Clinical Use of Pedometers

Brief Overview and Instructions for Health Care Providers

Ralph La Forge, MSc.
Duke University Medical Center
Division of Endocrinology, Metabolism, and Nutrition
rlaforge@nc.rr.com

Important Background Information

Simple step counters (pedometers) have gained much research support in recent years for their ability to incentivize and measure physical activity especially in preventive endocrinology programs, i.e., prediabetes, metabolic syndrome, and diabetes populations. Since 1999 over 600 published and peer-reviewed studies have demonstrated the use of simple pedometers in prevention and clinical settings (see select recent references). It is important to differentiate between accelerometers which are more expensive research tools in contrast to simple step-counters (pedometers). Physical activity accelerometers measure steps but also other forces, e.g., acceleration, usually in at least two axes and have been shown to more reliably estimate energy expenditure. Accelerometers are not cost justified for routine clinical use. Both accelerometers and well-engineered pedometers are equally reliable for recording step-count and step-count is perhaps the most important outcomes measure for most clinical applications.

Pedometers are specifically tailored to walking or stepping activities versus activity that involves mostly upper extremity movements. Each intentional walking step represents an insulin sensitizing muscular contraction (similar in mechanism to the diabetes drug metformin) which contributes to improved insulin sensitivity, blood lipid control and fat weight loss. Reliable and well-engineered step counters are reproducibly accurate and can be used for most physical activities for which there is a *stepping-motion* such as walking or activities that involve movement of the trunk, hip and legs (e.g. stair-climbing, dancing, hiking, running, ball sports, etc).

Consistent evidence supports that 30 minutes of at least moderate-intensity walking is equivalent to ~3000 steps in adults. There is also evidence that the walking speed of ≥100 steps/min (~2-2.5 mph) represents the lower boundary of moderate-intensity walking for most adults. Indeed, to meet current U.S. public health guidelines, individuals are encouraged to walk a minimum of 3000 steps in 30 minutes on 5 days each week. Three bouts of 1000 steps in 10 minutes each day can also be used to meet the recommended goal. (Marshall 2009)

The number of daily steps generally required for weight loss is considerably higher (>11,000 steps per day for men and >9,000 steps per day for women, *reference Tudor-Locke, 2008*) than the step-count required for overall cardiometabolic risk reduction although the actual number of steps per day for weight loss also depends on initial body weight and walking speed.

✔ It is important to note that for patients who are obese or who have the metabolic syndrome, prediabetes, or diabetes the *relative increase or change* in daily or weekly step-count above their previous sedentary step-count baseline is the most important exercise outcome parameter for improving cardiometabolic health.

Pedometers are best at measuring step count, less accurate and estimating distance and least accurate at measuring caloric expenditure. Step-count itself is the primary outcome measure (in contrast to estimated distance or caloric expenditure) for health care providers. Each intentional walking step is a measure of the number of large muscle group contractions each of which is an insulin sensitization process not unlike the mechanism of action of thiazolidinediones (PPARγ activation) and metformin as both are AMP kinase activators.

Instructions for patient application:

1. Clip the pedometer on to your belt or waistband and place over the mid-line of one of your legs or in-line over one of your feet. The pedometer must fit tightly to your waist (belt or waistband). For some it may be best to fit to the waistband of your underwear when there is no belt or snug pant waistband.

2. New Lifestyles, Omron, and Accusplit are three companies selling more reliable pedometers (mostly Japanese manufactured pedometers). We recommend pedometers that have been validated to accurately measure steps and have *step filters* such as the Accusplit Eagle 2720 and 120 XLM series pedometers (see Accusplit.com). Step filters are built into the pedometer's electronics and reduce the recording of spontaneous and fidgety movements. These pedometers are inexpensive, well engineered, and do not register most superfluous activities that are unrelated to more meaningful physical activity. The XLM model perhaps is the most useful model for clinically prescribed stepcounts because it incorporates step-filter functions and a large memory such that the pedometer does not need resetting but once a week or even once a month. Step totals can be used as meaningful behavioral outcomes measures during 8-12 week return visits. In 2010 the first true clinical pedometer will be available from Accusplit. This will be the first affordable steps-only pedometer that features a durable solid-state, step-filtered engine and a long-term memory function that permits only the healthcare provider to reset and can display total and average daily stepcount since last clinic visit.

3. Most adults take 1800 – 2200 steps per mile depending on leg length, height, and walking style. The average is ~2000 steps per mile. If you want to gauge how many steps per mile you take walk a measured mile (e.g., 4 laps in the inside-lane of a local quarter-mile track and record the step count).

Overall Recommendations for patients starting a program:

3. Measure and record how many steps you take in a day and a week before you start your program. Start by putting the pedometer on in the morning, reset to 0, and forget about the pedometer for the entire day. When retiring for the evening take the pedometer off and record the

number of steps you have accumulated over the course of the day. Repeat this for 5-7 days to see your daily average.

4. Begin a walking program by adding 2000-3000 step-counts (1-1.5 walking miles) to your daily average from #3 above. For those individuals who are in a very low state of fitness they can begin by adding a total of 1000-1500 steps per day (1/2-3/4 mile).

For example, if you averaged 4500 step-counts per day before you started your walking program then for the next several weeks add 2000 step counts to this average such that you are averaging 6500 - 7500 step counts per day. Note that for most people ~2000 step-counts equals a mile (plus or minus 200 step counts). Make every effort to stay above the "sedentary lifestyle index" which is < 5,000 steps (Tudor-Locke 2004).

5. After two to four weeks you can add another 2000-3000 step-counts to your daily average such that you are eventually averaging 10,000 or more steps per day on most days of the week. Remember that this 10,000 or more steps includes <u>all daily step count activities</u> including your walking program. This total step count should be adjusted to each patient's fitness level, health status, and age. It is important to note that some patients who are less ambulatory will have difficulty reaching 10,000 steps per day in which case the change in daily stepcount is a more appropriate outcome measure. For example, a patient whose baseline stepcount is 3,800 per day and after 6 weeks is averaging 7,500 steps per day is a significantly positive improvement in both walking endurance and insulin sensitization.

6. When using pedometers for monitoring physical activity for **weight loss** purposes the overall goal is to eventually record 70,000 – 90,000 step-counts per week or <u>at least</u> 10,000 steps a day. Several recent studies have reported ≥12,000 steps per day for significant weight loss. This step count includes all daily activity not just your walking program. Know also that the majority of studies indicate that significant weight loss requires ≥2,000 kcal per week of physical activity which is equivalent to 18-20 miles of walking (actual kcal expenditure is dependent on body weight). Also understand that even if you are not capable of attaining these relatively high weekly step counts you can accrue significant cardiometabolic health benefits including an improved glucose tolerance and lipoprotein profile and blood pressure reduction. Several large diabetes prevention studies demonstrated 40-60% reductions in diabetes risk with less than 10,000 walking steps per day average and only modest weight loss (Diabetes Prevention Program, DaGing Diabetes Prevention Program, Finnish and Indian diabetes prevention studies).

7. Patients should record their daily and/or weekly step-count by writing their weekly total information down on a sheet of paper. Many pedometer models have long-term memories and have the capacity to store step-totals over a 12-24 week or longer periods.

8. Creative pedometer walking programs such as *pedometer trekking* are most helpful in instilling longer term use of pedometers. Pedometer trekking programs are designed and measured over a series of local foot trails or courses that meet the age and fitness levels of the community involved. Course distances ranging from .5 to 8-10 miles (i.e., 1000 – 20,000 steps) are validated by standard pedometer assessment. Activities along the trek can be added and specific to the cultural heritage.

Key resources/references:

Aoyagi Y, Shepard RJ. Steps per day: the road to senior health? *Sports Med.* June 2009.

Accusplit pedometer volume orders for clinicians: Joey Sutton at Accusplit (Pleasanton CA: (800) 935-1996 x219 (state clinical use in diabetes or cardiometabolic risk reduction programs – mention this program for volume order discount)

American College of Sports Medicine's Medicine and Science in Sport and Exercise *Supplement on Walking Science*: July 2008, Volume 40, Issue 7 Supplement 1

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Bravata DM. Using Pedometers to Increase Physical Activity and Improve Health A Systematic Review. *JAMA.* 2007;298(19):2296-2304

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Tudor-Locke C, Bassett, et.al. BMI-Referenced Cut Points for Pedometer-Determined Steps per Day in Adults *J of Phys Act. Health*, 5(Supplement 1), January 2008

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Tudor-Locke C and Bassett DR. How many steps/day are enough? Preliminary pedometer indices for public health. Sports Med. 2004;34(1):1-8

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Diabetes Care 2009;*32:1404-1410;*