SMART WATCHES FOR HEART RATE ASSESSMENT IN ARRHYTHMIAS

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Background
Wrist-worn smart watches (SW) that estimate heart rate (HR) via photoplethysmography are increasingly popular. HR estimation using SW has been evaluated in healthy controls in sinus rhythm with variable accuracy depending on the device used, activity undertaken and HR attained.¹³ Although not marketed for medical use, patient-initiated presentations for medical assessment due to device-detected HR abnormalities are increasing, with a paucity of data on their validity in cardiac arrhythmias. We aimed to assess the accuracy of two leading SWs for HR estimation in a range of heart rhythms.

Methods
This prospective cohort study included 112 hospitalized patients (cardiac arrhythmias (n=60), sinus rhythm (n=52) recruited from a tertiary-care hospital. Patients were evaluated at rest using continuous electrocardiogram (ECG) monitoring as reference standard, with concomitant SW-HR monitoring for 30-minutes, with HR recorded every 15-seconds. Participants wore an Apple Watch (AW) (Apple Inc., Cupertino, USA) and Fitbit Blaze (FB) (Fitbit Inc., San Francisco, USA) on either wrist, secured firmly above the ulnar styloid.

Spearman rank correlation (rₛ) and Bland-Altman analysis with 95% limits of agreement (LoA) were used to assess agreement between SW-HR and ECG-HR. Bias was calculated as the mean difference between ECG-HR and SW-HR.

Results
Across all devices 40,720 HR values were collected. Sinus rhythm demonstrated strong correlation with ECG-HR (FB rₛ=0.90, AW rₛ=0.99, both p<0.01), with no differences observed between sinus bradycardia and tachycardia. AW demonstrated a stronger correlation with arrhythmia than FB (AW rₛ=0.87, FB rₛ=0.68, both p<0.01) with lower LoA. Subgroup arrhythmia analysis demonstrated the highest correlation for atrial flutter in both devices (AW rₛ=0.99, FB rₛ=0.98, both p<0.01) with a mean bias <1 beat (Figure). However, in atrial fibrillation (AF), there was significant HR underestimation with both devices with only a moderate correlation for AW (rₛ=0.63, p<0.01, mean bias 8 beats) and very weak for FB (rₛ=0.09, p<0.01, mean bias 28 beats) (Figure). Very weak, non-significant correlations were seen with both devices for complete heart block (FB rₛ =-0.05, AW rₛ=0.17, p 0.35).

Conclusion
SW estimation of HR demonstrated most accuracy in patients with sinus rhythm and atrial flutter, but was reduced for other arrhythmias. The discrepancy between devices was most marked in AF, with AW outperforming FB. Further improvements in these devices are needed before they can be reliably used for chronotropic assessment and arrhythmia detection.

TRIAL REGISTRATION
Australian New Zealand Clinical Trials Registry (ANZCTR 1261001374459)
Figure: Spearman correlations ($r_s$) between SW devices and ECG for both atrial fibrillation and atrial flutter. Measures are HR recorded every 15 seconds.

References