Supplementary Material

Evolving Concepts on Adjusting Human Energy Expenditure Measurements for Body Size

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I. Kiel Study. Two separate Kiel databases were used in the current report. The first cross-sectional data set involved 260 men and women with demographic characteristics as outlined in this table. Results for multiple regression analyses for REE vs. body size-composition are presented in **Supplementary Table 1**. Detailed methods are presented in reference 1.

	N	**Age** (yrs)	**Height** (cm)	**Weight** (kg)	**BMI** (kg/m^2)
Men	112				
Mean		45.1	178.6	86.6	27.1
SD		14.9	6.2	15.0	4.3
Women	148				
Mean		38.4	167.7	80.3	28.5
SD		13.3	6.7	20.9	6.8

The second Kiel data set includes the information on tissue-organ body composition as presented in **Table 2** and **Figures 4** and **5**. The characteristics of the 103 subjects are outlined in the table below and in references 1 and 2. Subjects included in the analysis were those with complete body composition measures for all involved variables.

	N	Age (yrs)	Height (cm)	Weight (kg)	BMI (kg/m^2)
Men	37				
Mean		45.4	1.763	81.6	26.2
SD		19.6	0.060	12.1	3.7
Women	66				
Mean		38.8	169.1	82.1	28.6
SD		15.1	7.1	21.6	6.7

II. New York-Obesity Research Center Study (NYORC). The data for NYORC subjects presented in **Supplementary Table 1** and **Figure 3** were published in-part in reference 3. The characteristics of these 362 subjects are presented in the table below.

	N	Age (yrs)	Height (cm)	Weight (kg)	BMI (kg/m^2)
Men	154				
Mean		39.7	177.1	80.0	25.5
SD		15.1	7.1	13.3	3.9
Women	208				
Mean		44.0	162.0	67.9	25.9
SD		15.9	7.4	15.4	5.7

III. Supplementary Table 1. Multiple regression analyses for REE vs. body size-composition for NYORC and Kiel groups.

	Men				**Women**			
	NYORC (n=154)		**Kiel** (n=112)		**NYORC** (n=208)		**Kiel** (n=148)	
	R (R^2)	**SEE**	**R (R^2)**	**SEE**	**R (R^2)**	**SEE**	**R (R^2)**	**SEE**
Weight	0.68 (0.46)	226	0.83 (0.69)	128	0.64 (0.41)	156.2	0.85 (0.72)	139
Weight$^{0.66}$	0.68 (0.46)	226‡	0.84 (0.70)	127	0.64 (0.41)	155.8	0.85 (0.72)	139
Weight$^{0.75}$	0.68 (0.46)	226	0.83 (0.69)	127	0.64 (0.41)	155.9	0.85 (0.72)	139
SA	0.68 (0.46)	226	0.82 (0.67)	132†	0.67 (0.45)	150.9	0.85 (0.72)	135‡
FFM	0.66 (0.46)	232	0.85 (0.72)	122†	0.64 (0.41)	155.9†	0.86 (0.74)	133
LST	0.66 (0.44)	231	0.85 (0.72)	120†	0.65 (0.42)	154.7†	0.86 (0.74)	133
CM	0.65 (0.42)	232†	Not Available		0.59 (0.35)	163.5†	Not Available	

All developed models included age as a potential covariate, which were all significant except †, which were non-significant. All regression model intercept terms are significant except ‡, which was non-significant. Abbreviations: CM, cell mass; FFM, fat-free mass; LST, lean soft tissue; SA, surface area.

IV. Body Mass Model

Model 1. Assume males and females age 25 yrs with a BMI of 24.2 kg/m^2. Systematically vary height while keeping BMI constant and predict REE using the Harris-Benedict equations[4]. REE scales to body mass with respective powers of 0.81 and 0.51 in males and females. Repeat for BMI 20.0 kg/m^2 and respective powers are 0.83 and 0.54.

Model 2. Assume males and females age 25 yrs with constant height of 170 cm. Beginning with a BMI of 24.2 kg/m^2, systematically vary weight and thus BMI. REE is then calculated using the Harris-Benedict equations[4]. REE scales to body mass with respective powers of 0.61 and 0.43 in males and females.

Model 3. Combine results from models 1 and 2. REE then scales to body mass in males and females with respective powers of 0.65 and 0.44. For males and females combined, REE scales to body mass with a power of 0.54.

V. Supplementary Table 2. Organ-Tissue Fat Content[5]

	Weight	Water	Ash	Fat	Protein	%fat
Total body	70,000	42,000	3,700	13,300	10,600	19.0
Lung	1,000	780	11	9.9	177	1.0
Bone	5,000	850	2,700	50	1,300	1.0
Spleen	180	140	2.5	2.9	35	1.6
Skeletal Muscle	28,000	22,000	340	620	4,800	2.2
Kidneys	310	240	3.4	16	53	5.2
GI tract	1,200	950	10	74	160	6.2
Liver	1,800	1,300	23	120	320	6.7
Pancreas	100	71	1.2	8	13	8.0
Heart	330	240	3.6	33	55	10.0
Skin	2,600	1,600	18	260	750	10.0
Brain	1,400	1,100	21	150	110	10.7
Adipose tissue	15,000	2,300	30	12,000	750	80.0

V. References

1. Müller MJ, Langemann D, Gehrke I, *et al*. Effect of constitution on mass of individual organs and their association with metabolic rate in humans--a detailed view on allometric scaling. *PLoS One*. 2011; 6: e22732.

2. Heymsfield SB, Müller MJ, Bosy-Westphal A, Thomas D, Shen W. Human brain mass: Similar body composition associations as observed across mammals. *Am J Hum Biol*. 2012; 24: 479-85.
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4. Harris JA, Benedict FG. A biometric study of basal metabolism in man. Carnegie Institution of Washington, 1919.
5. Snyder WS, Cook MJ, Nasset ES, Karhausen LR, Parry Howells G., Tipton IH. Report of the Task Group on Reference Man. Oxford: Pergamon Press, 1975.