University of Verona,
School of Exercise and Sport Science,
Laurea magistrale in Scienze motorie preventive ed adattate

Metodologia delle misure delle attività sportive

Wednesday 09/12/2015 h. 8:30÷10

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A class within a six classes module

Pedometer

Final pedometry issues

- no discrimination of weight lifting, gradient legged locomotion, cycling, swimming, rowing;
- shoe or ankle accelerometric pedometer -> stride #

Accelerometer

First generation

Rationale

a <- F (= m x a) <- by paying ME

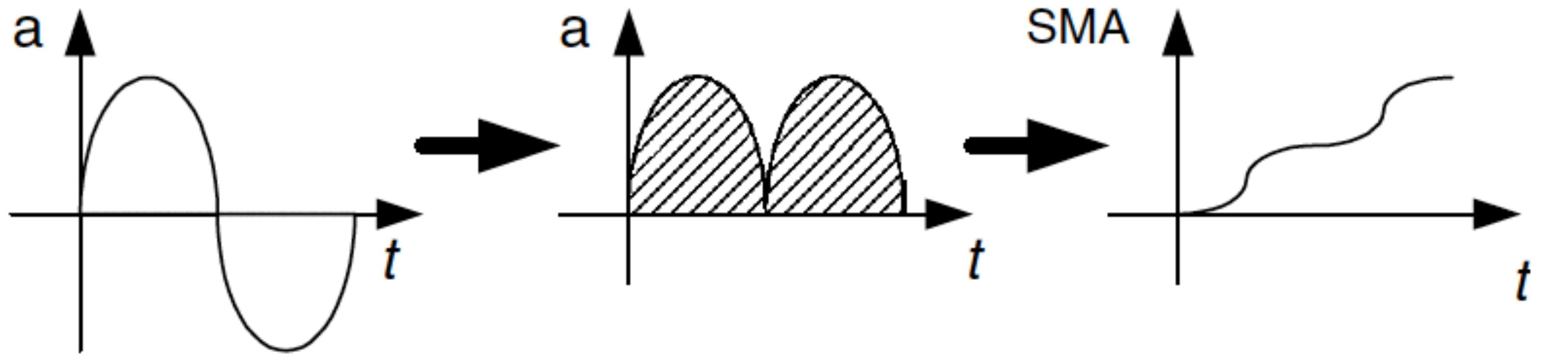


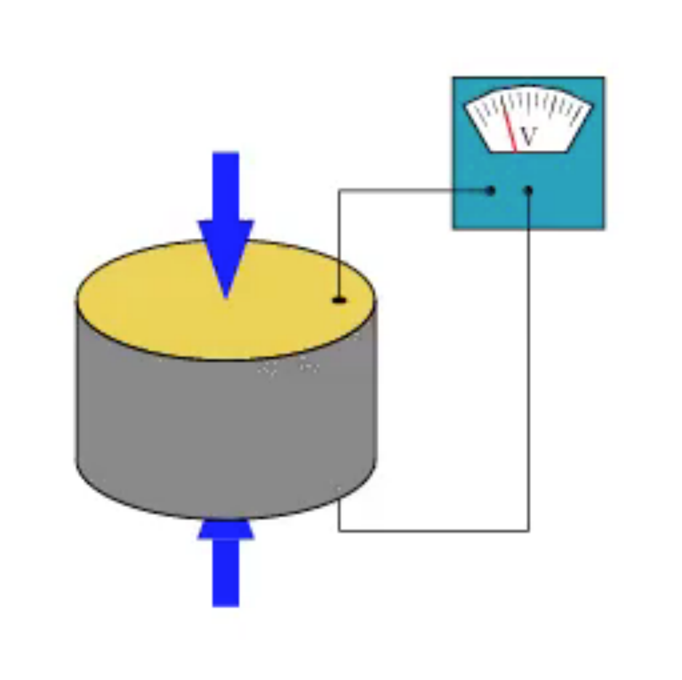
Figure 5. Metabolic energy expenditure (EE) is estimated by computing the signal magnitude area (SMA). The acceleration signal is rectified and then integrated. EE is then estimated by means of a linear regression.

Placement

waist but also chest, back, wrist, ankle

Accelerometer

- A piezo-electric or -resistive sensor;
- -> “counts” number, intensity;
- no isometric force



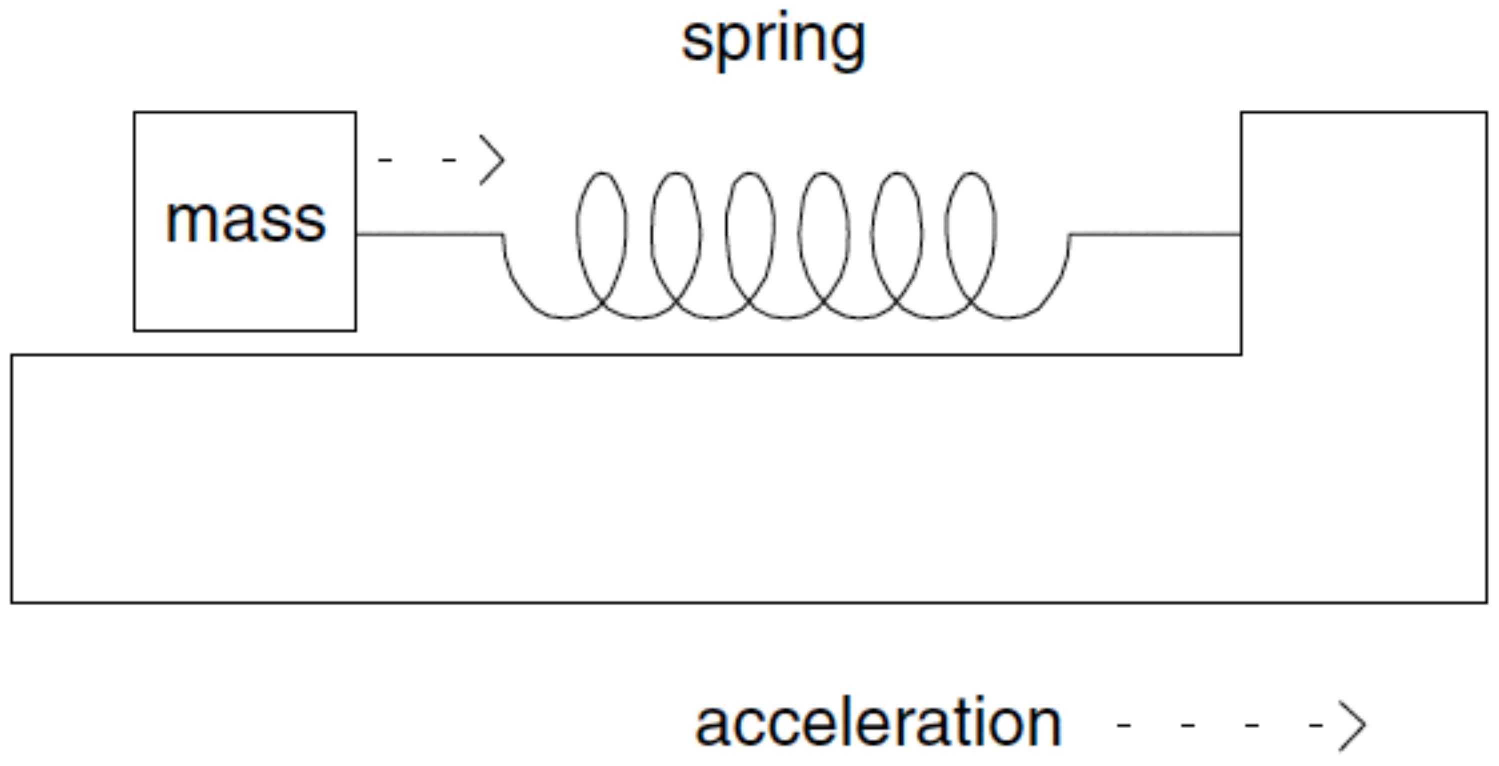
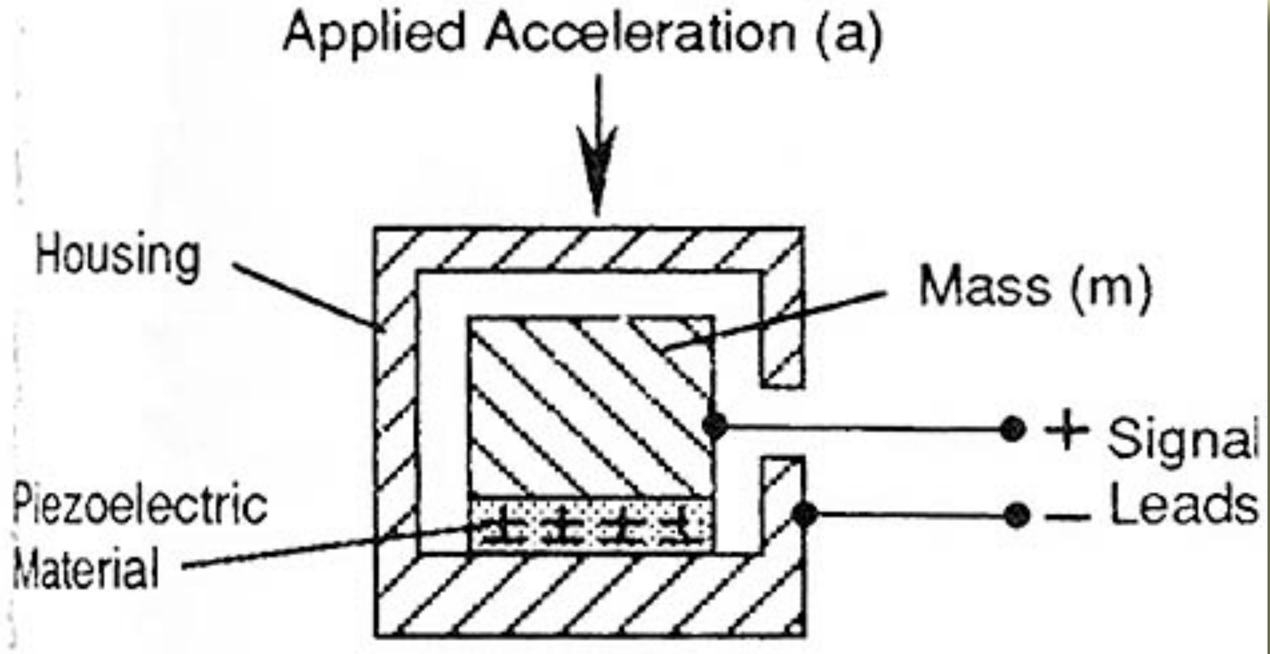


Figure 1. A piezoelectric accelerometer works like a simple mass spring system.



Basic Accelerometer

Accelerometer

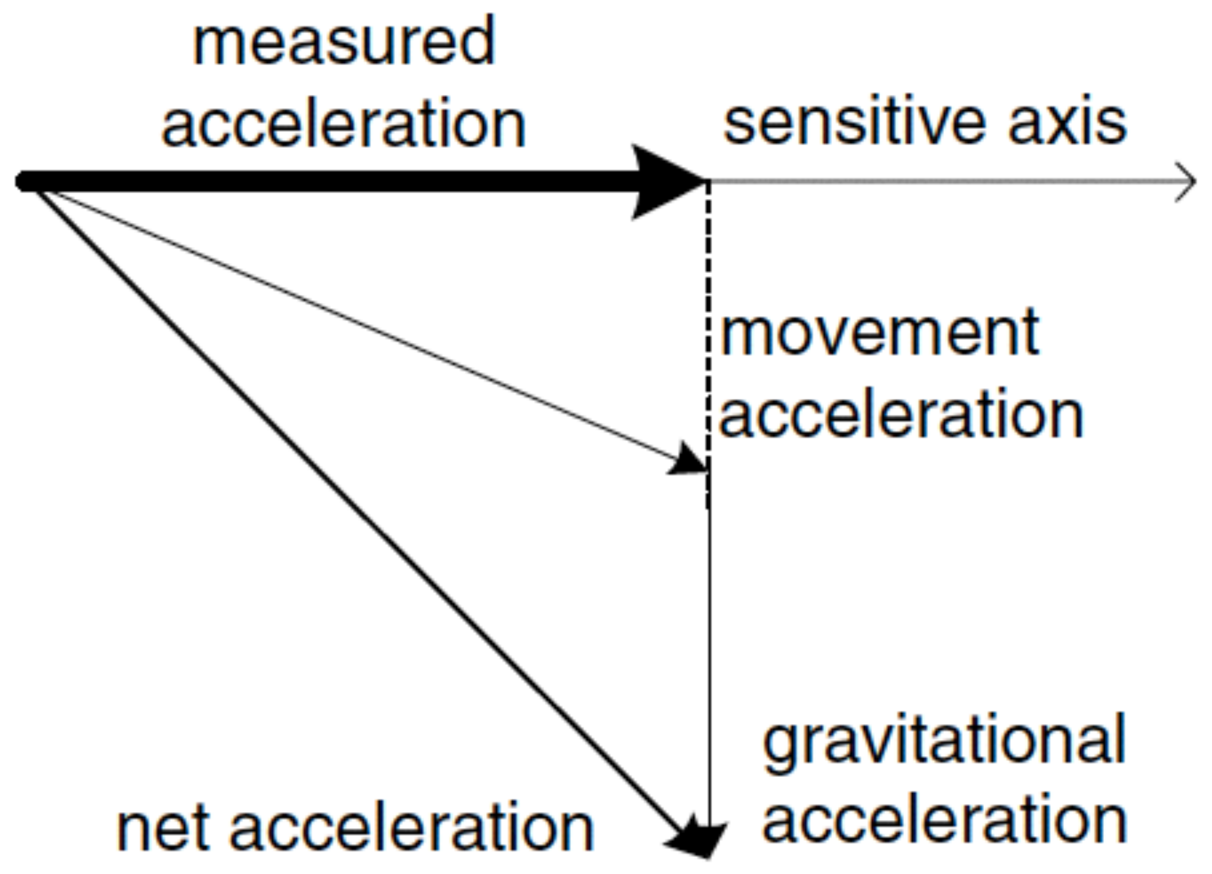


Figure 2. Piezoelectric accelerometers measure the sum of the acceleration due to movement and gravitational acceleration acting along the sensitive axis.

Mathiee et al., 2004

Accelerometer

measures

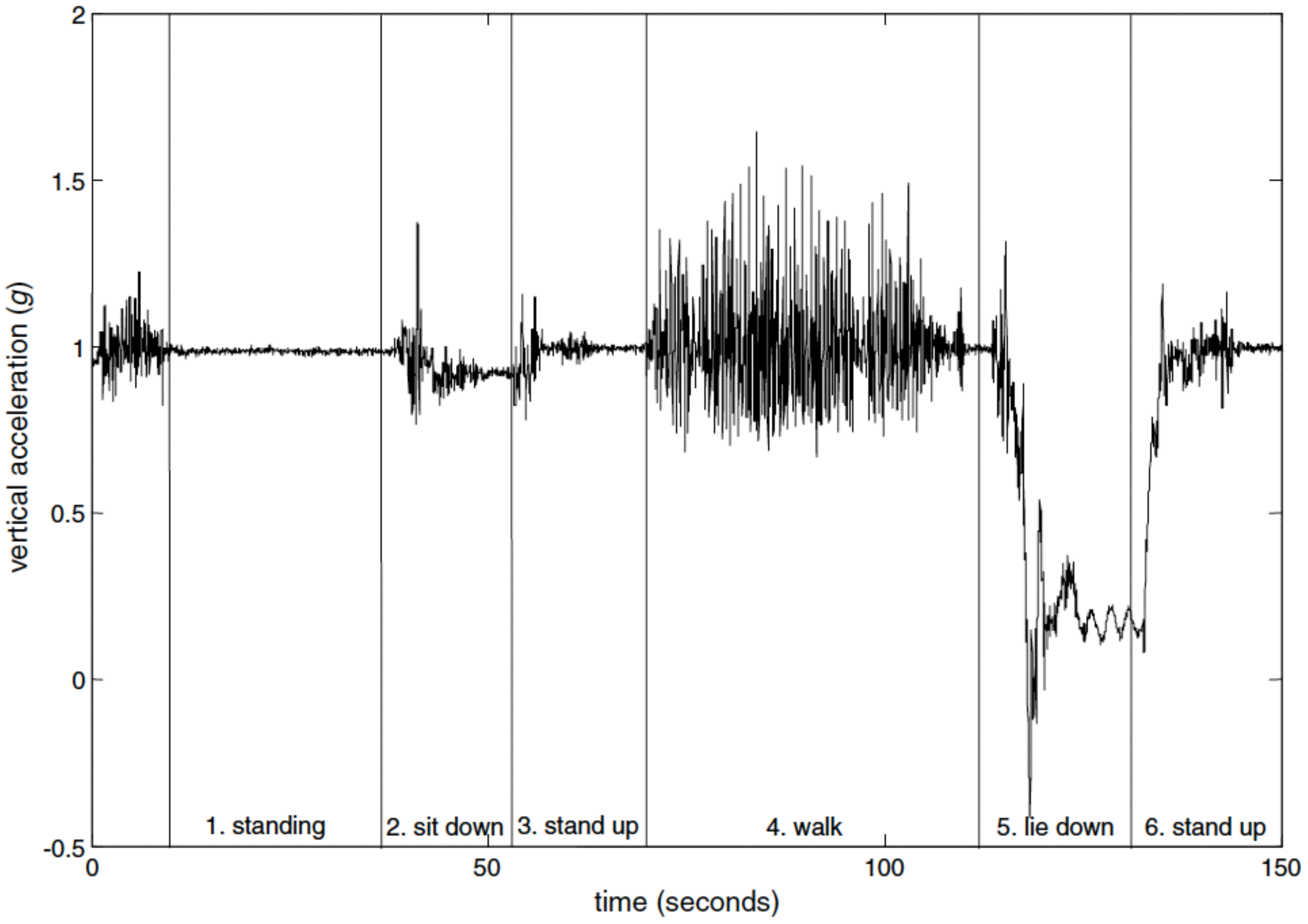


Figure 4. Acceleration signal produced by a waist-mounted accelerometer aligned in the vertical (gravitational) direction, during a selection of basic daily movements. The acceleration signal is composed of the gravitational acceleration due to the posture of the subject and the acceleration due to body movement. g is the acceleration due to gravity, approximately 9.81 m s^{-2}. The measured accelerations are dependent on the activity being performed. If the accelerometer was attached at a different point on the body, different acceleration signals would be recorded.

Mathiee et al., 2004

Accelerometer

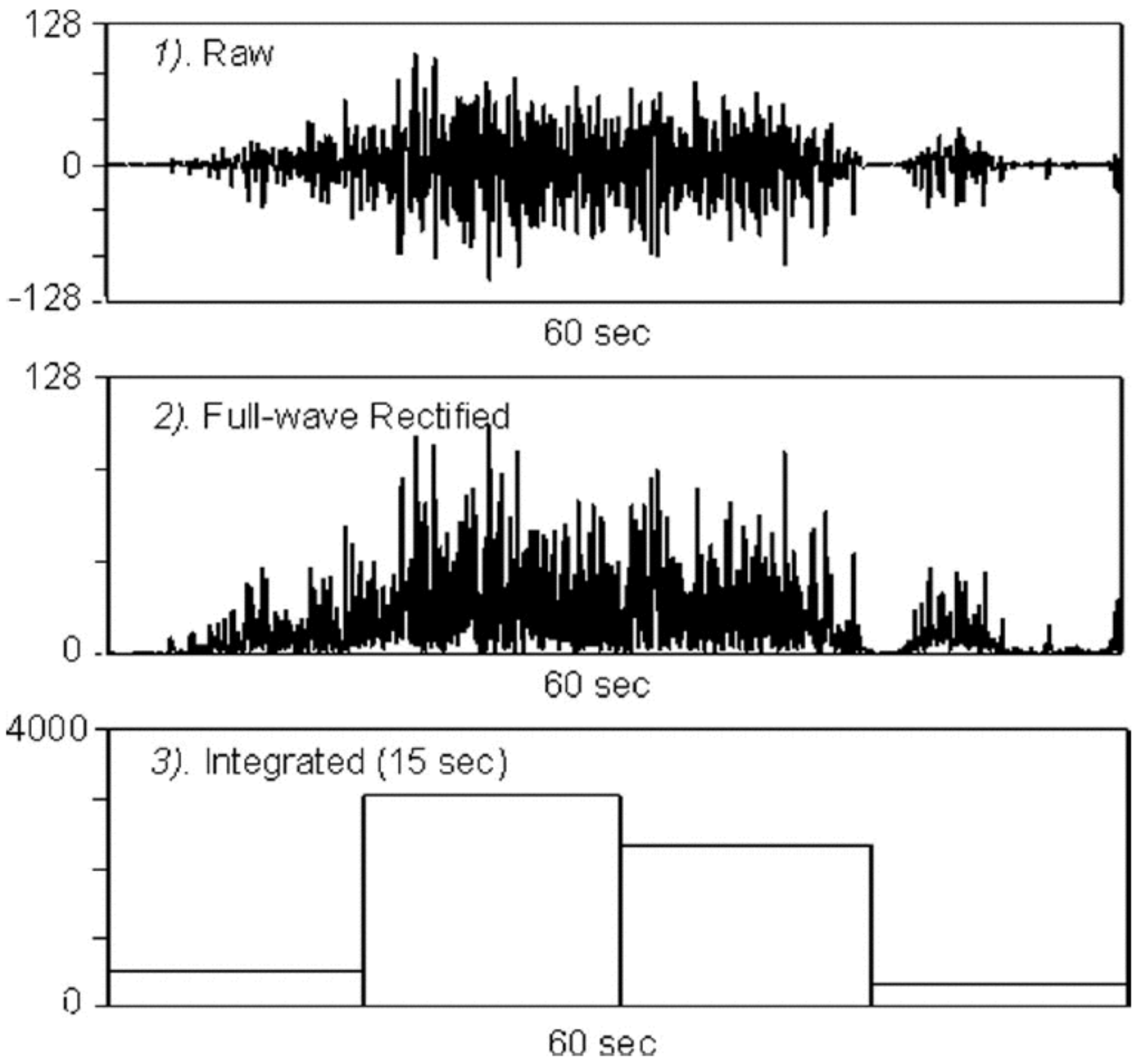


FIGURE 2—Analytical processing of the acceleration data. 1. Raw: a 60-s window of a digitized raw signal collected at 32 Hz and using a 8-bit A/D conversion. 2. Rectification: all negative signal from (1) was turned into positive. 3. Integration: 15-s epochs.

Chen et al., 2005

Accelerometer

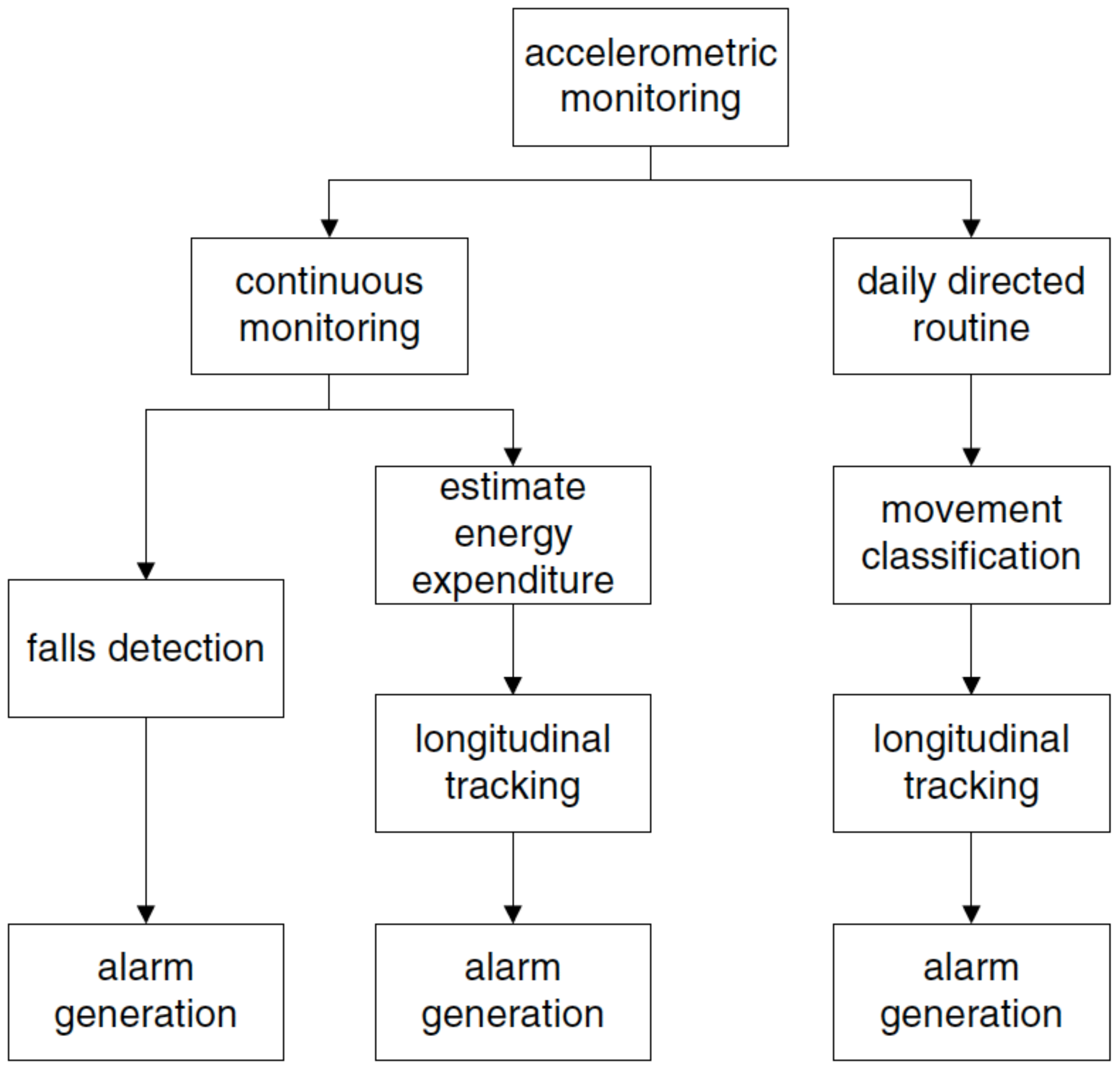


Figure 6. The three modes of monitoring.

Mathiee et al., 2004

Accelerometer

- Uniaxial accelerometer -> -59% children DLW ME;
  -59÷-50% old men DLW ME;
  +50÷+60% old claudicants DLW ME;
  -59% young women weekly DLW nME;
- Triaxial accelerometer -> +12÷+49% V'O2 locomotion ME;
  -21÷-8% V'O2 gradient walking ME;
  -68÷-53% V'O2 cycling ME;
  -45÷-35% V'O2 daily activity ME;
  -35% young women weekly DLW nME

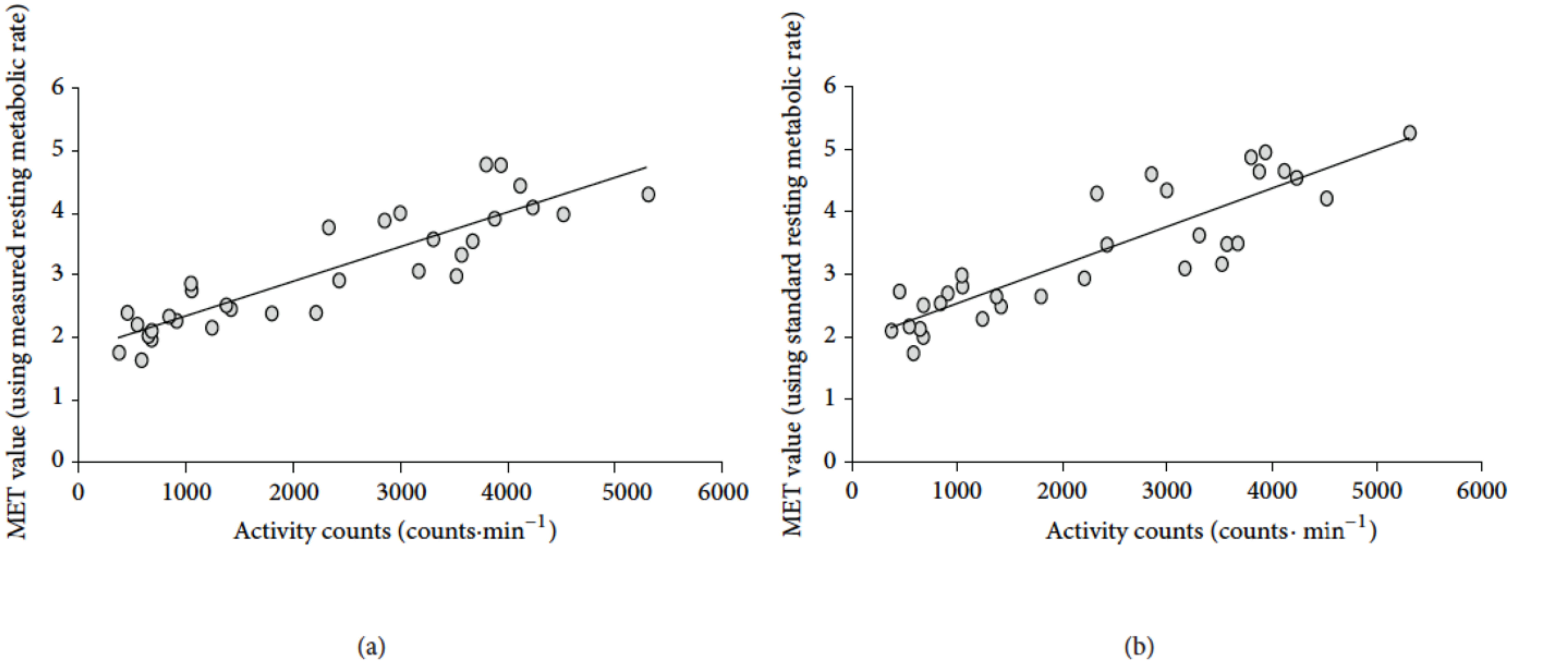
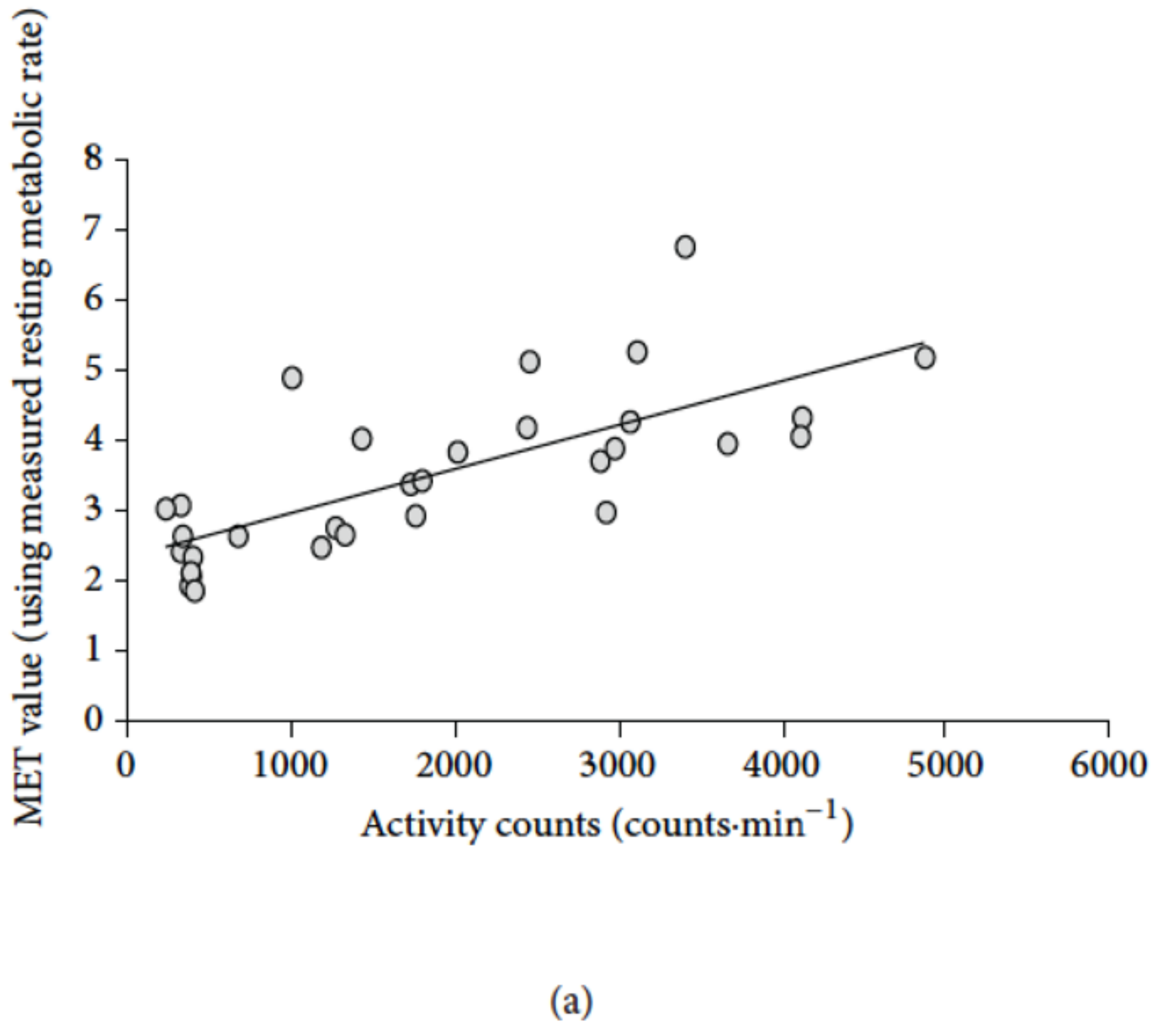


FIGURE 2: (a) Relationship between MET values and activity counts for young group using measured metabolic rate (R^2 = 0.80, standard error of estimate = 0.40). (b) Relationship between MET values and activity counts for young group using standard (3.5 mL·kg·min^{-1}) metabolic rate (R^2 = 0.82, standard error of estimate = 0.41).

Witcher et al., 2014



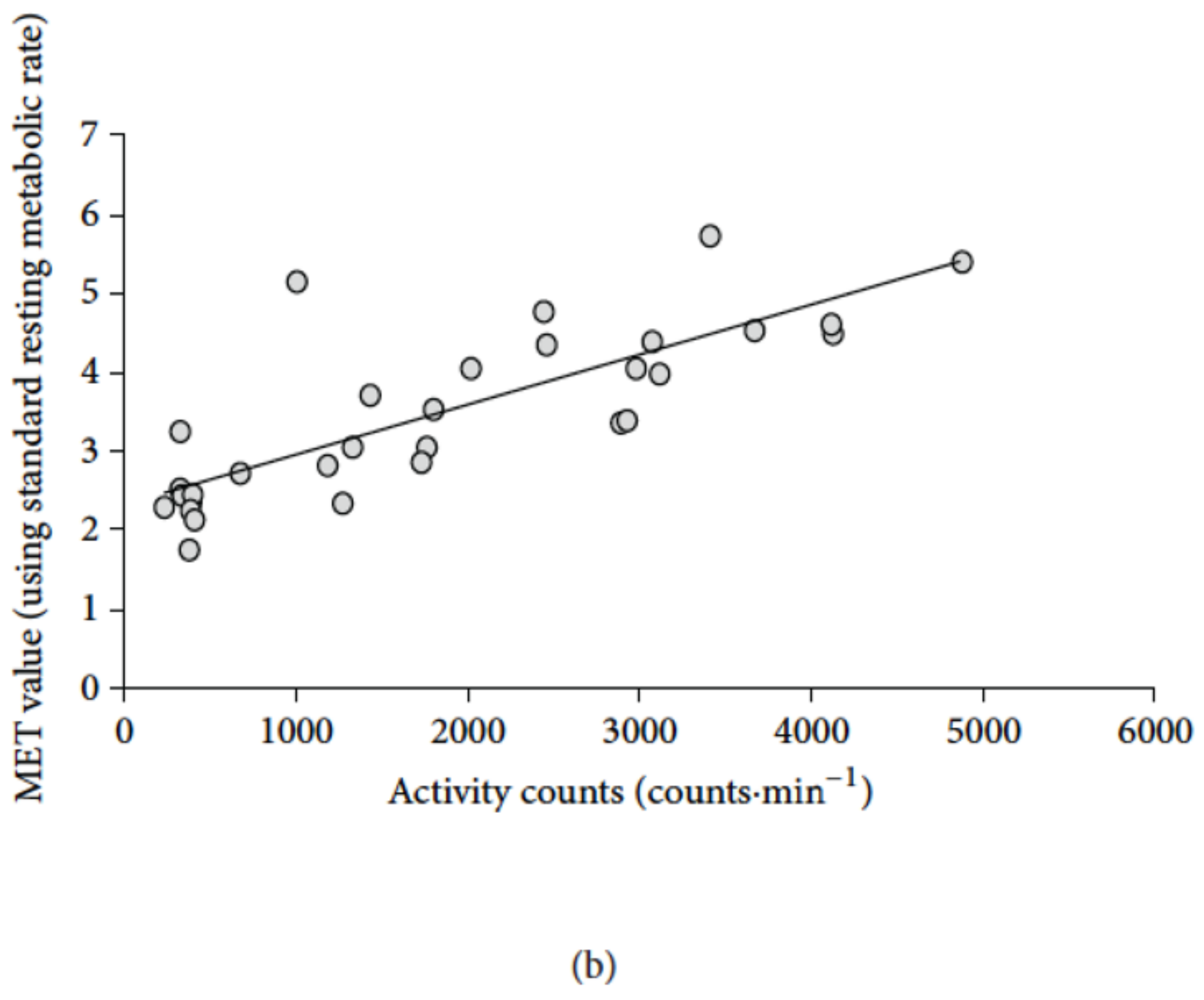


FIGURE 3: (a) Relationship between MET values and activity counts for elderly group using measured metabolic rate (R^2 = 0.57, standard error of estimate = 0.83). (b) Relationship between MET values and activity counts for elderly group using standard (3.5 mL·kg·min^{-1}) metabolic rate (R^2 = 0.52, standard error of estimate = 0.85).

Witcher et al., 2014

Accelerometer

measures

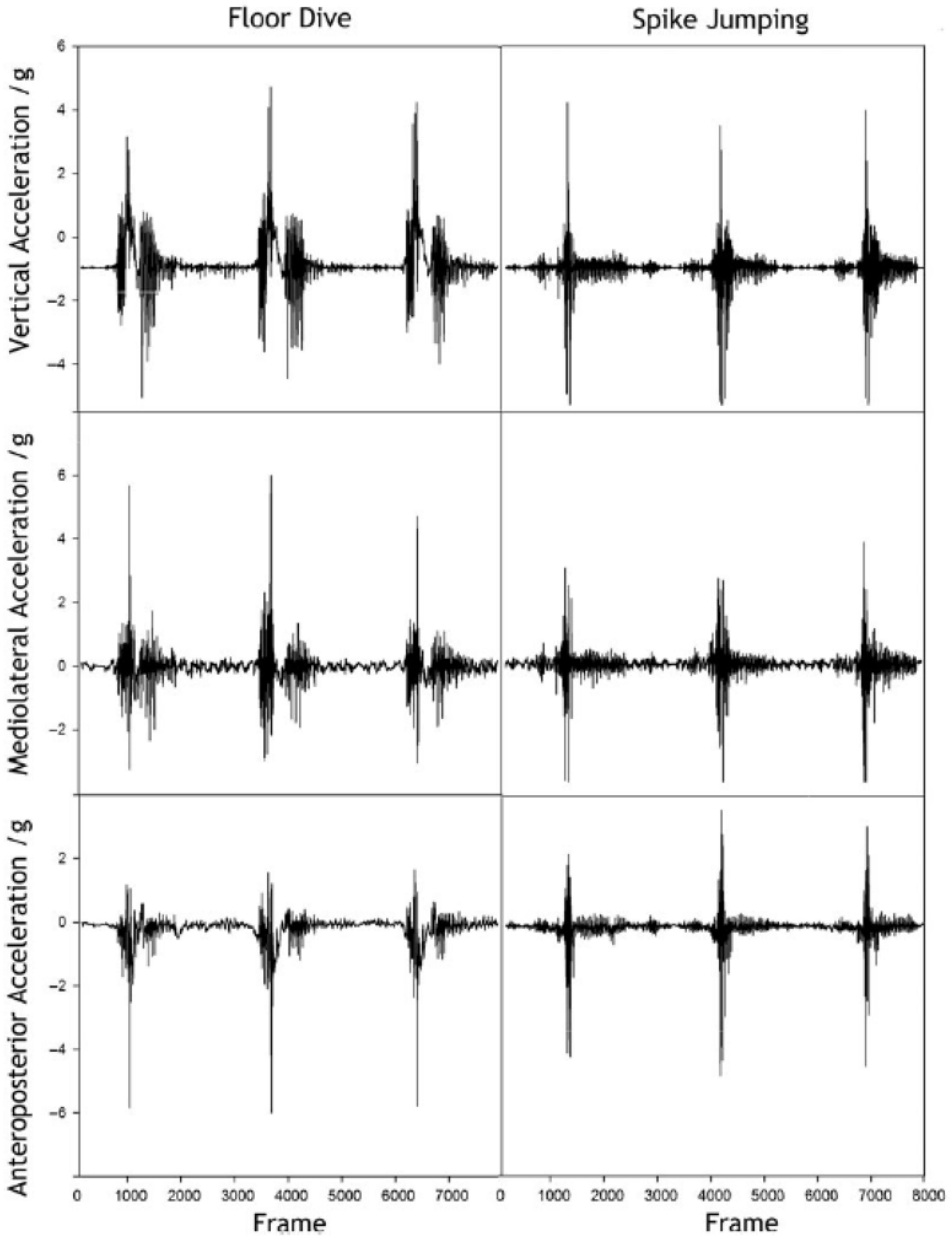


Figure 1. Acceleration in floor dive and spike jump for one randomly selected individual. Acceleration along the vertical, mediolateral and anteroposterior axes are presented in separate boxes.

Jarning et al., 2015

Accelerometer

measures

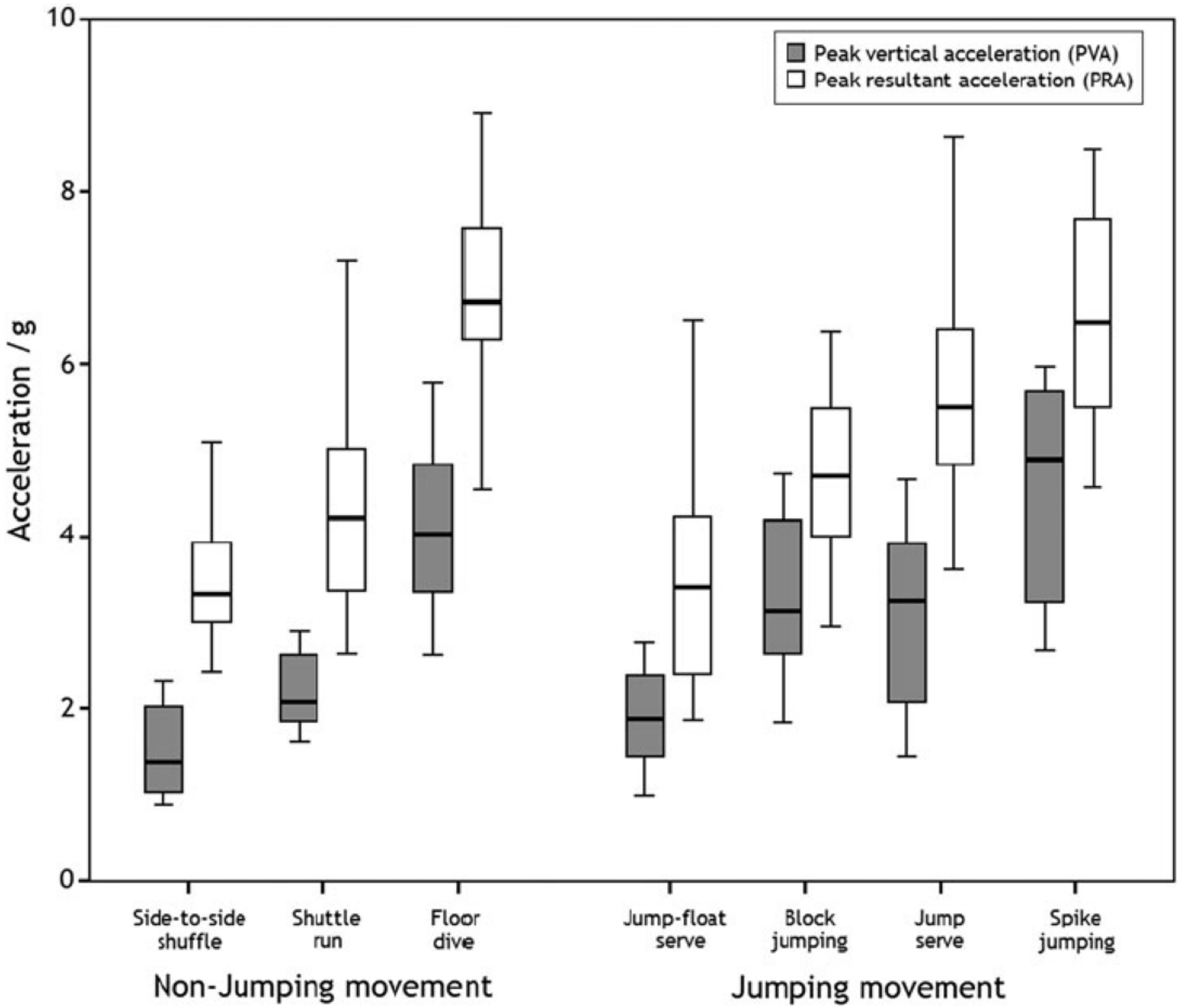


Figure 2. Box-plot showing median (and interquartile range) peak vertical acceleration for non-jumping and jumping volleyball specific movements.

Jarning et al., 2015

HR wrist monitor