VALIDITY AND RELIABILITY OF OMRON PEDOMETERS AT SLOW WALKING SPEEDS

Dear Editor-in-Chief,

Holbrook et al. (6) examined the validity and reliability of the HJ-151 and HJ-720ITC pedometers to record steps during prescribed and self-paced walking speeds when mounted on various body positions. They reported the devices to be highly accurate in detecting steps at walking speeds ranging from slow to brisk walking intensity and concluded them suitable for measuring ambulatory activity under prescribed and self-paced walking conditions in obese and nonobese individuals. Likewise, Hasson et al. (4) investigated the validity of the HJ-112 pedometer during treadmill walking and came to a similar conclusion regarding its high reliability at slow to brisk walking speeds. There are certain limitations to both studies that cause their conclusions to greatly diverge from previous findings. Slow walking is not sufficiently addressed in either of these studies, nor is the necessary data provided on which the authors base their conclusions regarding the pedometer's reliability to monitor low-intensity ambulatory activity.

Walking intensities presented by Holbrook et al. (6) and Hasson et al. (4) greatly exceed those typically considered as slow walking (1). Both studies average a slow walking intensity of 2.7 mph or 72 $m \cdot min^{-1}$, which we find highly questionable as being considered as slow walking. To bring it into context, these walking speeds exceed the fourth stage of the modified Bruce protocol (2.5 mph or 67 $m \cdot min^{-1}$). Moreover, the methodology used by Holbrook et al. (6) for probing participants to walk at desired walking intensities is not entirely clear nor seemed to be implemented with great success. This is because their study population consisted of healthy young college students (mean age = 24 ± 4.3 yr), who even if told to "walk slow" were not able to naturally adapt a walking gait as slow as 2.0 mph.

The importance in monitoring ambulatory physical activity lays predominately in prevention and rehabilitation. This includes people with chronic diseases such as obesity, diabetes, or heart failure and/or frail adults such as the elderly or otherwise functionally impaired. These typically show walking intensities around or below 50 $m \cdot min^{-1}$. Several previous investigators have shown that these slow walking intensities are not adequately measured by pedometers (1,3,5,8). In addition, associated gait disorders greatly compromise pedometer accuracy (2). We actively investigated the HJ-720ITC at slow walking speeds (≤50 $m \cdot min^{-1}$) under treadmill and field conditions in patients with chronic heart failure and found the device to be highly inaccurate in the low-intensity range (7). Although, it is understood that the piezoelectric pedometers are more reliable than the pendulum generation used in previous studies, it has not been established in either study by Holbrook et al. (6) or Hasson et al. (4), if this holds true for actual slow walking intensities, that is, ≤50 $m \cdot min^{-1}$ typically combined with an irregular walking gait. Hence, we believe it is premature to make any definite conclusions regarding the pedometer's reliability and validity in the slow walking range and thus question its suitability to monitor ambulatory activity in individuals truly in the need of being monitored.

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RESPONSE

Dear Editor-in-Chief:

In their recent letter, Jehn et al. (6) questioned our conclusions regarding measurement validity and reliability of the Omron HJ-151 and HJ-720ITC pedometers (5) and implied that our conclusions could not be extended to low-intensity ambulatory activity or for chronically ill populations. We agree that researchers cannot make generalizations across populations or conditions from a single piece of validity evidence. As a measurement tool is validated, its accuracy (or lack thereof) is specific to the population and parameters for which the device was originally assessed (7). Therefore, the use of the tool cannot be generalized to situations in which the environmental conditions, walking speeds, mounting positions, and populations are different from the context of the validation process. Our study was conducted among college students with a normal gait pattern. Considering that validity is context specific, the results of our study should not be generalized to other populations or conditions.

Similarly, the concept of context specificity also extends to the physical activity monitors themselves. For this reason, although Jehn et al. (6) provide evidence that spring-levered pedometers may not be accurate at slow speeds, we caution the authors in comparing the validity of physical activity monitors for recording ambulatory activity at slow speeds among monitors with vastly different internal mechanisms. Moreover, previous authors have shown the superiority of piezoelectric pedometers when compared with spring-levered models (2,4) and that piezoelectric pedometers are fairly accurate at speeds as slow as 54 $m \cdot min^{-1}$ (2,3).

In our study of college students, walking speeds were selected objectively from the compendium of physical activities (1) to illustrate walking at 2.0 mph ("slow"), 3.0 mph ("moderate"), and 4.0 mph ("very brisk"). The scripted protocol was used to allow natural variations in our participants' perceptions of "slow," "moderate," and "very brisk" speeds to be observed, enabling the pedometer to be assessed across a wide range of speeds (from 1.5 to 5.9 mph). In our study, the average speeds corresponding to "slow" and "moderate" were even slower than those elicited by older individuals (age = 71.9 ± 5.7 yr) at "slow" (3.1 mph) and "normal" (3.5 mph) walking speeds (4). Both models recorded steps with less than 3% absolute error, illustrating a high degree of accuracy among the tested intensities. Moreover, the incorporation of self-selected walking trials enabled validity and reliability evidence to be established for both pedometers at each participant's freely chosen walking speed, providing a "real-life" representation of the accuracy of these devices.

In regard to the concept of context specificity, perhaps Shepard (8) described the process of establishing validity evidence best, as "being a never-ending process" (1993, p. 407). We agree with the authors that the Omron pedometers may not be appropriate for clinical populations with abnormal gait characteristics. We encourage such research to be performed because the unique possibility of the Omron pedometers to be mounted at various body positions may make these pedometers more attractive to special populations.

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