Concurrent Validity of Fitbit Charge HR and Microsoft Band 2 to Measure Heart Rate

Clare M. McDermott [1,2] , Andrew McCarren [2,3] , Kieran M. Moran [1,2] , Niall M. Moyna [1,2]
[1] School of Health and Human Performance, Dublin City University, [2] Insight Centre for Data Analytics, [3] School of Computing, Dublin City University

Abstract:
Purpose: Wrist-worn monitors are developed to unobtrusively measure heart rate (HR) at rest and during exercise. This study assessed the concurrent validity and reliability of the Microsoft Band 2 (Microsoft-Band2) and Fitbit Charge HR (Fitbit) to measure HR at rest and during exercise.
Methods: Healthy men (n=12) and women (n=12) (mean (± SD); age 24.3 ± 3.1 yr) were tested on two occasions separated by at least 7 d. The same protocol was used during each visit and consisted of 3-min conditions in the following order - supine, sitting, 6 $km.h^{-1}$ walk, 10 $km.h^{-1}$ run, and 12.$km.h^{-1}$ run. HR was continuously measured using a Holter monitor, Microsoft-Band2, and Fitbit, and averaged across each 3-min condition. A Bland Altman analysis was conducted to calculate the intervals of agreement (95%). A 2 tailed t-test at $\alpha = 0.05$ was also used to compare the mean differences in measurements with the Holter for both devices and an F-test ($\alpha = 0.05$) was used to compare the measurement dispersion characteristics of both devices.
Results: The intervals of agreement for the Fitbit had comparable dispersion characteristics with the Microsoft-Band2 with the exception of the supine condition ($p = 0.004$). The difference between Fitbit and Holter are significantly further from zero than the difference between Microsoft-Band2 and Holter for sitting ($p = 0.004$) and 6 $km.h^{-1}$-walk ($p = 0.001$).
Conclusion: Microsoft-Band2 is more accurate than Fitbit at seated rest and during low intensity exercise, walking, and is comparable to Fitbit at 10$km.h^{-1}$ run.

INTRODUCTION

Advances in wearable technology has led to the emergence of new consumer-based wrist-worn HR monitors for personal health management. There is currently limited information available on the validity of wrist-worn HR monitors. The purpose of this study was to assess the validity of two commonly used wrist-worn HR monitors - the Fitbit Charge HR and the Microsoft Band 2.

METHODOLOGY

A total of 12 male and 12 females (mean (± SD); age 24.3 ± 3.1 yr, height 172.9 ± 10.1 cm; weight 69.4 ± 13.3 kg, BMI 23.1 ± 3.1. kg/m^2) made 2 separate visits to the vascular health research laboratory at DCU. Participants were fitted with a Holter monitor and wore both a Fitbit and a Microsoft-band2 (figure 1a-c) during each laboratory visit.

Figure 1a

Figure 1b

Figure 1c

During each visit which was separated by 7 d, HR was measured while supine, sitting, walking and (figure 2). The dispersion between the Holter monitor and the Fitbit and Microsoft-Band2 were compared for each experimental condition using a F-test at $\alpha=0.05$. The mean difference for each watch with the Holter monitor were then compared using a 2 tailed paired t-test at $\alpha=0.05$.

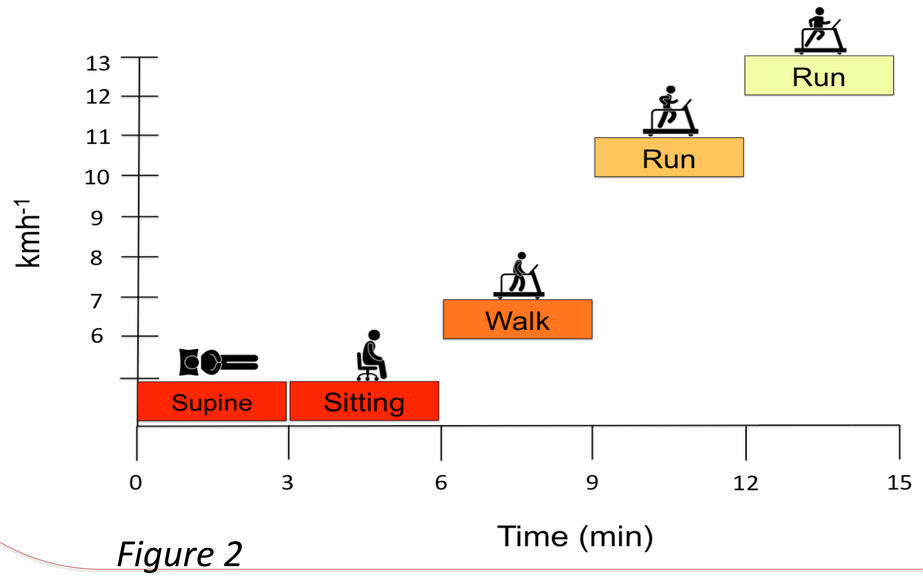

Figure 2

RESULTS

The intervals of agreement for the Fitbit had comparable dispersion characteristics with the Microsoft-Band2 with the exception of the supine condition ($F_{24,24} = 3.05$, p-value = 0.004). The MB displayed significantly higher accuracy for both sitting ($t_{24} = 2.93$, p-value=0.004) and the 6 $km.h^{-1}$ walk ($t_{24} = 3,24$,p-value=0.001). During the 10 $km.h^{-1}$ run, there was an equivalent difference between the Holter and both the Microsoft-band2 and the Fitbit, but in opposite directions.

Mean, SD & significance values for each experimental condition

Parameter	SD Holter-MB	SD Holter-Fitbit	$F_{24,24}$	P-value	Mean Holter-MB	Mean Holter-Fitbit	t_{24}	P-value
Supine	8.97	2.939	3.05	0.004	-3.977	-0.058	2.03	0.026
Sitting	4.746	3.295	1.44	0.188	-0.766	2.689	2.93	0.004*
6 $km.h^{-1}$	5.405	7.825	0.691	0.814	2.916	9.222	3.24	0.001*
10 $km.h^{-1}$	6.832	6.245	1.09	0.414	-2.902	2.147	2.67	0.007**
12 $km.h^{-1}$	6.887	7.346	0.937	0.561	4.166	6.141	0.961	0.173

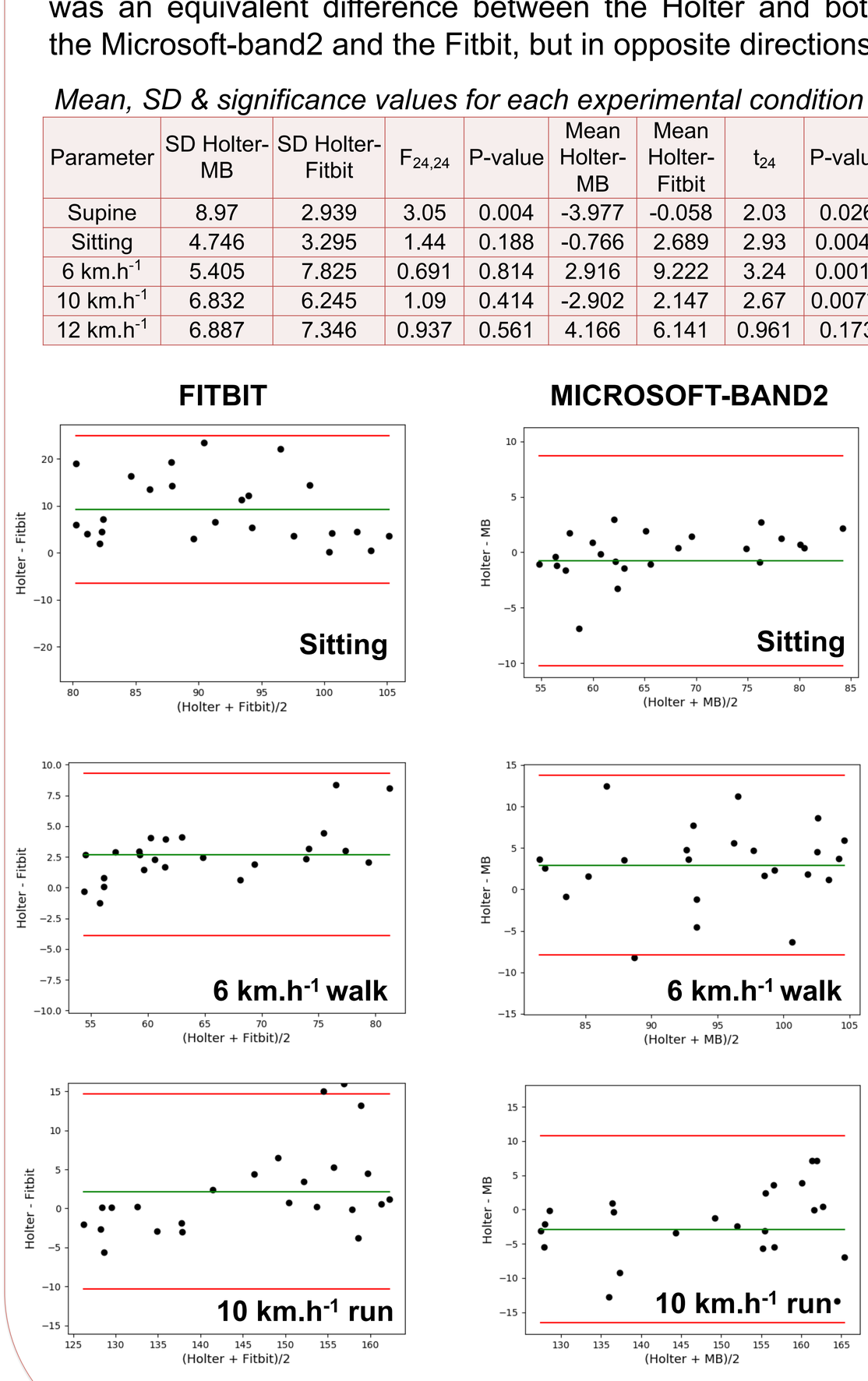

Figure 4: Bland Altman plots

Co-funded by the Horizon 2020 Framework Programme of the European Union (Grant Agreement No. 64349)

Presented at the Faculty of Sport and Exercise Medicine Conference , RCSI, Dublin, Ireland. September 2017