Using Fitbit Charge 4 to measure expert and novice teachers’ heart rate and step counts

*Abstract*

**Background:**

Accurate, continuous heart rate measurements are important for health assessment, physical activity, and sporting performance, and the integration of heart rate measurements into wearable devices has extended its accessibility. Although the use of photoplethysmography technology is not new, the available data relating to the validity of measurement are limited, and the range of activities being performed is often restricted to one exercise domain and/or limited intensities.

**Objective:**

The primary objective of this study was to assess the validity of the Fitbit Charge device for measuring heart rate and step counts during a micro-teaching-unit between novice and expert teachers.

**Methods:**

A total of 20 healthy adults (9 female; height: mean 1.73 [SD 0.1] m; body mass: mean 71.6 [SD 11.0] kg; and age: mean 40 [SD 10] years) volunteered and provided written informed consent to participate in the study consisting of 2 trials. Trial 1 was split into 3 components: 15-minute sedentary activities, 10-minute cycling on a bicycle ergometer, and incremental exercise test to exhaustion on a motorized treadmill (18-42 minutes). Trial 2 was split into 2 components: 4 × 15-second maximal sprints on a cycle ergometer and 4 × 30- to 50-m sprints on a nonmotorized resistance treadmill. Data from the 3 devices were time-aligned,

and the validity of Polar OH1 and Fitbit Charge 3 was assessed against Polar H10 (criterion device). Validity was evaluated using the Bland and Altman analysis, Pearson moment correlation coefficient, and mean absolute percentage error.

**Results:** Overall, there was a very good correlation between the Polar OH1 and Polar H10 devices (*r*=0.95), with a mean bias

of −1 beats·min-1 and limits of agreement of −20 to 19 beats·min-1. The Fitbit Charge 3 device underestimated heart rate by 7

beats·min-1 compared with Polar H10, with a limit of agreement of −46 to 33 beats·min-1 and poor correlation (*r*=0.8). The mean

absolute percentage error for both devices was deemed acceptable (<5%). Polar OH1 performed well across each phase of trial

1; however, validity was worse for trial 2 activities. Fitbit Charge 3 performed well only during rest and nonsprint-based treadmill

activities.

**Conclusions:** Compared with our criterion device, Polar OH1 was accurate at assessing heart rate, but the accuracy of Fitbit

Charge 3 was generally poor. Polar OH1 performed worse during trial 2 compared with the activities in trial 1, and the validity

of the Fitbit Charge 3 device was particularly poor during our cycling exercises.

**KEYWORDS**

heart rate; photoplethysmography; wearable electronic device; expertise differences

*Introduction*

**Background**

Classroom events are characterized as multidimensional, simultaneous, immediate, unpredictable, public and shared and teachers have to respond immediately to events as they develop (Barnes, 2004; Doyle, 2011).

Studies have shown that teaching is a stressful career and this can lead to teachers suffering from burnout (McCarthy,Lambert, O’Donnell, & Melendres, 2009).

The integration of heart rate measurements into wearable, low-cost, non-invasive devices has extended its accessibility

**Objectives**

The objective of this study was to assess the heart rate and step counts of expert and novice teachers.

*Methods*

**Participants**

**Study Design**

**Devices**

Fitbit Charge 4 was attached to a wrist, 2-finger widths above the ulnar styloid process, following the

manufacturer’s instructions. According to the manufacturer, Fitbit Charge 4 uses *PurePulse* wrist HR technology to measure HR. Data were automatically wireless synced with an iPad via Bluetooth to a Fitbit account, and subsequently, the intraday second-by-second data were exported for each session using the opensource software *Pulse Watch* (PulseWatch. URL: https://iccir919.github.io/pulseWatch/public/index.html [accessed 2022-08-03]).

**Study Procedures**

**Data Analysis**

*Results*

**Validity of HR Across All Data**

*Discussion*

**Principal Findings**

**Conclusions**