Table 5A-1. Statistics of the Age/Gender Cohorts Used to Develop Regression Equations for Predicting Basal Metabolic Rates (BMR) (from Schofield, 1985)

Gender/Age (y)	BMR MJ d^{-1}	±SD	CV[a]	Body Weight (kg)	N[b]	BMR Equation[c]	r[d]
Males							
Under 3	1.51	0.918	0.61	6.6	162	0.249 bw - 0.127	0.95
3 to < 10	4.14	0.498	0.12	21	338	0.095 bw + 2.110	0.83
10 to < 18	5.86	1.171	0.20	42	734	0.074 bw + 2.754	0.93
18 to < 30	6.87	0.843	0.12	63	2879	0.063 bw + 2.896	0.65
30 to < 60	6.75	0.872	0.13	64	646	0.048 bw + 3.653	0.6
60 +	5.59	0.928	0.17	62	50	0.049 bw + 2.459	0.71
Females							
Under 3	1.54	0.915	0.59	6.9	137	0.244 bw - 0.130	0.96
3 to < 10	3.85	0.493	0.13	21	413	0.085 bw + 2.033	0.81
10 to < 18	5.04	0.780	0.15	38	575	0.056 bw + 2.898	0.8
18 to < 30	5.33	0.721	0.14	53	829	0.062 bw + 2.036	0.73
30 to < 60	5.62	0.630	0.11	61	372	0.034 bw + 3.538	0.68
60 +	4.85	0.605	0.12	56	38	0.038 bw + 2.755	0.68

[a] Coefficient of variation (SD/mean)
[b] N = number of subjects
[c] Body weight (bw) in kg
[d] coefficient of correlation
Source: Layton, 1993.

Table 5A-2. Characteristics of Individual Subjects: Anthropometric Data, Job Categories, Calibration Results[a]

Subj. #	Age	Ht. (in.)	Wt. (lb.)	Ethnic Group[a]	Job[b]	Site[c]	Calibration HR Range[d]	Calibration r^2[e]
1761	26	71	180	Wht	GCW	Ofc	69-108	.91
1763	29	63	135	Asn	GCW	Ofc	80-112	.95
1764	32	71	165	Blk	Car	Ofc	56-87	.95
1765	30	73	145	Wht	GCW	Ofc	66-126	.97
1766	31	67	170	His	Car	Ofc	75-112	.89
1767	34	74	220	Wht	Car	Ofc	59-114	.98
1768	32	69	155	Blk	GCW	Ofc	62-152	.95
1769	32	77	230	Wht	Car	Hosp	69-132	.99
1770	26	70	180	Wht	Car	Hosp	63-106	.89
1771	39	66	150	Wht	Car	Hosp	88-118	.91
1772	32	71	260	Wht	Car	Hosp	83-130	.97
1773	39	69	170	Wht	Irn	Hosp	77-128	.95
1774	23	68	150	His	Car	Hosp	68-139	.98
1775	42	67	150	Wht	Irn	Hosp	76-118	.88
1776	29	70	180	His	Car	Hosp	68-152	.99
1778	35	76	220	Ind	Car	Hosp	70-129	.94
1779	40	70	175	Wht	Car	Hosp	72-140	.99
1780	37	75	242	His	Irn	Hosp	68-120	.98
1781	38	65	165	His	Lab	Hosp	66-121	.89
Mean	33	70	181				70-123	.94
S.D.	5	4	36				8-16	.04

[a] Abbreviations are interpreted as follows. Ethnic Group: Asn = Asian-Pacific, Blk = Black, His = Hispanic, Ind = American Indian, Wht = White

[b] Job: Car = carpenter, GCW = general construction worker, Irn = ironworker, Lab = laborer

[c] Site: Hosp = hospital buidling, Ofc = medical office complex. Calibration data

[d] Hr range = range of heart rates in calibration study

[e] r^2 = coefficient of determination (proportion of ventilation rate variability explainable by heart rate variability under calibration-study conditions, using quadratic prediction equation).

Source: Linn et al., 1993.

Table 5A-3. Mean Minute Ventilation (V_E, L/min) by Group and Activity for Laboratory Protocols

Activity		Young Children[a]	Children	Adult Females	Adult Males
Lying		6.19	7.51	7.12	8.93
Sitting		6.48	7.28	7.72	9.30
Standing		6.76	8.49	8.36	10.65
Walking	1.5 mph	10.25	DNP	DNP	DNP
	1.875 mph	10.53	DNP	DNP	DNP
	2.0 mph	DNP	14.13	DNP	DNP
	2.25 mph	11.68	DNP	DNP	DNP
	2.5 mph	DNP	15.58	20.32	24.13
	3.0 mph	DNP	17.79	24.20	DNP
	3.3 mph	DNP	DNP	DNP	27.90
	4.0 mph	DNP	DNP	DNP	36.53
Running	3.5 mph	DNP	26.77	DNP	DNP
	4.0 mph	DNP	31.35	46.03[b]	DNP
	4.5 mph	DNP	37.22	47.86[b]	57.30
	5.0 mph	DNP	DNP	50.78[b]	58.45
	6.0 mph	DNP	DNP	DNP	65.66[b]

[a] Young Children, male and female 3-5.9 yr olds; Children, male and female 6-12.9 yr olds; Adult Females, adolescent, young to middle-aged, and older adult females; Adult Males, adolescent, young to middle-aged, and older adult males; DNP, group did not perform this protocol or N was too small for appropriate mean comparisons

[b] Older adults not included in the mean value since they did not perform running protocol at particular speeds.

Source: CARB, 1993.

Table 5A-4.Mean Minute Ventilation (V_E, L/min) by Group and Activity for Field Protocols

Activity	Young Children[a]	Children	Adult Females	Adult Males
Play	11.31	17.89	DNP	DNP
Car Driving	DNP	DNP	8.95	10.79
Car Riding	DNP	DNP	8.19	9.83
Yardwork	DNP	DNP	19.23[e]	26.07[b]/31.89[c]
Housework	DNP	DNP	17.38	DNP
Car Maintenance	DNP	DNP	DNP	23.21[d]
Mowing	DNP	DNP	DNP	36.55[e]
Woodworking	DNP	DNP	DNP	24.42[e]

[a] Young Children, male and female 3-5.9 yr olds; Children, male and female 6-12.9 yr olds; Adult Females, adolescent, young to middle-aged, and older adult females; Adult Males, adolescent, young to middle-aged, and older adult males; DNP, group did not perform this protocol or N was too small for appropriate mean comparisons;

[b] Mean value for young to middle-aged adults only

[c] Mean value for older adults only

[d] Older adults not included in the mean value since they did not perform this activity.

[e] Adolescents not included in mean value since they did not perform this activity

Source: CARB, 1993.

Table 5A-5. Estimated Minute Ventilation Associated with Activity Level for Average Male Adult[a]

Level of work	L/min	Representative activities
Light	13	Level walking at 2 mph; washing clothes
Light	19	Level walking at 3 mph; bowling; scrubbing floors
Light	25	Dancing; pushing wheelbarrow with 15-kg load; simple construction; stacking firewood
Moderate	30	Easy cycling; pushing wheelbarrow with 75-kg load; using sledgehammer
Moderate	35	Climbing stairs; playing tennis; digging with spade
Moderate	40	Cycling at 13 mph; walking on snow; digging trenches
Heavy Heavy Very heavy	55 63 72	Cross-country skiing; rock climbing; stair climbing with load; playing squash or handball; chopping with axe
Very heavy	85	Level running at 10 mph; competitive cycling
Severe	100+	Competitive long distance running; cross-country skiing

[a] Average adult assumed to weigh 70 kg.
Source: Adapted from U.S. EPA, 1985

Table 5A-6. Minute Ventilation Ranges by Age, Sex, and Activity Level

		Ventilation ranges (liters/minute)											
Age	Sex	Resting			Light			Moderate			Heavy		
		n	Range	Mean	n	Range	Mean	n	Range	Mean	n	Range	Mean
Infants	M/F	316	0.25 - 2.09	0.84					---			---	
2	F		---			---			---			---	
	M		---			---			---			---	
3	F		---			---			---			---	
	M		---			---			---			---	
4	F		---			---			---		2	32.0 - 32.5	32.3
	M		---			---			---		4	39.3 - 43.3	41.2
5	F		---			---			---		3	31.0 - 35.0	32.8
	M		---			---			---		3	30.9 - 42.6	37.5
6	F		---			---			---		2	35.9 - 38.9	37.4
	M	8	5.0 - 7.0	6.5	16	5.0 - 32.0	13.9	4	28.0 - 43.0	33.3	3	35.5 - 43.5	40.3
7	F		---			---			---		3	48.2 - 51.4	49.6
	M		---			---			---		2	44.1 - 55.8	50.0
8	F		---			---			---		4	51.2 - 67.6	57.6
	M		---			---			---		3	59.3 - 62.2	60.7
9	F		---			---			---		27	55.8 - 63.4	50.9
	M		---			---			---		7	59.5 - 75.2	65.7
10	F		---			---			---		21	46.2 - 71.1	60.4
	M	10	5.2 - 8.3	7.1	20	5.2 - 35.0	17.2	9	41.0 - 68.0	53.4	6	63.9 - 74.6	70.5
	F		---			---			---		7	49.7 - 80.9	63.5
	M		---		20	---	20.3	20	---	33.1	9	47.6 - 77.5	65.5
12	F	54	4.1 - 16.1	15.4		---		4	19.6 - 46.3	26.5	31	65.5 - 79.9	71.8
	M	56	7.2 - 16.3	15.4		---		6	18.5 - 46.3	34.1	9	58.1 - 84.7	67.7
13	F	5	7.2 - 15.4	9.9		---		5	18.5 - 46.3	30.3	7	67.6 - 102.6	87.7
	M	16	3.1 - 15.4	8.9	30	3.1 - 24.9	16.4	29	14.4 - 48.4	32.8	38	27.8 - 105.0	57.9
14	F	53	3.1 - 15.6	14.9		---		3	21.6 - 37.1	28.1	5	80.7 - 100.7	88.9
	M	77	3.1 - 27.8	14.2		---		24	24.7 - 55.0	39.7	16	42.2 - 121.0	86.9
15	F	1	---	6.2		---		1	---	26.8	6	68.4 - 97.1	87.1
	M	8	3.1 - 26.8	11.1		---		7	27.8 - 46.3	39.3	6	48.4 - 140.3	110.5
16	F	50	---	15.2		---	---		---		8	73.6 - 119.1	93.9
	M	50	---	15.6		---			---		3	79.6 - 132.2	102.5
17	F		---			---			---		2	91.9 - 95.3	93.6
	M	12	5.8 - 9.0	7.3		---		12	40.0 - 63.0	48.6	3	89.4 - 139.3	107.7
18	F		---			---			---			---	
	M		---			---			---		9	99.7 - 143.0	120.9
Adults	F	595	4.2 - 11.66	5.7	786	4.2 - 29.4	8.1	106	20.7 - 34.2	26.5	211	23.4 - 114.8	47.9
Adults	M	454	2.3 - 18.8	12.2	102	2.3 - 27.6	13.8	102	14.4 - 78.0	40.9	267	34.6 - 183.4	80.0

n = number of observations

Note: Values in liters/minute can be converted to units of m^3/hour by multiplying by the conversion factor, $\frac{60 \text{ minutes/hour}}{1000 \text{ liters/m}^3}$

Source: Adapted from U.S. EPA, 1985.

Table 5A-7. Reference Values Obtained From Various Literature Sources

Col.	1	2	3			4			5			6		
Line	Subject	W (kg)	Resting			Light Activity			Heavy Work			Maximal Work During Exercise		
			f	VT	V*	f	VT	V*	f	VT	V*	f	VT	V*
	Adult													
1	Man	68.5	12	750	7.4	17	1670	29	21	2030	43			
2	1.7 m^2 SA		12	500	6									
3	30y; 170 cm L		15	500	7.5	16	1250	20						
4	20-33 y	70.4										40	3050	111
5	Woman	54	12	340	4.5	19	860	16	30	880	25			
6	30 y; 160 cm L		15	400	6	20	940	19						
7	20-25 y; 165.8 cm L	60.3										46	2100	90
8	Pregnant (8th mo)		16	650	10									
	Adolescent													
9	male, 14-16 y		16	330	5.2							53	2520	113
10	male, 14-15 y	59.4												
11	female, 14-16 y		15	300	4.5									
12	female, 14-15 y; 164.9 cm L	56										52	1870	88
	Children													
13	10 y; 140 cm L		16	300	4.8	24	600	14						
14	males, 10-11 y	36.5										58	1330	71
15	males, 10-11 y; 140.6 cm L	32.5										61	1050	61
16	females, 4-6 y	20.8										70	600	40
17	females, 4-6 y; 111.6 cm L	18.4										66	520	34
18	Infant, 1 y		30	48	1.4[a]									
19	Newborn	2.5	34	15	0.5									
20	10 h-13 wk	2.5-5.3										68[b]	51[a,b]	3.5[b]
21	9.6 h	3.6	25	21	0.5									
22	6.6 d	3.7	29	21	0.6									

W = body weights referable to the dimension quoted in column 1; f = frequency (breaths/min); VT = tidal volume (ml); V* = minute volume (l/min); SA = surface area.

[a] Calculated from V* = f x VT.
[b] Crying.

Source: ICRP, 1981.