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### PEDOMETER, ACCELEROMETER, AND MOBILE TECHNOLOGY FOR PROMOTING PHYSICAL ACTIVITY

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The benefits of physical activity are well recognized. For major health benefits, adults should engage in moderateintensity aerobic physical activity for at least 150 minutes per week or vigorous-intensity aerobic activity for at least 75 minutes per week or an equivalent combination. [1] Walking is the most popular and inexpensive physical activity and has significant potential in reducing the incidence of chronic diseases, such as heart disease, hypertension, and diabetes.

An accelerometer-based activity monitor is a tool for assessing physical activity. Recently, companies have been marketing wearable devices that use the technology of both pedometers and accelerometers. (See page 3, Table 1. Popular wearable devices for tracking your physical activity) These devices provide consumers and health professionals the ability to estimate and self-monitor physical activity. Pedometers have been widely used in campaigns at community and worksite level to promote walking. (See page 2, "Pedometers in the Workplace")

Also, many health and fitness apps are available for smartphone users, and there is some emerging evidence that smartphones and smartphone apps are effective at promoting physical activity [2, 3]. This article provides basic mechanisms and functions of pedometers and accelerometers. Additionally, we provide some examples of the different types of exercise and fitness apps for smartphones that may promote physical activity.

### What is a pedometer and how does it work?



A pedometer is a device that counts the number of steps taken. When you walk, there is an up and

down movement at the hip. Inside the pedometer there is a small lever arm that moves up and down in response to the movement of your hips that occurs with each step you take, thereby counting your steps as you move. Some pedometers can record distance walked and calories burned.

## What is an accelerometer and how does it work?

Accelerometers detect movement; when moved, it records acceleration. An accelerometer in smartphones, handheld game consoles, and wristband activity monitors (see Figure1, Fitbit®Flex<sup>TM</sup>) measure the acceleration of the device from side to side (lateral), up and down (longitudinal), and front to back (vertical). Wristband activity monitors use proprietary software algorithms to analyze movement and estimate the number of steps taken and calories burned. Activity monitors can record both activity and inactivity (the amount of time you have been sitting).

The accelerometer cannot measure exertion, such as weight lifting. It detects daily movement and calibrates for steps, but it can't convert steps from cycling, yoga, or any sitting physical activities.



Figure 1. Fitbit®Flex<sup>™</sup> with accompanying wristband

## Why should I wear a pedometer or accelerometer?

A pedometer or accelerometer provides immediate feedback to judge your physical activity and inactivity. It provides a persons' overall daily activity level. The stepcounting function of a pedometer or accelerometer can motivate individuals to increase physical activity, especially when they are encouraged to record daily step counts and set specific step-count goals (See page 2, "Pedometer Fun").

# How to properly wear a pedometer or an accelerometer?

Using the pedometer clip, the pedometer is placed on your waistband, near where the hipbone protrudes - make sure the pedometer is level. It can be worn on either side of the waist. Some newer pedometers and accelerometer-based devices are free from the usual pedometer "placement" constraints.



# How do I know if my pedometer or accelerometer is properly working?

Check the accuracy of your pedometer or accelerometerbased device by walking 20 steps and then checking the reading. If the reading is not accurate, adjust the positioning of the pedometer or accelerometer-based device.

### How many steps equal one mile?

About 2,000 steps equal one mile depending on stride length. Your stride length and the number of steps you take give you distance traveled.

## How much physical activity is recommended?

For substantial health benefits, adults should do at least 150 minutes (2 hours and 30 minutes) a week of moderateintensity, or 75 minutes (1 hour and 15 minutes) a week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate- and vigorous intensity aerobic activity. [1]

\* How can I tell the difference between a moderate and a vigorous activity?

**Moderate activities:** You can talk while you do them, but you can't sing. (Example: brisk walking, ballroom dancing)

**Vigorous activities:** You can only say a few words without stopping to catch your breath. (Example: race walking, running, aerobic dance)

10,000 steps in a day is a rough equivalent to the Surgeon General's recommendation to accumulate 30 minutes of activity most days of the week. To increase the effectiveness of walking 10,000 steps, you may add some intensity or "huff and puff" to your walking.



### **Pedometers in the Workplace**

Encourage co-workers to get engaged in a physical activity challenge at work! Form teams, come up with team names, select a team leader, and have everyone start wearing their pedometers. Try a 6 to 8 week challenge and have co-workers record their daily steps. At the end of each week, the team leaders can collect each person's weekly step count and inform other teams of the current standings. At the end of the challenge, celebrate the winners' success and great efforts!

#### **Pedometer Fun**

- Challenge co-workers to a walking contest! See who can get the most steps in one week.
- Encourage your kids to wear a pedometer and see who gets the most steps in one dance song.
- Wear a pedometer on your favorite walk...can you go 50 steps further next time?
- Set up a walking group with your friends or neighbors. Set up a rewards system for your group as you hit major milestones. For example, at 100,000 steps go to the movies together, 200,000 steps attend a cooking class, etc.

### New Tool: Smartphone apps

More and more people are looking for ways to engage in physical activity using smartphones, iPads, and other mobile devices. There are many different types of exercise and fitness apps on the market. Here are some examples of devices that track and promote physical activity:

#### **Training Program Apps**

This type of app provides individual lessons or training. Training program apps bear similarity to exercise DVDs or training programs offered via a website. *Couch-to-5K* is a popular training program that consists of spending 20-30 minutes, three times a week for nine weeks, preparing users for a 5K race (\$1.99 – Active.Trainer.com). Training program apps are good for users who would like to work out on their own time and place. Training program apps are simple and easy to start!

#### **Pedometer Apps**

This type of app typically includes a calendar, a daily log to keep record, and a walking speed and pace indicator. *Pedometer FREE* is equipped with a built in accelerometer, which counts steps as the user walks, runs, or jogs outdoors or on a treadmill. The app stores the users' body parameter (chest, waist, and hip circumferences) and BMI (body mass index; your weight in kilograms divided by the square of your height in meters) and tracks the distance, workout time, calories burned, and changes in BMI. The app also displays walking routes with markers using GPS. *Noom Walk* is another pedometer app that uses a mobile built-in accelerometer; it is a battery-friendly app compared to other activity tracking apps. Unlike other pedometer apps, there is no need to turn it on or off. It automatically counts steps, like a wearable device.

#### Game Apps

Game apps facilitate physical activity by playing games. *Zombies, Run!* may give users a jumpstart for running or walking routines. When a player goes for a run, they also take part in a mission in a post-apocalypse zombie world. The players collect much-needed supplies for Earth's survivors while listening to the games plot unfold on their headphones. There are more than 30 missions/stories to choose from. The app motivates users to run or walk faster. As the user moves along, the app tracks distance and pace (\$7.99). *GameFit Racing* is another exercise-powered game app that features a 3D race track that can be calibrated with almost any exercise machine at a gym or at home, making calorie-burning workouts more appealing and fun to users (\$1.99).

Table 1. Popular wearable devices for tracking your physical activity

#### Reference

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#### Abstract

Increased physical activity is associated with an improvement in many health conditions, including heart disease, hypertension, insulin sensitivity, osteoporosis and obesity. Self-monitoring and tracking physical activity is an effective strategy to initiate and maintain physical activity. A variety of physical activity monitors, such as pedometers, accelerometer-based activity monitors, wrist devices and smartphone apps are available for use by individuals interested in fitness, health and weight control. This article provides basic mechanisms and functions of pedometers and accelerometers. Additionally, a list of popular wearable devices and different types of exercise and fitness smartphone apps for tracking and promoting physical activity are included.

Name	BodyMedia	Fitbit One	Fitbit Flex	Nike+Fuel Band	Jawbone UP24
Price (MSRP)	\$99 + monthly web access fee	\$99.95	\$99.95	\$149.99	\$149.99
Туре	Armband	Clip-on	Wrist Band	Wrist Band	Wrist Band
Battery life	7 days	5-7 days	5-7 days	Up to 4 days	Up to 7 days
Water resistance	No	No	No	Yes	Yes
Smartphone app	iOS, Android	iOS, Android	iOS, Android	iOS, Android	iOS, Android
Web display output	Active calories burned, TDEE, PA time, Steps, Distance, Sleep time	TDEE, PA time, Steps, Sleep time, Distance, Floor climbed	TDEE, PA time, Steps, Sleep time, Distance	Active calories burned, PA time, Steps, Distance, Fuel point	TDEE, Active calories burned, PA time, Steps, Distance, Sleep pattern (light vs. deep sleep)
Diet log	Yes	Yes	Yes	No	Yes
Sleep tracker	Yes	Yes	Yes	No	Yes
Heart rate monitor	No	No	No	No	No
Health coach	Yes	No	No	No	Yes



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