possible. They will also be instructed to not exceed 5,000 steps per day, which is the pedometer criteria to define sedentary (40).

2. Light Intensity Condition

Following the sedentary period, participants will return to the laboratory for a 30 minute session that will include detailed information about the risks associated with sedentary time and the benefits associated with increasing light intensity activity without initiating any exercise. Participants will be instructed to wear the Omron pedometer, the ActiGraph, and activPAL during waking hours for a one week period. They will receive a detailed prescription that includes examples and strategies for decreasing sedentary time and a daily checklist of tasks to complete and strategies for accumulation of light intensity activity (e.g., standing during all commercials, taking a 5 minute break each hour at work). They will be given a goal of 7500 steps per day, the cut off for “somewhat active” (40). Recent evidence suggests women who are not sufficiently physically active but have low sitting jobs obtain 8995 steps per day (39), thus this goal is attainable in our sample. A sample checklist and strategies to decrease SB are in Appendix 5 and 6, respectively.

3c. Measurements:

Criterion measure: Direct observation, Activity Monitors (activPAL and ActiGraph GT1M), Omron Pedometer

References


SECTION B: THESIS OR PROJECT CONTRACT

Evaluation
I will be responsible for helping with subject recruitment, data collection and data analysis. Throughout September and October, I will be involved in subject recruitment. By the end of October, I will be expected to be trained on all physical activity measures. By December, I will have a final proposal that will incorporate the Background and Significance Section (Review of Literature). Data collection will take place from January through March. During March through April, I will complete data analysis and begin writing my thesis. My thesis will be completed by the middle of May and I will defend my thesis on or about May 15, 2011. I will be working directly under Dr. Sarah Smith, and she will be available to me to provide feedback. She will evaluate each one of the steps outlined above. I will also be required to maintain a weekly journal of everything I have learned, and Dr. Smith will provide weekly analyses of my results. I will turn in an outline for my thesis on May 1, 2011 for evaluation.

Communication
I will meet with Dr. Smith weekly during laboratory meetings and work with my direct graduate student mentor on a daily basis. During these meetings throughout the spring I will be expected to present my progress in data collection as well as any difficulties I may be having with the direct observation. In the fall I will present my proposal in the laboratory meeting for feedback. I will be expected to complete nine hours of work each week (3 credits).

Timeline
September-October, 2010 - Participate in subject recruitment.
October, 31, 2010 – Complete training in all physical activity measures.
December 15th , 2010 - Final proposal including Background and Significance Section (Review of Literature).
January-March, 2011- Data collection.
May 1st , 2011 – Complete thesis outline/draft