

Evidence Analysis Library: Chronic Obstructive Pulmonary Disease

Methods to Estimate Energy Requirements

If measurements are not available, what are the best methods to predict energy needs in adults with COPD?

Table 1. Predictive equations to estimate energy needs in adults with COPD, descriptions and studies examining the equations.

PREDICTIVE EQUATIONS	DESCRIPTION	STUDIES				
		Farooqi et al, 2015	Nordenson et al, 2010	Ramos et al, 2016	Slinde et al, 2008	Slinde et al, 2011
Body Weight $W \times 30 \text{ kcal}$ <i>W=weight (kg)</i>	Predicted total energy expenditure (TEE) in people with COPD using weight.					X
de Oliveira¹ $475.3 + (14.9 \times W) + (235.8 \times G)$ <i>Males G=1; Females G=0; W=weight (kg)</i>	Predicted resting metabolic rate (RMR) in healthy people using weight, height, age, sex.			X		
Harris-Benedict² <i>Males:</i> $66.47 + (13.75 \times W) + (5 \times H) - (6.75 \times A)$ <i>Females:</i> $655 + (9.5 \times W) + (1.8 \times H) - (4.67 \times A)$ <i>W=weight (kg), H=height (cm), A=age (years)</i>	Predicted RMR in healthy people using weight, height, age, sex.	X	X	X	X	
Moore and Angelillo³ <i>Males:</i> $(11.5 \times W) + 952$ <i>Females:</i> $(14.1 \times W) + 515$ <i>W=weight (kg)</i>	Predicted RMR in people with COPD using weight and sex.	X	X		X	
Owen^{4,5} <i>Males:</i> $879 + (10.2 \times W)$ <i>Females:</i> $795 + (7.18 \times W)$ <i>W=weight (kg)</i>	Predicted RMR in healthy people using weight and sex.			X		
Mifflin-St. Jeor⁶ <i>Males:</i> $(9.99 \times W) + (6.25 \times H) - (4.92 \times A) - 161$ <i>Females:</i> $(9.99 \times W) + (6.25 \times H) - (4.92 \times A) + 5$ <i>W=weight (kg), H=height (cm), A=age (years)</i>	Predicted RMR in healthy people using weight, height, age, sex.			X		
Nordenson⁷ $1,856 + 76.0 \times \text{FFM}$ <i>FFM=fat-free mass (kg)</i>	Predicted RMR in people with COPD using FFM.	X	X			

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		Farooqi et al, 2015	Nordenson et al, 2010	Ramos et al, 2016	Slinde et al, 2008	Slinde et al, 2011
Nordic Nutrition Recommendations⁸ 31-60 years: $9.7 \times W + 693$ kcal 61-70 years: $10.2 \times W + 571$ kcal >70 years: $10.0 \times W + 576$ kcal <i>W=weight (kg)</i>	Based on Henry 2005, which in turn is based on the 1985 World Health Organization (WHO) equation [WHO (omitting ht)].	X				
Schofield⁹ Females (30-60 years): $8.13 \times W + 846$ kcal Females (>60 years): $9.08 \times W + 659$ kcal <i>W=weight (kg)</i>	Predicted RMR in healthy people using weight, age, sex. The Schofield data constitute a large portion of the data used to calculate the 1985 WHO equation so the two are similar to one another. In 2004, the FAO/WHO/UNU updated its report and adopted the Schofield equation.	X				
RMR x 1.7¹⁰	Predicted TEE using predicted RMR x 1.7 in people with COPD.					X
Westerterp¹¹ Males and Females: $(0.102 \times \text{FFM}) + (0.024 \times \text{FM}) + 0.85 \times 1,000$ <i>FFM=fat-free mass (kg); FM=fat mass (kg)</i>	Predicted RMR in healthy people using FFM and FM.				X	
WHO (including height)¹² Males (<60 years): $(11.3 \times W) + (16 \times H) + 901$ Males (>60 years): $(8.8 \times W) + (1,128 \times H) - 1,071$ Females (<60 years): $(8.7 \times W) - (25 \times H) + 865$ Females (>60 years): $(9.2 \times W) + (637 \times H) - 302$ <i>W=weight (kg), H=height (m)</i>	Predicted RMR in healthy people from the WHO using weight, height, age, sex. This equation was published in 1985.			X	X	
WHO (omitting height)¹² Males (30-60 years): $(11.6 \times W) + 879$ kcal Males (>60 years): $(13.5 \times W) + 487$ kcal Females (30-60 years): $(8.7 \times W) + 829$ kcal Females (>60 years): $(10.5 \times W) + 596$ kcal <i>W=weight (kg)</i>	Shortened variation of WHO equation using only body weight, age, and sex. This equation was published in 1985.	X	X	X		X

¹de Oliveira EP, Orsatti FL, Teixeira O, Maestá N, Burini RC. Comparison of predictive equations for resting energy expenditure in overweight and obese adults. *J Obes.* 2011; 2011: 534714. Epub 2011 Jul 21. PMID: 21822484.

²Harris JA, Benedict FG. A biometric study of basal metabolism in man. Publication 279. Washington DC: Carnegie Institute; 1919.

³Moore JA, Angelillo VA. Equations for the prediction of resting energy expenditure in chronic obstructive lung disease. *Chest.* 1988 Dec; 94(6): 1260-3. PMID: 3191768.

- ⁴Owen OE, Kavle E, Owen RS, Polansky M, Caprio S, Mozzoli MA, Kendrick ZV, Bushman MC, Boden G. A reappraisal of caloric requirements in healthy women. *Am J Clin Nutr*. 1986 Jul; 44(1): 1-19. PMID: 3728346.
- ⁵Owen OE, Holup JL, D'Alessio DA, Craig ES, Polansky M, Smalley KJ, Kavle EC, Bushman MC, Owen LR, Mozzoli MA, et al. A reappraisal of the caloric requirements of men. *Am J Clin Nutr*. 1987 Dec; 46(6): 875-885. PMID: 3687821.
- ⁶Mifflin MD, St Jeor ST, Hill LA, Scott BJ, Daugherty SA, Koh YO. A new predictive equation for resting energy expenditure in healthy individuals. *Am J Clin Nutr*. 1990 Feb; 51(2): 241-247. PMID: 2305711.
- ⁷Nordenson A, Grönberg AM, Hulthén L, Larsson S, Slinde F. A validated disease specific prediction equation for resting metabolic rate in underweight patients with COPD. *Int J Chron Obstruct Pulmon Dis*. 2010 Sep 7; 5: 271-276. Review. PMID: 20856826.
- ⁸Henry CJ. Basal metabolic rate studies in humans: measurement and development of new equations. *Public Health Nutr*. 2005 Oct; 8(7A): 1133-52. Review. PMID: 16277825.
- ⁹Schofield WN. Predicting basal metabolic rate, new standards and review of previous work. *Hum Nutr Clin Nutr*. 1985; 39 Suppl 1:5-41. PMID: 4044297.
- ¹⁰Baarends EM, Schols AM, Pannemans DL, Westerterp KR, Wouters EF. Total free-living energy expenditure in patients with severe chronic obstructive pulmonary disease. *Am J Respir Crit Care Med*. 1997 Feb; 155(2): 549-554. PMID: 9032193.
- ¹¹Westerterp KR, Donkers JH, Fredrix EW, Boekhoudt P. Energy intake, physical activity and body weight: a simulation model. *Br J Nutr*. 1995; 73: 337-347. PMID: 7766558.
- ¹²Food and Agriculture Organization of the United Nations, World Health Organization and United Nations University. Energy and protein requirements: report of a joint FAO/WHO/UNU expert consultation. *World Health Organization Technical Report Series*. Geneva, Switzerland: WHO; 724; 1-206, 1985.