Rehearsal and Pedometer Reactivity in Children

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The main purpose of this study was to investigate whether rehearsal, defined as the tendency to recurrently ruminate over upsetting aversive experiences, had an effect on pedometry reactivity. A total of 156 Hong Kong Chinese children aged 9–12 years were recruited. Participants completed the Rehearsal Scale for Children-Chinese (RSC-C; Ling, Maxwell, Masters, & McManus, 2010) and wore the pedometers for 3 consecutive weeks. The mean number of steps was significantly higher in Week 1 than in Week 3. High rehearsers showed a larger decrease in mean number of steps from Week 1 to Week 3 than low rehearsers. Future physical activity intervention studies should adjust for reactivity in their baseline measurements and should further examine the relationship between habitual PA and individual propensities for rehearsal

Keywords: rehearsal; rumination; mental health; reactivity; physical activity; validation study; pedometer; children

Introduction

Pedometers have been used as an objective tool with which to assess physical activity (PA) and as a motivational prompt to increase PA in children (e.g., McClain & Tudor-Locke, 2009; Tudor-Locke, Williams, Reis, & Pluto, 2002). An important premise underlying the use of pedometers to promote behavioral change is the concept of ‘‘reactivity.’’ Reactivity, in the context of PA, refers to a change in behavior due to participant awareness of being measured. Reactivity is desirable if behavioral change is a goal and the device (i.e., the pedometer) is left unsealed to provide feedback to the wearer. Reactivity is undesirable if the device is sealed for use as a measurement tool when investigating habitual PA level. The present study was designed to examine the psychological mechanisms that underlie potential pedometer reactivity in Chinese preadolescents.

Investigations into pedometer reactivity have presented mixed results. In adults, Clemes and Parker (2009) found reactivity in the first 3 days of monitoring in both sealed and unsealed conditions. In children, Southard and Southard (2006) noted a substantial elevation of preintervention baseline (1-week mean step count) compared with mean step counts in the subsequent 3 months of measurement. This reactivity was apparent in a control group of 9- to 11-year-old healthy children and underweight children, but was not observed in obese and at-risk participants. Other studies examining pedometer reactivity in children have concluded that no reactivity exists (Ozdoba, Corbin, & le Masurier, 2004; Rowe, Mahar, Raedeke, & Lore, 2004; Vincent & Pangrazi, 2002). However, caution is warranted when considering results of these studies because small sample size (Ozdoba, Corbin, & le Masurier, 2004; Vincent & Pangrazi, 2002), self-recorded steps (Rowe et al., 2004), and relatively short measurement periods (Ozdoba, Corbin, & le Masurier, 2004; Rowe et al., 2004) are all limitations. Of interest, significant main effects were found for reactivity in Rowe et al.’s (2004)

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study, with a significant difference in steps between the first two days. The authors, however, argued that this did not indicate reactivity, as there was neither a subsequent decrease nor a leveling off in the mean number of steps of the participants. Vincent and Pangrazi's data also show fluctuations in step count, with a mean difference varying from 1,220 to 2,326 steps per day. They argued that these differences are negligible because they fall within one averaged standard deviation.

In view of the inconsistencies in reactivity research findings, the aim of the current study was to investigate pedometer reactivity in children and ask whether an underlying mechanism that might explain individual differences in reactivity is the predisposition to ‘‘rehearse or ruminate on emotionally upsetting events’’ (Roger, 1997, p. 71). Rehearsal has been evidenced to be related to physiological responses to stress (Roger & Jamieson, 1988; Roger & Najarian, 1998), trait anxiety (Roger & Najarian, 1989), and health complaints (Lok & Bishop, 1999). Experimental research has also consistently shown that high rehearsers/ruminators tend to show greater attention bias towards negative information and affect than low rehearsers/ ruminators when subjected to stressors (e.g., Kuehner, Huffziger, & Liebsch, 2009; Morrison & O'Connor, 2008). We therefore expected that high rehearsers would demonstrate greater reactivity when wearing a pedometer than low rehearsers, as they may initially view the monitoring of their PA to be more emotionally taxing. Thus far, only one psychometric instrument has been validated for the measurement of rehearsal/rumination tendencies in Chinese preadolescents, the Rehearsal Scale for Children-Chinese (RSC-C; Ling, Maxwell, Masters, & McManus, 2010). We utilized the RSC-C to examine the relationship between reactivity and rehearsal in Chinese children.

To achieve the above aims, we monitored the PA level of 156 Chinese children (aged 9 to 12 years) over a 3-week period, using the New Lifestyles NL-800 pedometer (NL-800; New Lifestyles, Inc., Lees Summit, MO). We administered the RSC-C at the beginning and at the end of the monitoring period. The NL-800, a piezoelectric pedometer, has only recently emerged in the market and its validity has not been tested for research or practical purposes in the child population. Previous research has shown that pedometers are more accurate at detecting fast walking speed than slow walking speed (Melanson et al., 2004); however, newer piezoelectric pedometers are believed to be better at sensing slower walking speed, making them appropriate for populations such as children (Duncan, Schofield, Duncan, & Hickson, 2007). A secondary purpose of this study was to examine the validity of the NL-800 in 9- to 12-year-old Hong Kong Chinese children.

Methods

Participants

Children were recruited from three local government-aided primary schools in Hong Kong. Sample 1 (pedometer validation study) was drawn from a school on Hong Kong island (41 students, 26 boys, 15 girls; mean age 9.827.29 years). Sample 2 (rehearsal/reactivity study) was drawn from two schools, one on Hong Kong Island and the other in the Kowloon district (156 students, 80 boys, 76 girls; mean age 10.147.73 years). Informed consent was received from all parents and the methods and procedures utilized were endorsed by the Institutional Ethics Committee for Human Research.

Instruments

Pedometers.

The New Lifestyles NL-800 peizoelectric pedometer was used. An adjustable nylon belt was provided for attaching the pedometer on the left hip and for standardizing the tilt angle at which the pedometers were worn (Duncan et al., 2007). The pedometer was worn in a sealed condition.

Anthropometric measurements.

Participant height and weight were assessed in school. Height was measured barefoot to the nearest 0.1 cm using a fixed stadiometer (Invicta

2007246, UK). Body weight was measured to the nearest 0.1 kg using an electronic scale (Tanita TBF-410, Japan).

Rehearsal Scale for Children-Chinese (RSC-C). The RSC-C (Ling et al., 2010) is a 13-item self-report questionnaire that measures rehearsal tendencies in preadolescent Chinese children. The RSC-C was originally translated from the Rehearsal Scale of the Emotional Control Questionnaire (ECQ; Roger & Nesshoever, 1987) and modified for the Chinese preadolescent population. The RSC-C has been shown to possess good internal validity (a 5.83) and satisfactory 1-year test-retest reliability (r 5.43). All items are rated on a 4-point Likert scale, ranging from1 (never) to 4 (all the time), with a minimum score of 13 and a maximum score of 52. Examples from the scale are ‘‘I never forget people making me angry or upset, even about small things’’ and ‘‘If I lose out, I get over it quickly.’’

Procedure

Gait speed assessment. In the school playground, Sample 1 children were asked to walk along a marked 8-meter course at their ‘‘usual walking speed.’’ The speed in the first and last 2 meters of the course was discarded because this may reflect acceleration and deceleration. The time taken to walk the middle 4 meters was recorded as usual gait speed. Each participant completed the walk twice and the average time (in seconds) was calculated. Gait speed was

expressed in m s 1. Sample 1 was divided into 1 three equal groups on the basis of gait speed 1

(slow - o.97 m s , average - .97–1.20 m s and fast - 41.20 m s walking speeds).

100-step accuracy test. Sample 1 children walked along the perimeter of a marked large rectangular area in the school playground at ‘‘normal walking speed’’ while wearing an NL-800 pedometer attached to a nylon belt as outlined above. Before the test began, the pedometer was set to zero. A researcher walked behind the participant and counted the number of steps taken by the participant using a handheld counter. The participant was instructed to stop on completion of the 100th step. The number of steps shown on the pedometer was recorded while the participant remained stationary.

Reactivity and rehearsal. The children in Sample 2 were given a NL-800 pedometer fixed to a nylon belt to wear on their left hip every day during waking hours for a 3-week period (except during water sports and bathing). All pedometers were sealed with a plastic strap so that no feedback on step count was available to the participants. The number of steps taken each day was stored to the device memory and downloaded manually by the researcher every 7 days. We considered at least 2,000 steps per day to be a realistic reflection of weekday free-living activity level because a sizable amount of walking takes place in school. Rodearmel et al. (2006) considered 30,000 steps each day, or less, to be credible in children; thus, we included only step data that fell between 2,000 and 30,000 (inclusive) for analysis. A minimum of two weekdays was seen as representative of a week and was a necessity for inclusion in the final analyses. Average steps per day were computed for Week 1 and Week 3.

Participants completed the RSC-C before they received the pedometers (T1) and at the end of the third week when they returned the pedometers (T2). Mean RSC-C scores were computed from the scores at T1 and T2.

Statistical Analyses

Descriptive data are presented as means and standard deviations (mean7SD). Accuracy (percent error) of the NL-800 output during the 100-step test was compared between the three gait speed groups using a one-way analysis of variance (ANOVA).

We used one-third cut points to identify participants who scored low and high on the mean RSC-C. Mean RSC-C score was 21.9172.46 for low rehearsers (n 543) and 33.0572.65 for high rehearsers (n 556). An independent samples t-test showed that the scores were significantly different (po.001). Differences in number of steps between Week 1 and Week 3 were examined for the low and high rehearsers using a two-way ANOVA with repeated measures on the Week factor. Follow-up analyses were carried out using t tests where appropriate. A p-value of o0.05 was set a priori for all analyses.

Results

Anthropometric Measurements

Mean height and weight for Sample 1 were 138.1475.99 cm and 33.5576.10 kg, respectively, and for Sample 2 they were 138.5977.76 cm and 35.6679.17 kg, respectively.

100-Step Accuracy Test

The average gait speed of the three groups was 0.827.10 m s ^{1} for the slow walking group, 1.077.08 m s ^{1} for the average walking group, and 1.447.24 m s ^{1} for the fast walking group. Percent error between the 100 counted steps and NL-800 output was 4.73%, 3.68% and 2.39% for the slow, average and fast walking groups, respectively. One-way ANOVA showed that there was no significant difference in percent error between the three gait speed groups, F (2, 38) 51.55, p4.05.

Reactivity and Rehearsal

Of the 156 participants in Sample 2, 133 had pedometer data that fit the inclusion criteria for the repeated measures ANOVA analysis. Figure 1 shows the mean number of steps taken by high and low rehearsers in Week 1 and Week 3. A main effect was present for Week, F(1, 82) 525.52, po.001, Z^2 5.24, but not for Rehearsal score, F(1, 82) 5.01, p 5.916, Z^2 5.001. An interaction was evident, F(1,82) 54.40, p 5.039, Z^2 5.052. High rehearsers showed significantly greater change in mean steps from Week 1 to Week 3 than low rehearsers (po.05); however, mean step count was not significantly different between high rehearsers and low rehearsers in Week 1 or Week 3 (p’s4.05).

Discussion

Our results suggest that reactivity was present, as shown by an elevation in the steps per day in the first week compared with the third week. The difference between the highest and lowest mean daily step is similar to the previous findings for children (Ozdoba et al., 2004; Vincent & Pangrazi, 2002), falling between 1,500 and 2,700 steps per day. Importantly, high rehearsers showed significantly greater reactivity as revealed by larger decreases in step count from

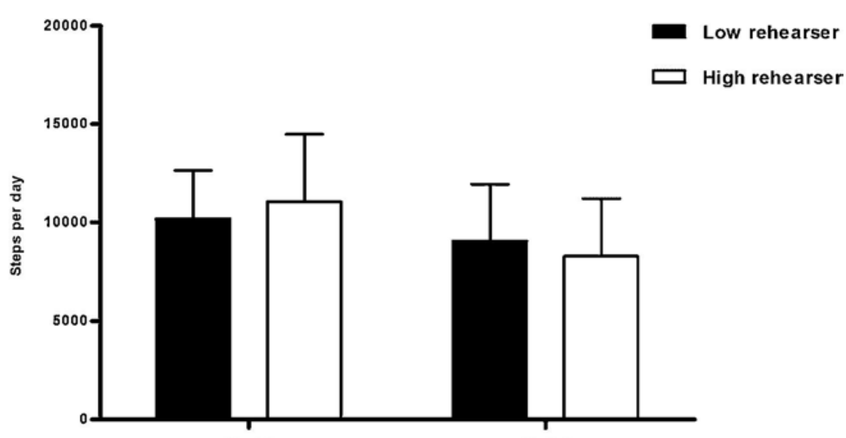

Figure 1. Mean (SD) pedometer steps per week as a function of high and low scores on the RSC-C.

Week 1 to Week 3 than low rehearsers, suggesting that the tendency to ruminate on emotional events may play a part in reactivity.

To our knowledge, this study is the first to explore the underlying psychological mechanisms behind reactivity. Our results suggest that for high rehearsers, the recurrent reminder that their PA was being monitored may have motivated them to engage in more than usual PA during the first week of wearing a pedometer. Possibly, high rehearsers found the thought of being monitored to be emotionally upsetting because it raised personal concerns about self-perceived low habitual PA level. The lower number of steps of the high rehearsers at Week 3, though not statistically significant, suggests that they may have lower habitual levels of PA than low rehearsers. This finding lends support to numerous studies that have shown a positive association between PA and mental health (e.g., Haugland, Wold, & Torsheim, 2003; Holmes, Eisenmann, Ekkekakis, & Gentile, 2008; Newman & Motta, 2007). Although data on Hong Kong Chinese children's habitual PA level is not available, the mean daily steps shown by the high rehearsers in Week 3 was far below the international PA standard in a free-living environment (see Tudor-Locke, McClain, Hart, Sisson, & Washington, 2009). This interpretation yields two important questions. One, given a larger sample, would high rehearsers show a significantly lower habitual PA level than low rehearsers? Two, what is the most effective intervention strategy to encourage PA for these respective groups? For example, would high rehearsers be more responsive to PA interventions that emphasize negative messages about sedentary lifestyle, or would low rehearsers respond better to positive messages about an active lifestyle? Answers to these questions could have crucial practical implications for the design of intervention work for children.

Our secondary aim was to investigate the validity of the NL-800 and our results are in keeping with previous findings (Melanson et al., 2004), demonstrating that the faster the walking speed, the lower the percent error. However, the percent error recorded for the NL-800 was less than 5% for all three walking speeds, which we believe is satisfactory. These findings are similar to those of a previous validation study of a similar pedometer, the NL-2000 (Duncan et al., 2007), and confirm that the NL-800 is a useful tool for assessing walking in the child population.

There are several limitations to the study. First, we used a minimum of 2 days as indicative of ''daily'' step count. This does not follow the recommendation to include at least 4 weekdays and 1 weekend day for achieving representativeness of free-living PA level (Wickel et al., 2007). We did not include weekend data because previous studies have shown weekday and weekend data differ considerably (Duncan, Schofield, & Duncan, 2006; Tudor-Locke et al., 2009). We also found wear time at the weekends was very low with data attrition of approximately 46% for the entire sample. This limitation highlights the unresolved issue of noncompliance in pedometry studies that is more prominent in children than in adults (Trost, 2001). Second, our sample size for the validation of NL-800 is relatively small. However, for the purpose of the simple validity tests that we used within this tight age range, increasing the sample size is unlikely to change our findings.

This study has shown that reactivity does exist when children use sealed pedometers, and this particularly applies to children with a high propensity to rehearse or ruminate about emotionally upsetting events. Future PA intervention initiatives should take rehearsal tendencies into account.

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