Feasibility and validity of a SenseWear™ Armband in estimating Resting Energy Expenditure in patients with Amyotrophic Lateral Sclerosis

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Background

Amyotrophic Lateral Sclerosis (ALS) is a neurodegenerative disease characterized by loss of motor neurons in the spinal cord, brainstem and motor cortex. Resting Energy Expenditure (REE) is the amount of energy, usually expressed in kcal (food calories), required for a 24-hour period by the body during resting conditions, closely related to, but not identical to, basal metabolic rate. Evaluation of REE can be a clinically useful indicator of the need for nutritional support to maintain a neutral energy balance in ALS patients. Its maintenance helps preventing malnutrition and its complications, improving physical functioning, quality of life and survival. Indirect Calorimetry (IC) is the traditional method to measure REE, but is difficult to apply in clinical setting and above all in the different stages of the disease in ALS patients. Alternatively, the most widely used predictive equation for REE extimation is Harris-Benedict equation, also demonstrated to be a good prediction of REE for patients with ALS. SenseWear™ system Armband (SWA) is a multisensory activity monitor that, through an exclusive algorithm, elaborates measured physical parameters and demographic and anthropometric data to extimate EE. Previous studies have shown the validity of SWA in order to assess REE in healthy subjects and several physiological and pathological condition, while ALS population has not been studied so far.

Objective

The aim of this study is

- to assess the feasibility of SWA at any stage of our ALS population
- to assess the validity of the SWA, compared to extimation of REE from Harris-Benedict equation.
- to verify if REE measured with SWA was correlated with the progression of the disease.

The SWA permits a continuous sampling of physiological variables and data of physical activity, as equipped with a 2-axis accelerometer, heat flux sensor, galvanic skin response sensor (GSR), skin temperature sensor and a near-body ambient temperature sensor. The SWA, therefore, provides a variety of measured parameters (accelerometry, heat flux, galvanic skin response, skin temperature, near body temperature) that, in addiction to demographic and anthropometric data (gender, age, height, weight), entered into exclusive patented algorithm (Innerview Research Software) to estimate energy expenditure.

Methods

Study population: We enrolled 74 patients with probable or definite ALS according to revised El Escorial criteria, 32 women and 42 men, aged 53-74 years.

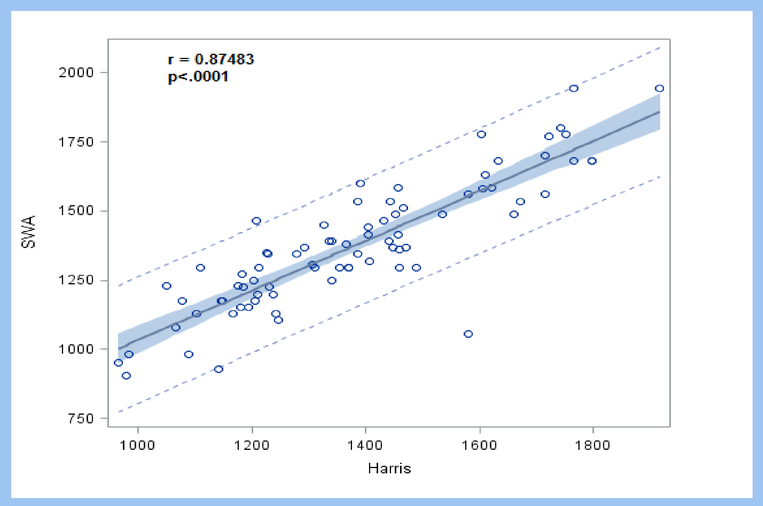
Study period: 2011 to 2014

Clinical characteristics: age at onset, duration of symptom, site of onset (bulbar or spinal), severity of the disease at evaluation measured by ALS-FRSr and of progression measured as monthly reduction of ALS-FRSr score were evaluated.

Anthropometric measurements: performed according to the Anthropometric Standardization Reference Manual (15). Weight (Wt) was measured to the nearest 100 gr using an electronic balance. Height (Ht) was measured to the nearest to the 0,1 cm and BMI was calculated as Wt/Ht2 (Kg/m2).

REE measuring by SWA: SWA (SenseWear Pro 3 Armband, BodyMedia Inc, Pittsburgh, PA, USA was typically worn on the upper right arm and provides estimation of energy expenditure during free living based on a biaxial accelerometer, the galvanic skin response and the body heat loss. During a hospital stay, patients were asked to keep the device on their arm for two days doing their normal activities. At the beginning and at the end of each activity they should press the SWA "TimeStamp" button and note it down in the diary. Patients were also invited to report the time of sleep. Assessment of REE, measured in Kcal/day, was obtained by multiplying EE estimated during 1 hour of night rest for 24 hours.

RESULTS



Demographic and clinical characteristics of ALS Patients (n=79)	
Age at evaluation, mean (SD), y	64 (10.26)
Sex, No. (%) female	32 (40.51)
BMI at evaluation, mean (SD)	24.22 (3.82)
Harris-Benedict, mean (SD)	1379.95 (223.90)
SWA, mean (SD)	1374.94 (229.99)
Interval from the onset to diagnosis, mean (SD)	13.51 (15.67)
ALSFRS-R score at evaluation, mean (SD)	32 (8.01)
Site of onset, No. (%) bulbar	16 (20.25)

1) Mean REE estimated by SWA (1374.94 ± 229.99 Kcal/day) was significantly correlated with the Harris-Benedict equation (1379.55 ± 223.90 Kcal/day) adjusted for age, sex and Body Mass Index (BMI) (p<.0001).
2) After adjusting for age, sex and BMI no statistically significant correlation was demonstrated among REE and ALS-FRSr score, survival from diagnosis and rate of progression expressed as monthly variation of ALS-FRSr in a six months period.

Multivariate Analysis		
Variable	Parameter Estimate	p-value
Harris	0.81691	<.0001

Pearson Correlation Coefficient Prob > |r| under H0: Rho=0		
	SWA	
Harris	0.87483	<.0001

CONCLUSIONS

In our experience SWA is a feasible way to estimate Energy Expenditure in patients affected by ALS at any stage of the disease. It is well tolerated by the patients and can be repeated during the follow up.

We demonstrated that it is a valid method to estimate REE in ALS, compared to Harris-Benedict equation. Further validation compared to IC is needed

We could not demonstrate any significant correlation of REE with clinical and prognostic parameters. Further follow up studies can be suggested to evaluate its potential value as prognostic marker.

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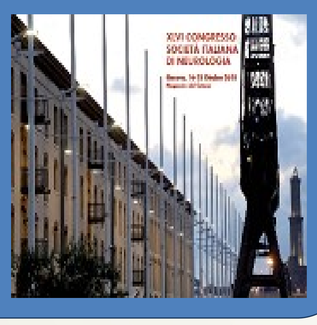

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