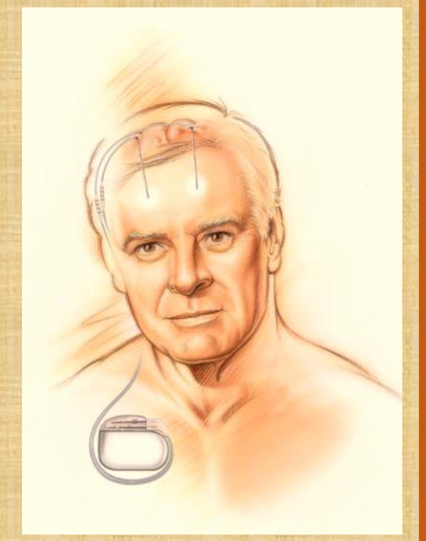
Usefulness of calorimetric chambers for measuring changes of energy expenditure in Parkinson disease patients

C. Montaurier[1]*, Y. Boirie[1,2], D. Morand[2], C. Lambert[2], B. Pereira[2], I. Rieu[2], R. Richard[1,2], M. Duclos[1,2] and F. Durif[2]

[1]INRAE, Unité de Nutrition Humaine (UNH), Université Clermont Auvergne, CRNH d'Auvergne, Clermont-Ferrand, France
[2]CHU de Clermont-Ferrand, Clermont-Ferrand, France
*christophe.montaurier@inrae.fr

Background: The most important clinical disorders in patients with Parkinson disease (PD) are akinesia which seriously deprive patients from motor skills. The implantation of subthalamic stimulation electrodes is an interesting therapeutical option to reduce these symptoms. PD patients have a frequent and significant weight gain after surgery. A first study highlighted energy expenditure (EE) alterations (Montaurier et al. 2007) confirmed in a recent study, both based on our 2 calorimetric chambers (CC). We used jointly data from CC and from wearable device like Actiheart (AH). AH records heart rate and physical activity, and calculates EE from these parameters added with gender, age and weight. The objective was to compare the EE results obtained by the 2 measurement systems (CC and AH).



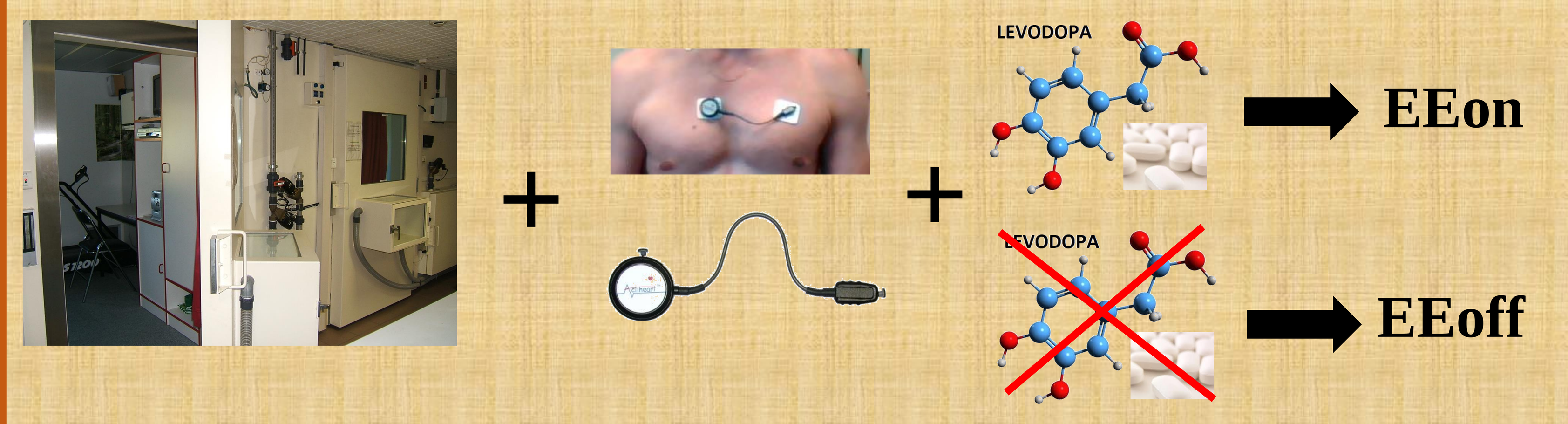
Material and methods:

The 19 volunteers (15 men and 4 women) observed in this study, spent 2 periods (1 month before: m-1, and 3 months after surgery: m+3) of 24h in CC wearing simultaneously an AH.

	n	Age (y)	Weight gain at m+3 (kg)
Men	15	61.3 ± 8.0	+3.97 ± 4.80
Women	4	62.0 ± 8.6	+1.80 ± 1.41
All	19	61.4 ± 7.9	+3.46 ± 4.31

The total duration of the measurements was 24 hours during the exact same observation periods for simultaneous recording data from the CC and from the AH.

The periods included 1) sleep for sleeping metabolic rate (SMR) during the quietest 197.55 (± 62.07) consecutive minutes of the night, 2) the quiet period of wakefulness excluding activity and meals. For this quiet awake period, we compared the EE from CC and AH when the patients were in 2 distinct states: EE in patients with medications and no blockage (EEon), and EE in patients off medications with akinesia (EEoff). For this part 19 PD patients were observed before surgery, and 11 of them after surgery.



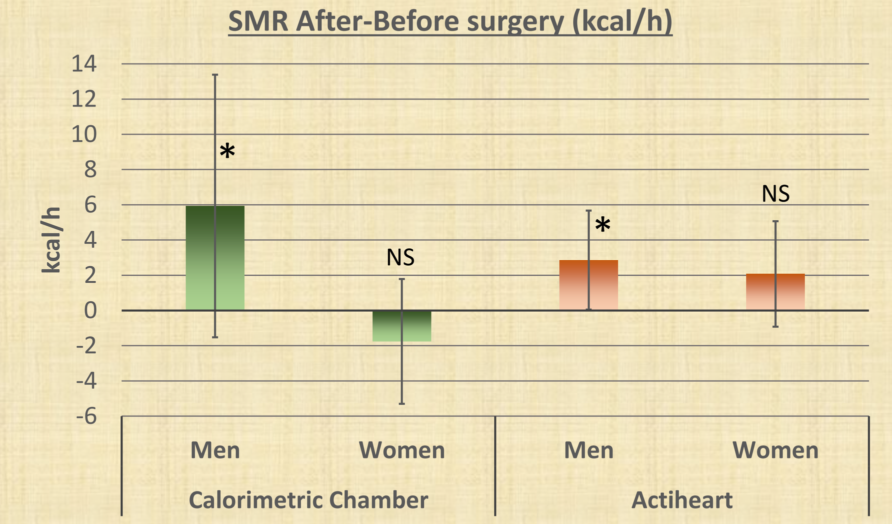
With our 2 CC, EE was calculated using Weir's equation (De Weir, 1949) from minute-per-minute measurements of corrected gas exchanges.
With the AH, the total EE is evaluated from the basal metabolic rate calculated from the Schofield equations that use age and weight (Schofield 1985) associated with an algorithm using the recorded parameters (heart rate and actimetry).

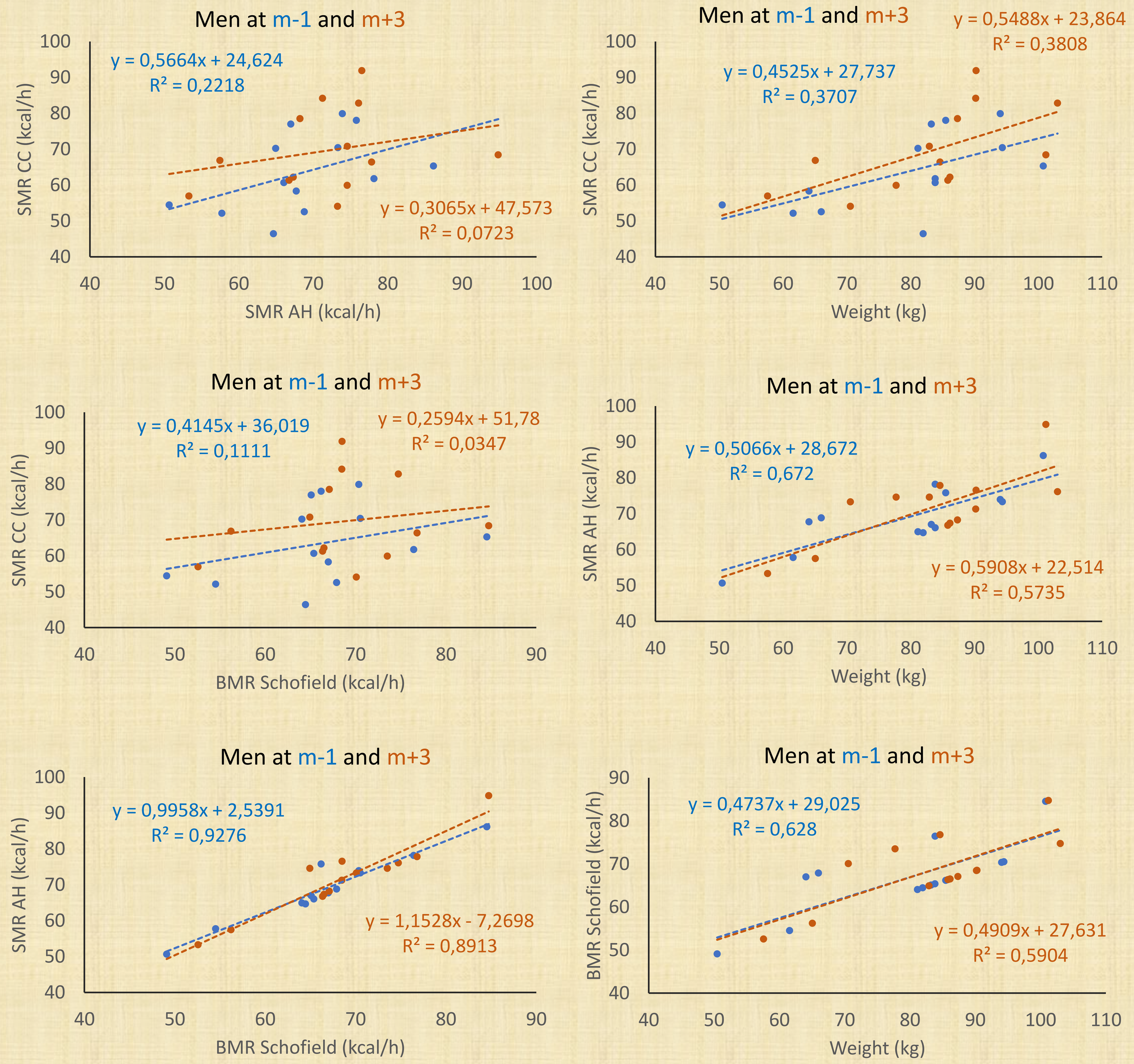
Results are given as mean ± standard deviation (sd).

Conclusions: If AH make it possible to perform estimates of EE on an outpatient basis at home, there are situations for which CC represent an indispensable tool. This is the case to obtain a real value of SMR or to highlight a difference in metabolism with patients having different states of motor disorders (ON vs OFF) and no change in physical activity.

Results

Both measurement methods (CC and AH) showed an increase in SMR for men after surgery (5.93 ± 7.46 kcal/h ; P=0.014 and 2.86 ± 2.81 kcal/h ; P=0.003, respectively), but not for women (-1.75 ± 3.54 kcal/h ; NS and 2.07 ± 2.99 kcal/h ; NS, respectively).
We note a deficit of 6% ± 13% in DE measured in men with HA compared to those provided by CC.

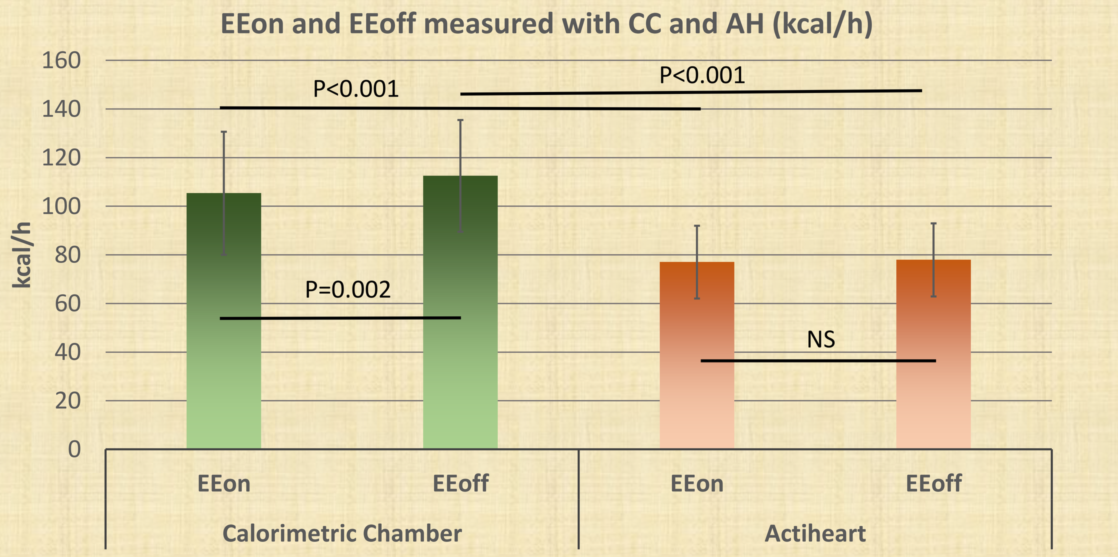


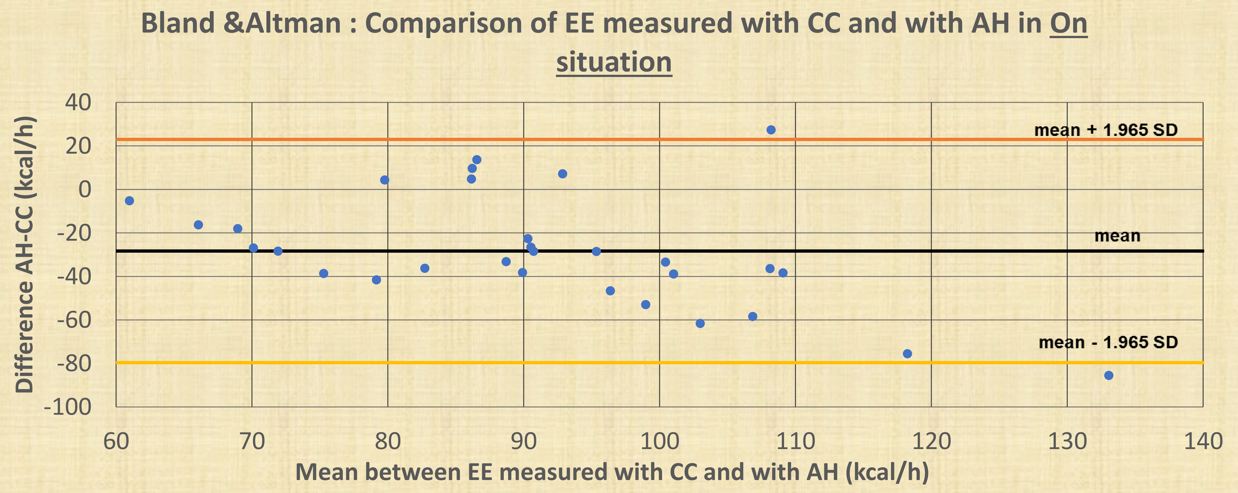


For men, the weight gain after surgery (5.76% ± 6.94%, P=0.012) led to an increase in the BMR (3.07% ± 3.58%, P=0.011) calculated with Schofield equations that were used by AH for the calculation of the EE when the patients were inactive. In fact, SMR AH and BMR Schofield are strongly correlated, while SMR CC is uncorrelated to BMR Schofield and less correlated to weight than SMR HA may be. The profiles of the plots as well as the coefficients of correlations with respect to weight are very close between SMR AH and BMR Schofield. The SMR data delivered by the AH, although dependent on other factors (heart rate and actimetry), are more correlated to the weights and the Schofield BMR, than are the SMR data from the measurement of respiratory exchanges in CC.

The CC make it possible to highlight variations in SMR which are linked to the evolution of physiological parameters, other than the simple evolution of weight, over amplitudes that the HA do not see.

For the EEon and EEoff periods, the CC made it possible to highlight an EEoff greater than the EEon at equal posture of the volunteers (7.89% ± 10.85%, P=0.002), whereas the AH did not detect any modification (1.61 ± 9.93, P=NS).





In this context, AH underestimated the EEs of Parkinsonian patients with a systematic bias of –28.35 ± 26.12 kcal/h, and did not see the variations in EE between the On state and the Off state.