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DIABETOLOGY & METABOLIC SYNDROME

MEETING ABSTRACT Open Access

Performance of resting metabolic rate estimation equations in obese patients

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Background

Weight gain may be associated with an imbalance between energy intake and energy expenditure. The resting metabolic rate (RMR) is the main component of total energy expenditure, and is related mainly to lean mass (LM), as well as to other factors such as fat mass (FM), age, sex and genetic factors. A RMR lower than expected may be a risk factor for weight gain. RMR is estimated by equations that use patient's weight, sex, age and height to calculate energy needs. Several studies have shown that these equations have a poor agreement with RMR measured by indirect calorimetry (IC) in obese patients once their excess fat-free mass (FFM) is usually not taken into account.

Objective

To evaluate the accuracy of five equations in predicting RMR in obese subjects. Results were compared with measured RMR (mRMR) determined by IC.

Materials and methods

Cross-sectional study was conducted in obese Southern Brazilian volunteers recruited from community. Body mass index (BMI) was calculated by dividing weight (in kilograms) by squared height (in meters). Body composition was evaluated by dual-energy X-ray. RMR was measured by IC (Weir equation) and estimated (eRMR) by Mifflin–St. Jeor, Owen, Harris-Benedict, Ireton-Jones and Horie-Waitzberg & Gonzalez (H & WG) equations (Figure 1). The latter takes into consideration the FFM. Equations performance were determined by bias (mean difference between mRMR and eRMR); precision (standard deviation of bias) and by accuracy (percentage of estimates within 5% of mRMR).

Results

Sixty individuals (46 women [75%], 48 white [84%]) aged 46±13 yrs. (range, 21-83 yrs.) were evaluated. Overall, mRMR was 1941±642 kcal/day. mRMR increased along

Harris-Benedict	Male: RMR = 66.47 + 13.75 × BW + 5.0 × H - 6.75 × A
	Female: RMR = 655.09 + 9.56 × BW + 1.84 × H - 4.67 × A
Owen	Male: RMR = 879 + 10.2 × BW
	Female: RMR = 795 + 7.18 × BW
Ireton-Jones	RMR = 629 – (11 × A) + (25 × BW) – 609
Mifflin St. Jeor	Male: 9.99 × BW + 6.25 × H -4.92 × A +5
	Female: RMR = 9.99 × BW + 6.25 × H - 4.92 × A - 161
HW & G	RMR = 560.43 + (5.39 × BW) + (14.14 × FFM)

RMR, resting metabolic rate (kcal/day); BW, actual body weight (kg); H, height (cm); A, age (years); FFM, fat-free mass.

Figure 1 Prediction equations for comparison with indirect calometry in obese subjects.

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	All patients	BMI (kg/m²) 30-34.9 (n=21)	35-39.9 (n=9)	≥40 (n=30)	P
Age (years)	46±13	46±14	48±11	43±11	0.093
White (%)	53 (84%)	17 (80%)	7 (77%)	26 (89%)	0.710
Women (%)	49 (77%)	16 (76%)	5 (55%)	25 (83%)	0.394
Actual weight (kg)	104±27	83±10	99±17	126±19	<0.001
LM (kg)	52±12	46±11	55±11	58±9	<0.001
FM (%)	44±7	41±4	41±9	50±5	<0.001
mRMR (kcal/day)	1941±642	1687±481	2040±724	2236±603	<0.001

BMI = body mass index; LM= lean mass; FM = fat mass; mRMR = measured resting metabolic rate.

Figure 2 Obese patients distributed by anthropometric and body composition parameters.

Equation	RMR (kcal/day)	Bias (kcal/day) and limits of agreement (±2 s.d.; kcal/day)	Precision	*P* value	P_5 (%)
mRMR	1941				
Harris-Benedict	1801	148 (13; 282)	467	0.032	68
Ireton Jones	2241	-199 (-388; -9)	681	0.040	47
Owen	1642	299 (154; 443)	549	<0.001	55
Mifflin	1709	245 (107; 381)	521	0.001	60
HW & G	1957	-17 (-148; 115)	503	0.801	70

Bias (mean difference between mRMR and eRMR); precision (standard deviation of bias); P_5 (percentages of eRMR within 5% of mRMR).

Figure 3 Comparison between estimated RMR from several equations and measured RMR in obese patients.

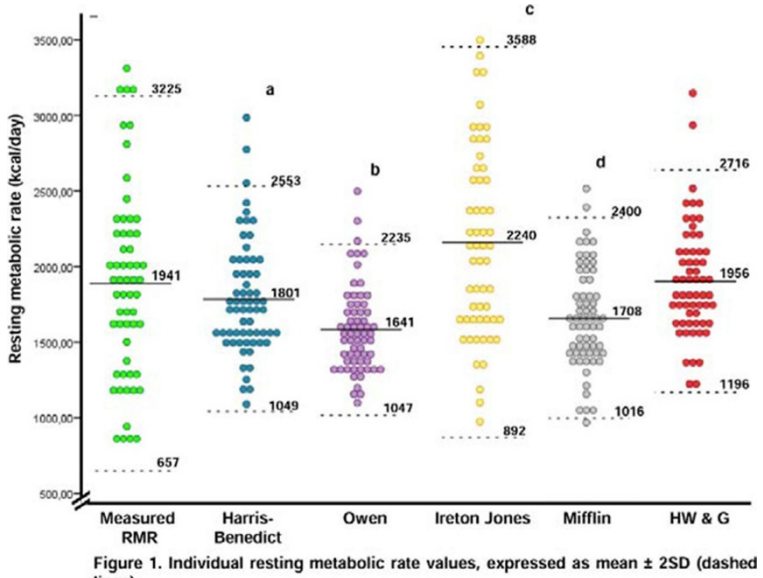

Figure 1. Individual resting metabolic rate values, expressed as mean ± 2SD (dashed lines)

[a]P =0.032, [b]P <0.001, [c]P =0.040, [d]P =0.001 for eRMR compared to mRMR, respectively

Figure 4 Individual resting metabolic rate values, expressed as mean ± 2SD (dashed lines)

with BMI (Figure 2), but the association was lost when corrected for LM (P=0,859). H & WG equation was the only equation unbiased (P=0.801) (Figure 3). The Harris-Benedict, Owen and Mifflin–St. Jeor equations were biased overall toward underestimation, while Ireton-Jones equation was biased toward overestimation (Figure 4). Bias was significantly higher in women for Harris-Benedict, Mifflin St. Jeor and Owen equations. Accuracy to estimate RMR at ±5% was suboptimal for all equations, except for H & WG.

Conclusion

In this sample of obese subjects, the available RMR estimate equations that do not take into account the FFM have poor accuracy when compared with mRMR.

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