

Evaluation of Average and Maximum Heart Rate of Wrist-worn Wearable Technology Devices During Trail Running

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ABSTRACT

It has been estimated that there are 20 million people who participate in trail running, and these numbers are expected to increase by 15% each year. Our laboratory group has conducted studies on the validity of wearable technology watches and heart rate (HR) during trail running. The previous generation devices were mostly inaccurate, and a limitation was that reliability was not measured. **PURPOSE:** To determine both validity and reliability in newer models of wearable devices during trail running. **METHODS:** Seventeen participants (F = 7) ran on the Thunderbird Gardens Lightning Switch trail in Cedar City, UT. Demographic characteristics: Age = 25 (9) years (mean [standard deviation]), ht = 168 (9) cm, mass = 72 (14) kg. Two Garmin Instincts and two Polar Vantage M2s were evaluated, along with the Polar H10 chest strap as the criterion measure. Participants ran out on the trail for 10-minutes, and then returned to the trailhead. Maximum HR and average HR were measured during the run. Data were analyzed for validity (Mean Absolute Percent Error [MAPE] and Lin's Concordance [CCC]) and reliability (Coefficient of Variation [CV] and Intraclass Correlation Coefficient [ICC]). Predetermined thresholds were: MAPE<10%, CCC>0.70, CV<10%, ICC>0.70. **RESULTS:** The Garmin Instinct met the threshold for both reliability tests for average and maximum HR (see table). The Garmin Instinct and Polar Vantage met the threshold for both validity tests for maximum HR. **CONCLUSION:** In order for a device to be considered valid, it must meet the predetermined thresholds for both validity and reliability. These results indicate that only the Garmin Instinct is valid and reliable, but only for measuring maximum HR. This is challenging for those who wish to track their HR while trail running, because neither of the studied devices were valid and reliable for maximum and average HR.

	Maximum			Average		
Validity	HR	MAPE	CCC	HR	MAPE	CCC
Polar H10	185 (12)			163 (13)		
Garmin Instinct	184 (15)	3.18	0.705	156 (15)	4.37	0.602
Polar Vantage M2	181 (12)	2.45	0.788	152 (15)	6.48	0.506
Reliability	HR	CV	ICC	HR	CV	ICC
Garmin Instinct 1	184 (15)	2.04	0.873	157 (15)	2.91	0.821
Garmin Instinct 2	184 (15)			157 (15)		
Polar Vantage M2 1	183 (11)	2.90	0.646	157 (12)	7.55	0.180
Polar Vantage M2 2	180 (12)			149 (17)		