

## Original Research

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# Children and Pedometers: A Study in Reactivity and Knowledge

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### ABSTRACT

*International Journal of Exercise Science* 6(3) : 230-235, 2013. Pedometers are simple inexpensive tools that are widely used for the measurement of physical activity. Reactivity is always a concern when using pedometers. An issue not yet addressed is the role previous knowledge has on the impact of reactivity. The primary purpose of this study was to examine if reactivity exists in 4<sup>th</sup>-6<sup>th</sup> grade students and if prior knowledge about pedometers had an effect on reactivity. Participants included 109 (54 females) 4<sup>th</sup>- 6<sup>th</sup> grade students from a suburban charter school. Prior to data collection, students completed a questionnaire to measure their knowledge of pedometers. Pedometers were worn from after-school until before school each day for two weeks with half of the students wearing sealed devices the first week, then switching to unsealed. Steps were counted and pedometers were redistributed each afternoon. Repeated measures ANOVA results showed no significant differences in step counts between unsealed and sealed conditions, or when knowledge and experience regarding pedometers was included as a covariate. Pedometers are inexpensive and reliable tools that researchers and educators can use to measure physical activity. In this study reactivity did not occur with older elementary students and a student's knowledge of pedometers did not affect reactivity.

KEY WORDS: Elementary, physical activity measurement, prior experience

## INTRODUCTION

Children of each succeeding generation are exposed to greater technology. With this familiarity, previous reactivity studies involving physical activity measurement tools need to be re-examined. Within the last decade there have been very few published studies that have examined pedometer reactivity in children and none of which have accounted for familiarity with pedometers.

Reactivity is the term used to describe activity that is not "normal" while a subject is engaged in a study where they know that their activity is being monitored or

measured (6). This can present itself as either an increase or a decrease in activity. This raises an important question: if a person can view how many steps they take, will they automatically alter their activity levels? A common practice used to minimize reactivity with pedometers is sealing the devices with a sticker or with a plastic tie, making it extremely difficult for the participant to view the number of steps accrued. In 2002, Vincent and Pangrazi (10) examined reactivity in 2<sup>nd</sup>, 4<sup>th</sup>, and 6<sup>th</sup> grade children (n=48), comparing step counts between sealed and unsealed pedometers. Their findings suggested that reactivity did not exist and that sealing the devices may not be needed to obtain reliable results.

Later, in 2004, Ozdoba, Corbin, and Le Masurier (5) studying 45 fourth-graders, reached a similar result pertaining to children and reactivity. Recently, Foley, Beets and Cardinal (4) studied reactivity within a group of 32 children (ages 7-11) during a structured summer camp setting. Their results showed that there were significant differences between open and closed pedometer step counts during the initial 30 minutes of the morning session, but no differences at any other time. Other than this study, there have been few studies within the last several years that have examined reactivity in older elementary children.

At no time in history have physical activity monitors, particularly pedometers, become more commonplace. In 2004, McDonalds introduced their "Go Active Happy Meal" which included a pedometer with the concept of promoting and increasing physical activity (11). In more recent years, Nintendo, with its release of the Pokémon series "HeartGold" and "SoulSilver", has incorporated a pedometer (PokéWalker) to enhance the player's character (12). The premise is the player attaches the PokéWalker to their body and during the day accrues steps which translate into increases in the Pokémon character when downloaded into the video game. As technology advances and becomes more readily accessible within society, it is usually the younger generation that is best adapted to adopt and use the new advances. This raises questions regarding the use of physical activity monitors, particularly pedometers, as research and teaching assessment tools.

Reactivity is a constant concern with researchers and practitioners. With

children having an increased familiarity with pedometers we asked the research question: "What is the influence of prior knowledge on pedometer reactivity in elementary aged students?" Therefore, the primary purpose of this study was to examine if reactivity exists in 4<sup>th</sup>-6<sup>th</sup> grade students and if prior knowledge of pedometers had an effect on reactivity.

## METHODS

### *Participants*

Students enrolled in the fourth (n= 21), fifth (n= 39), and sixth grades (n= 49) attending a suburban charter elementary school near a major city in the Mountain West region of the United States volunteered to participate in the study. Two hundred twenty eight students were solicited from the school's upper elementary classes with a total of 126 (55%) agreeing to participate. After obtaining University Institutional Review Board and school administration approval, parental consent and student assent was obtained.

### *Protocol*

Prior to the collection of data, participating students were asked to complete a five-question survey (Figure 1) to determine prior knowledge regarding the function and purpose of pedometers. Due to the lack of research in the area of prior knowledge and pedometers, the questionnaire was created by the research team as a basic tool to assess participant's understanding of pedometers. Participants were also asked to submit routine demographic information including age, grade, and gender. Steps were measured using the Yamax Digi-Walker (SW-200) pedometer; a valid and reliable device for

measuring step counts within an older elementary population (7).

Student Questionnaire		
My age is:	_____	
My teacher is:	_____	
My gender is (circle one):	Male	Female
Please answer the following questions to the best of your ability.		
Y	N	I know what a pedometer is.
Y	N	I have used a pedometer before.
Y	N	A pedometer can measure how much I move.
Y	N	I know how a pedometer works.
Y	N	A pedometer can help to see how fit I am.

Figure 1. Prior Knowledge Quiz

Prior to the distribution of the pedometers on Day 1, students were instructed on the proper handling of their assigned pedometer. Instructions included when not to wear the pedometer (i.e. when the possibility of water immersion would take place) and proper pedometer placement on the waistband of the right hip at the midline of thigh. Students were instructed to wear the pedometer from after school on day 1 until bedtime and then place it back on upon getting dressed the next morning and wear it to school.

Pedometers were returned before school on the following day. Half of the group received sealed pedometers while the other half received open pedometers. After collecting pedometers the researcher recorded steps, reset instruments to zero, and prepared sealed pedometers with plastic cable ties. Students returned at the end of school to receive pedometers. These procedures were repeated daily for four consecutive weekdays. The following week, groups switched treatment condition, thereby providing step counts for eight days total, which, according to Vincent and Pangrazi (10) provides ample time to establish habitual activity.

### Statistical Analysis

Missing data was treated as described by Rowe et al. (7). If subjects missed three or more days per condition, their results were discarded from the analysis, which lead to a dropout of 17 students (13.4%). If students missed one or two days, missing values were replaced with mean scores from days present. Daily step totals were then entered into SPSS 20.0 for statistical analysis. Descriptive statistics of the study participants was generated. Means and standard deviations were analyzed for open and sealed step counts, total steps, age, and prior knowledge assessment scores. An analysis of variance examination to investigate potential significant differences between quiz scores was conducted, as well as potential order effect. To answer the primary research question data were analyzed using two repeated measure ANOVA's; one with quiz scores as a covariates and one without scores to examine differences in step counts. Significance level for all statistical analyses was set at 0.05.

Table 1. Demographic Characteristics of Participants.

	Male (n=55)	Female (n=54)	Total (n=109)
Grade Level			
4 <sup>th</sup>	11	10	21
5 <sup>th</sup>	21	18	39
6 <sup>th</sup>	23	26	49
Mean Age (SD)	10.9(0.8)	11.0 (0.9)	11.0(0.9)
Quiz Scores by Grade Level			
4 <sup>th</sup>	4.2(1.3)	2.8(1.6)	3.1 (1.5)
5 <sup>th</sup>	3.5(1.9)	3.4(1.8)	3.4 (1.8)
6 <sup>th</sup>	4.6 (0.7)	4.0 (1.0)	4.3 (0.9)
Total Quiz Scores	4.1(1.4)	3.6(1.4)	3.8 (1.5)

Table 2 . Average Step Counts  $\pm$  Standard Deviations by Gender and Grade Level

	Open Pedometer	Sealed Pedometer	Total Average
Male *			
4 <sup>th</sup>	7359 $\pm$ 3556	8128 $\pm$ 3910	7744 $\pm$ 3398
5 <sup>th</sup>	7570 $\pm$ 3554	6707 $\pm$ 3170	7136 $\pm$ 3048
6 <sup>th</sup>	6638 $\pm$ 3148)	6771 $\pm$ 3457	6721 $\pm$ 3080
Female *			
4 <sup>th</sup>	5283 $\pm$ 3301	4837 $\pm$ 1958	5060 $\pm$ 2374
5 <sup>th</sup>	5473 $\pm$ 2107	5201 $\pm$ 2066	5337 $\pm$ 1890
6 <sup>th</sup>	5924 $\pm$ 2907	5482 $\pm$ 2812	5730 $\pm$ 2640
Total			
4 <sup>th</sup>	6371 $\pm$ 3514	6561 $\pm$ 3494	6466 $\pm$ 3193
5 <sup>th</sup>	6602 $\pm$ 3124	6012 $\pm$ 2789	6306 $\pm$ 2704
6 <sup>th</sup>	6692 $\pm$ 3214	6753 $\pm$ 3379	6737 $\pm$ 3073
Total	6598 $\pm$ 3213	6451 $\pm$ 3192	6530 $\pm$ 2949

\*  $p < 0.001$ 

## RESULTS

Descriptive statistics of the participants are included in Table 1. The mean result for total average steps taken during the eight day intervention was 6552 steps per day. Results showed a significant difference between male and female step counts ( $t=15.51$ ,  $p < 0.001$ ) (Table 2), but there were no differences in regards to grade and age. Further analysis revealed no significant step count differences when examining which type of pedometer (sealed or unsealed) a participant received first. This would help explain any potential "excitement" regarding a new device.

Participants scored an average of 3.8 ( $\pm 1.5$ ) out of 5 on the prior knowledge quiz. Further investigation showed that gender did not play a significant role in the differences in scores ( $F[1, 108]=3.28$ ,  $p=0.07$ ). However, a one-way analysis of variance showed that there were significant differences between the three grades in regards to quiz scores ( $F[2, 108]=4.89$ ,

$p=0.009$ ). A Tukey's *post hoc* analysis revealed no significant difference between 4<sup>th</sup> and 5<sup>th</sup> grades ( $p=0.97$ ) and 5<sup>th</sup> and 6<sup>th</sup> grades ( $p=0.08$ ), whereas a significant difference was observed between 4<sup>th</sup> and 6<sup>th</sup> graders ( $p=0.01$ ). Multivariate analysis showed that there was no significant differences amongst females when comparing quiz scores at grade level ( $F[2, 54]= 0.375$ ,  $p=0.690$ ), or males ( $F[2, 55]=.388$ ,  $p=0.680$ ).

Repeated measures ANOVA results showed that there was also no significant difference in step counts between unsealed and sealed conditions ( $F[1,108]=0.231$ ,  $p=0.63$ ), nor a significant difference in step counts when knowledge quiz scores regarding pedometers was included as a covariate ( $F[1,108]=0.004$ ,  $p=0.95$ ). As mentioned previously, there were no significant differences reported, except for the effect of gender ( $F[1,108] = 13.28$ ,  $p < 0.001$ ).

## DISCUSSION

The primary purpose of this study was to examine if reactivity exists in 4<sup>th</sup>-6<sup>th</sup> grade students and if prior knowledge of pedometers had an effect on reactivity. The results of this research suggest that reactivity did not exist and that having prior knowledge or experience with pedometers did not affect reactivity within this older elementary population. This study supports the work of Vincent and Pangrazi (10) and Ozdoba, Corbin, and Le Masurier (5), and extends that work by demonstrating that prior knowledge does not affect reactivity.

An interesting finding of this study was the difference between pedometer knowledge of fourth, fifth, and sixth grade males.. One might expect the older students to have more experience with the measurement devices thereby increasing their previous knowledge. However, the fourth grade boys demonstrated a higher quiz score (4.2) than the fifth grade boys (3.5). If age significantly increased prior knowledge, then the fifth-grade students should have had significantly higher scores (than fourth graders) on the knowledge quiz. Further research is needed to help explain this result.

A significant difference between genders was also observed, with boys having, on average, higher step counts than their female counterparts. This finding corresponds with previous studies (3, 9). Other results showed that there were no order effects signifying that the initial condition of the pedometer, whether sealed or unsealed, does not play a role in reactivity.

There are several choices for measuring physical activity including heart rate monitors, accelerometers, and pedometers. Pedometers have gained tremendous popularity due to being inexpensive, objective, and non-invasive tools to measure physical activity within many research studies and practical settings (5). These results are of importance to physical educators and researchers who might use pedometers to quantify physical activity outcomes. One challenge that can arise with educators and researchers desiring to examine the physical activity of students is time limitations. The procedural steps involved in preparing the instruments for use, including opening the pedometer, recording the steps, resetting, and then resealing each device, make it challenging for pedometers to be used. If reactivity does not exist within the younger populations, then educators and researchers need not go through the time consuming trouble of all the before mentioned procedures and still receive reliable and accurate results.

Although the results of this study were positive it is not without limitations. The knowledge instrument was created by the research team and had not been previously validated. However, the research team has significant experience using pedometers and collecting pedometer data with school aged youth. This study was also conducted at one school in a single geographic region and may not be generalizable to all youth. A major strength of this study is the novel aspect of accounting for previous knowledge of pedometers on reactivity. In addition, the sample size of this study is more than double the sample size of all previous reactivity studies conducted with elementary aged youth. Future studies

should consider validating a knowledge instrument and should include a wider range of age groups, including lower elementary, middle and high school students. In addition, future studies can be conducted in more rural and urban areas since the present study was conducted in a suburban location.

In conclusion, the results of this study demonstrated that reactivity did not exist among this sample of 4-6<sup>th</sup> grade children and that prior knowledge of pedometers had no effect on reactivity. This finding supports and extends previous research and has important implications for scholars and teachers who use pedometers in elementary school settings.

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