

Are activity wrist-worn devices accurate for determining heart rate during intense exercise?

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Abstract-

The market for wrist-worn devices is growing at previously unheard-of speeds. A consequence of their fast commercialization is a lack of adequate studies testing their accuracy on varied populations and pursuits. To provide an understanding of wearable sensors for sports medicine, the present study examined heart rate (HR) measurements of four popular wrist-worn devices, the (Fitbit Charge (FB), Apple Watch (AW), Tomtom runner Cardio (TT), and Samsung G2 (G2)), and compared them with gold standard measurements derived by continuous electrocardiogram examination (ECG). Eight athletes participated in a comparative study undergoing maximal stress testing on a cycle ergometer or a treadmill. We analyzed 1,286 simultaneous HR data pairs between the tested devices and the ECG. The four devices were reasonably accurate at the lowest activity level. However, at higher levels of exercise intensity the FB and G2 tended to underestimate HR values during intense physical effort, while the TT and AW devices were fairly reliable. Our results suggest that HR estimations should be considered cautiously at specific intensities. Indeed, an effective intervention is required to register accurate HR readings at high-intensity levels (above 150 bpm). It is important to consider that even though none of these devices are certified or sold as medical or safety devices, researchers must nonetheless evaluate wrist-worn wearable technology in order to fully understand how HR affects psychological and physical health, especially under conditions of more intense exercise.

Index Terms- heart rate; wearables; physical exertion; exercise prescription; digital health; monitoring; photoplethysmography; accuracy; medical devices

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