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Adaptation of night median heart rate in calorimetric chambers versus in free living conditions : a critical evaluation



C. Montaurier¹, M. Vermorel¹, P. Ritz², A. Chamoux³, Y. Boirie¹, B. Morio¹

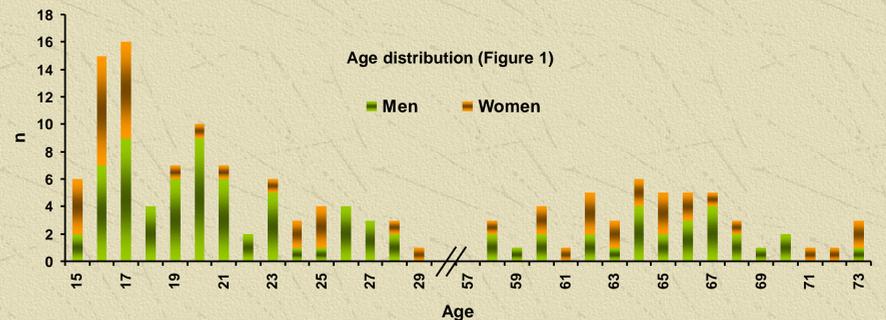


¹INRA UMR 1019 UNH-MLE, Clermont Ferrand, ²University Hospital, Angers, ³Auvergne University, Clermont-Ferrand, France

Introduction : Heart rate (HR) is an interesting variable for the assessment of energy expenditure in humans because it is strongly related to oxygen consumption and therefore to energy expenditure (EE) across a wide range of values (Ainslie et al. 2003). Twenty-four hour-HR recording using cardiofrequencemeter (CFM) is frequently used in cohorts of free living subjects for the calculation of daily energy expenditure (Lazzer et al. 2003) as for the estimation of the cardiac cost of physical activities (Chatterjee et al. 2002). For that purpose, a calibration period in calorimetric chamber (CC) using ECG is frequently considered (Treuth et al. 1998). These energy metabolism measurements are often used to establish nutritional energy intake recommendations.

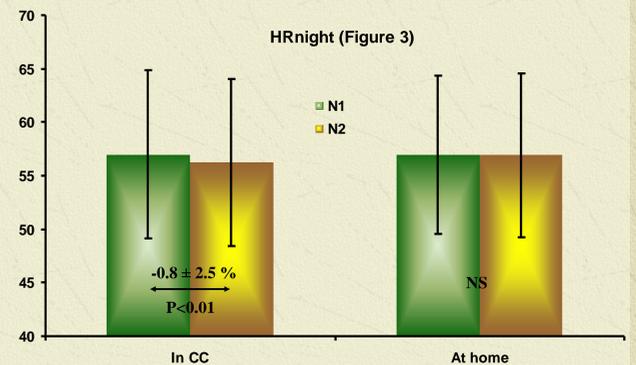
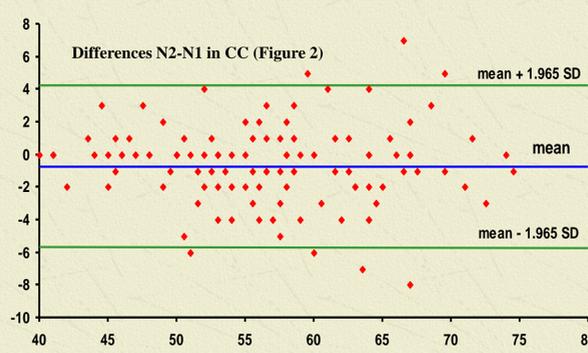
The **aim of the study** is 1) to determine if a stress does exist due to HR and EE recording methods, 2) to compare and to establish a conformity between both methods of HR recording to optimise future evaluation of EE at home from CC measurements.

Methods : As night median HR (HR_{night}) is a good indicator of stress, we studied its variation during two consecutive nights spent in CC in 120 volunteers (Figure 1), and in free living conditions in 69 volunteers. HR_{night} corresponded to the 50th percentile of data recorded during the 6 lower consecutive hours of the night. We also compared simultaneous HR recordings using both appliances (ECG and CFM) in CC in 20 men, and the HR_{night} and the daily median heart rate (HR_{day}) determined in CC and at home in 62 volunteers. HR_{day} corresponded to the 50th percentile of the active period during the day, i.e. from 8 am to 9 pm.

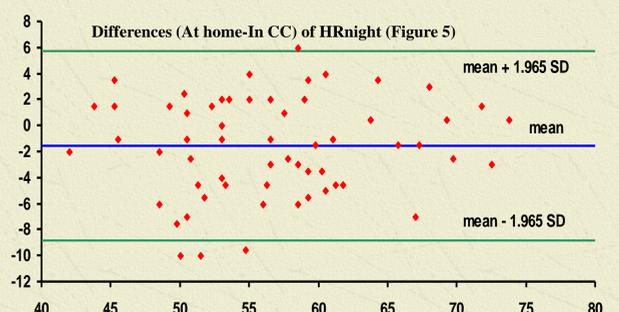
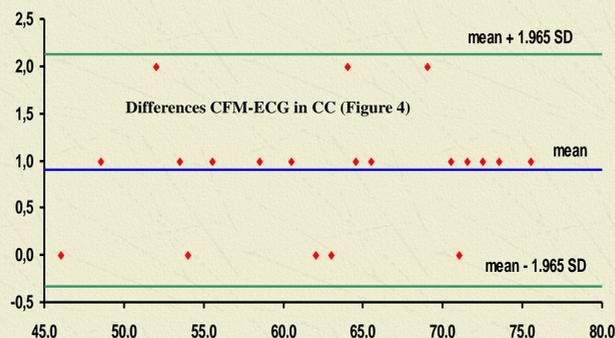


Results

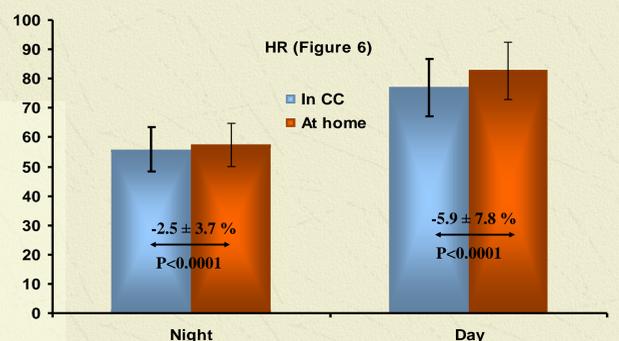
HR_{night} during the second night (N2) spent in CC was significantly lower than during the first night (N1) (-0.8 ± 2.5 bpm; $P < 0.01$) (Figure 2), whereas no significant difference was found using CFM at home. These results (Figure 3) suggested that a minor but significant adaptation period existed in CC and that the volunteers required a period of adaptation before the measurements start, whereas there was no adaptation period to the CFM in free living conditions.



Simultaneous recording using ECG and CFM showed significant difference (0.9 ± 0.6 bpm; $P < 0.0001$) (Figure 4). This bias may lead to an average underestimation of daily EE in free living conditions of $2.5 \pm 0.8\%$.



After correction for the bias, HR_{night} (Figure 5) and HR_{day} determined in CC were significantly lower than those determined at home (-2.5 ± 3.7 bpm; $P < 0.0001$ and -5.9 ± 7.8 bpm; $P < 0.0001$, respectively (Figure 6)). This suggested that a greater level of activity in free living conditions may have a persistent effect on the HR_{night} and may alter the comparison between HR_{night} determined at home or in CC.



Conclusions : In conclusion, when HR-EE equations are used to calculate daily EE, HR kinetics have to be corrected for the bias observed between the appliances used for HR recordings. Moreover, the intensity of the activities performed during the day may have a significant influence on HR_{night}. This may explain the lower HR_{night} determined in the calorimetric chambers in comparison with free living conditions, and also the significant adaptation of HR_{night} between the first and the second night in the calorimetric chambers. From the present study, it appears that HR_{night} recording is a robust method for the determination of energy expenditure and cardiac cost, once bias introduced by the use of different appliances is taken into consideration. These points should be considered to establish good relationships between HR and EE and to accurately evaluate the physical activity level.

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