

The HRV of the Ring – Comparison of nocturnal HR and HRV between a commercially available wearable ring and ECG

Kinnunen Hannu ^{1,2)}, Koskimäki Heli ^{1,3)}

1) Oura Health, Oulu, Finland, 2) University of Oulu, Optoelectronics and Measurement Techniques Research Group, Finland, 3) University of Oulu, Biomimetics and Intelligent Systems Group, Finland

Introduction: The beat of a healthy heart shows significant variation among the time intervals between heartbeats. Heart rate variability (HRV) consists of periodic and aperiodic changes in the duration of the cardiac “QRS-wave” cycle, which have both clinical and practical relevance. Greater nocturnal HRV has been linked with better sleep quality in healthy and clinical populations. Measurement of HRV during sleep might therefore have applications for sleep related maladies, but to collect long term data there is a strong need for comfortable measurement devices that do not disturb rest. Here we assess the Oura ring’s (Ring) ability to fill this need.

Methods: We measured nocturnal photoplethysmogram (PPG) based inter-beat interval (IBI) data with the Ring (Oura Health Ltd, Oulu, Finland) and simultaneous R-R interval data with Faros 360 electrocardiogram (ECG) device (Mega Electronics, Kuopio, Finland) in 10 healthy individuals (3 female, 7 male). All subjects had the Oura ring on both hands, resulting in 20 nightly recordings for analysis. Root mean square of successive differences (rMSSD) was used as the HRV measurement. We determined heart rate HR and HRV as nightly averages for Oura using only the normal IBI values (HR_{Oura} and $rMSSD_{\text{Oura}}$) and for ECG using Kubios software with automatic filter having medium setting (HR_{ECG} and $rMSSD_{\text{ECG}}$). The agreement between the methods was assessed by correlation analysis using Matlab software.

Results: High correlation was observed between HR_{Oura} and HR_{ECG} ($r^2 = .998$) with a bias of -0.53 bpm ($p < .001$). Moreover, high correlation was found between $rMSSD_{\text{Oura}}$ and $rMSSD_{\text{ECG}}$ ($r^2 = .967$) with a bias of -0.47 ($p < .001$). The observed HR range was 48 to 66 bpm, and rMSSD range was 21 to 78 ms.

Conclusion: As a ring provides high wearing comfort for the measurement of nocturnal HR and HRV, the present confirmation about the reliability of the HR and HRV numbers is welcome for sleep and recovery related long-term studies. High correlation observed in rMSSD encourage comparing other parameters of HRV, too.

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