



# Validation of QUARK RMR (COSMED) against DELTATRAC II® (GE HEALTH CARE) for the measurement of energy expenditure at rest and after a test meal



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## CONTEXT

- Indirect Calorimetry = Reference technique for studying the energy metabolism in clinical research

- Reference system: DELTATRAC II® (GE Health Care)

- Problem: Reference system has been discontinued – Many indirect calorimeters in the market

⇒ Need for a reliable system to replace the DELTATRAC II – Choice focused on the QUARK RMR (COSMED) (system for measurement of VO<sub>2</sub> and VCO<sub>2</sub> identical to the DELTATRAC II®)

⇒ Need for a validation of its accuracy and its reliability in the measurement of energy expenditure at rest or after a test meal in healthy subjects and obese in order to guarantee its effectiveness in clinical research.

## METHODOLOGY

- 30 Subjects divided by BMI category in 3 groups of 10 subjects of normal weight – 10 overweight subjects – 10 obese subjects (sex ratio : 1/2)

- Randomised, cross study over two consecutive days in two stages :

→ Measurement of resting energy expenditure in standardized conditions during 3 periods of 45 minutes alternating calorimeters (Standardised meal the night before – Controlled physical activity (Pedometer – Baecke Score) – Fasting for 12 hours – Systems calibrated before each series of measures – Standardised environment (T°C and humidity))

→ Measurement of the resting energy expenditure after a test meal of 700 kcal for 3 hours with the same calorimeter – (44g of proteins (32%), 27g of fats (19%), 68 g of carbohydrate (49%))

## STUDY DESIGN

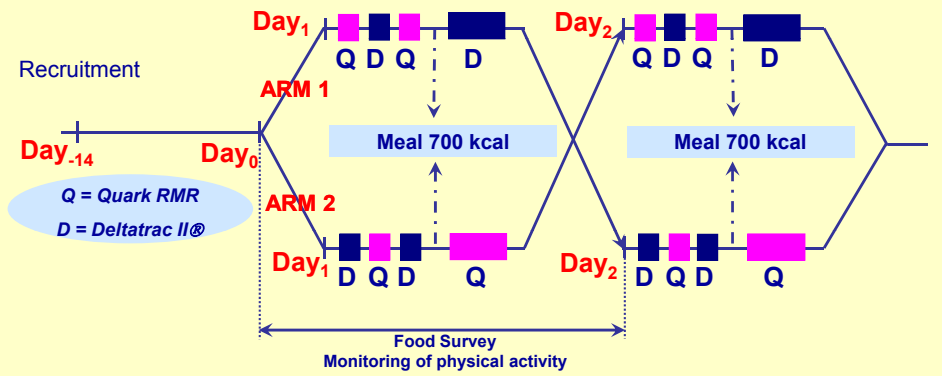


Figure 1 : Design of the study

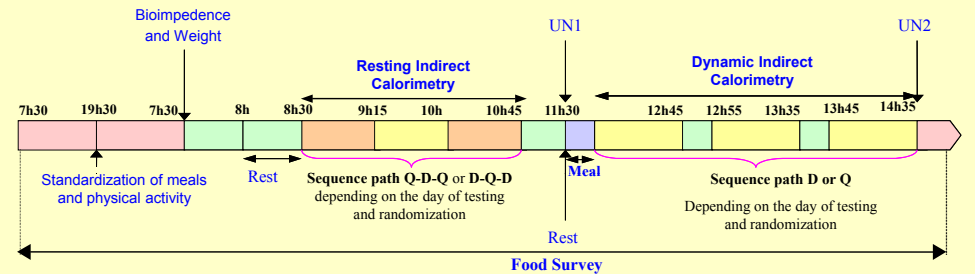


Figure 2 : Typical day of the metabolic exploration

## RESULTS

### Baseline

Unit	Normal Weight 18 < BMI < 25		Overweight 25 < BMI < 30		Obese 30 < BMI < 35	
	Men	Women	Men	Women	Men	Women
Staff	5	5	5	5	5	5
Age yrs	26,8 ± 4,9	37,4 ± 13,4	29,2 ± 10,1	30,4 ± 9,9	39,4 ± 5,5	35,0 ± 4,9
Weight kg	68,8 ± 9,8	59,3 ± 5,7	94,9 ± 10,4	73,0 ± 7,2	95,9 ± 3,8	82,3 ± 11,6
Height m	1,76 ± 0,04	1,62 ± 0,04	1,82 ± 0,08	1,62 ± 0,06	1,76 ± 0,03	1,59 ± 0,09
BMI kg/m <sup>2</sup>	22,1 ± 2,5	22,8 ± 2,3	28,6 ± 1,0	27,8 ± 1,7	31,1 ± 0,6	32,6 ± 1,5
Fat Body Mass kg	13,6 ± 3,1	18,1 ± 3,1	28,2 ± 6,5	25,6 ± 2,4	30,7 ± 6,0	31,0 ± 5,6
Lean Body Mass kg	55,0 ± 6,4	41,2 ± 4,2	65,5 ± 10,5	46,8 ± 4,9	64,8 ± 5,8	50,5 ± 5,6
Glycemia mM	4,7 ± 0,4	4,4 ± 0,2	5,3 ± 0,4	4,6 ± 0,5	5,3 ± 0,5	5,0 ± 0,5
C-Reactive protein mg/L	1,7 ± 1,5	1,5 ± 0,9	1,4 ± 0,8	4,0 ± NC	3,1 ± 2,5	4,6 ± 2,1
Creatinemia μM	83 ± 15	73 ± 7	95 ± 16	73 ± 10	87 ± 18	79 ± 10
TSH mUI/L	1,9 ± 0,8	1,8 ± 0,7	2,2 ± 1,2	2,2 ± 1,7	1,8 ± 1,0	1,6 ± 0,8
Baecke's score	14,1 ± 1,7	11,3 ± 3,0	11,7 ± 2,6	9,8 ± 3,3	12,9 ± 1,9	12,4 ± 1,7

No significant differences between the different male/female BMI categories in terms of body composition, glucose, creatinine, TSH or Baecke Score

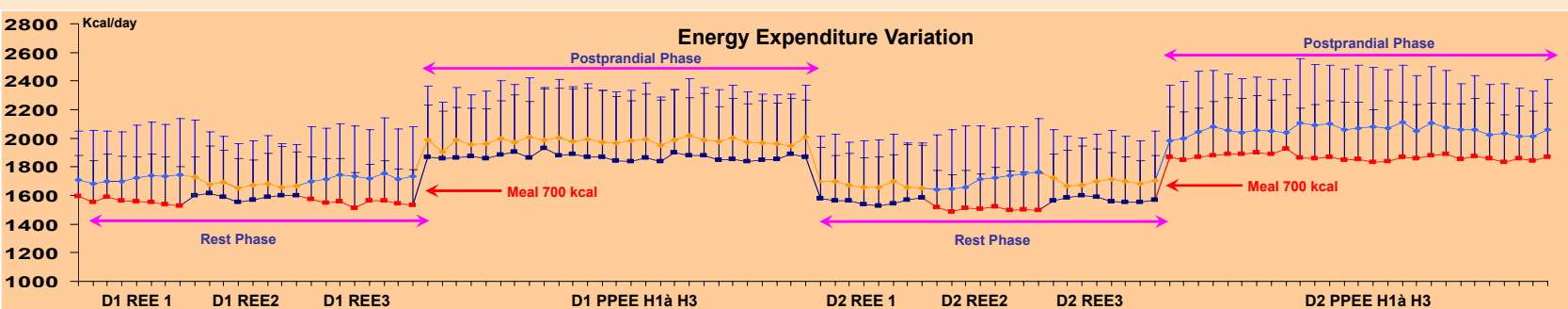
### Evaluation of the correlation and precision of the two calorimeters DELTATRAC II – QUARK RMR at rest

#### Measurement at rest (3 periods, 45 min.)

N=30	Average +/- SD		p value	Correlation		Average diff. +/- SD	Agreement limit	Correlation
	QUARK RMR	DELTATRAC II		r	p value			
VCO <sub>2</sub> (mL/min)	195 ± 39	193 ± 36	NS	0,929	p<0,0001	-2,8 ± 14,2	[26;-31]	0,187 p=0,038
VO <sub>2</sub> (mL/min)	239 ± 49	235 ± 43	NS	0,947	p<0,0001	-4,3 ± 16	[28;-36]	0,368 p<0,0001
RQ	0,82 ± 0,03	0,82 ± 0,03	NS	0,296	p=0,002	0,004 ± 0,037	[0,08;-0,07]	-0,074 NS
REE (kcal/day)	1670 ± 337	1641 ± 299	NS	0,947	p<0,0001	-28,9 ± 109,5	[190;-248]	0,398 p<0,0001
CHO Oxidation (mg/min)	95 ± 44	96 ± 53	NS	0,482	p<0,0001	1,2 ± 40,8	[83;-80]	
FAT Oxidation (mg/min)	56 ± 23	54 ± 23	NS	0,426	p<0,0001	-2,4 ± 17,2	[32;-37]	

RQ : Important limits to approval → to be attributed to the utilized methodology (comparison of the calorimeters in different periods and days (see: design of the study)). If one looks at the variability of the measure on the same system DELTATRAC II® against DELTATRAC II® or QUARK RMR against QUARK RMR, the same limits can be found. The limits to approval are not dependent on variation between systems but to the variability of the subjects in different periods and days

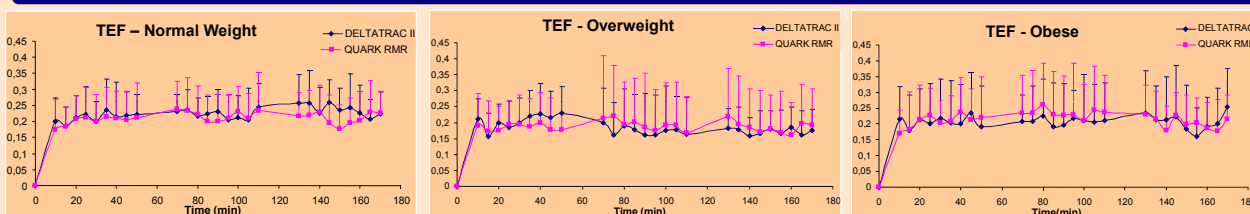
### Variation of the energy expenditure during the study



No significant variation in resting energy expenditure after taking a test meal in the use of QUARK RMR against DELTATRAC II®

Legend:  
 — QUARK RMR Arm 1 (blue)  
 — QUARK RMR Arm 2 (dark blue)  
 — DELTATRAC II Arm 1 (orange)  
 — DELTATRAC II Arm 2 (red)  
 REE : Resting Energy Expenditure  
 PPEE : Postprandial Energy Expenditure

### Variation of the food thermogenesis in function of the used calorimeter



N=30	TEF variation (%)			p value
	Normal Weight	Overweight	Obese	
DELTATRAC II	4,91 ± 1,86	5,36 ± 1,41	4,45 ± 1,46	NS
QUARK RMR	4,88 ± 1,99	5,01 ± 1,05	4,53 ± 2,67	NS

TEF (%) = (Σ(PPEE-REE) × Number of measurement) / Energy uptake of meals consumed in 15 min × 100  
 With TEF : Thermic Effect of Food

Differences, in terms of energy expenditure, after making a meal of 700 kcal and 3 hours of measurements, no significant between the measurement obtained with the QUARK RMR and the DELTATRAC II® regardless of the considered BMI category (same results overall)

## DISCUSSION

### Measurement of the resting energy expenditure :

VO<sub>2</sub>, VCO<sub>2</sub>, RQ, REE, carbohydrate and fat oxidations are significantly correlated and are validated for the Bland et Altman test. These different results do not reveal any difference between the two systems for measurements at rest

### Measurement of the postprandial energy expenditure :

No significant differences were found between measurement made by QUARK RMR and DELTATRAC II® to measure the postprandial energy expenditure.

## CONCLUSION

Given these results, QUARK RMR and DELTATRAC II® are strongly correlated and could be interchanged without risk to generate biased values, making the QUARK RMR a system valid for the measurement of resting energy expenditure or after a test meal of healthy subjects and obese.