Measure or estimate energy expenditure in spinal cord injury patients? A comparison of indirect calorimetry and commonly used predictive equations

S. Wong[1,2], P. Subong, A. Pandely[1], M. Saif[1] and A Graham[1,2]

[1]*National Spinal Injuries Centre, Stoke Mandeville Hospital, Aylesbury and* [2]*Health Service Research, City University London*

Little is known about the energy expenditure after spinal cord injury (SCI). Commonly used predictive equations tend to overestimate resting metabolic rate (RMR) by 5–32 %[1]. The objective of this study is to (1) measured 15-minutes energy expenditure to determine 24-hours RMR (m-RMR) using QUARK indirect calorimeter; (2) compare the m-RMR with estimated RMR (e-RMR) using predictive equations (Harris-Benedicts[2], Mifflin-St. Jeor[3], Oxford-Henry[4] and Schofield equation[5]). Fifty-four adult subjects (median age: 43, range 18–74 years) had their RMR measured during October 14 to August 15. Of 32 of SCI patients (37·5 % tetraplegia; 43·7 % complete SCI) and 22 able-bodied control. There were no difference in m-RMR, 6,593 ± 1,743 kJ/d, 6,928 ± 1,174 kJ/d in SCI and control respectively. No difference was observed in m-RMR and e-RMR in control group. SCI group's BMI was significantly higher than able-bodied control (32·5 v 24·3 kg/m^2, p = 0·006). Predictive equations were found to be over-estimated m-RMR in SCI patients by 9·1 to 32·4 % (Harris-Benedict: 32·4 %, p < 0·001; Mifflin-St. Jeor: 16·4 %, p = 0·013; Oxford-Henry: 14·2 %, p = 0·004; Schofiled: 21·7 %, p = 0·0012). No significant difference was observed in age, % of Caucasian and onset of SCI when comparing tetraplegic and paraplegic group. Tetraplegic group had a significant lower m-RMR (5,610 v 6,995 kJ, p = 0·008), lower VO2 (162 v 240 ml/min, p = 0·002) and lower VCO2 (165 v 204 ml/min, p = 0·027) than paraplegic group. All 4 predictive equations were overestimated RMR in tetraplegic patients by 25·1 to 39·7 % (Harris-Benedict: 39·7 %, p = 0·001; Mifflin-St. Jeor: 25·1 %, p = 0·023; Oxford-Henry: 29·8 %, p = 0·018 and; Schofiled: 33·2 %, p = 0·014). No significant difference was observed when compared m-RMR and e-RMR in paraplegia patients. Although predictive equations are sensitive to estimate RMR in able-bodied control, there is high variability in SCI patients, especially in tetraplegia. Our findings highlight the importance of IC to adequately estimate RMR in this vulnerable population. Given the limited resources constraint, tetraplegic patients who are at malnutrition-risk should have their RMR measured via indirect calorimeter when they admitted to SCI centre. Development of validated RMR equation in SCI population is warranted.

Table 1. Percentage difference of m-RMR and predictive equations in SCI and control group.

	SCI group, n = 32	Control group, n = 22	p-value
% difference m-RMR vs HB	Median: 32·4 % Q1: 9·4 %; Q3: 44 %	Median: 11·3 % Q1: −1·25 %; Q3: 29 %	0·004
% difference m-RMR vs MS	Median: 9·1 % Q1: 1·25 %; Q3: 28·3 %	Median: −7·8 % Q1: −14·7 %; Q3: −0·03 %	<0·001
% difference m-RMR vs OH	Median: 14·2 % Q1: 3·6 %; Q3: 32·7 %	Median: −6·9 % Q1: −11·2 %; Q3: 1·4 %	<0·001
% difference m-RMR vs SC	Median: 16·5 % Q1: 8·9 %; Q3: 31·5 %	Median: −2·7 % Q1: 11·3 %; Q3: 4·5 %	<0·001

HB: Harris-Benedict; MS: Mifflin-St. Jeor; OH: Oxford-Henry; SC: Schofield

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