

Supplemental Appendix Q
Multiple Imputation GLM results

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DRI energy - Multiple Imputation GLM results

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1 Notes

Data were cleaned for analysis with the following steps:

- In infants (0 to 11.9 mo) and children 1-3 year old
 - If PAL (observed) is <1 or >2.5 , then infant is dropped.
 - If PAL estimated from Schofield is <1 or >2.5 then infant is dropped.
- For children (4+) & adults,
 - If observed PAL >2.5 then person is dropped.
 - If observed PAL <1 made PAL missing and use multiple imputation.
 - If PAL is unobserved, but PAL estimated from Schofield >2.5 then these people are dropped (These are people with very high TEE for their age & wt)
 - If PAL is unobserved, but PAL estimated from Schofield <1 , leave them be because PAL will be imputed.

The clean dataset contained $n=8,600$ people . Of these 3,938 had observed data for PAL, and 4,662 had missing PAL

Multiple Imputation

- 20 multiple imputations (8,600 per imputation x 20), total $n=172,000$ records.
- Records with imputed values for PAL less than 1 for PAL were truncated to 1 ($n=2,250$).
- Records with imputed values for PAL more than 2.5 for PAL were removed ($n=54$), total $n=171,946$ for analysis.
- We ran general linear models (e.g. linear regression) on TEE to obtain the coefficients for each imputed data set.
- Coefficients and SE from each of the 20 results were pooled using Rubin's methods to obtain final equation.
- R^2 and other model fit measures were calculated using predicted values for TEE from final equations, only for people with complete data, compared to their observed TEE.

Terms

BMI categories are labeled in the following ways:

For Adults:

- Models for 'All included' include all BMI levels <18.5 to >40
- Models for 'Sensitivity' include BMI [18.5 to 40)
- Models for 'Healthy' include BMI [18.5 to 25).
- Models for 'Overweight / Obese' include BMI 25 or more

For Children/Teens:

- Models for 'All included' include all weight/BMI percentiles <5th to >95th
- Models for 'Sensitivity' include weight/BMI percentiles [5th to 95th]
- Models for 'Healthy' include weight/BMI percentiles [5th to 85th)
- Models for 'Overweight/Obese' include weight/BMI percentiles 85th or more

where percentiles are calculated as follows:

- For infants (0-11 mo) and children (12-24 mo): Weight Percentiles were calculated based on Girls/Boys percentiles: expanded-tables (Weight-for-length) from WHO, <https://www.who.int/tools/child-growth-standards/standards/weight-for-length-height> (<https://www.who.int/tools/child-growth-standards/standards/weight-for-length-height>).
- For children/teens 2 – 18: BMI Percentiles were calculated based on sex, age growth charts from CDC https://www.cdc.gov/growthcharts/percentile_data_files.htm (https://www.cdc.gov/growthcharts/percentile_data_files.htm).

2 PAL

2.1 Percentiles

Percentiles for PAL were calculated on each of the imputed dataset (1 to 20) and took the mean across imputations.

2.1.1 Mean overall the imputations

By Age category

Percentile	Infants n=555	Children n=1121	Teenagers n=704	Adults n=5525	Lactating n=167	Pregnant n=522
10%	1.00	1.16	1.34	1.36	1.33	1.32
25%	1.09	1.29	1.50	1.51	1.49	1.48
50%	1.25	1.42	1.66	1.67	1.68	1.64
75%	1.41	1.58	1.85	1.84	1.83	1.82
90%	1.60	1.74	2.04	2.01	2.03	2.02

By New Age Category

Percentile	0-2.99 yo n=750	3-8.99 yo n=926	9-18.99 yo n=704	19-70.99 yo n=4299	71+ yo n=1281	Lactating n=203	Pregnant n=431
10%	1.00	1.20	1.34	1.39	1.31	1.34	1.30

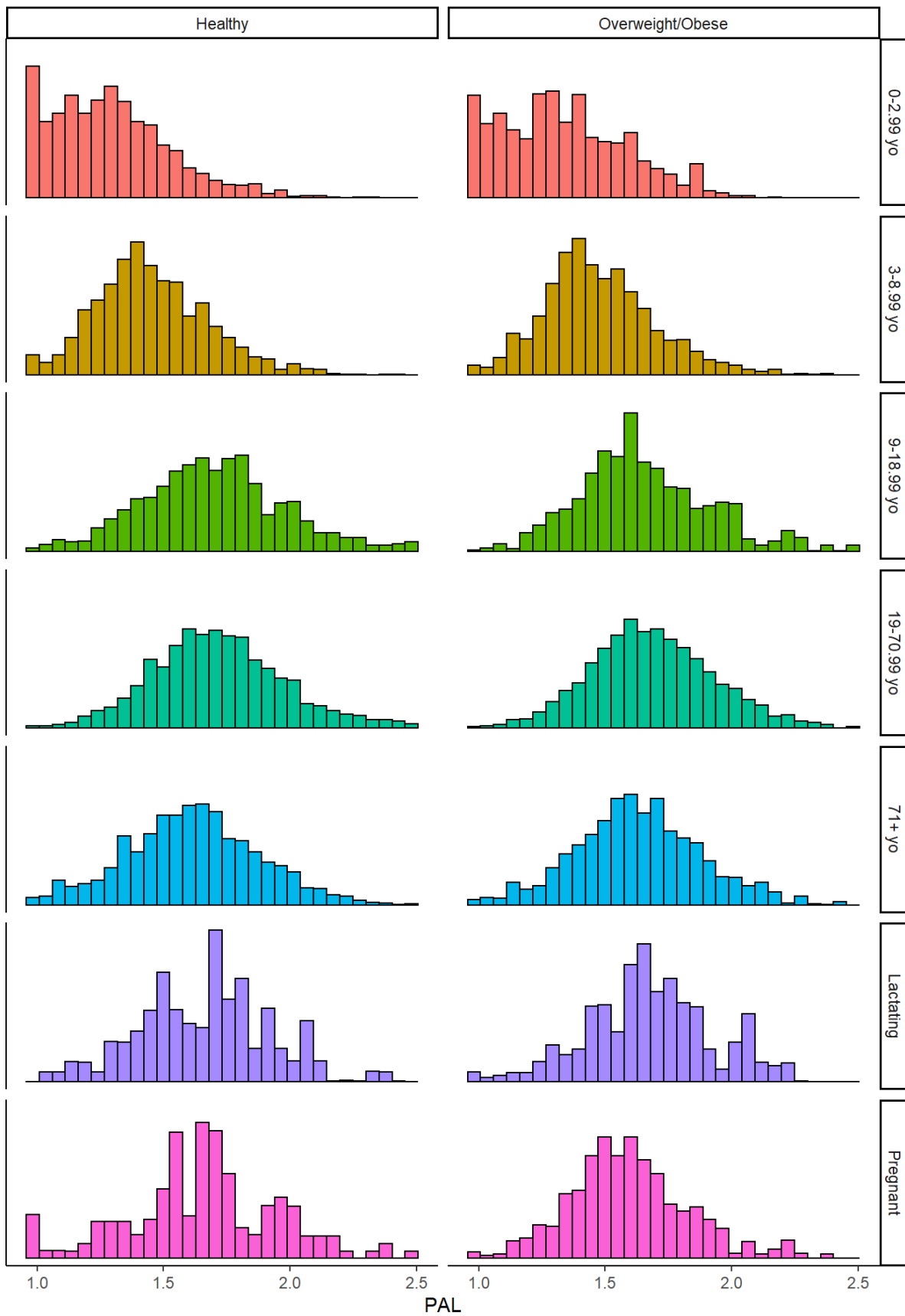
Percentile	0-2.99 yo n=750	3-8.99 yo n=926	9-18.99 yo n=704	19-70.99 yo n=4299	71+ yo n=1281	Lactating n=203	Pregnant n=431
25%	1.11	1.31	1.50	1.53	1.46	1.50	1.46
50%	1.27	1.44	1.66	1.68	1.62	1.69	1.60
75%	1.44	1.59	1.85	1.85	1.79	1.83	1.77
90%	1.61	1.75	2.04	2.03	1.95	2.05	1.97

By Life Stage

Percentile	0-6 months n=443	7-11 months n=112	1-3 years n=243	4-8 years n=878	9-13 years n=304	14-18 years n=403	19-30 years n=1417	31-50 years n=1994	51-70 years n=1519	>=71 years n=1281
10%	1.00	1.08	1.06	1.20	1.29	1.40	1.35	1.39	1.39	1.31
25%	1.07	1.19	1.17	1.32	1.44	1.56	1.50	1.53	1.52	1.46
50%	1.23	1.31	1.33	1.44	1.59	1.73	1.67	1.69	1.67	1.62
75%	1.40	1.47	1.49	1.60	1.77	1.92	1.85	1.86	1.82	1.79
90%	1.58	1.65	1.64	1.76	1.92	2.11	2.05	2.03	1.99	1.95

2.2 Histograms

Histograms of PAL by age category and BMI (19+ yo)/BMI percentile (2-18.99 yo)/Weight-to-length percentile (0-1.99 yo) group.



2.3 New Categories

Note that IOM 2005 report defined 4 PAL categories loosely based on percentiles in the data:

- Sedentary PAL $\geq 1.0 < 1.4$

- Low Active PAL $\geq 1.4 < 1.6$
- Active PAL $\geq 1.6 < 1.9$
- Very Active PAL $\geq 1.9 < 2.5$

Fao.org defines:

- Sedentary or light PAL 1.40-1.69
- Active or moderately active PAL 1.70-1.99
- Vigorous or vigorously active PAL 2.00-2.40

PAL categories in current analysis

For $3.0 \leq \text{Age} < 9.0$:

- Sedentary PAL $\geq 1.0 < 1.31$
- Low Active PAL $\geq 1.31 < 1.44$
- Active PAL $\geq 1.44 < 1.59$
- Very Active PAL $\geq 1.59 < 2.5$

For $9.0 \leq \text{Age} < 14.0$:

- Sedentary PAL $\geq 1.0 < 1.44$
- Low Active PAL $\geq 1.44 < 1.59$
- Active PAL $\geq 1.59 < 1.77$
- Very Active PAL $\geq 1.77 < 2.5$

For $14.0 \leq \text{Age} < 19.0$:

- Sedentary PAL $\geq 1.0 < 1.56$
- Low Active PAL $\geq 1.56 < 1.73$
- Active PAL $\geq 1.73 < 1.92$
- Very Active PAL $\geq 1.92 < 2.5$

For $\text{Age} \geq 19$: *(Note that these are based on percentiles of 19 to 70.99, but 71+ use these too)*

- Sedentary PAL $\geq 1.0 < 1.53$
- Low Active PAL $\geq 1.53 < 1.68$
- Active PAL $\geq 1.68 < 1.85$
- Very Active PAL $\geq 1.85 < 2.5$

3 Women, 19+ years old

3.1 Coefficients by PAL

- Models for 'all included' used sample size of $n=3584$ on average in each of 20 imputed data sets (min=3580, max=3585).
- Models for Sensitivity (BMI [18.5 to 40]) used sample size of $n=3407$ on average in each of 20 imputed data sets (min=3403, max=3408).
- Models for Healthy (BMI [18.5 to 25]) used sample size of $n=1436$ on average in each of 20 imputed data sets (min=1434, max=1438).
- Models for all Overweight / Obese (BMI [25+]) used sample size of $n=2100$ on average in each of 20 imputed data sets (min=2098, max=2101).

The linear model performed was:

TEE = Intercept + Age (years) + Height (cm) + Weight (kg) + PALCAT + PALCAT x Weight (kg) + PALCAT x Height (cm)

This uses a constant slope for age across PAL categories (PALCAT), but different slopes for height and weight in each PAL category.

The full set of parameter estimates including interaction terms are shown in the next section. Here we show the slopes of height and weight separately for each PALCAT which were calculated based on the interaction terms (shown in 3.2).

TEE can be predicted for a person in a given PAL group using the equation:

$$\text{TEE} = \text{Intercept} + \text{A} \times \text{Age (years)} + \text{B} \times \text{Height (cm)} + \text{C} \times \text{Weight (kg)}$$

For example, based on the model with all BMI levels included, a woman who is sedentary, 50 years old, 160 cm tall, 70 kg would be predicted to be:

$$\text{TEE} = 584.90 - 7.01 \times 50y + 5.72 \times 160\text{cm} + 11.71 \times 70\text{kg} = 1969.3 \text{ kcal/day}$$

Parameter	All included		Sensitivity (18.5 to 40)		Healthy (18.5 to 25)		Overweight / Obese (25+)		FM & FFM	
Parameter	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Sedentary										
Intercept	584.90	210.30	539.86	214.62	578.41	356.19	555.98	272.23	850.18	204.25
Age	-7.01	0.26	-7.00	0.26	-6.32	0.35	-7.67	0.38	-5.45	0.24
Height	5.72	1.32	5.72	1.37	4.88	2.70	6.53	1.80	0.90	1.43
Weight	11.71	0.56	12.37	0.68	13.36	2.75	10.96	0.87	.	.
FM	.	.	.	.	.	.	.	.	5.93	0.86
FFM	.	.	.	.	.	.	.	.	26.14	1.74
Low Active										
Intercept	575.77	219.29	579.59	228.62	506.91	388.66	630.99	325.82	964.46	211.90
Age	-7.01	0.26	-7.00	0.26	-6.32	0.35	-7.67	0.38	-5.45	0.24
Height	6.60	1.37	6.57	1.47	6.66	2.96	6.64	2.09	0.37	1.53
Weight	12.14	0.61	12.18	0.75	12.50	2.95	11.85	0.93	.	.
FM	.	.	.	.	.	.	.	.	4.58	0.94
FFM	.	.	.	.	.	.	.	.	30.06	2.10
Active										
Intercept	710.25	249.40	614.76	255.57	514.11	383.65	819.03	352.13	1281.29	238.23
Age	-7.01	0.26	-7.00	0.26	-6.32	0.35	-7.67	0.38	-5.45	0.24
Height	6.54	1.59	7.17	1.69	9.23	2.98	5.65	2.35	-1.63	1.62
Weight	12.34	0.64	12.25	0.92	7.86	3.40	13.16	1.00	.	.
FM	.	.	.	.	.	.	.	.	2.72	1.08
FFM	.	.	.	.	.	.	.	.	34.38	1.94
Very Active										
Intercept	511.83	241.43	478.64	247.16	312.23	340.93	622.99	385.90	1220.75	238.19
Age	-7.01	0.26	-7.00	0.26	-6.32	0.35	-7.67	0.38	-5.45	0.24
Height	9.07	1.48	9.31	1.53	11.75	2.64	8.23	2.44	-1.11	1.66
Weight	12.56	0.71	12.51	0.80	8.14	3.06	13.26	1.20	.	.
FM	.	.	.	.	.	.	.	.	1.24	1.13
FFM	.	.	.	.	.	.	.	.	39.22	2.14

3.2 Full Output

While the previous section reports coefficients separately for each PAL category for convenience, this section reports the same model but shows the full statistical output with coefficients for the interaction terms that defined the slopes above. The coefficients for interaction terms here are the difference in slopes for height and weight between each PAL category versus the reference category for Very Active (VA). This section is included in full-transparency to show the full output; however, the previous section is in a more interpretable form for lay understanding.

For example, the coefficient for Weight is 12.58, which represents the slope for Weight in the VA group as shown above. Whereas, adding the coefficient of -0.44 for the Low Active (LA) group gives (12.58-0.44=) 12.14 for the slope of weight in the LA group, as shown above.

Model performed:

$$\text{TEE} = \text{Intercept} + \text{Age (years)} + \text{Height (cm)} + \text{Weight (kg)} + \text{PALCAT} + \text{PALCAT} \times \text{Weight (kg)} + \text{PALCAT} \times \text{Height (cm)}$$

Parameter	All included		Sensitivity (18.5 to 40)		Healthy (18.5 to 25)		Overweight / Obese (25+)		FM & FFM	
	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Intercept	511.83	241.43	478.64	247.16	312.23	340.93	622.99	385.90	1220.75	238.19
Age	-7.01	0.26	-7.00	0.26	-6.32	0.35	-7.67	0.38	-5.45	0.24
Height	9.07	1.48	9.31	1.53	11.75	2.64	8.23	2.44	-1.11	1.66
Weight	12.56	0.71	12.51	0.80	8.14	3.06	13.26	1.20	.	.
FM	.	.	.	.	.	.	.	.	1.24	1.13
FFM	.	.	.	.	.	.	.	.	39.22	2.14
PALCAT A	198.42	353.55	136.12	359.35	201.87	533.08	196.04	544.47	60.54	337.24
PALCAT LA	63.94	340.12	100.95	349.49	194.68	507.26	8.00	489.37	-256.29	326.28
PALCAT S	73.07	312.08	61.22	316.17	266.18	459.87	-67.01	471.88	-370.57	300.57
Height*PALCAT A	-2.53	2.26	-2.14	2.34	-2.52	4.12	-2.58	3.65	-0.51	2.34
Height*PALCAT LA	-2.47	2.13	-2.75	2.21	-5.09	3.91	-1.58	3.20	1.48	2.34
Height*PALCAT S	-3.36	1.98	-3.59	2.03	-6.88	3.68	-1.69	3.11	2.01	2.12
Weight*PALCAT A	-0.22	0.99	-0.26	1.25	-0.28	4.78	-0.11	1.72	.	.
Weight*PALCAT LA	-0.42	0.94	-0.33	1.12	4.36	4.31	-1.41	1.54	.	.
Weight*PALCAT S	-0.85	0.93	-0.14	1.05	5.22	4.10	-2.31	1.55	.	.
FM*PALCAT A	.	.	.	.	.	.	.	.	1.47	1.53
FM*PALCAT LA	.	.	.	.	.	.	.	.	3.34	1.51
FM*PALCAT S	.	.	.	.	.	.	.	.	4.68	1.46
FFM*PALCAT A	.	.	.	.	.	.	.	.	-4.84	2.90
FFM*PALCAT LA	.	.	.	.	.	.	.	.	-9.16	2.93
FFM*PALCAT S	.	.	.	.	.	.	.	.	-13.08	2.71

3.3 Comparison of slopes

Model performed: $\text{TEE} = \text{Intercept} + \text{Age (years)} + \text{Height (cm)} + \text{Weight (kg)} + \text{PALCAT} + \text{BMIgrp} + \text{PALCAT} \times \text{Weight} + \text{PALCAT} \times \text{Height} + \text{Age} \times \text{BMIgrp} + \text{PALCAT} \times \text{BMIgrp} + \text{Weight} \times \text{BMIgrp} + \text{Height} \times \text{BMIgrp} + \text{PALCAT} \times \text{Weight} \times \text{BMIgrp} + \text{PALCAT} \times \text{Height} \times \text{BMIgrp}$

PAL	Healthy		Overweight / Obese		Difference 'H vs O/O'		
	Estimate	SE	Estimate	SE	Estimate	SE	p-value
Height							
S	4.89	2.79	6.53	1.76	-1.64	3.36	0.6248
LA	6.68	3.05	6.64	2.05	0.03	3.77	0.9926
A	8.90	3.10	5.65	2.31	3.25	3.90	0.4050

PAL	Healthy		Overweight / Obese		Difference 'H vs O/O'		
	Estimate	SE	Estimate	SE	Estimate	SE	p-value
VA	11.64	2.73	8.23	2.40	3.41	3.67	0.3545
Weight							
S	13.37	2.85	10.96	0.85	2.41	3.01	0.4235
LA	12.50	3.04	11.85	0.91	0.64	3.08	0.8348
A	8.28	3.53	13.16	0.98	-4.87	3.63	0.1804
VA	8.41	3.17	13.26	1.19	-4.85	3.54	0.1718

3.4 Model fit

Sample sizes, R^2 , $R^2_{adjusted}$, and Pearson correlation r of predicted vs observed by model.

	All included	Sensitivity (18.5 to 40)	Healthy (18.5 to 25)	Overweight / Obese (25+)	FM & FFM
n	1342.00	1273.00	542.00	781.00	909.00
R2	0.71	0.70	0.69	0.70	0.73
R2adj	0.70	0.69	0.68	0.70	0.73
r	0.84	0.84	0.84	0.84	0.86
MSE	60393.43	59563.89	57399.25	63229.81	49185.95
RMSE	245.75	244.06	239.58	251.46	221.78

3.5 Model fit by Subgroups

Sample sizes, and Pearson correlation r of predicted vs observed by PAL category, BMI category and Life Stage.

Parameter	All included		Sensitivity (18.5 to 40)		Healthy (18.5 to 25)		Overweight / Obese (25+)		FM & FFM	
	n	r	n	r	n	r	n	r	n	r
By PAL category										
S	343	0.80	321	0.77	127	0.78	211	0.75	224	0.80
LA	337	0.78	325	0.77	131	0.73	202	0.79	252	0.83
A	327	0.79	307	0.76	123	0.71	203	0.80	227	0.80
VA	335	0.71	320	0.69	161	0.62	165	0.72	206	0.81
By BMI category										
< 18.5 kg/m2	19	0.90	.	.	.	.	.	.	19	0.94
>= 18.5 & <25 kg/m2	542	0.83	542	0.83	542	0.84	.	.	307	0.86
>= 25 & <30 kg/m2	416	0.84	416	0.84	.	.	416	0.83	296	0.84
>= 30 & <35 kg/m2	234	0.80	234	0.80	.	.	234	0.80	178	0.82
>= 35 & <40 kg/m2	81	0.81	81	0.81	.	.	81	0.81	74	0.77
>= 40 kg/m2	50	0.79	.	.	.	.	50	0.80	35	0.75
By Life Stage										
19-30 years	332	0.76	318	0.74	192	0.73	133	0.79	214	0.83
31-50 years	393	0.82	362	0.81	121	0.73	263	0.82	280	0.84
51-70 years	340	0.75	323	0.76	116	0.79	224	0.73	190	0.78
>=71 years	277	0.78	270	0.77	113	0.79	161	0.73	225	0.80

4 Men, 19+ years old

4.1 Coefficients by PAL

- Models for 'all included' used sample size of n=1870 on average in each of 20 imputed data sets (min=1866, max=1871).
- Models for Sensitivity (BMI [18.5 to 40]) used sample size of n=1814 on average in each of 20 imputed data sets (min=1811, max=1816).
- Models for Healthy (BMI [18.5 to 25]) used sample size of n=698 on average in each of 20 imputed data sets (min=696, max=700).
- Models for all Overweight / Obese (BMI [25+]) used sample size of n=1151 on average in each of 20 imputed data sets (min=1148, max=1153).

The linear model performed was:

$$\text{TEE} = \text{Intercept} + \text{Age (years)} + \text{Height (cm)} + \text{Weight (kg)} + \text{PALCAT} + \text{PALCAT} \times \text{Weight (kg)} + \text{PALCAT} \times \text{Height (cm)}$$

This uses a constant slope for age across PAL categories (PALCAT), but different slopes for height and weight in each PAL category.

The full set of parameter estimates including interaction terms are shown in the next section. Here we show the slopes of height and weight separately for each PALCAT which were calculated based on the interaction terms (shown in 4.2).

TEE can be predicted for a person in a given PAL group using the equation:

$$\text{TEE} = \text{Intercept} + \text{A} \times \text{Age (years)} + \text{B} \times \text{Height (cm)} + \text{C} \times \text{Weight (kg)}$$

Parameter	All included		Sensitivity (18.5 to 40)		Healthy (18.5 to 25)		Overweight / Obese (25+)		FM & FFM	
	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Sedentary										
Intercept	753.07	448.76	723.80	451.86	-290.13	786.01	1183.66	580.28	1361.67	423.14
Age	-10.83	0.47	-10.94	0.48	-10.33	0.73	-11.07	0.67	-8.15	0.44
Height	6.50	2.69	7.14	2.76	12.09	5.78	4.88	3.62	-2.46	2.71
Weight	14.10	1.23	13.22	1.59	14.54	5.81	12.72	1.73	.	.
FM	.	.	.	.	.	.	.	.	3.77	1.69
FFM	.	.	.	.	.	.	.	.	33.79	2.58
Low Active										
Intercept	581.47	443.10	603.51	449.83	270.07	885.57	646.37	551.75	1171.01	407.93
Age	-10.83	0.47	-10.94	0.48	-10.33	0.73	-11.07	0.67	-8.15	0.44
Height	8.30	2.61	7.85	2.73	8.94	6.69	8.58	3.41	0.27	2.64
Weight	14.94	1.28	15.72	1.57	17.20	6.51	13.90	1.72	.	.
FM	.	.	.	.	.	.	.	.	3.79	1.82
FFM	.	.	.	.	.	.	.	.	31.86	2.58
Active										
Intercept	1004.82	443.46	1014.53	444.97	928.82	746.67	1431.79	676.89	1650.82	426.28
Age	-10.83	0.47	-10.94	0.48	-10.33	0.73	-11.07	0.67	-8.15	0.44
Height	6.52	2.66	6.44	2.67	4.61	5.83	3.54	4.36	-2.59	2.88
Weight	15.91	1.42	16.03	1.51	21.63	6.11	17.01	2.22	.	.
FM	.	.	.	.	.	.	.	.	3.49	2.12
FFM	.	.	.	.	.	.	.	.	35.31	3.01
Very Active										
Intercept	-517.88	441.22	-646.79	451.71	-653.47	705.63	-471.46	586.07	725.37	430.54
Age	-10.83	0.47	-10.94	0.48	-10.33	0.73	-11.07	0.67	-8.15	0.44

Parameter	All included		Sensitivity (18.5 to 40)		Healthy (18.5 to 25)		Overweight / Obese (25+)		FM & FFM	
	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Height	15.61	2.56	16.29	2.63	18.92	5.37	14.16	3.65	1.83	2.69
Weight	19.11	1.17	19.33	1.37	12.89	5.79	21.36	1.86	.	.
FM	.	.	.	.	.	.	.	.	3.04	1.70
FFM	.	.	.	.	.	.	.	.	42.97	2.02

4.2 Full Output

While the previous section reports coefficients separately for each PAL category for convenience, this section reports the same model but shows the full statistical output with coefficients for the interaction terms that defined the slopes above. The coefficients for interaction terms here are the difference in slopes for height and weight between each PAL category versus the reference category for Very Active (VA). This section is included in full-transparency to show the full output; however, the previous section is in a more interpretable form for lay understanding.

Model performed:

TEE = Intercept + Age (years) + Height (cm) + Weight (kg) + PALCAT + PALCAT x Weight (kg) + PALCAT x Height (cm)

Parameter	All included		Sensitivity (18.5 to 40)		Healthy (18.5 to 25)		Overweight / Obese (25+)		FM & FFM	
	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Intercept	-517.88	441.22	-646.79	451.71	-653.47	705.63	-471.46	586.07	725.37	430.54
Age	-10.83	0.47	-10.94	0.48	-10.33	0.73	-11.07	0.67	-8.15	0.44
Height	15.61	2.56	16.29	2.63	18.92	5.37	14.16	3.65	1.83	2.69
Weight	19.11	1.17	19.33	1.37	12.89	5.79	21.36	1.86	.	.
FM	.	.	.	.	.	.	.	.	3.04	1.70
FFM	.	.	.	.	.	.	.	.	42.97	2.02
PALCAT A	1522.70	591.31	1661.32	602.93	1582.29	1025.96	1903.25	859.18	925.45	593.00
PALCAT LA	1099.35	638.31	1250.31	658.36	923.54	1138.47	1117.84	814.00	445.64	607.01
PALCAT S	1270.95	591.62	1370.60	604.48	363.34	982.57	1655.12	796.59	636.30	579.85
Height*PALCAT A	-9.09	3.54	-9.84	3.63	-14.30	8.13	-10.62	5.54	-4.41	3.89
Height*PALCAT LA	-7.32	3.75	-8.44	3.94	-9.97	8.75	-5.58	5.11	-1.55	3.87
Height*PALCAT S	-9.11	3.55	-9.15	3.66	-6.82	7.42	-9.28	5.02	-4.28	3.78
Weight*PALCAT A	-3.20	1.77	-3.29	1.94	8.74	8.86	-4.35	2.81	.	.
Weight*PALCAT LA	-4.17	1.65	-3.61	2.00	4.31	8.70	-7.46	2.53	.	.
Weight*PALCAT S	-5.01	1.77	-6.11	2.15	1.65	7.93	-8.64	2.58	.	.
FM*PALCAT A	.	.	.	.	.	.	.	.	0.46	2.71
FM*PALCAT LA	.	.	.	.	.	.	.	.	0.76	2.43
FM*PALCAT S	.	.	.	.	.	.	.	.	0.74	2.54
FFM*PALCAT A	.	.	.	.	.	.	.	.	-7.65	3.67
FFM*PALCAT LA	.	.	.	.	.	.	.	.	-11.10	3.20
FFM*PALCAT S	.	.	.	.	.	.	.	.	-9.18	3.24

4.3 Comparison of slopes

Model performed: TEE = Intercept + Age (years) + Height (cm) + Weight (kg) + PALCAT + BMIgrp + PALCAT

× Weight + PALCAT × Height + Age × BMIgrp + PALCAT × BMIgrp + Weight × BMIgrp + Height × BMIgrp + PALCAT

× Weight × BMIgrp + PALCAT × Height × BMIgrp

PAL	Healthy		Overweight / Obese		Difference 'H vs O/O'		
	Estimate	SE	Estimate	SE	Estimate	SE	p-value
Height							
S	11.67	5.99	4.88	3.56	6.79	6.86	0.3223
LA	8.90	6.86	8.58	3.37	0.33	7.59	0.9658
A	4.57	5.97	3.54	4.31	1.03	7.19	0.8863
VA	18.88	5.49	14.16	3.61	4.72	6.41	0.4618
Weight							
S	15.24	6.12	12.72	1.71	2.53	6.24	0.6857
LA	17.22	6.67	13.90	1.70	3.32	6.88	0.6301
A	21.65	6.26	17.01	2.20	4.63	6.55	0.4795
VA	12.90	5.91	21.36	1.84	-8.46	6.00	0.1598

4.4 Model fit

Sample sizes, R^2 , $R^2_{adjusted}$, and Pearson correlation r of predicted vs observed by model.

	All included	Sensitivity (18.5 to 40)	Healthy (18.5 to 25)	Overweight / Obese (25+)	FM & FFM
n	1016.00	988.00	403.00	605.00	682.00
R2	0.73	0.72	0.71	0.73	0.75
R2adj	0.73	0.72	0.70	0.73	0.75
r	0.86	0.86	0.85	0.86	0.87
MSE	114615.10	113592.20	108825.20	116500.20	101117.30
RMSE	338.55	337.03	329.89	341.32	317.99

4.5 Model fit by Subgroups

Sample sizes, and Pearson correlation r of predicted vs observed by PAL category, BMI category and Life Stage.

Parameter	All included		Sensitivity (18.5 to 40)		Healthy (18.5 to 25)		Overweight / Obese (25+)		FM & FFM	
	n	r	n	r	n	r	n	r	n	r
By PAL category										
S	226	0.80	211	0.73	85	0.76	134	0.78	144	0.83
LA	229	0.78	223	0.76	81	0.74	148	0.79	161	0.82
A	240	0.75	240	0.75	107	0.74	133	0.77	156	0.81
VA	321	0.80	314	0.81	130	0.75	190	0.81	221	0.83
By BMI category										
< 18.5 kg/m2	8	0.91	.	.	.	.	.	.	8	0.94
>= 18.5 & <25 kg/m2	403	0.84	403	0.85	403	0.85	.	.	235	0.87
>= 25 & <30 kg/m2	390	0.84	390	0.84	.	.	390	0.84	280	0.86
>= 30 & <35 kg/m2	153	0.85	153	0.85	.	.	153	0.85	116	0.83

Parameter	All included		Sensitivity (18.5 to 40)		Healthy (18.5 to 25)		Overweight / Obese (25+)		FM & FFM	
	n	r	n	r	n	r	n	r	n	r
	>= 35 & <40 kg/m2	42	0.87	42	0.87	.	.	42	0.88	30	0.86
>= 40 kg/m2	20	0.84	.	.	.	.	20	0.84	13	0.80
By Life Stage										
19-30 years	186	0.79	179	0.78	125	0.77	59	0.82	127	0.81
31-50 years	322	0.82	313	0.83	123	0.62	199	0.85	195	0.84
51-70 years	214	0.84	205	0.82	46	0.85	165	0.81	136	0.87
>=71 years	294	0.73	291	0.71	109	0.72	182	0.67	224	0.75

5 Girls, 3-18 years old

5.1 Coefficients by PAL

- Models for 'all included' used sample size of n=955 on average in each of 20 imputed data sets (min=953, max=955).
- Models for Sensitivity (BMI percentile [5th to 95th]) used sample size of n=804 on average in each of 20 imputed data sets (min=802, max=806).
- Models for Healthy (BMI percentile [5th to 85th]) used sample size of n=684 on average in each of 20 imputed data sets (min=682, max=687).
- Models for Overweight / Obese (BMI percentile [85+]) used sample size of n=263 on average in each of 20 imputed data sets (min=261, max=265).

The linear model performed was:

TEE = Intercept + Age (years) + Height (cm) + Weight (kg) + PALCAT + PALCAT x Weight (kg) + PALCAT x Height (cm)

This uses a constant slope for age across PAL categories (PALCAT), but different slopes for height and weight in each PAL category.

The full set of parameter estimates including interaction terms are shown in the next section. Here we show the slopes of height and weight separately for each PALCAT which were calculated based on the interaction terms (shown in 5.2).

TEE can be predicted for a person in a given PAL group using the equation:

TEE = Intercept + A x Age (years) + B x Height (cm) + C x Weight (kg)

Parameter	All included		Sensitivity (5th to 95th)		Healthy (5th to 85th)		Overweight / Obese (85th+)		FM & FFM	
	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Sedentary										
Intercept	55.59	152.76	235.90	221.07	186.66	261.25	120.93	396.06	312.51	164.27
Age	-22.25	5.07	-28.01	6.28	-34.05	7.32	-5.21	9.89	-20.19	4.88
Height	8.43	1.63	6.24	2.49	6.80	2.98	7.88	4.01	4.56	1.93
Weight	17.07	1.95	21.94	3.63	22.95	4.54	13.86	3.45	.	.
FM	.	.	.	.	.	.	.	.	11.79	2.41
FFM	.	.	.	.	.	.	.	.	28.70	4.02
Low Active										
Intercept	-297.54	173.51	-5.88	236.16	-135.62	285.46	-492.00	365.60	-69.20	197.24
Age	-22.25	5.07	-28.01	6.28	-34.05	7.32	-5.21	9.89	-20.19	4.88
Height	12.77	1.83	9.08	2.60	10.59	3.18	15.48	3.73	9.56	2.27

Parameter	All included		Sensitivity (5th to 95th)		Healthy (5th to 85th)		Overweight / Obese (85th+)		FM & FFM	
Parameter	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Weight	14.73	1.73	21.95	3.51	21.49	4.46	8.65	2.84	.	.
FM	.	.	.	.	.	.	.	.	10.95	2.33
FFM	.	.	.	.	.	.	.	.	23.13	4.16
Active										
Intercept	-189.55	201.78	-61.37	242.13	-234.32	284.27	-271.34	553.27	35.92	201.80
Age	-22.25	5.07	-28.01	6.28	-34.05	7.32	-5.21	9.89	-20.19	4.88
Height	11.74	2.24	10.06	2.63	12.06	3.16	12.77	5.94	8.46	2.32
Weight	18.34	2.72	22.72	3.47	21.57	4.53	14.05	5.69	.	.
FM	.	.	.	.	.	.	.	.	13.98	3.00
FFM	.	.	.	.	.	.	.	.	27.30	4.19
Very Active										
Intercept	-709.59	206.28	-511.36	245.80	-321.06	288.44	-914.66	347.74	-236.95	214.78
Age	-22.25	5.07	-28.01	6.28	-34.05	7.32	-5.21	9.89	-20.19	4.88
Height	18.22	2.10	16.02	2.54	13.64	3.04	21.00	3.45	11.62	2.40
Weight	14.25	2.09	18.67	2.81	24.25	4.08	7.26	3.34	.	.
FM	.	.	.	.	.	.	.	.	6.32	2.73
FFM	.	.	.	.	.	.	.	.	31.23	4.14

5.2 Full Output

While the previous section reports coefficients separately for each PAL category for convenience, this section reports the same model but shows the full statistical output with coefficients for the interaction terms that defined the slopes above. The coefficients for interaction terms here are the difference in slopes for height and weight between each PAL category versus the reference category for Very Active (VA). This section is included in full-transparency to show the full output; however, the previous section is in a more interpretable form for lay understanding.

Model performed:

TEE = Intercept + Age (years) + Height (cm) + Weight (kg) + PALCAT + PALCAT x Weight (kg) + PALCAT x Height (cm)

Parameter	All included		Sensitivity (5th to 95th)		Healthy (5th to 85th)		Overweight / Obese (85th+)		FM & FFM	
Parameter	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Intercept	-709.59	206.28	-511.36	245.80	-321.06	288.44	-914.66	347.74	-236.95	214.78
Age	-22.25	5.07	-28.01	6.28	-34.05	7.32	-5.21	9.89	-20.19	4.88
Height	18.22	2.10	16.02	2.54	13.64	3.04	21.00	3.45	11.62	2.40
Weight	14.25	2.09	18.67	2.81	24.25	4.08	7.26	3.34	.	.
FM	.	.	.	.	.	.	.	.	6.32	2.73
FFM	.	.	.	.	.	.	.	.	31.23	4.14
PALCAT A	520.03	258.53	449.99	313.83	86.74	386.65	643.31	662.74	272.87	280.39
PALCAT LA	412.05	257.90	505.47	339.92	185.44	421.89	422.66	514.67	167.75	290.87
PALCAT S	765.17	241.34	747.26	324.07	507.72	370.36	1035.58	505.73	549.46	244.39
Height*PALCAT A	-6.48	2.71	-5.96	3.29	-1.59	4.20	-8.23	6.93	-3.16	3.21
Height*PALCAT LA	-5.45	2.56	-6.94	3.58	-3.06	4.55	-5.52	5.12	-2.06	3.25
Height*PALCAT S	-9.79	2.46	-9.78	3.48	-6.85	4.03	-13.11	4.97	-7.06	2.76

Parameter	All included		Sensitivity (5th to 95th)		Healthy (5th to 85th)		Overweight / Obese (85th+)		FM & FFM	
	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Weight*PALCAT A	4.09	3.50	4.05	4.22	-2.68	5.81	6.79	6.70	.	.
Weight*PALCAT LA	0.48	2.78	3.28	4.49	-2.77	6.07	1.38	4.54	.	.
Weight*PALCAT S	2.82	2.93	3.28	4.50	-1.30	5.51	6.59	4.45	.	.
FM*PALCAT A	.	.	.	.	.	.	.	.	7.66	4.22
FM*PALCAT LA	.	.	.	.	.	.	.	.	4.63	3.52
FM*PALCAT S	.	.	.	.	.	.	.	.	5.48	3.60
FFM*PALCAT A	.	.	.	.	.	.	.	.	-3.93	6.11
FFM*PALCAT LA	.	.	.	.	.	.	.	.	-8.10	6.10
FFM*PALCAT S	.	.	.	.	.	.	.	.	-2.53	5.56

5.3 Comparison of slopes

Model performed: $TEE = \text{Intercept} + \text{Age (years)} + \text{Height (cm)} + \text{Weight (kg)} + \text{PALCAT} + \text{BMIgrp} + \text{PALCAT} \times \text{Weight} + \text{PALCAT} \times \text{Height} + \text{Age} \times \text{BMIgrp} + \text{PALCAT} \times \text{BMIgrp} + \text{Weight} \times \text{BMIgrp} + \text{Height} \times \text{BMIgrp} + \text{PALCAT} \times \text{Weight} \times \text{BMIgrp} + \text{PALCAT} \times \text{Height} \times \text{BMIgrp}$

PAL	Healthy		Overweight / Obese		Difference 'H vs O/O'		
	Estimate	SE	Estimate	SE	Estimate	SE	p-value
Height							
S	5.24	5.36	12.33	8.29	-7.08	10.25	0.4901
LA	11.77	6.25	14.20	6.74	-2.42	9.75	0.8040
A	12.45	6.27	16.28	10.40	-3.83	11.96	0.7493
VA	12.66	5.71	18.59	6.34	-5.94	8.44	0.4822
Weight							
S	28.31	8.01	12.09	5.58	16.22	10.14	0.1108
LA	21.49	9.09	6.24	4.31	15.24	10.68	0.1555
A	23.66	9.34	11.12	11.39	12.54	14.37	0.3837
VA	26.24	7.41	9.15	5.42	17.09	9.07	0.0598

5.4 Model fit

Sample sizes, R^2 , $R^2_{adjusted}$, and Pearson correlation r of predicted vs observed by model.

	All included	Sensitivity (5th to 95th)	Healthy (5th to 85th)	Overweight / Obese (85th+)	FM & FFM
n	477.00	408.00	338.00	136.00	98.00
R2	0.84	0.83	0.83	0.87	0.71
R2adj	0.84	0.83	0.82	0.86	0.67
r	0.92	0.91	0.91	0.94	0.84
MSE	56049.24	59286.20	56859.68	46845.56	128160.85
RMSE	236.75	243.49	238.45	216.44	358.00

5.5 Model fit by Subgroups

Percentile categories are based BMI percentile categories.

Sample sizes, and Pearson correlation r of predicted vs observed by PAL category, BMI category and Life Stage.

Parameter	All included		Sensitivity (5th to 95th)		Healthy (5th to 85th)		Overweight / Obese (85th+)		FM & FFM	
	n	r	n	r	n	r	n	r	n	r
By PAL category										
S	96	0.87	80	0.84	69	0.85	26	0.86	12	0.93
LA	121	0.92	95	0.92	79	0.90	42	0.96	26	0.81
A	115	0.94	96	0.93	85	0.93	28	0.95	28	0.83
VA	145	0.87	137	0.86	105	0.86	40	0.89	32	0.78
By Percentile category										
<5th	3	0.94	.	.	.	.	.	.	1	.
5th to 85th	338	0.91	338	0.91	338	0.91	.	.	77	0.83
85th to 95th	70	0.91	70	0.91	.	.	70	0.91	13	0.89
>95th	66	0.96	.	.	.	.	66	0.96	7	0.54
By Life Stage										
1-3 years	1	.	1	.	1	.	.	.	1	.
4-8 years	225	0.88	186	0.88	159	0.88	63	0.88	10	0.84
9-13 years	118	0.88	99	0.87	73	0.86	45	0.82	6	0.97
14-18 years	133	0.75	122	0.75	105	0.76	28	0.70	81	0.69

6 Boys, 3-18 years old

6.1 Coefficients

- Models for 'all included' used sample size of n=675 on average in each of 20 imputed data sets (min=674, max=675).
- Models for Sensitivity (BMI percentile [5th to 95th]) used sample size of n=529 on average in each of 20 imputed data sets (min=527, max=531).
- Models for Healthy (BMI percentile [5th to 85th]) used sample size of n=452 on average in each of 20 imputed data sets (min=449, max=455).
- Models for Overweight / Obese (BMI percentile [85+]) used sample size of n=213 on average in each of 20 imputed data sets (min=210, max=217).

The linear model performed was:

$$\text{TEE} = \text{Intercept} + \text{Age (years)} + \text{Height (cm)} + \text{Weight (kg)} + \text{PALCAT} + \text{PALCAT} \times \text{Weight (kg)} + \text{PALCAT} \times \text{Height (cm)}$$

This uses a constant slope for age across PAL categories (PALCAT), but different slopes for height and weight in each PAL category.

The full set of parameter estimates including interaction terms are shown in the next section. Here we show the slopes of height and weight separately for each PALCAT which were calculated based on the interaction terms (shown in 6.2).

TEE can be predicted for a person in a given PAL group using the equation:

$$\text{TEE} = \text{Intercept} + \text{A} \times \text{Age (years)} + \text{B} \times \text{Height (cm)} + \text{C} \times \text{Weight (kg)}$$

<u>Parameter</u>	<u>All included</u>		<u>Sensitivity (5th to 95th)</u>		<u>Healthy (5th to 85th)</u>		<u>Overweight / Obese (85th+)</u>		<u>FM & FFM</u>	
<u>Parameter</u>	<u>Estimate</u>	<u>SE</u>	<u>Estimate</u>	<u>SE</u>	<u>Estimate</u>	<u>SE</u>	<u>Estimate</u>	<u>SE</u>	<u>Estimate</u>	<u>SE</u>
Sedentary										
Intercept	-447.51	256.23	550.08	437.16	520.63	466.57	-1023.31	641.42	-77.53	287.10
Age	3.68	9.37	-6.03	11.21	-11.46	12.04	-9.46	17.47	-8.22	9.16
Height	13.01	2.88	0.40	5.27	0.86	5.63	20.94	6.60	8.30	3.45
Weight	13.15	3.16	35.53	7.45	35.93	8.01	5.66	5.35	.	.
FM	.	.	.	.	.	.	.	.	6.83	3.66
FFM	.	.	.	.	.	.	.	.	28.01	5.77
Low Active										
Intercept	19.12	360.58	520.95	372.81	450.66	404.76	-541.03	547.76	230.50	332.45
Age	3.68	9.37	-6.03	11.21	-11.46	12.04	-9.46	17.47	-8.22	9.16
Height	8.62	4.25	2.49	4.39	3.43	4.71	15.71	6.09	5.75	3.93
Weight	20.28	5.19	31.96	5.64	31.80	6.01	13.73	6.99	.	.
FM	.	.	.	.	.	.	.	.	15.03	5.37
FFM	.	.	.	.	.	.	.	.	31.14	5.64
Active										
Intercept	-388.19	290.49	434.79	364.78	590.89	400.11	-705.96	668.25	109.43	293.18
Age	3.68	9.37	-6.03	11.21	-11.46	12.04	-9.46	17.47	-8.22	9.16
Height	12.66	3.35	2.76	4.34	0.97	4.71	17.80	7.24	6.48	3.41
Weight	20.46	3.91	37.75	6.25	41.90	6.89	13.49	6.18	.	.
FM	.	.	.	.	.	.	.	.	10.58	4.81
FFM	.	.	.	.	.	.	.	.	38.20	5.13
Very Active										
Intercept	-671.75	335.01	-245.00	358.31	-44.66	396.33	-122.14	590.60	-246.56	307.42
Age	3.68	9.37	-6.03	11.21	-11.46	12.04	-9.46	17.47	-8.22	9.16
Height	15.38	3.85	10.19	3.99	7.86	4.41	12.33	6.74	10.44	3.48
Weight	23.25	4.94	33.76	5.59	38.74	6.41	21.06	7.20	.	.
FM	.	.	.	.	.	.	.	.	14.55	5.25
FFM	.	.	.	.	.	.	.	.	37.38	4.77

6.2 Full Output

While the previous section reports coefficients separately for each PAL category for convenience, this section reports the same model but shows the full statistical output with coefficients for the interaction terms that defined the slopes above. The coefficients for interaction terms here are the difference in slopes for height and weight between each PAL category versus the reference category for Very Active (VA). This section is included in full-transparency to show the full output; however, the previous section is in a more interpretable form for lay understanding.

Model performed:

TEE = Intercept + Age (years) + Height (cm) + Weight (kg) + PALCAT + PALCAT x Weight (kg) + PALCAT x Height (cm)

<u>Parameter</u>	<u>All included</u>		<u>Sensitivity (5th to 95th)</u>		<u>Healthy (5th to 85th)</u>		<u>Overweight / Obese (85th+)</u>		<u>FM & FFM</u>	
<u>Parameter</u>	<u>Estimate</u>	<u>SE</u>	<u>Estimate</u>	<u>SE</u>	<u>Estimate</u>	<u>SE</u>	<u>Estimate</u>	<u>SE</u>	<u>Estimate</u>	<u>SE</u>
Intercept	-671.75	335.01	-245.00	358.31	-44.66	396.33	-122.14	590.60	-246.56	307.42
Age	3.68	9.37	-6.03	11.21	-11.46	12.04	-9.46	17.47	-8.22	9.16
Height	15.38	3.85	10.19	3.99	7.86	4.41	12.33	6.74	10.44	3.48
Weight	23.25	4.94	33.76	5.59	38.74	6.41	21.06	7.20	.	.
FM	.	.	.	.	.	.	.	.	14.55	5.25

Parameter	All included		Sensitivity (5th to 95th)		Healthy (5th to 85th)		Overweight / Obese (85th+)		FM & FFM	
Parameter	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
FFM	.	.	.	.	.	.	.	.	37.38	4.77
PALCAT A	283.56	404.01	679.79	520.17	635.56	573.15	-583.82	788.17	355.99	404.15
PALCAT LA	690.87	445.65	765.95	516.99	495.32	567.76	-418.89	788.25	477.06	412.74
PALCAT S	224.24	415.81	795.08	574.96	565.30	630.09	-901.18	881.65	169.03	412.07
Height*PALCAT A	-2.72	4.57	-7.43	5.95	-6.90	6.47	5.47	8.60	-3.97	4.51
Height*PALCAT LA	-6.76	5.25	-7.71	5.94	-4.44	6.45	3.38	8.68	-4.69	4.87
Height*PALCAT S	-2.37	4.60	-9.79	6.65	-7.00	7.28	8.61	9.22	-2.15	4.65
Weight*PALCAT A	-2.79	6.19	3.99	8.68	3.15	9.36	-7.57	9.53	.	.
Weight*PALCAT LA	-2.96	7.42	-1.80	8.42	-6.95	9.18	-7.33	10.03	.	.
Weight*PALCAT S	-10.10	5.94	1.77	9.40	-2.82	10.42	-15.40	8.92	.	.
FM*PALCAT A	.	.	.	.	.	.	.	.	-3.97	6.98
FM*PALCAT LA	.	.	.	.	.	.	.	.	0.48	7.59
FM*PALCAT S	.	.	.	.	.	.	.	.	-7.72	6.60
FFM*PALCAT A	.	.	.	.	.	.	.	.	0.82	7.06
FFM*PALCAT LA	.	.	.	.	.	.	.	.	-6.23	7.70
FFM*PALCAT S	.	.	.	.	.	.	.	.	-9.37	7.40

6.3 Comparison of slopes

Model performed: $TEE = \text{Intercept} + \text{Age (years)} + \text{Height (cm)} + \text{Weight (kg)} + \text{PALCAT} + \text{BMIgrp} + \text{PALCAT} \times \text{Weight} + \text{PALCAT} \times \text{Height} + \text{Age} \times \text{BMIgrp} + \text{PALCAT} \times \text{BMIgrp} + \text{Weight} \times \text{BMIgrp} + \text{Height} \times \text{BMIgrp} + \text{PALCAT} \times \text{Weight} \times \text{BMIgrp} + \text{PALCAT} \times \text{Height} \times \text{BMIgrp}$

PAL	Healthy		Overweight / Obese		Difference 'H vs O/O'		
	Estimate	SE	Estimate	SE	Estimate	SE	p-value
Height							
S	-0.62	10.70	13.36	19.12	-13.98	21.98	0.5257
LA	1.96	8.23	22.18	17.88	-20.23	19.92	0.3104
A	0.95	9.21	18.36	13.40	-17.41	16.46	0.2921
VA	15.43	7.69	19.27	21.05	-3.84	21.72	0.8597
Weight							
S	35.13	14.84	5.07	13.56	30.06	20.23	0.1395
LA	30.64	11.78	2.43	15.96	28.21	20.21	0.1641
A	40.38	12.65	9.59	12.86	30.80	18.93	0.1075
VA	24.73	11.13	4.90	23.87	19.83	25.17	0.4315

6.4 Model fit

Sample sizes, R^2 , $R^2_{adjusted}$, and Pearson correlation r of predicted vs observed by model.

All included	Sensitivity (5th to 95th)	Healthy (5th to 85th)	Overweight / Obese (85th+)	FM & FFM
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	All included	Sensitivity (5th to 95th)	Healthy (5th to 85th)	Overweight / Obese (85th+)	FM & FFM
n	250.00	182.00	149.00	100.00	53.00
R2	0.92	0.94	0.95	0.90	0.86
R2adj	0.92	0.94	0.94	0.88	0.81
r	0.97	0.97	0.98	0.95	0.95
MSE	66831.33	66921.72	67363.73	20761.57	185708.93
RMSE	258.52	258.69	259.55	144.09	430.94

6.5 Model fit by Subgroups

Percentile categories are based BMI percentile categories.

Sample sizes, and Pearson correlation r of predicted vs observed by PAL category, BMI category and Life Stage.

Parameter	All included		Sensitivity (5th to 95th)		Healthy (5th to 85th)		Overweight / Obese (85th+)		FM & FFM	
	n	r	n	r	n	r	n	r	n	r
	By PAL category									
S	43	0.94	33	0.96	30	0.97	13	0.91	7	0.96
LA	83	0.97	55	0.97	42	0.98	41	0.96	6	0.97
A	70	0.94	49	0.95	38	0.97	31	0.95	13	0.94
VA	54	0.97	45	0.97	39	0.97	15	0.96	27	0.94
By Percentile category										
<5th	1	.	.	.	.	.	.	.	1	.
5th to 85th	149	0.97	149	0.98	149	0.98	.	.	36	0.93
85th to 95th	33	0.94	33	0.93	.	.	33	0.94	8	0.84
>95th	67	0.95	.	.	.	.	67	0.95	8	0.92
By Life Stage										
1-3 years	1	.	1	.	1	.	.	.	.	.
4-8 years	151	0.89	109	0.89	88	0.87	63	0.84	5	0.67
9-13 years	57	0.86	31	0.85	19	0.95	37	0.77	18	0.88
14-18 years	41	0.81	41	0.84	41	0.84	.	.	30	0.72

7 Infant Girls, 0-2 years old

7.1 Coefficients

- Models used sample size of $n=433$ on average in each of 20 imputed data sets (min=433, max=433).

Note: PAL is not used for Infants

TEE = Intercept + C x Weight (kg)

TEE = Intercept + A x Age (years) + B x Height (cm) + C x Weight (kg)

TEE = Intercept + A x Age (years) + B x Height (cm) + C x FM (kg) + D x FFM (kg)

Parameter	Weight only	Age Weight Height	Age FM FFM Height
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Parameter	Weight only	SE	Age Weight Height	SE	Age FM FFM Height	SE
Parameter	Estimate	SE	Estimate	SE	Estimate	SE
All included						
Intercept	-49.05	15.26	-69.15	102.51	-126.58	113.94
Age	.	.	80.00	23.65	84.82	26.67
Weight	82.15	1.86	54.15	7.31	.	.
FM	.	.	.	.	46.77	8.04
FFM	.	.	.	.	46.13	7.85
Height	.	.	2.65	2.28	4.32	2.53

7.2 Model fit

Sample sizes, R^2 , $R^2_{adjusted}$, and Pearson correlation r of predicted vs observed by model.

	Weight only	Age Weight Height	Age FM FFM Height
n	432.00	432.00	238.00
R2	0.82	0.83	0.84
R2adj	0.82	0.83	0.84
r	0.90	0.91	0.92
MSE	9727.96	9059.24	6844.86
RMSE	98.63	95.18	82.73

7.3 Model fit by Subgroups

Percentile categories are based on Weight-for-length percentile categories for 0-1.99 year olds and BMI percentile categories for 2-2.99 year olds.

Sample sizes, and Pearson correlation r of predicted vs observed by PAL category, BMI category and Life Stage.

Parameter	Weight only		Age Weight Height		Age FM FFM Height	
	n	r	n	r	n	r
By Percentile category						
<5th	12	0.94	12	0.95	10	0.98
5th to 85th	367	0.91	367	0.91	198	0.93
85th to 95th	39	0.85	39	0.85	20	0.81
>95th	14	0.87	14	0.90	10	0.92
By Life Stage						
0-6 months	250	0.80	250	0.81	180	0.81
7-11 months	69	0.48	69	0.49	25	0.33
1-3 years	113	0.57	113	0.58	33	0.55

8 Infant Boys, 0-2 years old

8.1 Coefficients by PAL

- Models used sample size of $n=317$ on average in each of 20 imputed data sets (min=317, max=317).

Note: PAL is not used for Infants

TEE = Intercept + C x Weight (kg)

TEE = Intercept + A x Age (years) + B x Height (cm) + C x Weight (kg)

TEE = Intercept + A x Age (years) + B x Height (cm) + C x FM (kg) + D x FFM (kg)

Parameter	Weight only		Age Weight Height		Age FM FFM Height	
Parameter	Estimate	SE	Estimate	SE	Estimate	SE
All included						
Intercept	-22.58	20.81	-716.45	110.36	-715.21	109.98
Age	.	.	-1.00	28.40	-1.25	28.99
Weight	80.49	2.45	15.06	6.86	.	.
FM	.	.	.	.	15.19	6.85
FFM	.	.	.	.	15.56	7.39
Height	.	.	17.82	2.32	17.75	2.32

8.2 Model fit

Sample sizes, R^2 , $R^2_{adjusted}$, and Pearson correlation r of predicted vs observed by model.

	Weight only	Age Weight Height	Age FM FFM Height
n	317.00	317.00	206.00
R2	0.77	0.83	0.83
R2adj	0.77	0.83	0.83
r	0.88	0.91	0.91
MSE	14190.67	10732.61	10782.52
RMSE	119.12	103.60	103.84

8.3 Model fit by Subgroups

Percentile categories are based on Weight-for-length percentile categories for 0-1.99 year olds and BMI percentile categories for 2-2.99 year olds.

Sample sizes, and Pearson correlation r of predicted vs observed by PAL category, BMI category and Life Stage.

Parameter	Weight only		Age Weight Height		Age FM FFM Height	
	n	r	n	r	n	r
By Percentile category						
<5th	14	0.99	14	0.99	11	0.99
5th to 85th	257	0.91	257	0.91	161	0.91
85th to 95th	32	0.91	32	0.91	27	0.91
>95th	14	0.59	14	0.80	7	0.90
By Life Stage						
0-6 months	192	0.82	192	0.83	152	0.84
7-11 months	43	0.38	43	0.39	17	0.29
1-3 years	82	0.43	82	0.59	37	0.59

9 Pregnant women

9.1 Coefficients by PAL

- Models for 'all included' used sample size of n=561 on average in each of 20 imputed data sets (min=561, max=561).

- Models for Sensitivity (BMI [18.5 to 40]) used sample size of n=508 on average in each of 20 imputed data sets (min=507, max=508).
- Models for Healthy (BMI [18.5 to 25]) used sample size of n=249 on average in each of 20 imputed data sets (min=248, max=251).
- Models for all Overweight / Obese (BMI [25+]) used sample size of n=301 on average in each of 20 imputed data sets (min=299, max=302).

The linear model performed was:

$$\text{TEE} = \text{Intercept} + \text{Age (years)} + \text{Height (cm)} + \text{Weight (kg)} + \text{Weeks pregnant} + \text{PALCAT} + \text{PALCAT} \times \text{Weight (kg)} + \text{PALCAT} \times \text{Height (cm)}$$

This uses a constant slope for age across PAL categories (PALCAT), but different slopes for height and weight in each PAL category.

The full set of parameter estimates including interaction terms are shown in the next section. Here we show the slopes of height and weight separately for each PALCAT which were calculated based on the interaction terms (shown in 9.2).

TEE can be predicted for a person in a given PAL group using the equation:

$$\text{TEE} = \text{Intercept} + \text{A} \times \text{Age (years)} + \text{B} \times \text{Height (cm)} + \text{C} \times \text{Weight (kg)} + \text{Weeks pregnant}$$

Parameter	All included		Sensitivity (18.5 to 40)		Healthy (18.5 to 25)		Overweight / Obese (25+)	
	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Sedentary								
Intercept	1131.20	632.67	1254.46	674.25	759.26	1282.83	1010.01	744.04
Age	-2.04	3.19	-0.17	3.31	-2.99	4.88	-1.39	4.27
Height	0.34	3.88	-1.30	4.21	0.71	9.51	2.66	4.64
Weight	12.15	1.25	13.56	1.65	18.00	9.31	8.79	1.91
Weeks Preg	9.16	1.09	8.68	1.12	4.85	1.60	11.26	1.71
Low Active								
Intercept	693.35	667.73	790.94	678.18	477.81	1014.02	902.24	1006.27
Age	-2.04	3.19	-0.17	3.31	-2.99	4.88	-1.39	4.27
Height	5.73	4.15	3.76	4.32	4.51	8.09	5.51	6.52
Weight	10.20	1.41	12.81	1.99	17.96	8.19	7.74	2.30
Weeks Preg	9.16	1.09	8.68	1.12	4.85	1.60	11.26	1.71
Active								
Intercept	-223.84	804.00	-140.36	839.52	127.30	1134.61	-877.27	1348.65
Age	-2.04	3.19	-0.17	3.31	-2.99	4.88	-1.39	4.27
Height	13.23	5.04	11.98	5.32	12.33	8.97	19.88	8.75
Weight	8.15	1.98	9.22	2.65	5.38	9.33	3.11	3.40
Weeks Preg	9.16	1.09	8.68	1.12	4.85	1.60	11.26	1.71
Very Active								
Intercept	-779.72	779.10	-1107.90	792.08	-1637.38	1029.23	1395.25	1347.73
Age	-2.04	3.19	-0.17	3.31	-2.99	4.88	-1.39	4.27
Height	18.45	4.98	20.92	5.16	19.44	7.76	6.30	8.79
Weight	8.73	2.60	6.86	3.19	21.86	8.00	6.21	3.91
Weeks Pre	9.16	1.09	8.68	1.12	4.85	1.60	11.26	1.71

9.2 Full Output

While the previous section reports coefficients separately for each PAL category for convenience, this section reports the same model but shows the full statistical output with coefficients for the interaction terms that defined the slopes above. The coefficients for interaction terms here are the difference in slopes for height and weight between each PAL category versus the reference category for Very Active (VA). This section is included in full-transparency to show the full output; however, the previous section is in a more interpretable form for lay understanding.

Model performed:

$$\text{TEE} = \text{Intercept} + \text{Age (years)} + \text{Height (cm)} + \text{Weight (kg)} + \text{Weeks pregnant} + \text{PALCAT} + \text{PALCAT} \times \text{Weight (kg)} + \text{PALCAT} \times \text{Height (cm)}$$

Parameter	All included		Sensitivity (18.5 to 40)		Healthy (18.5 to 25)		Overweight / Obese (25+)	
	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Age	-2.04	3.19	-0.17	3.31	-2.99	4.88	-1.39	4.27
Height	18.45	4.98	20.92	5.16	19.44	7.76	6.30	8.79
Height*PALCAT A	-5.22	7.03	-8.94	7.35	-7.11	11.53	13.59	12.56
Height*PALCAT LA	-12.72	6.33	-17.16	6.76	-14.92	10.93	-0.79	10.85
Height*PALCAT S	-18.12	6.42	-22.22	6.58	-18.72	12.04	-3.63	10.12
Intercept	-779.72	779.10	-1107.90	792.08	-1637.38	1029.23	1395.25	1347.73
PALCAT A	555.88	1110.02	967.53	1151.12	1764.69	1473.17	-2272.53	1935.10
PALCAT LA	1473.06	1000.59	1898.84	1037.30	2115.20	1396.30	-493.01	1676.76
PALCAT S	1910.92	1009.40	2362.36	1023.69	2396.64	1609.58	-385.24	1546.29
Weeks	9.16	1.09	8.68	1.12	4.85	1.60	11.26	1.71
Weight	8.73	2.60	6.86	3.19	21.86	8.00	6.21	3.91
Weight*PALCAT A	-0.58	3.03	2.36	4.05	-16.48	11.83	-3.10	4.82
Weight*PALCAT LA	1.47	3.00	5.95	3.58	-3.90	11.01	1.52	4.70
Weight*PALCAT S	3.43	2.61	6.70	3.35	-3.86	11.78	2.58	4.14

9.3 Comparison of slopes

Model performed: $\text{TEE} = \text{Intercept} + \text{Age (years)} + \text{Height (cm)} + \text{Weight (kg)} + \text{PALCAT} + \text{Weeks} + \text{BMIgrp} + \text{PALCAT} \times \text{Weight} + \text{PALCAT} \times \text{Height} + \text{Age} \times \text{BMIgrp} + \text{PALCAT} \times \text{BMIgrp} + \text{Weeks} \times \text{BMIgrp} + \text{Weight} \times \text{BMIgrp} + \text{Height} \times \text{BMIgrp} + \text{PALCAT} \times \text{Weight} \times \text{BMIgrp} + \text{PALCAT} \times \text{Height} \times \text{BMIgrp}$

PAL	Healthy		Overweight / Obese		Difference 'H vs O/O'		
	Estimate	SE	Estimate	SE	Estimate	SE	p-value
Height							
S	0.71	9.74	2.66	4.56	-1.95	10.82	0.8570
LA	4.51	8.28	5.51	6.43	-1.00	10.37	0.9233
A	12.33	9.18	19.88	8.63	-7.56	12.66	0.5507
VA	19.44	7.94	6.30	8.69	13.14	11.61	0.2584
Weight							
S	18.00	9.54	8.79	1.88	9.21	9.71	0.3428
LA	17.96	8.39	7.74	2.27	10.23	8.68	0.2386
A	5.38	9.55	3.11	3.35	2.27	10.07	0.8216
VA	21.86	8.19	6.21	3.88	15.65	8.98	0.0817

9.4 Model fit

Sample sizes, R^2 , $R^2_{adjusted}$, and Pearson correlation r of predicted vs observed by model.

	<u>All included</u>	<u>Sensitivity (18.5 to 40)</u>	<u>Healthy (18.5 to 25)</u>	<u>Overweight / Obese (25+)</u>
n	413.00	402.00	234.00	168.00
R2	0.63	0.64	0.65	0.57
R2adj	0.62	0.63	0.63	0.54
r	0.80	0.81	0.81	0.77
MSE	79769.92	78541.46	70714.79	76749.46
RMSE	282.44	280.25	265.92	277.04

9.5 Model fit by Subgroups

Sample sizes, and Pearson correlation r of predicted vs observed by PAL category, BMI category and Life Stage.

<u>Parameter</u>	<u>All included</u>		<u>Sensitivity (18.5 to 40)</u>		<u>Healthy (18.5 to 25)</u>		<u>Overweight / Obese (25+)</u>	
	<u>n</u>	<u>r</u>	<u>n</u>	<u>r</u>	<u>n</u>	<u>r</u>	<u>n</u>	<u>r</u>
By PAL category								
S	116	0.70	115	0.71	53	0.52	62	0.50
LA	99	0.81	97	0.84	58	0.70	39	0.74
A	82	0.67	78	0.68	53	0.49	25	0.73
VA	116	0.66	112	0.63	70	0.64	42	0.49
By BMI category								
< 18.5 kg/m2	11	0.64	.	.	.	.	.	.
>= 18.5 & <25 kg/m2	234	0.79	234	0.80	234	0.81	.	.
>= 25 & <30 kg/m2	120	0.80	120	0.80	.	.	120	0.80
>= 30 & <35 kg/m2	37	0.75	37	0.77	.	.	37	0.74
>= 35 & <40 kg/m2	11	0.79	11	0.80	.	.	11	0.80
By Life Stage								
19-30 years	236	0.83	229	0.83	152	0.83	77	0.77
31-50 years	177	0.76	173	0.76	82	0.76	91	0.78

10 Prediction Error

10.1 Average level

Predicted values reported with SE of the predicted values for each strata at average levels of age, height, weight, and "Active" PALCAT.

These can be interpreted such that a new observation is expected to fall within \pm these values, where the 95% prediction interval is $1.96 * SE$ at these values of covariates.

<u>Strata</u>	<u>Age</u>	<u>Height</u>	<u>Weight</u>	<u>Weeks_preg</u>	<u>Predicted TEE</u>	<u>SE of the predicted value</u>
Adult Women 19+	53.87	162.34	71.87	.	2280.94	240.93
Adult Men 19+	50.25	175.92	83.10	.	2930.26	342.37

Strata	Age	Height	Weight	Weeks_preg	Predicted TEE	SE of the predicted value
Child Girls 3-18	9.58	135.02	37.63	.	1872.65	221.06
Child Boys 3-18	8.65	134.03	37.06	.	2098.77	257.61
Child Girls 0-2	0.72	68.31	7.81	.	592.58	95.87
Child Boys 0-2	0.69	68.46	8.03	.	623.81	104.42
Pregnant	29.40	164.13	74.89	19.86	2679.76	302.35

10.2 2 SD above the mean

Here predicted values and SE are reported for participants at 2 SD above average levels of age, height, and weight.

Strata	Age	Height_2sd	Weight_2sd	Weeks_preg	Predicted TEE	SE of the predicted value
Adult Women 19+	53.87	169.43	87.99	.	2526.23	241.28
Adult Men 19+	50.25	183.46	99.55	.	3241.22	343.32
Child Girls 3-18	9.58	157.71	57.12	.	2496.52	223.35
Child Boys 3-18	8.65	161.26	58.34	.	2878.92	262.99
Child Girls 0-2	0.72	78.81	10.36	.	758.52	96.96
Child Boys 0-2	0.69	79.06	10.76	.	853.83	105.88
Pregnant	29.40	170.72	95.07	19.86	2931.34	306.19

References:

- <https://online.stat.psu.edu/stat462/node/151/> (<https://online.stat.psu.edu/stat462/node/151/>)
- <https://online.stat.psu.edu/stat501/lesson/3/3.3> (<https://online.stat.psu.edu/stat501/lesson/3/3.3>)
- https://documentation.sas.com/doc/en/pgmsascdc/9.4_3.4/statug/statug_glm_syntax17.htm (https://documentation.sas.com/doc/en/pgmsascdc/9.4_3.4/statug/statug_glm_syntax17.htm)

11 Summary of final models

Women, 19 years and above

- Sedentary: 584.90 -7.01 Age (y) + 5.72 Height (cm) + 11.71 Weight (kg)
- Low Active: 575.77 -7.01 Age (y) + 6.60 Height (cm) + 12.14 Weight (kg)
- Active: 710.25 -7.01 Age (y) + 6.54 Height (cm) + 12.34 Weight (kg)
- Very Active: 511.83 -7.01 Age (y) + 9.07 Height (cm) + 12.56 Weight (kg)

Men, 19 years and above

- Sedentary: 753.07 -10.83 Age (y) + 6.50 Height (cm) + 14.10 Weight (kg)
- Low Active: 581.47 -10.83 Age (y) + 8.30 Height (cm) + 14.94 Weight (kg)
- Active: 1004.82 -10.83 Age (y) + 6.52 Height (cm) + 15.91 Weight (kg)
- Very Active: -517.88 -10.83 Age (y) + 15.61 Height (cm) + 19.11 Weight (kg)

Girls, 3-18 years old

- Sedentary: 55.59 -22.25 Age (y) + 8.43 Height (cm) + 17.07 Weight (kg)
- Low Active: -297.54 -22.25 Age (y) + 12.77 Height (cm) + 14.73 Weight (kg)
- Active: -189.55 -22.25 Age (y) + 11.74 Height (cm) + 18.34 Weight (kg)
- Very Active: -709.59 -22.25 Age (y) + 18.22 Height (cm) + 14.25 Weight (kg)

Boys, 3-18 years old

- Sedentary: -447.51 + 3.68 Age (y) + 13.01 Height (cm) + 13.15 Weight (kg)
- Low Active: 19.12 + 3.68 Age (y) + 8.62 Height (cm) + 20.28 Weight (kg)
- Active: -388.19 + 3.68 Age (y) + 12.66 Height (cm) + 20.46 Weight (kg)

- Very Active: $-671.75 + 3.68 \text{ Age (y)} + 15.38 \text{ Height (cm)} + 23.25 \text{ Weight (kg)}$

Girls, 0-2 years old

- $-69.15 + 80.00 \text{ Age (y)} + 2.65 \text{ Height (cm)} + 54.15 \text{ Weight (kg)}$

Boys, 0-2 years old

- $-716.45 - 1.00 \text{ Age (y)} + 17.82 \text{ Height (cm)} + 15.06 \text{ Weight (kg)}$

Pregnant women

- Sedentary: $1131.20 - 2.04 \text{ Age (y)} + 0.34 \text{ Height (cm)} + 12.15 \text{ Weight (kg)} + 9.16 \text{ Weeks pregnant}$
- Low Active: $693.35 - 2.04 \text{ Age (y)} + 5.73 \text{ Height (cm)} + 10.20 \text{ Weight (kg)} + 9.16 \text{ Weeks pregnant}$
- Active: $-223.84 - 2.04 \text{ Age (y)} + 13.23 \text{ Height (cm)} + 8.15 \text{ Weight (kg)} + 9.16 \text{ Weeks pregnant}$
- Very Active: $-779.72 - 2.04 \text{ Age (y)} + 18.45 \text{ Height (cm)} + 8.73 \text{ Weight (kg)} + 9.16 \text{ Weeks pregnant}$