

In a past issue of Weightology Weekly, [I told you how critical physical activity is for maintaining long term weight loss](#). I've also told you how I like the use of pedometers to help monitor and increase non-exercise activity thermogenesis (NEAT) levels, and [how certain Omron models are among the most accurate pedometers](#). However, a limitation of the use of pedometers is that they are only useful for tracking walking activity, and they cannot give reasonable estimates of activity energy expenditure.

The only accurate way to measure activity energy expenditure in free living people is through the use of doubly labeled water, [which I described in a past Weightology Weekly article](#). Unfortunately, this technique is very expensive and is only available in research settings. Methods that have been used to estimate people's energy expenditure include physical activity diaries and heart rate monitors. However, these techniques can have very poor accuracy. Three-dimensional accelerometers, which measure the body's acceleration in three dimensions, have become increasingly popular over the past decade. The Bodymedia Fit (formerly known as the Gowear Fit, and the previous models Bodybugg or Sensewear armband) is one such device that, through combining an accelerometer with measurements of other things such as skin temperature, gives reasonably good estimates of total daily energy expenditure. [One study](#) showed this device to estimate total daily energy expenditure to within  $\pm 300$  calories in 80% of the subjects, and  $\pm 454$  calories in 98% of the subjects, when compared to doubly labeled water. The problem with this device is that it must be worn on the arm at all times (except for in the shower or when swimming), and thus can be somewhat obtrusive.

There is now a device on the market called [the Phillips DirectLife Accelerometer](#). The device is only approximately 1 inch by 1 inch and can easily fit in your pocket or be worn around your neck:



The Phillips DirectLife 3-D Accelerometer only measures 1 inch by 1 inch

The device is a 3-dimensional accelerometer and tracks your side-to-side, back-and-

forth, and up-and-down movements. It is water-resistant up to 30 meters, so it can be used to track movement while swimming. It has a battery life of about 3 weeks and can store 22 weeks of data. When you plug the device into the USB port of your computer, the DirectLife website takes the movement data off of the device and calculates estimates of your activity energy expenditure (while using other variables such as your body weight and sex).

[A study was recently published](#) looking at the accuracy of this device for estimating energy expenditure. My current employer also gave me one of these devices to try out. Let's take a look at the study first, and then I will discuss my personal experience.

### **Caloric Study Construction**

The researchers recruited 30 subjects for the study (18 men and 12 women). They had an average age of 41 years and an average body mass index (BMI) of 24.4. The researchers measured the sleeping metabolic rate (the calories you burn while sleeping) of the subjects. The subjects then participated in a 2-week observation period, during which they wore the accelerometer. Energy expenditure was measured during this period using doubly labeled water. The researchers then analyzed the data to see how well the accelerometer could predict total energy expenditure (the total calories you burn over a 24-hour period) and activity energy expenditure (the calories you burn through physical activity). Body composition of the subjects was estimated using [a 3-compartment model](#).

### **Burning Outcomes**

The subjects wore the accelerometer an average of 14.4 hours of the day, which was 95% of their waking hours. The activity counts per day (the movements tracked by the accelerometer) significantly correlated with activity energy expenditure, with a correlation coefficient of 0.54 (where 1 means a perfect 1:1 correlation). Activity counts did not correlate with total daily energy expenditure. When the researchers developed equations to predict total energy expenditure from the accelerometer data, they found that an equation that used sleeping metabolic rate and activity counts could explain 76% of the variance in total daily energy expenditure (a perfect prediction would be if you could explain 100% of the variance). Thus, the

accelerometer could give reasonably good estimates of total daily energy expenditure, when sleeping metabolic rate was used as part of making the estimate. An equation that used activity counts and body weight was not quite as accurate, explaining 54% of the variance in total energy expenditure. An equation that used activity counts and lean mass was a bit better, explaining 68% of the variance.

In terms of activity energy expenditure, an equation that had activity counts and sleeping metabolic rate could explain 53% of the variance. Activity counts and body weight could explain 46% of the variance, and activity counts and lean body mass could explain 53% of the variance.

### **Accelerated Estimates**

This study indicates that the activity counts measured by the Phillips DirectLife 3-D accelerometer can provide somewhat reasonable estimates of total and activity energy expenditure when sleeping metabolic rate is known. Results are not as good when you only know body weight, and are a bit better (but not as good as for sleeping metabolic rate) if you know lean body mass.

Of course, there are a number of limitations that you need to consider:

- These results are only applicable to the equations that the researchers developed in this study from their small sample of subjects. These may not be the same equations that the Phillips DirectLife website uses in calculating your calorie burn from physical activity.
- The device gives the best estimates when sleeping metabolic rate is known, but most people do not know their sleeping metabolic rate. The Phillips DirectLife website only uses body weight data in its calculations.
- The average error for the predictions was as high as 300 calories when it came to total daily energy expenditure, and 225 calories when it came to activity energy expenditure. That is an average error, which means the error rate in individuals can be higher. Unfortunately the researchers did not report the 95% limits of agreement (which gives you an idea of how high the error rate can get in individual subjects).
- The sample size in this study was small, and consisted mostly of normal weight individuals. It is not clear how good the predictions are in

overweight and obese people.

## **My Personal Experience**

I have been experimenting with this device for the past two weeks now. Here are some of my thoughts and observations:

- I have been wearing it in the same pocket as my pedometer. The device seems to reflect my overall activity levels fairly well; on days where I know that I have been more active, the accelerometer shows it.
- The Phillips DirectLife website only gives you activity energy expenditure estimates, and not total daily energy expenditure (like the Bodymedia Fit does). However, there is a section of the site that will take your predicting metabolic rate (based on your age, gender, weight, and height) and add that to your activity energy expenditure to give you an average total. You can estimate your total daily energy expenditure for a particular day by taking the activity energy expenditure for that day, and adding it to your predicted metabolic rate.
- The device will not detect some upper body activities like weight training, but the online software gives you an opportunity to identify activities at certain time points in the day and will re-calculate your activity energy expenditure estimates based on what you identify.
- The device certainly is unobtrusive; you can wear it in your pocket, around your neck, on your chest, or on your belt.
- You can look at activity levels over the past year, month, week, day, and even hour. When you click on a particular day, you can see an hour-by-hour estimate of your activity levels, and if you click on an hour, you can get a minute-by-minute estimate.
- When you take the device out and lay it flat, it will light up and show you how close you are to your daily physical activity goal. If the lights hit 100%, then you have hit your goal, and if the lights pass 100%, then you have exceeded your goal. However, the device does not give you any digital display of numbers like a pedometer will, so you do not have as much of the immediate feedback as a pedometer can give you.

## **Caloric Conclusions**

Overall, the Phillips DirectLife Accelerometer appears to be a reasonable and unobtrusive device for tracking your daily physical activity. I think it is best used as a device for helping to track, maintain, and/or increase NEAT levels. I would not pay as much attention to the specific numbers it gives you regarding the number of calories you have burned; instead, it is best used to establish a certain baseline activity level to which you can then use as a benchmark. If your activity falls below that benchmark, you know it is time to get more active. Likewise, you can use the benchmark as a target to exceed on a daily basis.

Of course, the question is whether this device is worth the cost. The initial cost is \$99 for the first 4 months, along with \$12.50 per month after that. Over time, that can become expensive. An Omron pedometer, while it will only track walking activity, will only cost \$30 with no further cost (other than a couple bucks for a new battery every 6 months). Remember that walking makes up the majority of daily NEAT, so a pedometer may be good enough for helping you keep your NEAT elevated. However, if money is not an object, then the Phillips DirectLife Accelerometer can be an additional tool in your arsenal to help you lose weight and keep it off.

REFERENCE: [Bonomi, A.G., et al. Estimation of free-living energy expenditure using a novel activity monitor designed to minimize obtrusiveness. \*Obesity\* 18\(9\):1845-1851, 2010.](#)