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Validity of a Low-Cost, Commercially-Available Accelerometer During Free-Choice Physical Activity in a Controlled Environment in Children

Research Brief

Mallory Kobak[1], Curtis Fennell[2], Ellen L. Glickman[1], Gregory S. Farnell[3], Jacob E. Barkley[1]

[1]*Kent State University, Kent, OH*
[2]*The University of Montevallo, Montevallo, AL*
[3]*John Carroll University, University Heights, OH*

Introduction: The purpose of this study was to test the relationship between accelerometer counts from a novel, low-cost physical activity monitor (Movband) and a previously-validated monitor (Actigraph GT1M) during two conditions of differing physical activity behavior in children.
Methods: Twenty children (n = 10 girls) participated in 30 minutes of physical activity/sedentary behavior in a controlled gymnasium setting on two separate occasions: *low activity* and *high activity*. During each condition, children had free access to physical activities (e.g., obstacle courses, balls) and sedentary options (e.g., books, toys) while wearing the Movband and Actigraph accelerometers simultaneously to measure physical activity. To manipulate physical activity behavior, children were given access to an internet-connected tablet computer (Apple iPad) during the *low* but not the *high activity* condition. Children were 40% more physically active in the *high* versus the *low activity* condition.
Results: There was a large, significant, positive association between the Movband and Actigraph (r = 0.91, p < 0.001) in the *low activity* condition. This was also true during the *high activity* condition, however the strength of the correlation (r = 0.77, p < 0.001) was weaker.
Conclusion: The Movband could be considered a valid measure of physical activity behavior in children.

Key words: child, physical activity, accelerometer

Corresponding author: Jacob E. Barkley, jbarkle1@kent.edu

Introduction

Wearable physical activity monitors were recently cited as the top fitness trend for 2017 by the American College of Sports Medicine (ACSM)[1]. Many of these wearable monitors include low-cost accelerometers marketed to consumers who wish to monitor their personal physical activity. Such monitors, if valid, may have

also potential utility to researchers interested in objectively monitoring physical activity in large samples of participants at a low cost. However, many of these low-cost monitors have not been validated.

Using low-cost objective measures for assessing physical activity in children may be particularly important. Children often lack the cognitive development necessary to accurately estimate their physical activity behavior[2-4]. Therefore, researchers often rely on proxy (e.g., parental) reports to estimate children's physical activity. While this method is valid, objective measures, which are not prone to bias, are preferable[5]. If valid, low-cost accelerometers could affordably provide these objective measures in children.

The purpose of the present study was to assess the validity of a novel, low-cost accelerometer (Movband) to measure physical activity in children during two conditions of free-choice physical activity in a gymnasium setting: *low activity* and *high activity*. We hypothesized that the low-cost accelerometer would exhibit strong, positive associations with the previously validated, research-grade accelerometer (Actigraph) during each activity condition[6].

Methods

Participants

Participants included 20 (n = 10 girls) children (6.9 ± 1.9 years) with no contraindications (e.g., orthopedic, metabolic disorder) to physical activity. Participants were recruited from flyers posted in the local community and from a database of children who had previously participated in separate, unrelated studies within our laboratory.

Protocol

After a parent or legal guardian read and signed an informed consent form and children signed an assent form, participants were brought to the research laboratory by a parent or legal guardian on two separate occasions. During each visit, children were granted 30 minutes of free-choice access to physical activities (e.g., balls, hoops, obstacle courses, etc.) and a table with sedentary alternatives (e.g., books, blocks, coloring sheets, pencils, etc.) and a chair for sitting in a 4,360-square foot gymnasium within the same building as the laboratory. During one visit an internet-connected, tablet computer (Apple iPad, Culver City, CA) was included among the sedentary options. It was believed that the inclusion of the tablet computer would encourage sedentary behavior. Therefore, the condition with the iPad present was the *low activity* condition. During the other visit, the *high activity* condition, there was no tablet computer among the sedentary activities. The order of these two conditions was counterbalanced across participants. During each condition children could play with any of the physical or sedentary activities in any pattern they wished for a period of 30 minutes. Physical activity was monitored during each condition via the Actigraph GT1M accelerometer (60 second epoch was used), which was worn around the waist, and the novel, low-cost Movband 2 accelerometer (DHS Group, Brecksville, OH) which was worn upon the wrist. Both monitors were worn on the non-dominant side of the body. Total physical activity counts accumulated during each 30-minute condition from both the Actigraph and Movband were recorded. Because it has been previously validated for use with children, the Actigraph served as the criterion measure of physical activity for this study[6]. Each participant completed their gymnasium sessions with only research personnel and no other children present. All procedures were approved via the University Institutional Review Board.

Statistical Analysis

As a manipulation check to ensure children were more physically active in the *high activity* versus the *low activity* condition, a paired samples t-test was utilized to compare Actigraph counts across the two conditions. Pearson correlation analyses were then used to assess the relationship between Actigraph and Movband physical activity counts during the *low activity* and *high activity* conditions separately and then again assessing the relationship from both conditions combined. All data were analyzed via IBM SPSS version 22 (Armonk, NY).

Results

Participants accumulated significantly (t = 2.2, p = 0.045) more Actigraph accelerometer counts during the *high activity* (i.e., no tablet computer present) condition (80437 ± 48211 counts) than the *low activity* (i.e., no tablet computer was present) condition (57580 ± 51164 counts). The 40% greater accelerometer counts accumulated in the *high activity* versus *low activity* condition confirms that our manipulation was successful.

There was a strong, significant, positive association (r = 0.91, p < 0.001) between Actigraph and Movband counts during the *low activity* condition (Figure 1). While not as strong at the *low activity* condition, there was also a large, significant, positive effect size (r = 0.77, p < 0.001) for the correlation between accelerometers during the *high activity* condition (Figure 2). There was also a significant, large, positive effect size (r = 0.84, p < 0.001) for the correlation between accelerometers when both conditions were combined (Figure 3).

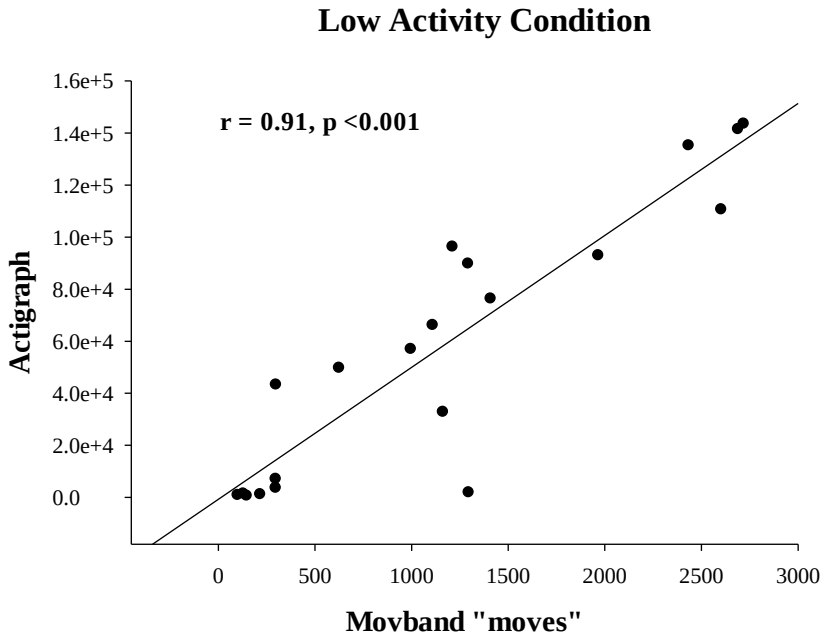

Figure 1. The correlation between the Actigraph counts and Movband "moves" during the *low activity* condition.

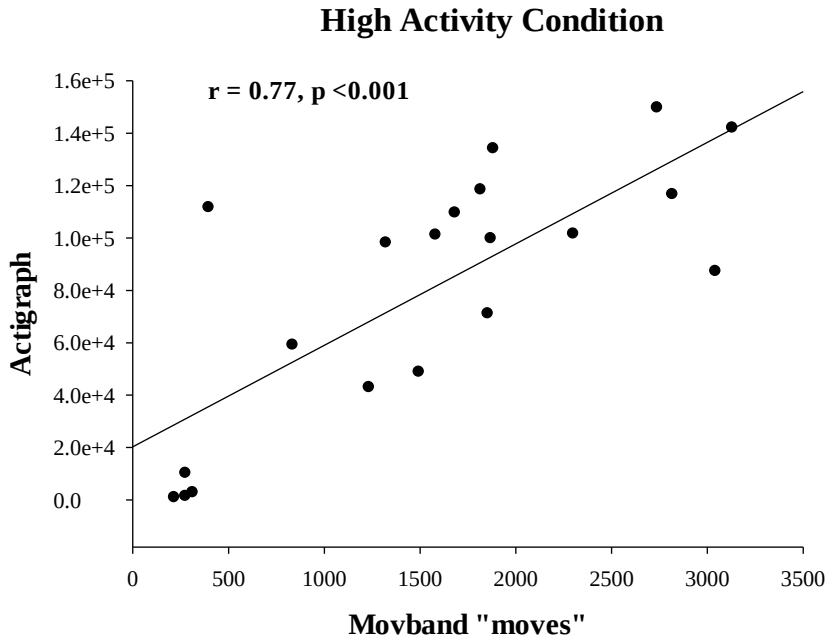

Figure 2. The correlation between the Actigraph counts and Movband "moves" during the *high activity* condition.

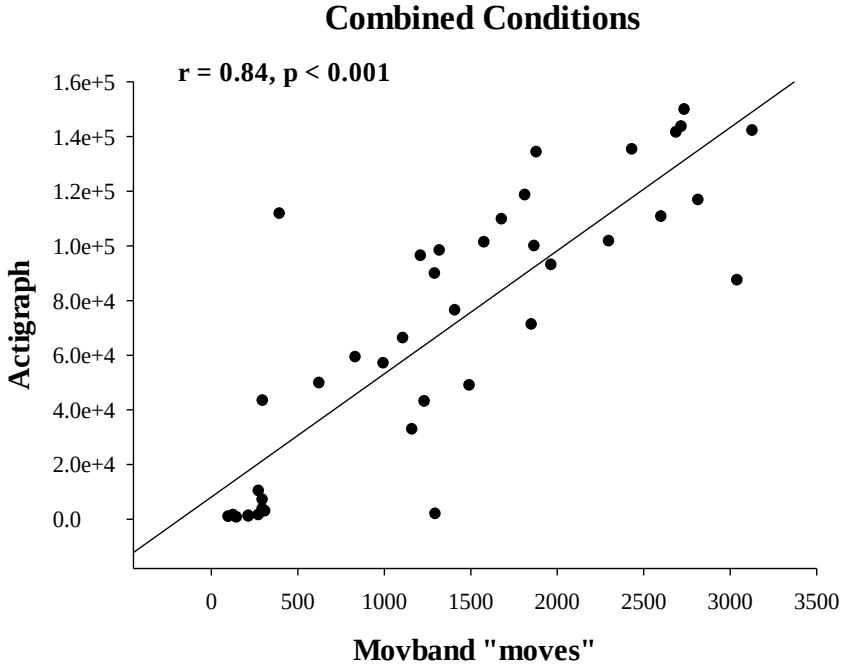

Figure 3. The correlation between the Actigraph counts and the Movband "moves" with the two activity conditions (*low* and *high*) combined.

Discussion

This was the first study we are aware of to assess the validity of a novel, commercially-available, low-cost accelerometer (Movband) to measure physical activity behavior in children. Presently we have reported strong, positive associations between physical activity counts from the criterion accelerometer (Actigraph) and the novel, low-cost accelerometer in a group of children during

two different free-choice physical activity conditions. While these associations support the validity of the Movband to measure physical activity in children, it is worth noting that there was a greater correlation coefficient during the *low activity* versus the *high activity* condition. This is not surprising as prior research has indicated that even in the validated Actigraph accelerometer, monitoring physical activity during higher intensity (e.g., running) physical activity is less accurate than at lower intensities (e.g., walking)[7,8]. Because activity intensity (accelerometer counts per 30 minutes) during the *high activity* condition was greater than the *low activity* condition, it is possible that the limitations of the accelerometers at greater intensities could partially explain the lower correlation coefficient between the two monitors during the *high activity* condition in the present study.

While this was a small sample and researching additional settings (e.g., outside a controlled environment, treadmill exercise) is warranted, we have provided initial evidence supporting the validity of a novel, low-cost accelerometer for assessing children's physical activity, during differing intensities of free-choice activity, in a controlled environment.

Media-Friendly Summary

It is possible that inexpensive physical activity monitors may provide an accurate estimate of children's physical activity behavior.

Reference

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