

Supplemental Appendix R

Performance Report

1 Model fits

2 Comparison of Models

3 Predicted Plots of Random People

4 External Validation

Performance Report

Code ▾

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1 Model fits

This section summarizes the model fits, broken down by Strata (Women 19+, Men 19+, Girl 3-18, Boy 3-18). There are five models (all-included, sensitivity, healthy, obese, fat mass/ fat free mass). The summary statistics included are Sample sizes, R², R² adjusted, Shrunken R², Pearson correlation r for predicted TEE vs observed TEE, and the MSE, RMSE, MAE (Mean Absolute Error) and MAPE (Mean Absolute Percentage Error).

Let y_1, \dots, y_n be the observed values and $\hat{y}_1, \dots, \hat{y}_n$ be the predicted values; let the mean of the observed values be $\bar{y} = 1/n \sum y_i$, the mean of the predicted values be $\hat{\bar{y}} = 1/n \sum \hat{y}_i$, the residual sum of squares be $SS_{res} = \sum (y_i - \hat{y}_i)^2$ and the total sum of squares be $SS_{tot} = \sum (y_i - \bar{y})^2$. Finally, let k be the number of predictors in the model. Then,

$$R^2 = 1 - \frac{SS_{res}}{SS_{tot}},$$

$$R_{adj}^2 = 1 - \frac{n-1}{n-k-1} (1 - R^2),$$

$$R_{shr}^2 = \frac{(n-k-3)(R_{adj}^2)^2 + R_{adj}^2}{(n-2k-2)R_{adj}^2 + 12},$$

$$r = \frac{\sum (y_i - \bar{y})(\hat{y}_i - \hat{\bar{y}})}{\sqrt{\sum (y_i - \bar{y})^2 \sum (\hat{y}_i - \hat{\bar{y}})^2}}$$

$$MSE = \frac{1}{n} \sum_{i=1..n} (y_i - \hat{y}_i)^2,$$

$$RMSE = \sqrt{MSE},$$

$$MAE = \frac{1}{n} \sum_{i=1..n} |y_i - \hat{y}_i|,$$

$$MAPE = 100\% \cdot \frac{1}{n} \sum_{i=1..n} \frac{|y_i - \hat{y}_i|}{|y_i|}.$$

Please note that both the RMSE and MAE are in the same units as TEE (kcal/day). Sample sizes (n) for model fits only include participants with complete data, including PAL.

1.1 Women, 19+ years old

	All included	Sensitivity (18.5 to 40 BMI)	Healthy (18.5 to 25 BMI)	Overweight / Obese (25+ BMI)	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
R2shr	0.70	0.69	0.68	0.69	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
MAPE (%)	8.67	8.69	8.62	8.79	8.03
MAE	190.89	189.80	183.64	198.06	174.25

1.2 Men, 19+ years old

	All included	Sensitivity (18.5 to 40 BMI)	Healthy (18.5 to 25 BMI)	Overweight / Obese (25+ BMI)	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
R2shr	0.73	0.72	0.70	0.72	0.74
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
MAPE (%)	9.35	9.32	9.41	9.16	8.95
MAE	265.54	264.69	256.47	268.98	246.80

1.3 Child Girls, 3-18 years old

	All included	Sensitivity (5th to 95th BMI Percentile)	Healthy (5th to 85th BMI Percentile)	Overweight / Obese (>=85th BMI Percentile)	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
R2shr	0.83	0.82	0.82	0.85	0.63
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
MAPE (%)	8.19	8.44	8.31	7.51	10.56
MAE	165.44	170.40	163.83	160.64	262.81

1.4 Child Boys, 3-18 years old

	All Included	Sensitivity (5th to 95th BMI Percentile)	Healthy (5th to 85th BMI Percentile)	Overweight / Obese (>=85th BMI Percentile)	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
R2shr	0.92	0.93	0.94	0.87	0.77
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
MAPE (%)	7.11	6.75	6.57	5.51	9.23
MAE	163.25	161.34	160.56	110.01	318.25

1.5 Child Girls, 0-2 years old

	Age Weight Height	Age FM FFM Height	Weight Only
n	432.00	238.00	432.00
R2	0.83	0.84	0.82
R2adj	0.83	0.84	0.82
R2shr	0.83	0.83	0.82
r	0.91	0.92	0.90
MSE	9059.24	6844.86	9727.96
RMSE	95.18	82.73	98.63
MAPE (%)	12.80	12.73	13.48
MAE	73.51	61.47	77.56

1.6 Child Boys, 0-2 years old

	Age Weight Height	Age FM FFM Height	Weight Only
n	317.00	206.00	317.00
R2	0.83	0.83	0.77
R2adj	0.83	0.83	0.77
R2shr	0.83	0.82	0.77
r	0.91	0.91	0.88
MSE	10732.61	10782.52	14190.67
RMSE	103.60	103.84	119.12
MAPE (%)	13.56	14.19	14.35
MAE	79.47	76.51	83.79

1.7 Pregnancy

	All included	Sensitivity (18.5 to 40 BMI)	Healthy (18.5 to 25 BMI)	Overweight / Obese (25+ BMI)
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
R2shr	0.61	0.62	0.62	0.51
r	0.80	0.81	0.81	0.77
MSE	79769.92	78541.46	70714.79	76749.46

	All included	Sensitivity (18.5 to 40 BMI)	Healthy (18.5 to 25 BMI)	Overweight / Obese (25+ BMI)
RMSE	282.44	280.25	265.92	277.04
MAPE (%)	8.80	8.66	8.49	7.98
MAE	222.10	219.43	203.87	217.56

1.8 Summary Table

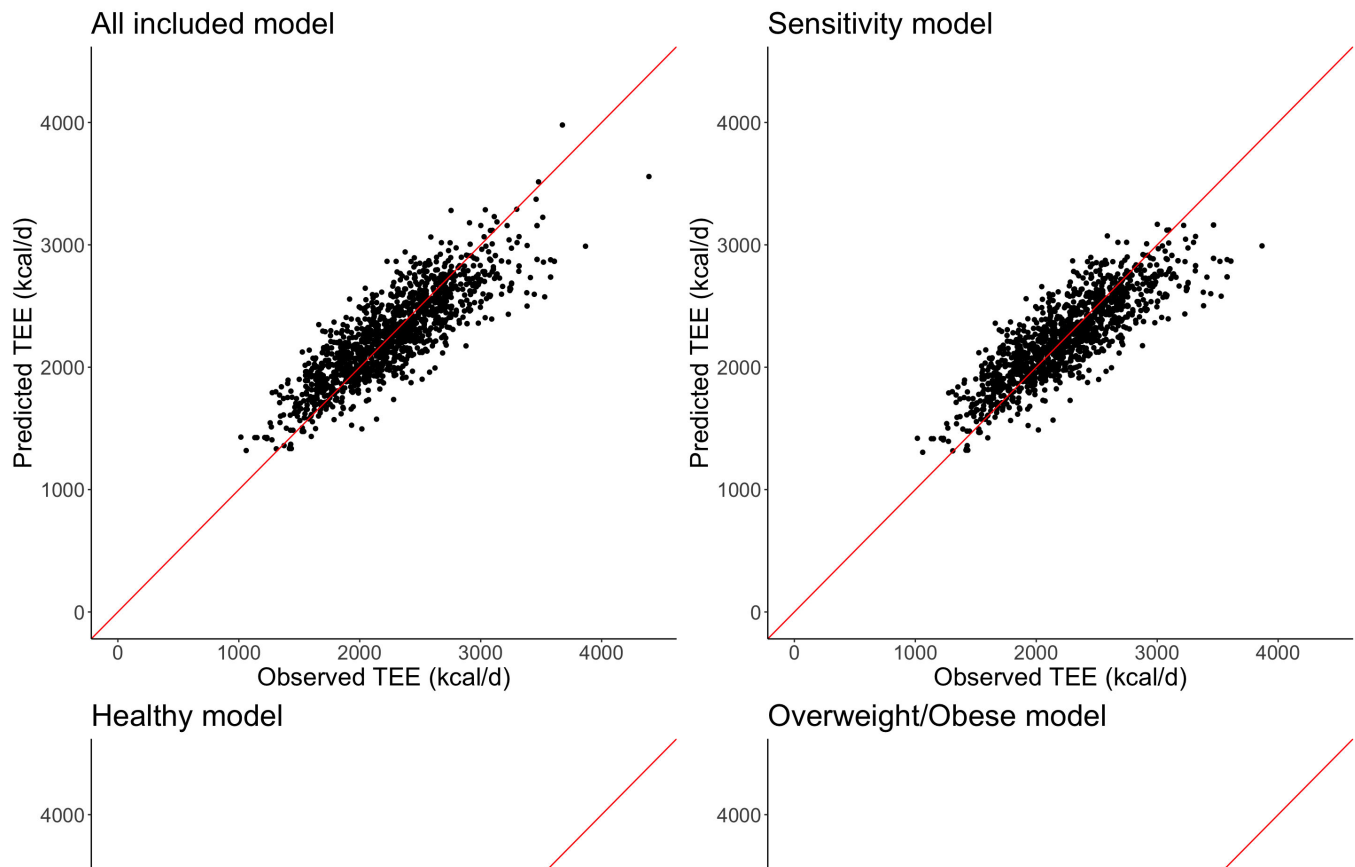
This table is a summary of model fit for models with all participants included, for each strata.

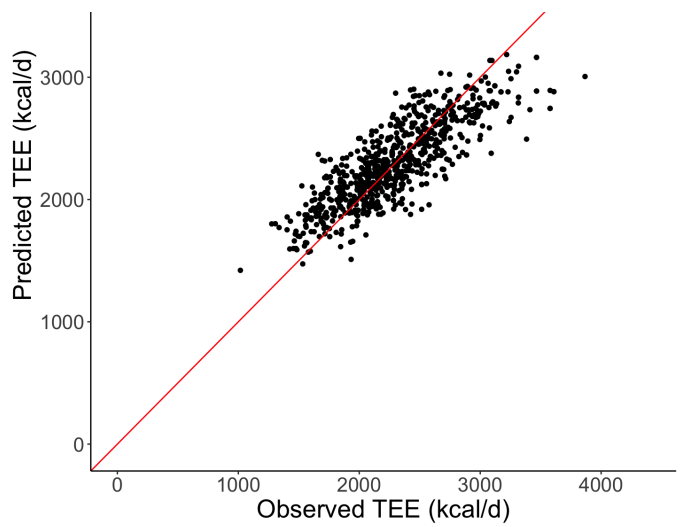
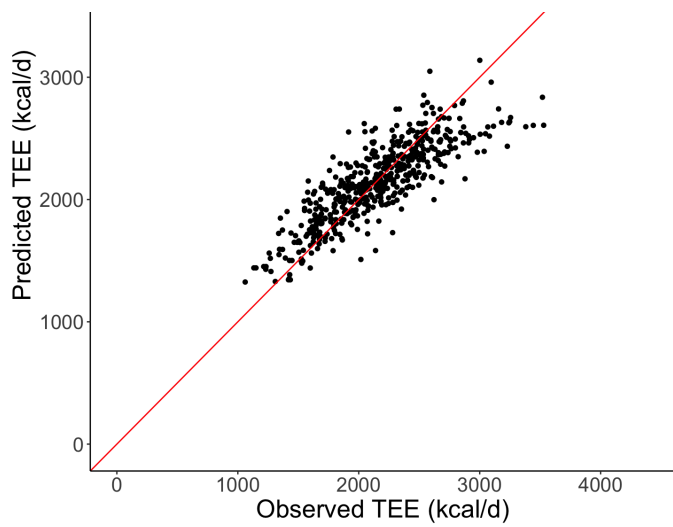
Strata	n	R2	R2adj	R2shr	r	MSE	RMSE	MAPE (%)	MAE
Adult Women 19+	1342	0.71	0.70	0.70	0.84	60393.43	245.75	8.67	190.89
Adult Men 19+	1016	0.73	0.73	0.73	0.86	114615.05	338.55	9.35	265.54
Child Girls 3-18	477	0.84	0.84	0.83	0.92	56049.24	236.75	8.19	165.44
Child Boys 3-18	250	0.92	0.92	0.92	0.97	66831.33	258.52	7.11	163.25
Child Girls 0-2	432	0.83	0.83	0.83	0.91	9059.24	95.18	12.80	73.51
Child Boys 0-2	317	0.83	0.83	0.83	0.91	10732.61	103.60	13.56	79.47
Pregnancy	413	0.63	0.62	0.61	0.80	79769.92	282.44	8.80	222.10

1.9 Plots of model fit

The following is a visualization of the model fits.

1.9.1 Women, 19+ years old





FM & FFM model

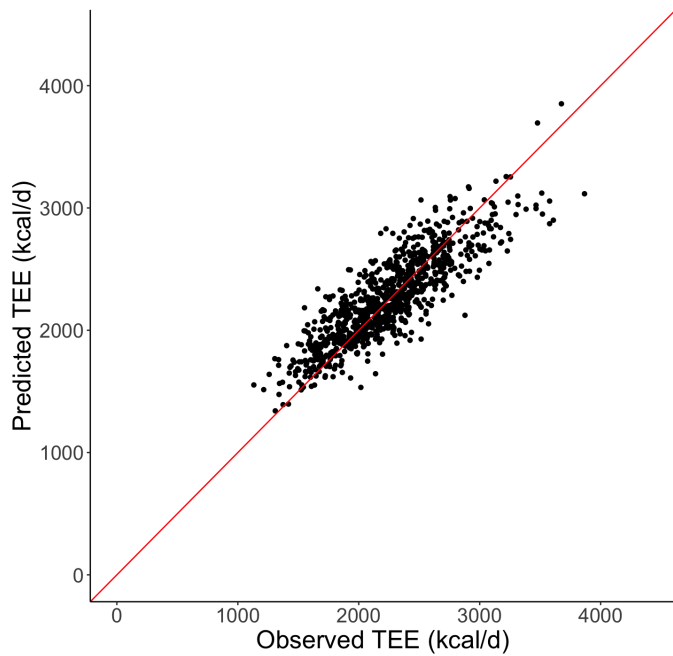
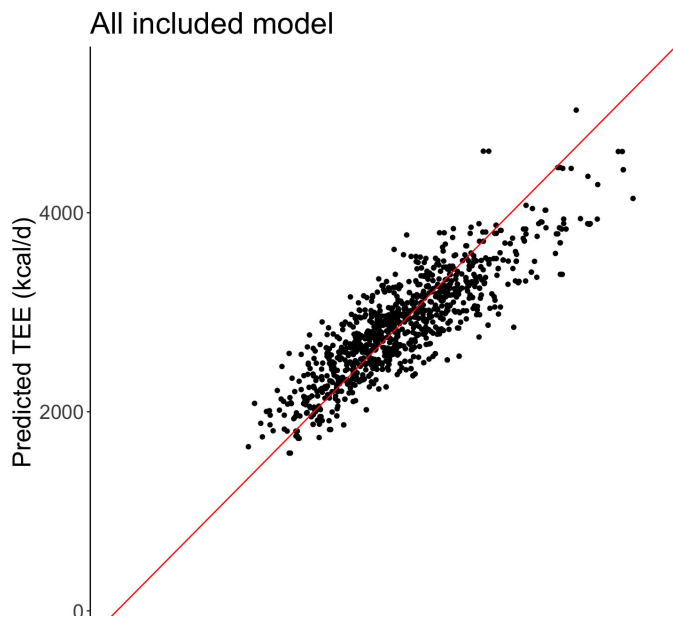
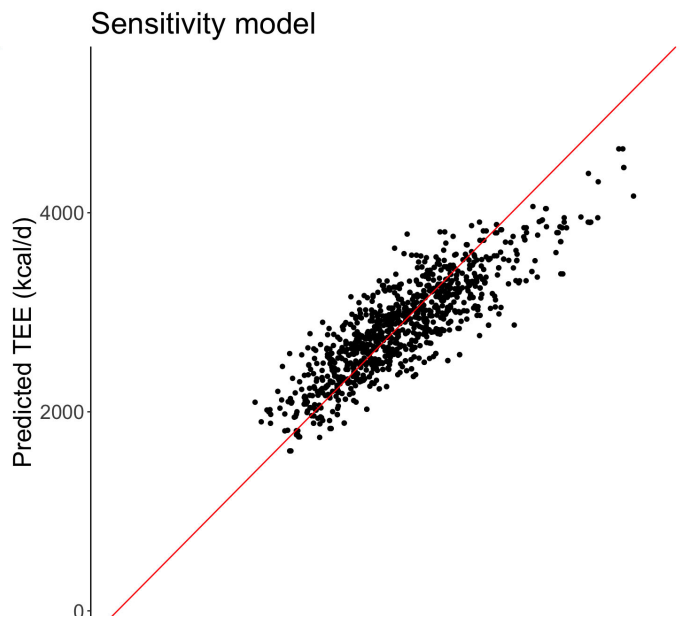


Figure 1.1: Model Fit, Women

1.9.2 Men, 19+ years old



All included model



Sensitivity model

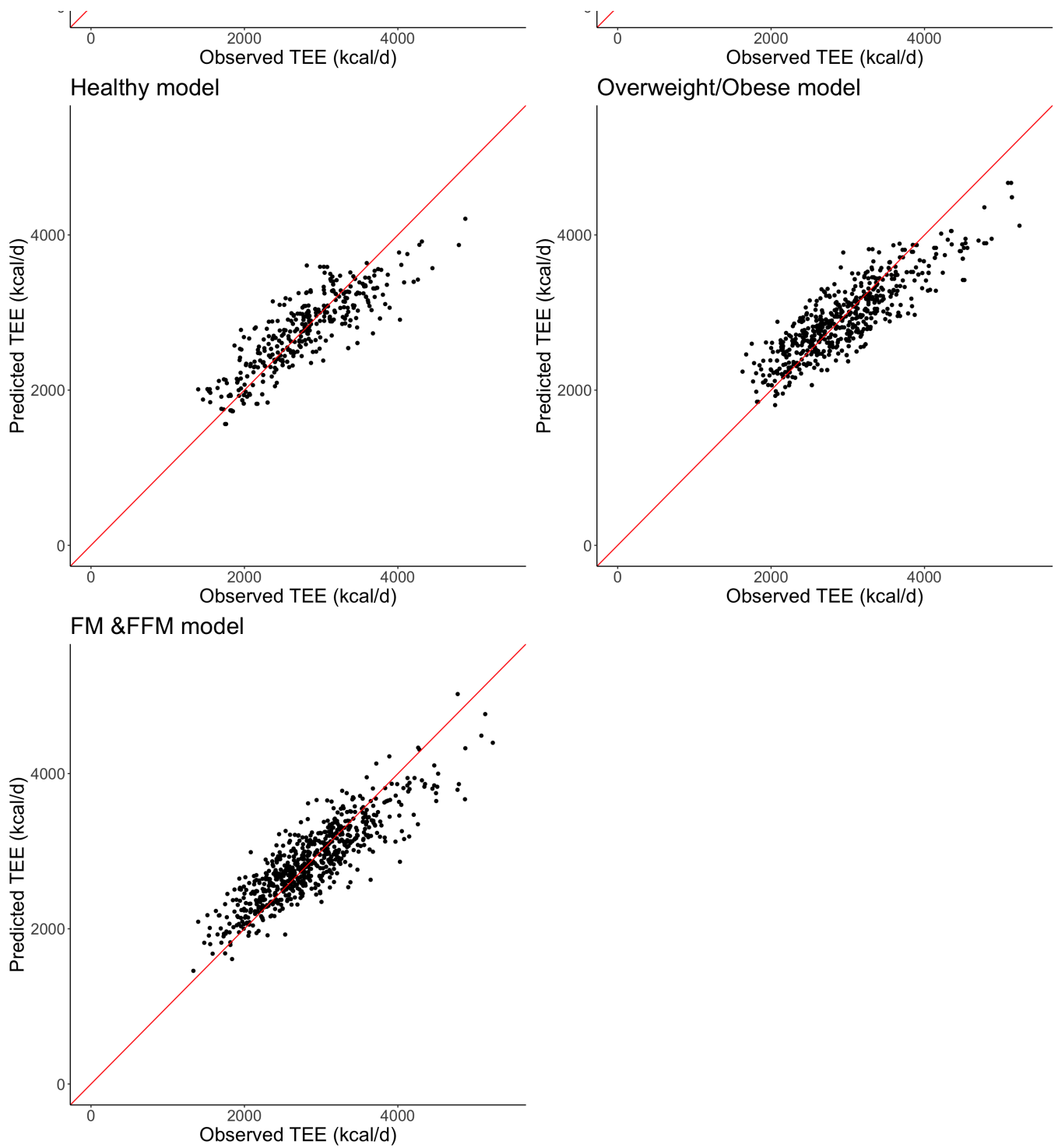
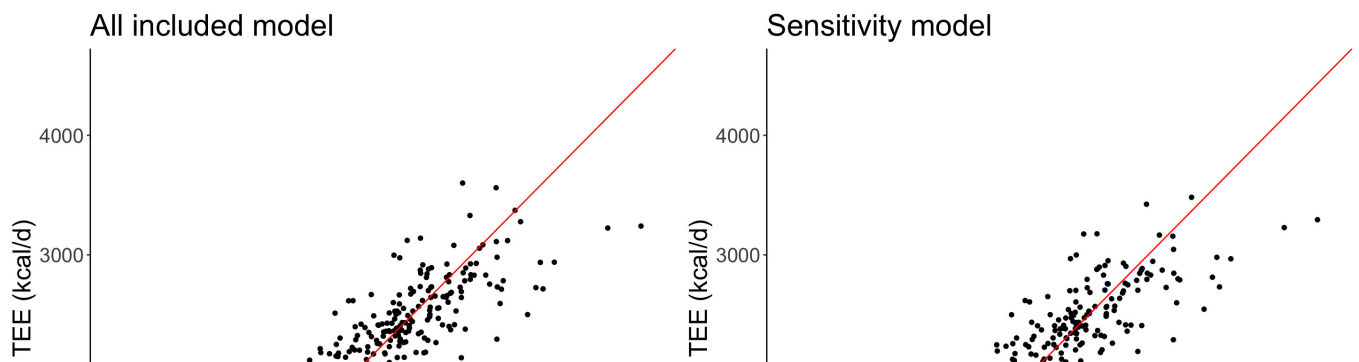
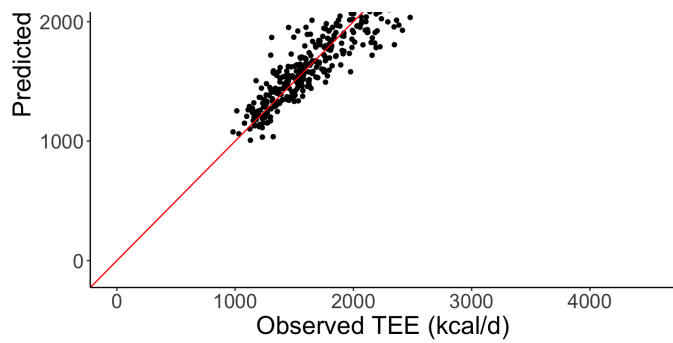


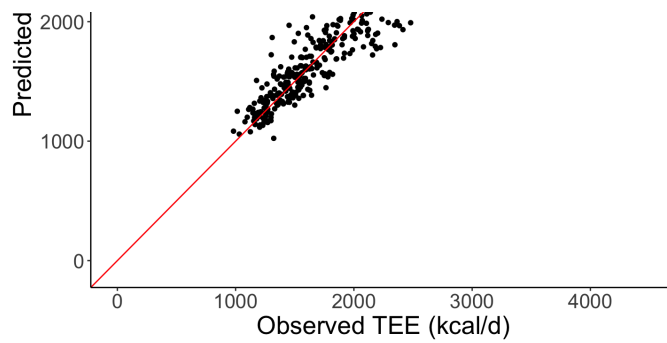
Figure 1.2: Model Fit, Men

1.9.3 Girls, 3-18 years old

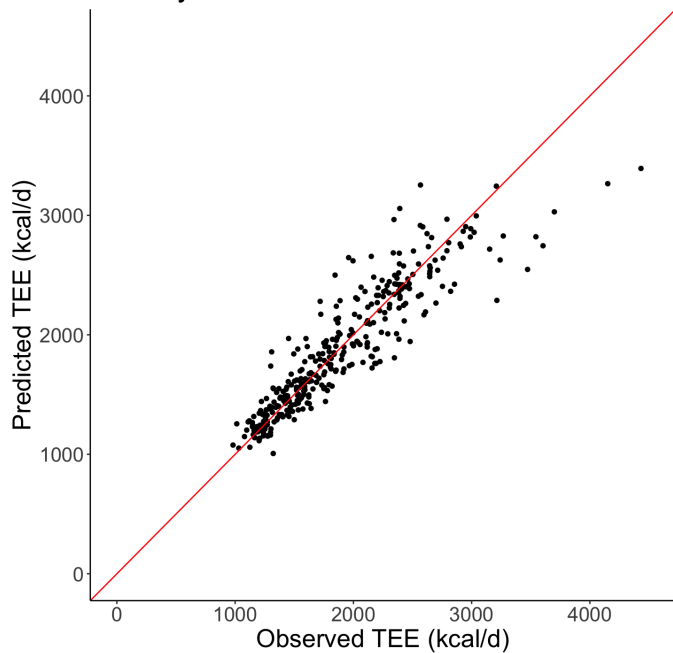




Healthy model



Overweight/Obese model



FM & FFM model

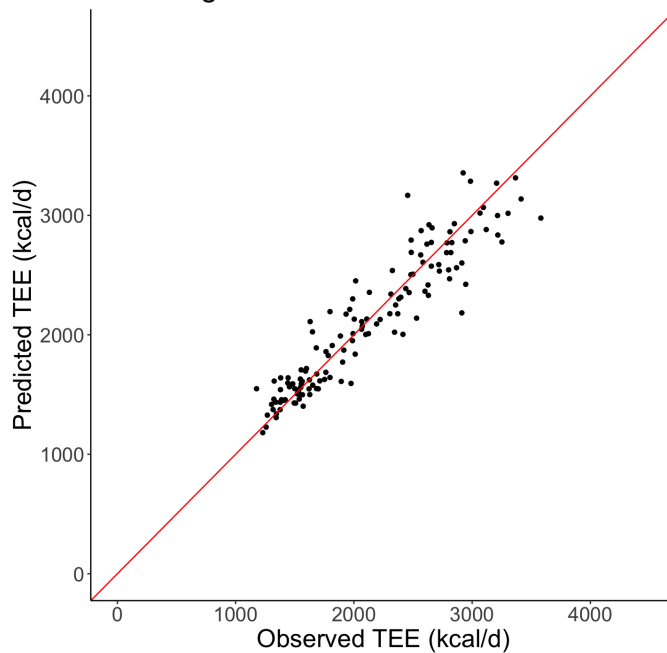


Figure 1.3: Model Fit, Girl 3-18

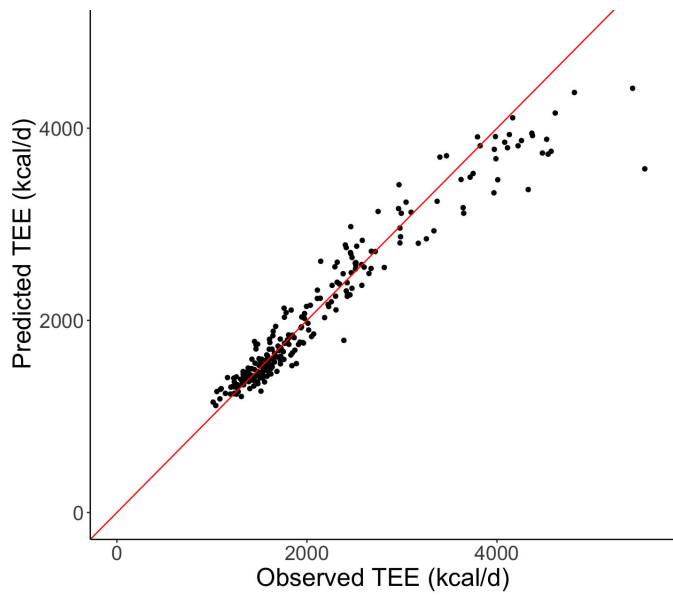
1.9.4 Boys, 3-18 years old

All included model

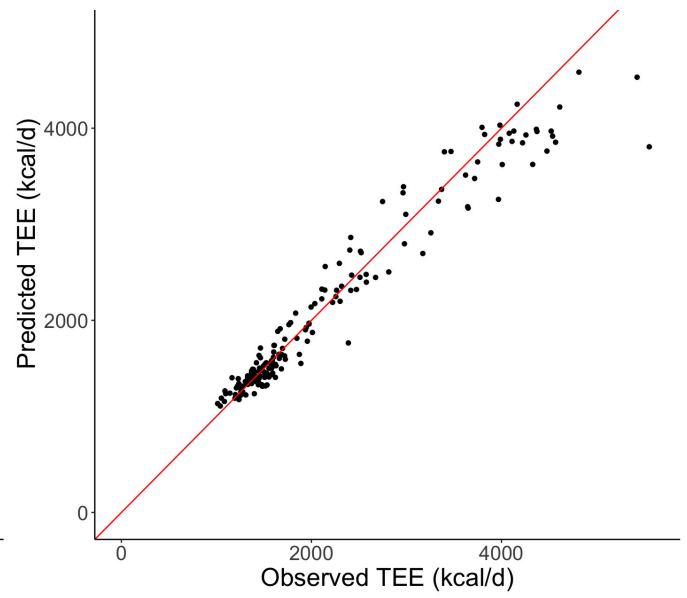


Sensitivity model

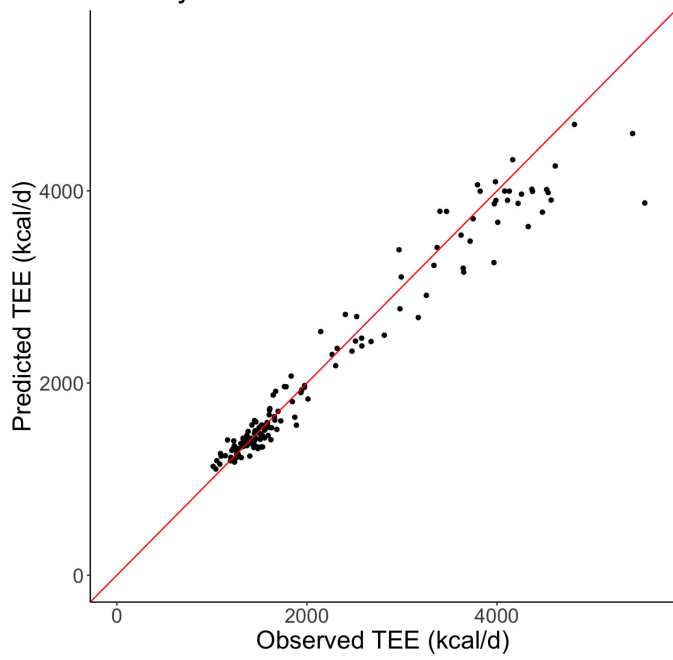




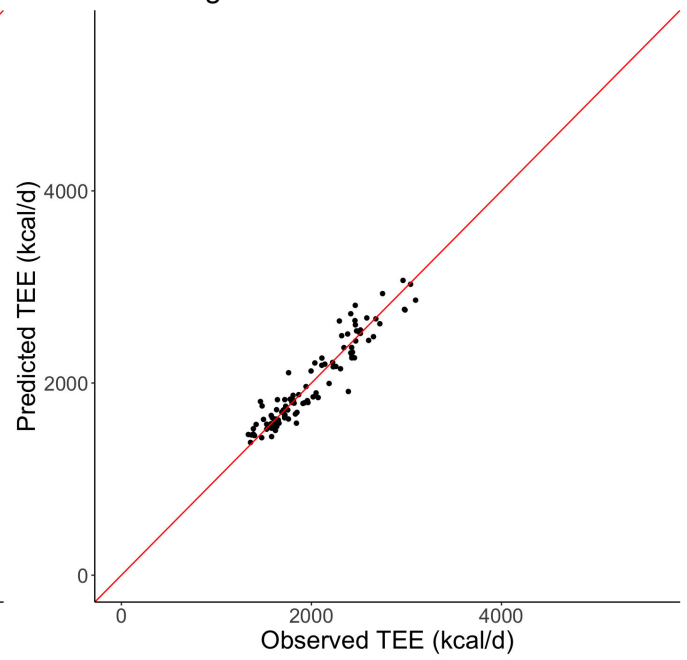
Healthy model



Overweight/Obese model



FM & FFM model



Observed TEE (kcal/d)

Figure 1.4: Model Fit, Boy 3-18

1.9.5 Child Girls, 0-2 years old

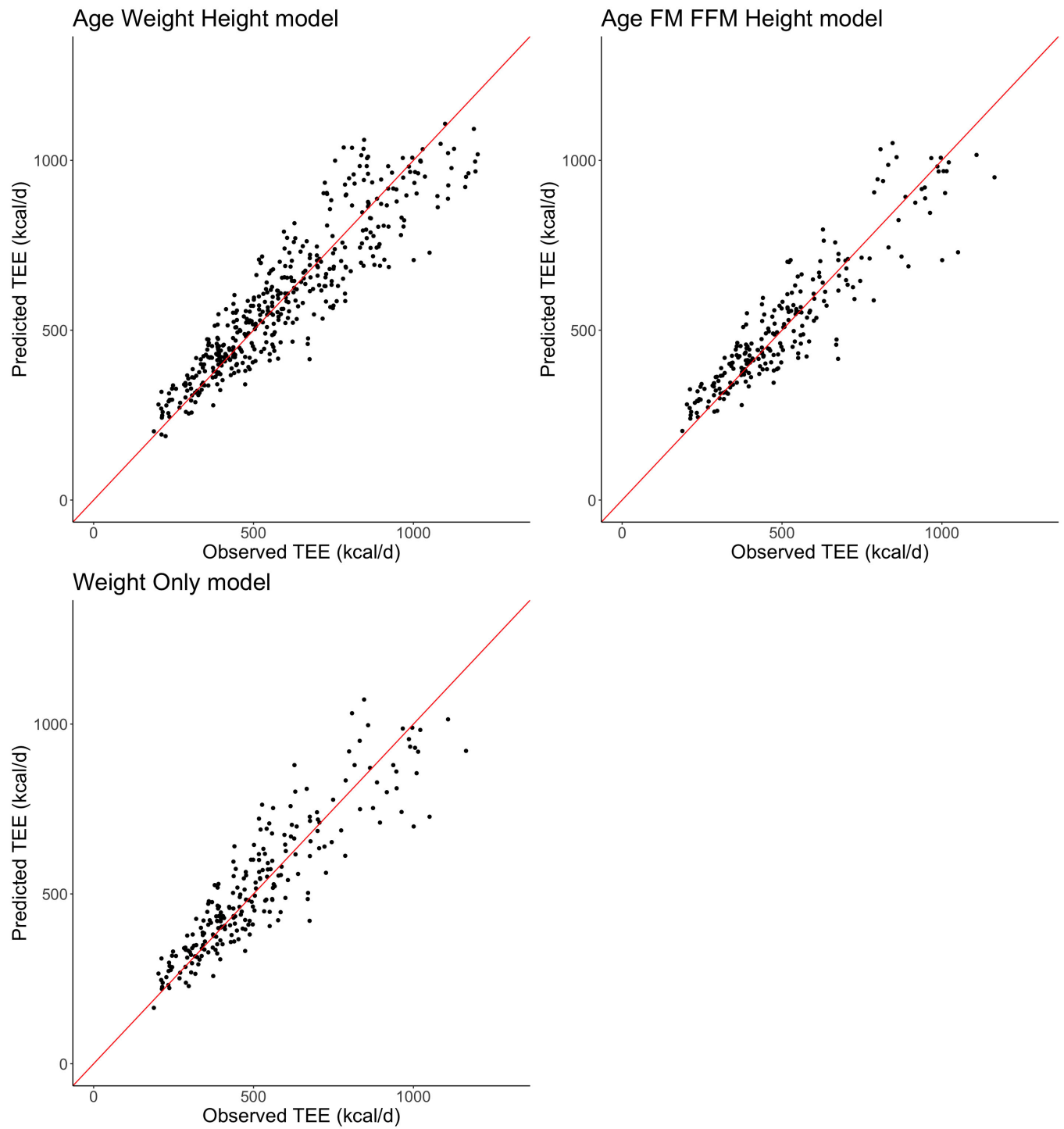


Figure 1.5: Model Fit, Girl 0-2

1.9.6 Child Boys, 0-2 years old

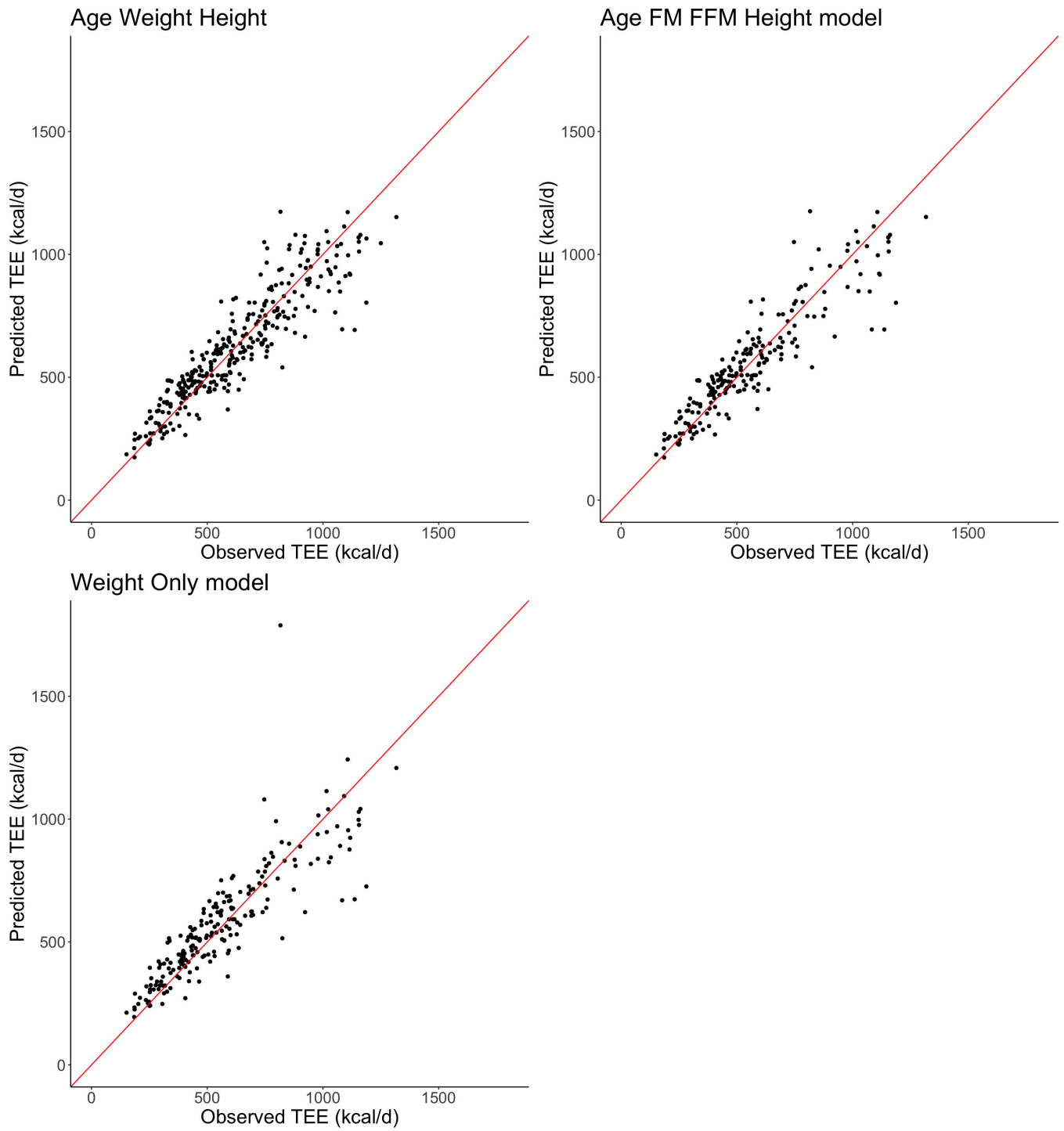


Figure 1.6: Model Fit, Boys 0-2

1.9.7 Pregnancy

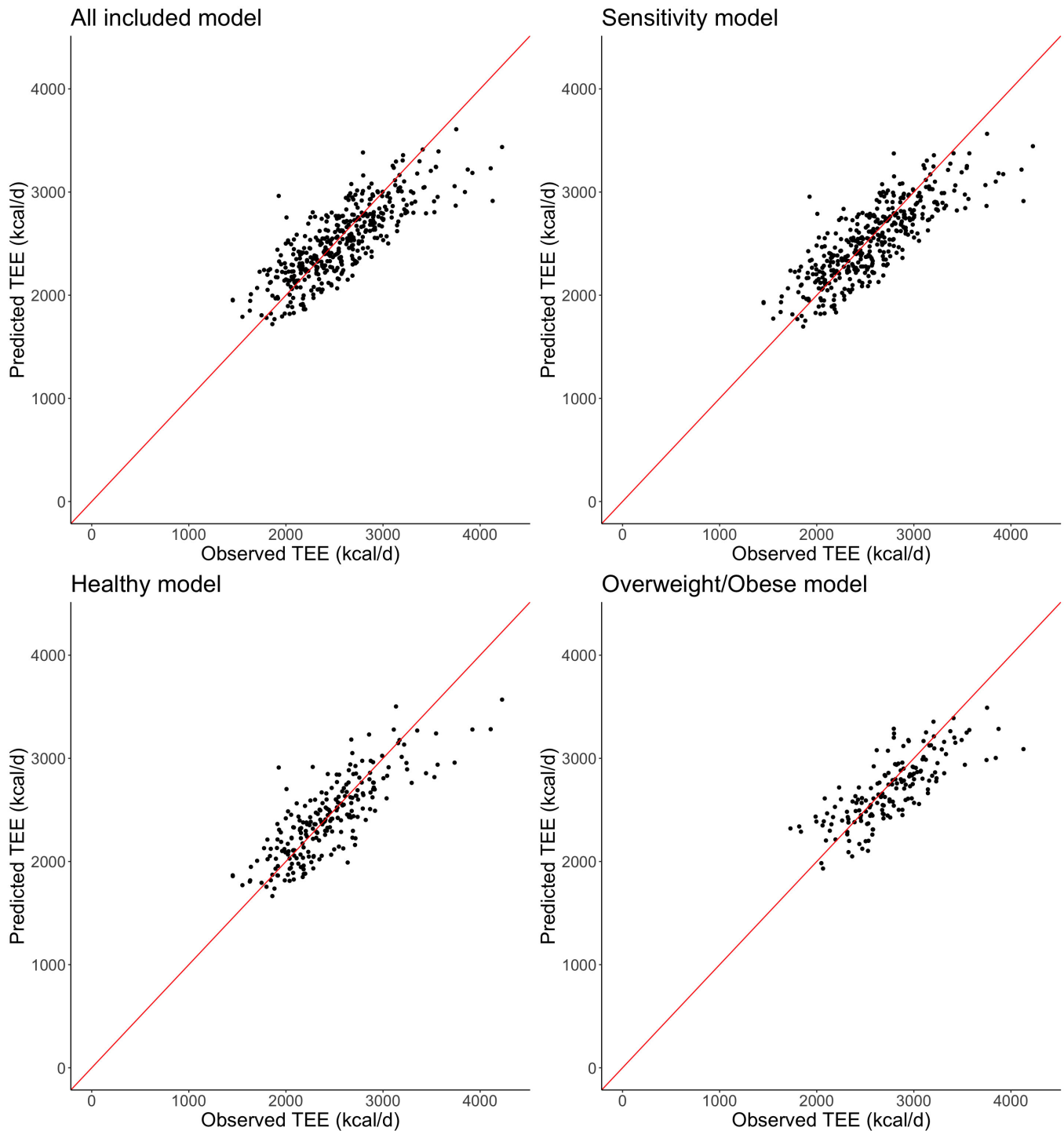
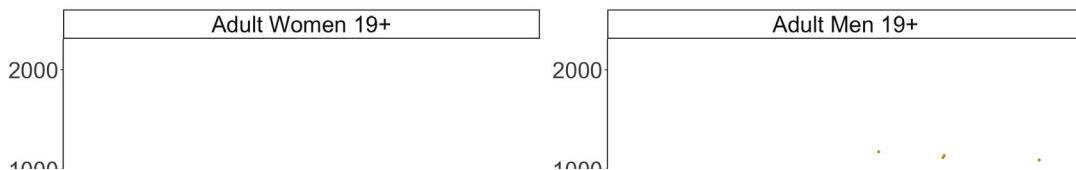


Figure 1.7: Model Fit, Pregnancy

1.10 Bland-Altman Plot

The following is a Bland-Altman plot of the predicted TEE vs observed TEE, with predicted TEE coming from the full model (all-included). On the x-axis is the mean of TEE observed and TEE predicted for each data point, and on the y-axis is the difference of TEE observed minus TEE predicted. Also plotted are horizontal lines for the mean of the differences and the 95% limits of agreement (mean ± 1.96 standard deviation) for the differences.



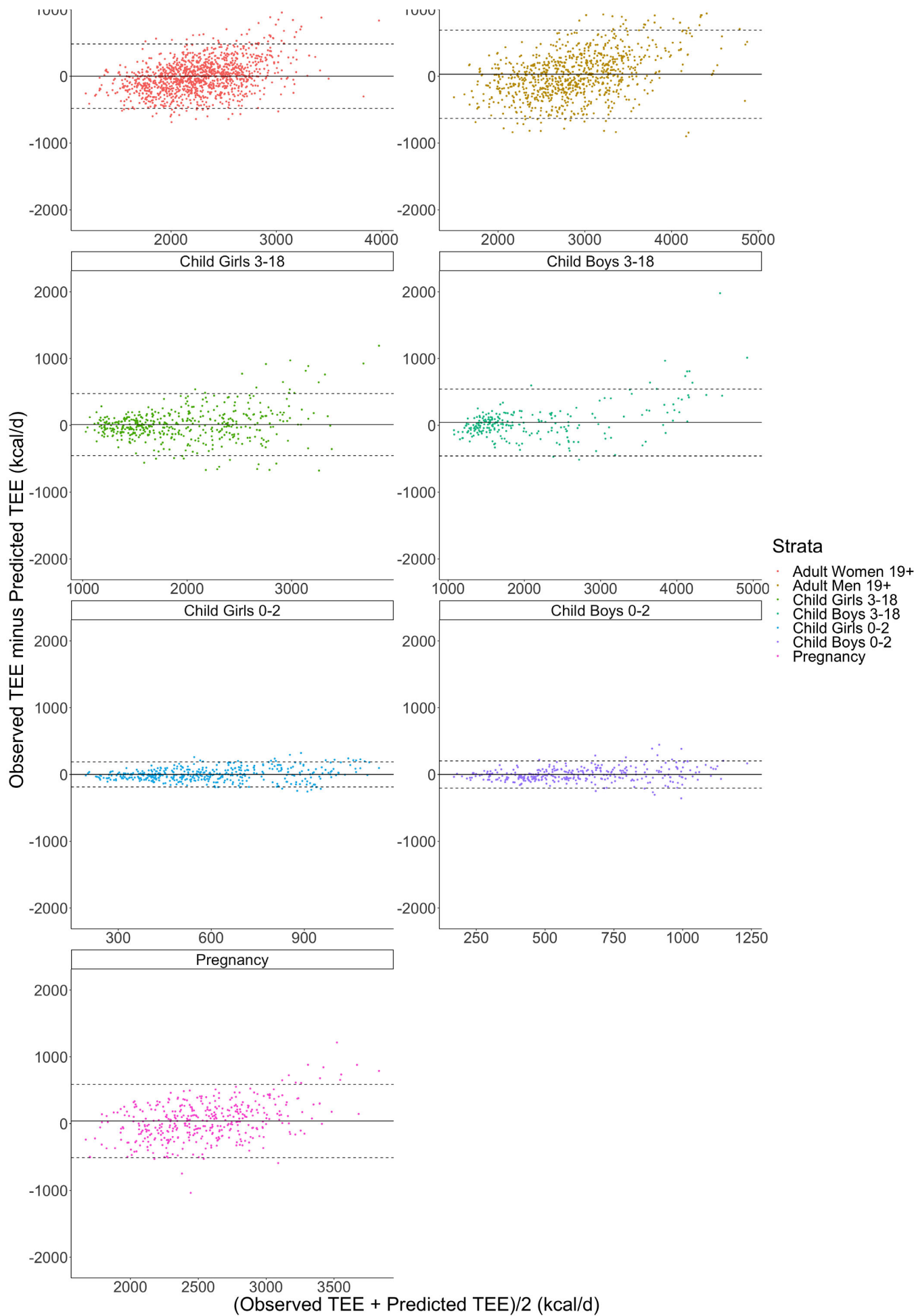


Figure 1.8: Bland-Altman plots

Below we included a table for the mean and sample standard deviation (with Bessel's correction) for the quantity on the y-axis, the difference "Observed TEE minus Predicted TEE".

Strata	n	Mean	Std Dev.
Adult Women 19+	1342	0.611	245.842
Adult Men 19+	1016	29.387	337.437
Child Girls 3-18	477	11.452	236.718
Child Boys 3-18	250	43.162	255.400
Child Girls 0-2	432	0.510	95.289
Child Boys 0-2	317	0.059	103.762
Pregnancy	413	39.593	279.986

2 Comparison of Models

This section compares the predicted TEE values among the 5 models (all-included, sensitivity, healthy, obese, FM & FFM). We take pairwise comparisons for each pair of model, using Pearson r correlation of predicted TEE (for each model pair), the symmetric mean absolute percentage error (sMAPE), the MAE, MSE and the RMSE. See equation (??) for the MAE. The sMAPE is given by the following formula:

$$sMAPE = 100\% \cdot \frac{1}{n} \sum_{i=1 \dots n} \frac{|x_i - y_i|}{(|x_i| + |y_i|)/2}, \quad (2.1)$$

where x_i is the predicted TEE for model 1, and y_i is the predicted TEE for model 2.

2.1 All-included model

2.1.1 Predictions for All-included Model Vs. Sensitivity Model

Strata	n	MSE	RMSE	MAE	sMAPE (%)
Adult Women 19+	1342	43.86	6.62	4.39	0.20
Adult Men 19+	1016	119.88	10.95	7.19	0.26
Child Girls 3-18	477	3220.66	56.75	31.25	1.46
Child Boys 3-18	250	14039.68	118.49	74.14	3.29
Pregnancy	413	541.46	23.27	18.71	0.75

2.1.2 Predictions for All-included Model Vs. Healthy Model

Strata	n	MSE	RMSE	MAE	sMAPE (%)
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Strata	n	MSE	RMSE	MAE	sMAPE (%)
Adult Women 19+	1342	4043.14	63.59	39.30	1.62
Adult Men 19+	1016	6871.34	82.89	56.64	1.86
Child Girls 3-18	477	5578.75	74.69	42.38	1.93
Child Boys 3-18	250	19697.11	140.35	89.52	3.87
Pregnancy	413	12307.74	110.94	83.75	3.22

2.1.3 Predictions for All-included Model Vs. Obese Model

Strata	n	MSE	RMSE	MAE	sMAPE (%)
Adult Women 19+	1342	334.70	18.29	14.21	0.65
Adult Men 19+	1016	1367.20	36.98	30.64	1.10
Child Girls 3-18	477	9741.96	98.70	83.66	4.23
Child Boys 3-18	250	18975.30	137.75	91.05	4.04
Pregnancy	413	13782.98	117.40	102.36	4.04

2.1.4 Predictions for All-included Model Vs. FM & FFM Model

Strata	n	MSE	RMSE	MAE	sMAPE (%)
Adult Women 19+	909	9018.17	94.96	70.18	3.07
Adult Men 19+	682	20240.24	142.27	104.66	3.63
Child Girls 3-18	98	3494.45	59.11	43.04	1.84
Child Boys 3-18	53	15591.15	124.86	102.01	3.66
Child Girls 0-2	238	28.06	5.30	4.06	0.86
Child Boys 0-2	206	0.87	0.93	0.74	0.17

2.2 Sensitivity Model

2.2.1 Predictions for Sensitivity Model Vs. All-included Model

Strata	n	MSE	RMSE	MAE	sMAPE (%)
Adult Women 19+	1342	43.86	6.62	4.39	0.20
Adult Men 19+	1016	119.88	10.95	7.19	0.26
Child Girls 3-18	477	3220.66	56.75	31.25	1.46

Strata	n	MSE	RMSE	MAE	sMAPE (%)
Child Boys 3-18	250	14039.68	118.49	74.14	3.29
Pregnancy	413	541.46	23.27	18.71	0.75

2.2.2 Predictions for Sensitivity Model Vs. Healthy Model

Strata	n	MSE	RMSE	MAE	sMAPE (%)
Adult Women 19+	1342	3943.03	62.79	37.80	1.56
Adult Men 19+	1016	7140.93	84.50	57.11	1.88
Child Girls 3-18	477	1131.37	33.64	17.16	0.76
Child Boys 3-18	250	865.98	29.43	18.29	0.75
Pregnancy	413	11782.61	108.55	78.71	2.99

2.2.3 Predictions for Sensitivity Model Vs. Obese Model

Strata	n	MSE	RMSE	MAE	sMAPE (%)
Adult Women 19+	1342	426.95	20.66	16.00	0.73
Adult Men 19+	1016	1357.50	36.84	30.29	1.07
Child Girls 3-18	477	16111.12	126.93	99.48	4.97
Child Boys 3-18	250	44325.59	210.54	145.52	6.26
Pregnancy	413	15714.83	125.36	107.99	4.28

2.2.4 Predictions for Sensitivity Model Vs. FM & FFM Model

Strata	n	MSE	RMSE	MAE	sMAPE (%)
Adult Women 19+	909	9068.48	95.23	70.35	3.08
Adult Men 19+	682	20271.67	142.38	104.48	3.62
Child Girls 3-18	98	10519.17	102.56	61.61	2.38
Child Boys 3-18	53	17650.34	132.85	100.63	3.63

2.3 Healthy Model

2.3.1 Predictions for Healthy Model Vs. All-included Model

Strata	n	MSE	RMSE	MAE	sMAPE (%)
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Strata	n	MSE	RMSE	MAE	sMAPE (%)
Adult Women 19+	1342	4043.14	63.59	39.30	1.62
Adult Men 19+	1016	6871.34	82.89	56.64	1.86
Child Girls 3-18	477	5578.75	74.69	42.38	1.93
Child Boys 3-18	250	19697.11	140.35	89.52	3.87
Pregnancy	413	12307.74	110.94	83.75	3.22

2.3.2 Predictions for Healthy Model Vs. Sensitivity Model

Strata	n	MSE	RMSE	MAE	sMAPE (%)
Adult Women 19+	1342	3943.03	62.79	37.80	1.56
Adult Men 19+	1016	7140.93	84.50	57.11	1.88
Child Girls 3-18	477	1131.37	33.64	17.16	0.76
Child Boys 3-18	250	865.98	29.43	18.29	0.75
Pregnancy	413	11782.61	108.55	78.71	2.99

2.3.3 Predictions for Healthy Model Vs. FM & FFM Model

Strata	n	MSE	RMSE	MAE	sMAPE (%)
Adult Women 19+	909	12264.95	110.75	79.29	3.42
Adult Men 19+	682	26131.15	161.65	120.10	4.17
Child Girls 3-18	98	16039.09	126.65	73.91	2.78
Child Boys 3-18	53	25379.61	159.31	119.75	4.25

2.4 Overweight/Obese Model

2.4.1 Predictions for Overweight/Obese Model Vs. All-included Model

Strata	n	MSE	RMSE	MAE	sMAPE (%)
Adult Women 19+	1342	334.70	18.29	14.21	0.65
Adult Men 19+	1016	1367.20	36.98	30.64	1.10
Child Girls 3-18	477	9741.96	98.70	83.66	4.23
Child Boys 3-18	250	18975.30	137.75	91.05	4.04
Pregnancy	413	13782.98	117.40	102.36	4.04

2.4.2 Predictions for Overweight/Obese Model Vs. Sensitivity Model

Strata	n	MSE	RMSE	MAE	sMAPE (%)
Adult Women 19+	1342	426.95	20.66	16.00	0.73
Adult Men 19+	1016	1357.50	36.84	30.29	1.07
Child Girls 3-18	477	16111.12	126.93	99.48	4.97
Child Boys 3-18	250	44325.59	210.54	145.52	6.26
Pregnancy	413	15714.83	125.36	107.99	4.28

2.4.3 Predictions for Overweight/Obese Model Vs. FM & FFM Model

Strata	n	MSE	RMSE	MAE	sMAPE (%)
Adult Women 19+	909	9569.39	97.82	72.87	3.20
Adult Men 19+	682	21188.45	145.56	106.35	3.67
Child Girls 3-18	98	25215.75	158.79	139.74	5.95
Child Boys 3-18	53	92987.17	304.94	242.22	7.72

2.5 FM & FFM Model

2.5.1 Predictions for FM & FFM Model Vs. All-included Model

Strata	n	MSE	RMSE	MAE	sMAPE (%)
Adult Women 19+	909	9018.17	94.96	70.18	3.07
Adult Men 19+	682	20240.24	142.27	104.66	3.63
Child Girls 3-18	98	3494.45	59.11	43.04	1.84
Child Boys 3-18	53	15591.15	124.86	102.01	3.66
Child Girls 0-2	238	28.06	5.30	4.06	0.86
Child Boys 0-2	206	0.87	0.93	0.74	0.17

2.5.2 Predictions for FM & FFM Model Vs. Sensitivity Model

Strata	n	MSE	RMSE	MAE	sMAPE (%)
Adult Women 19+	909	9068.48	95.23	70.35	3.08
Adult Men 19+	682	20271.67	142.38	104.48	3.62
Child Girls 3-18	98	10519.17	102.56	61.61	2.38

Strata	n	MSE	RMSE	MAE	sMAPE (%)
Child Boys 3-18	53	17650.34	132.85	100.63	3.63

2.5.3 Predictions for FM & FFM Model Vs. Healthy Model

Strata	n	MSE	RMSE	MAE	sMAPE (%)
Adult Women 19+	909	12264.95	110.75	79.29	3.42
Adult Men 19+	682	26131.15	161.65	120.10	4.17
Child Girls 3-18	98	16039.09	126.65	73.91	2.78
Child Boys 3-18	53	25379.61	159.31	119.75	4.25

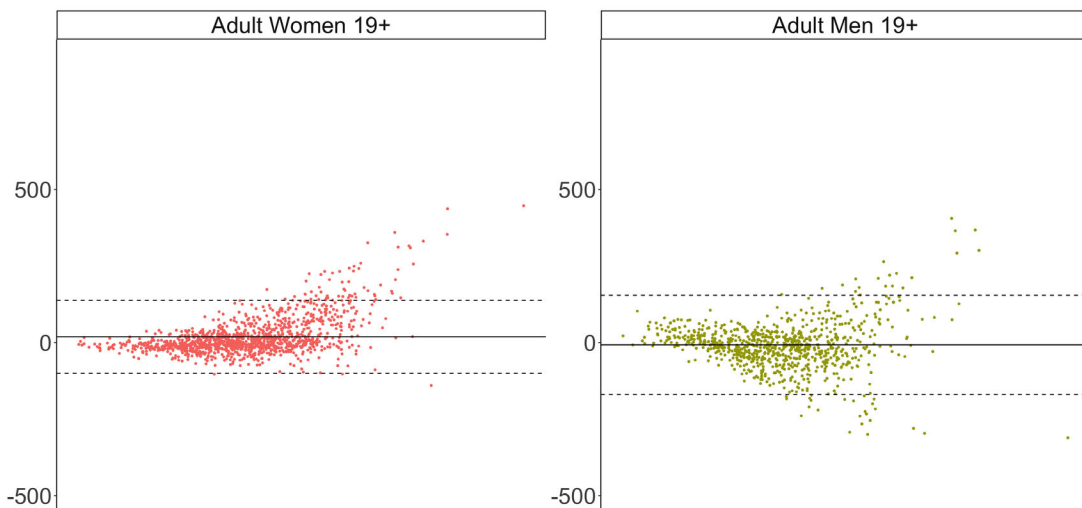
2.5.4 Predictions for FM & FFM Model Vs. Obese Model

Strata	n	MSE	RMSE	MAE	sMAPE (%)
Adult Women 19+	909	9569.39	97.82	72.87	3.20
Adult Men 19+	682	21188.45	145.56	106.35	3.67
Child Girls 3-18	98	25215.75	158.79	139.74	5.95
Child Boys 3-18	53	92987.17	304.94	242.22	7.72

2.6 Bland-Altman Plots

This section contains Bland-Altman plots that compare different model fits for total energy expenditure (TEE). In particular, we focus on the full model vs. the healthy model, as well as the full model vs. the overweight/obese model. See the Bland-Altman subsection in Section 1 (Model Fits) for more details about the Bland-Altman plots. Note: differences for predicted TEE are calculated as (full model minus healthy model) for the first plot and (full model minus obese model) for the second.

2.6.1 All vs. Healthy Models



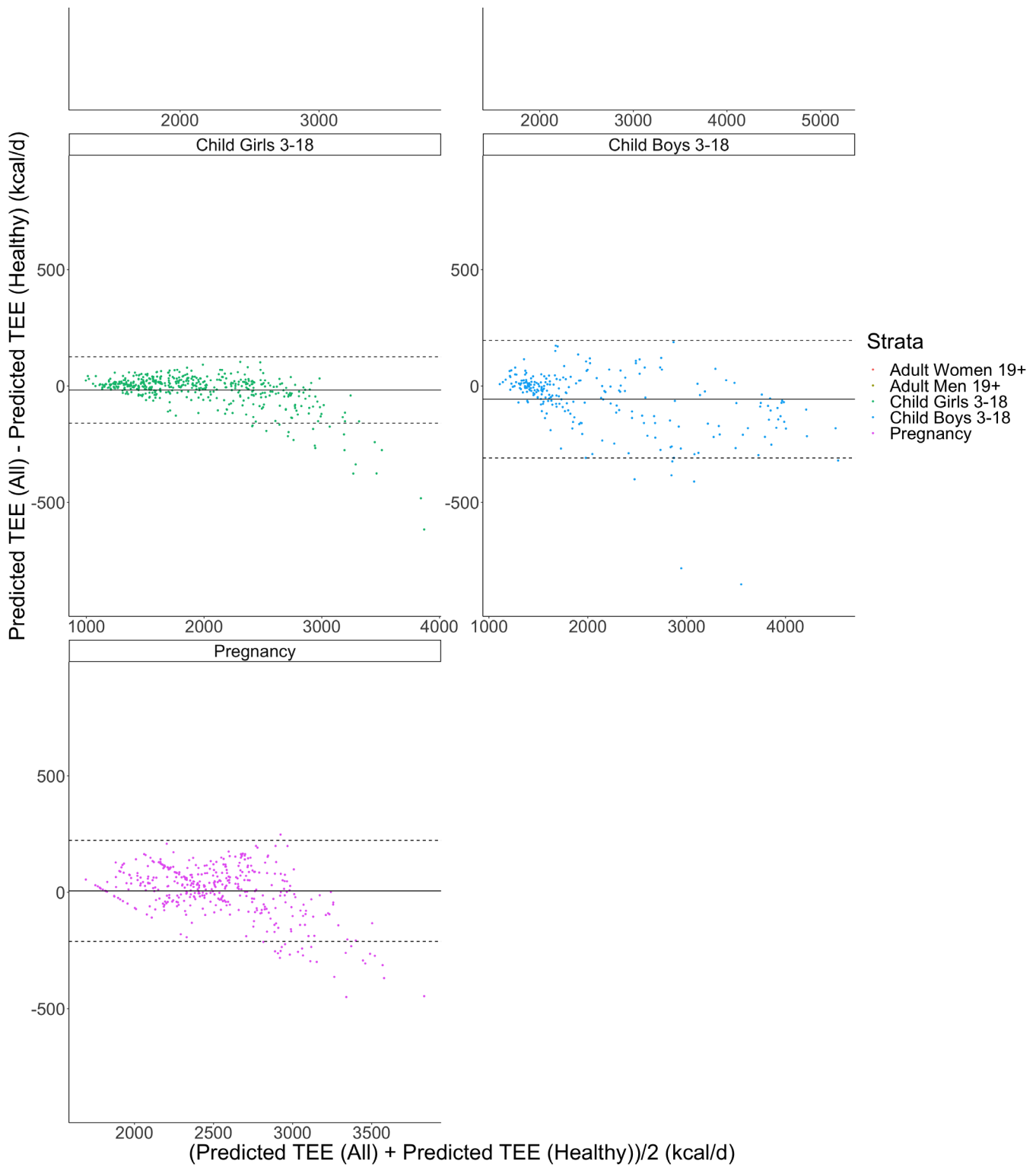


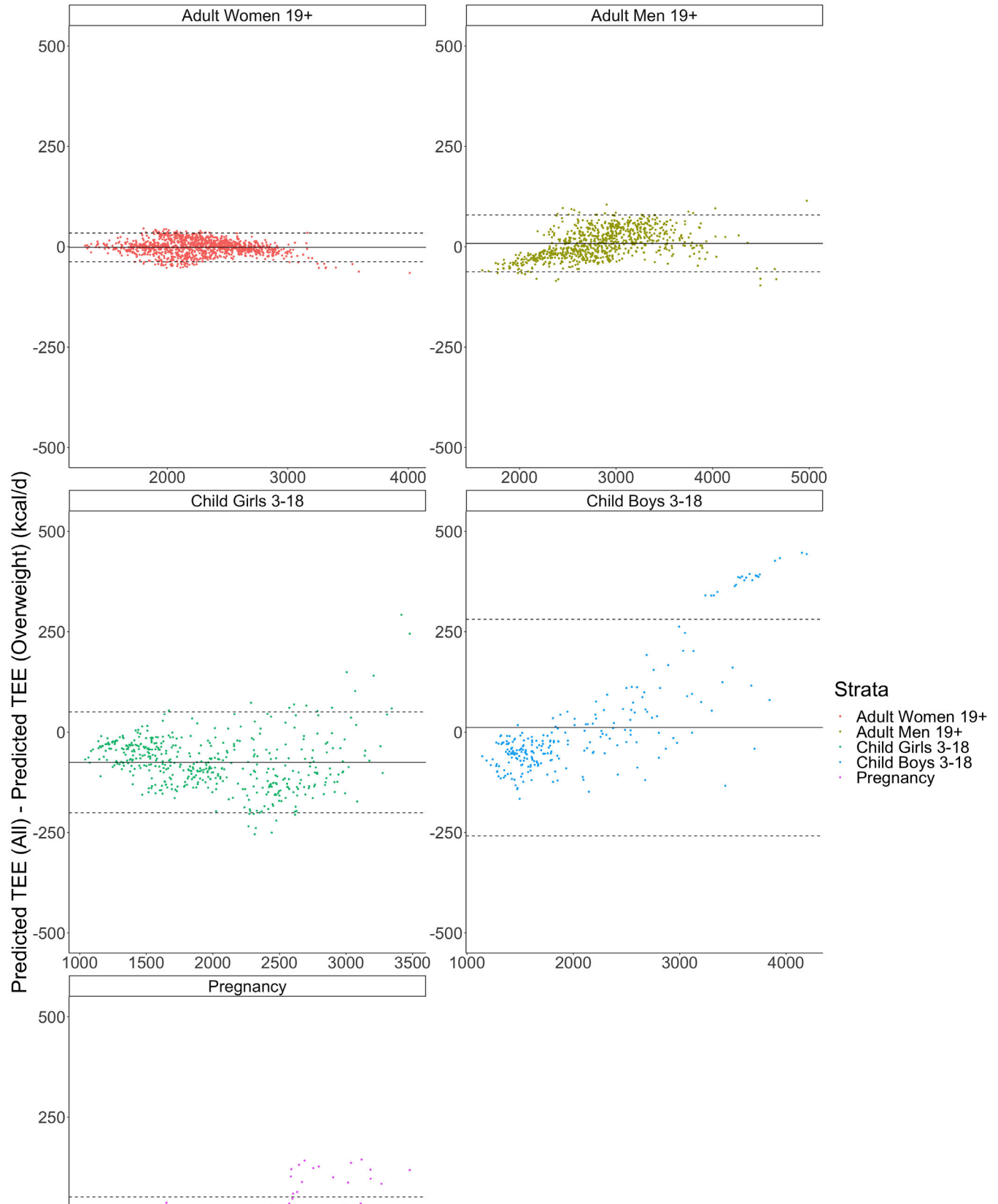
Figure 2.1: Bland-Altman Plots Comparing Models All vs Healthy, Paneled

Below is the table for the mean and standard deviation (Bessel corrected) of the difference “Predicted TEE (All) minus Predicted TEE (Healthy)”:

Strata	n	Mean	Std Dev.
Adult Women 19+	1342	18.778	60.772
Adult Men 19+	1016	-7.586	82.586
Child Girls 3-18	477	-17.106	72.782

Strata	n	Mean	Std Dev.
Child Boys 3-18	250	-56.450	128.751
Pregnancy	413	6.136	110.905

2.6.2 All vs. Overweight Models



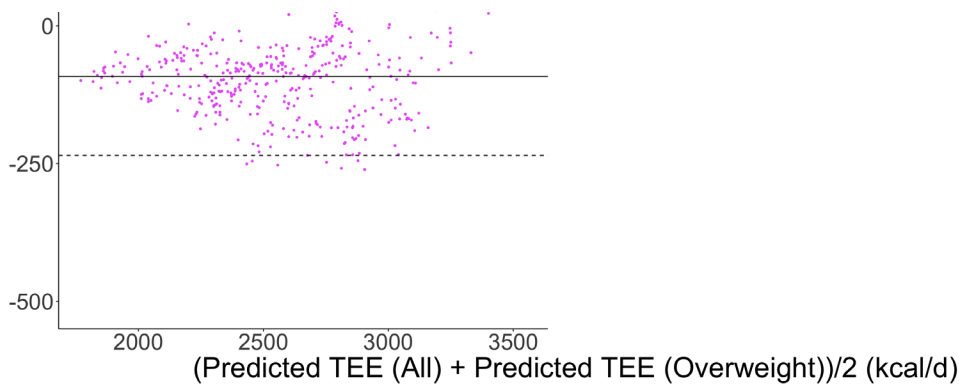


Figure 2.2: Bland-Altman Plots Comparing Models All vs Overweight, Paneled

Below is the table for the mean and standard deviation (Bessel corrected) of the difference “Predicted TEE (All) minus Predicted TEE (Overweight)”:

Strata	n	Mean	Std Dev.
Adult Women 19+	1342	-1.518	18.239
Adult Men 19+	1016	8.410	36.024
Child Girls 3-18	477	-75.224	63.968
Child Boys 3-18	250	11.443	137.550
Pregnancy	413	-91.944	73.090

3 Predicted Plots of Random People

This section provides visualizations to accompany the Multiple Imputation GLM Results report (DRI-energy-MI-glm). In particular, it looks at how the different models in that report compare with regard to predicted total energy expenditure (TEE).

There is a separate plot for each strata:

- Women (19+),
- Men (19+),
- Girls (3-18),
- Boys (3-18),
- Girls (0-2),
- Boys (0-2),
- Pregnancy.

For each strata there is a paneled plot with 6 panels,

- Panel 1: Observed TEE against Age
- Panel 2: Predicted TEE All-included Model predicted TEE against Age
- Panel 3: Sensitivity Model predicted TEE against Age
- Panel 4: Healthy Model predicted TEE against Age

- Panel 5: Obese/Overweight Model predicted TEE against Age
- Panel 6: Fat Mass/Fat free Mass Model predicted TEE against Age

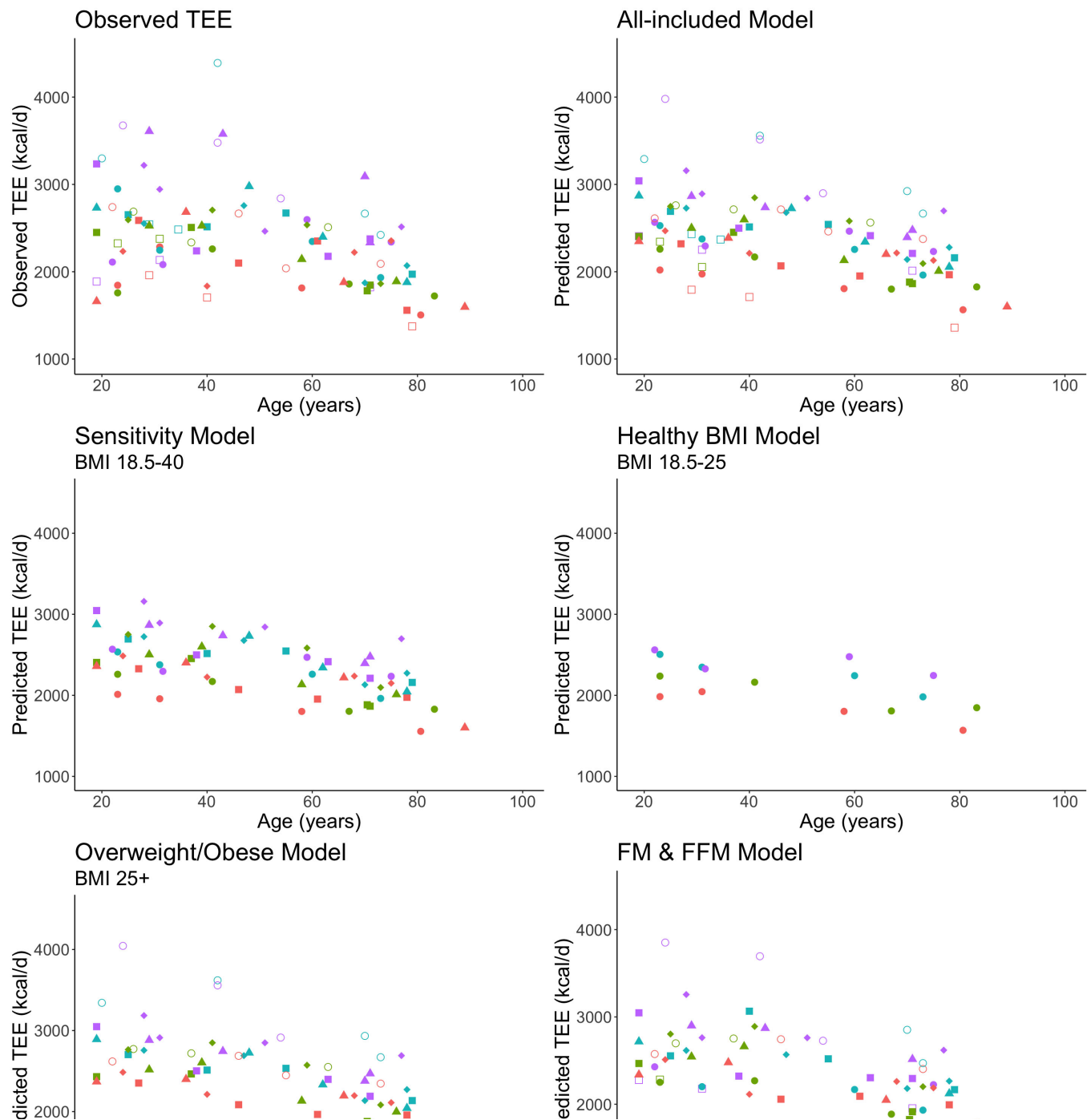
Each panel is a plot of TEE against Age. Shapes are used to indicate BMI Category, and colors indicate PAL (physical activity level) Category

Points in the plot are randomly selected individuals from the dataset. We randomly selected 1 person from each combination of Sex, Age (Life-stage group), BMI range, and PAL category, for up to 100 people in each plot (less when fewer BMI categories are included). The same individuals are then displayed in each panel with their observed TEE in Panel 1, and the person's predicted TEE from each of the 5 models.

Parameters for each model are outlined in the html report: [DRI-energy-MI-glm.html](#).

3.1 Women

This plot is for women, ages 19+.



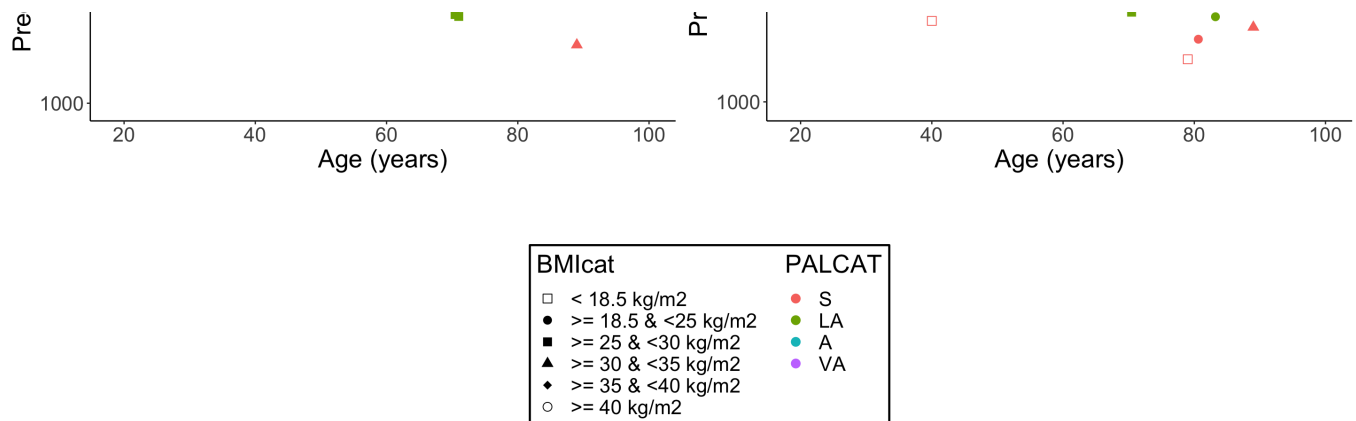
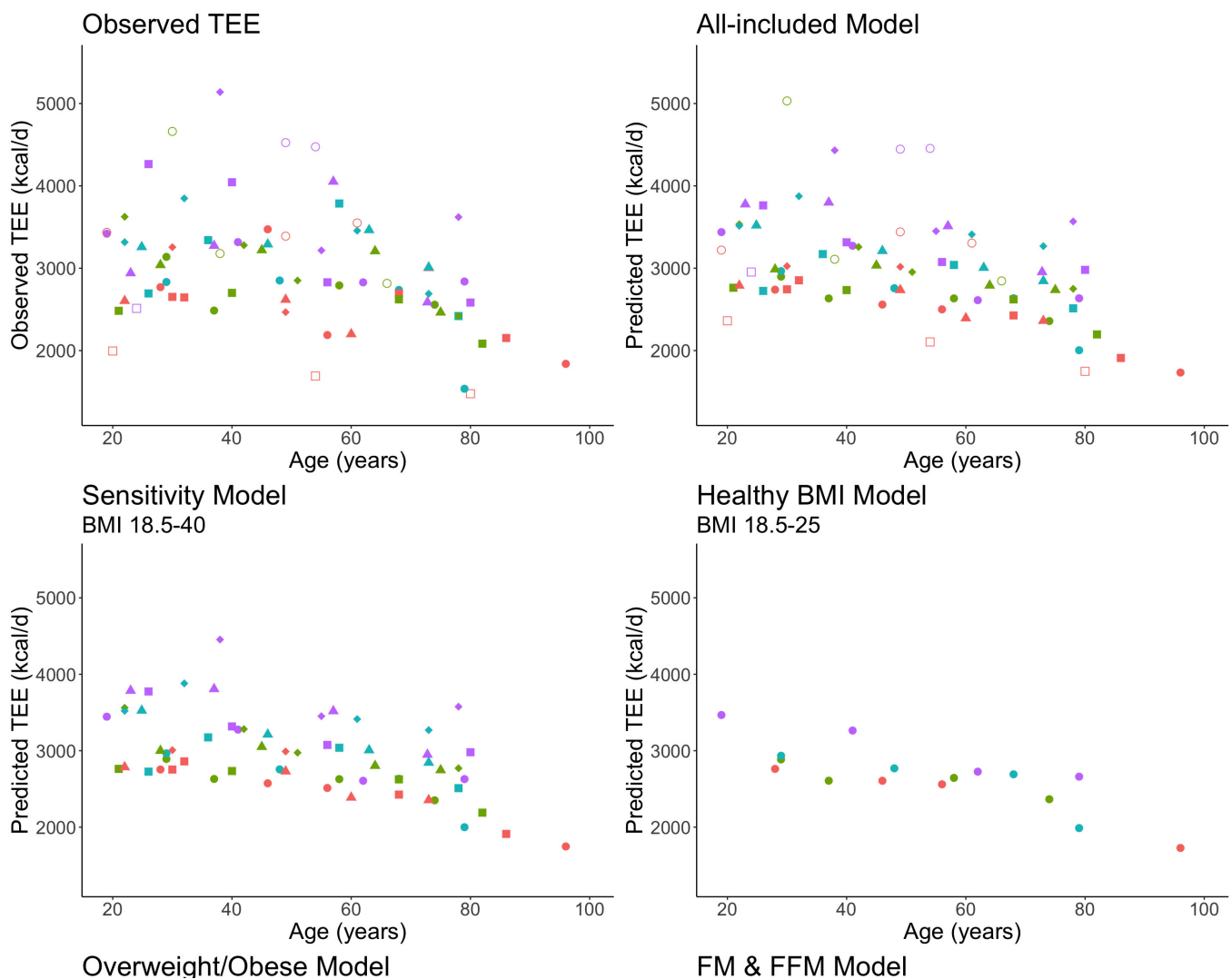


Figure 3.1: Predicted Plots, Women

3.2 Men

This plot is for men, ages 19+.



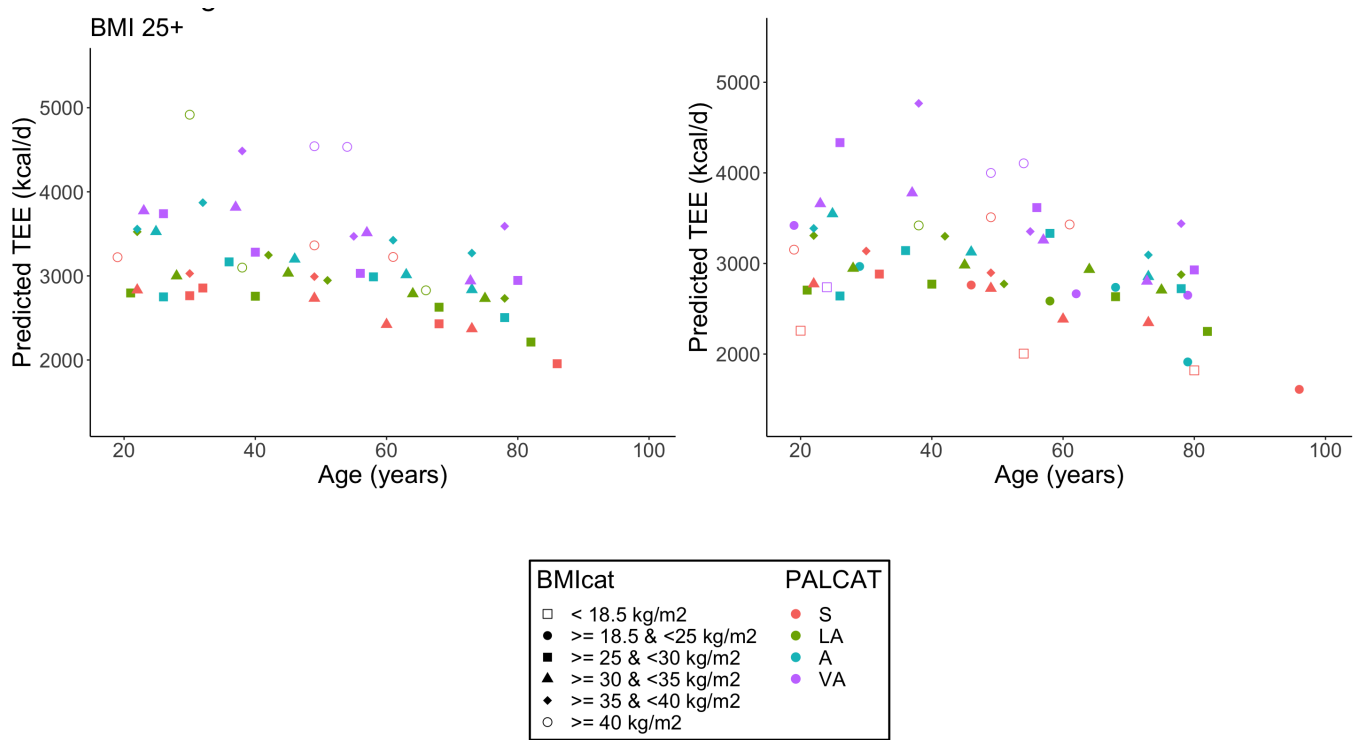
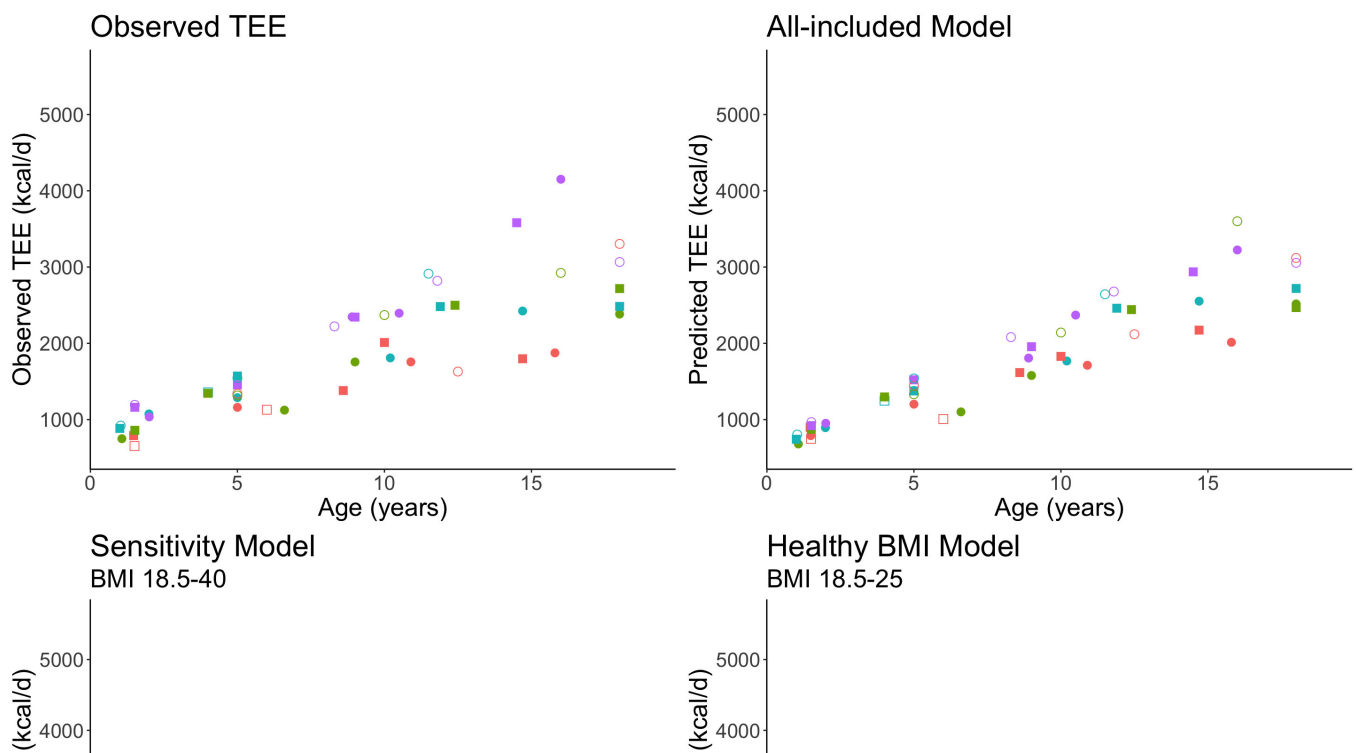


Figure 3.2: Predicted Plot, Men

3.3 Child Girls 3-18

This plot is for girls, ages 3-18. Note that "Percentile Group" here refers to BMI percentiles.



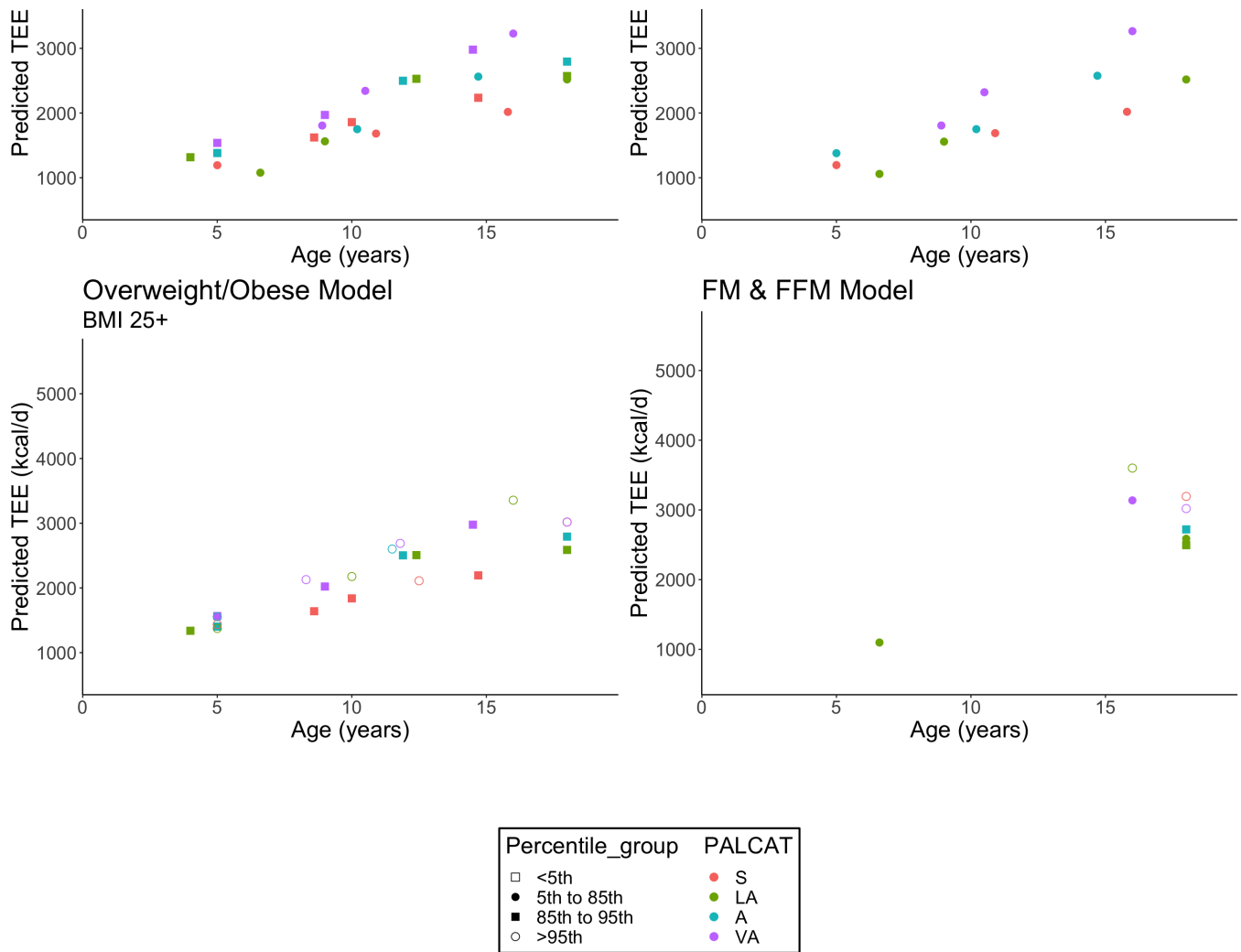
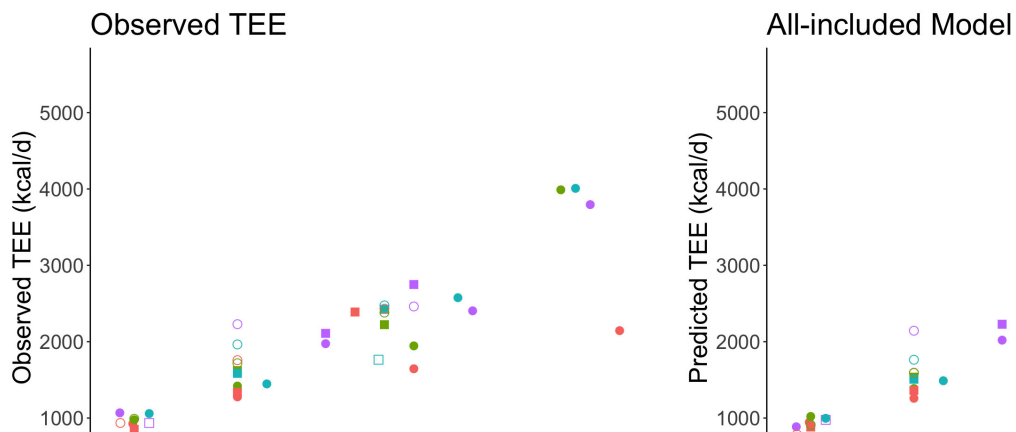


Figure 3.3: Predicted Plot, Child Girl 3-18

3.4 Child Boys 3-18

This plot is for boys, ages 3-18. Note that “Percentile Group” here refers to BMI percentiles.



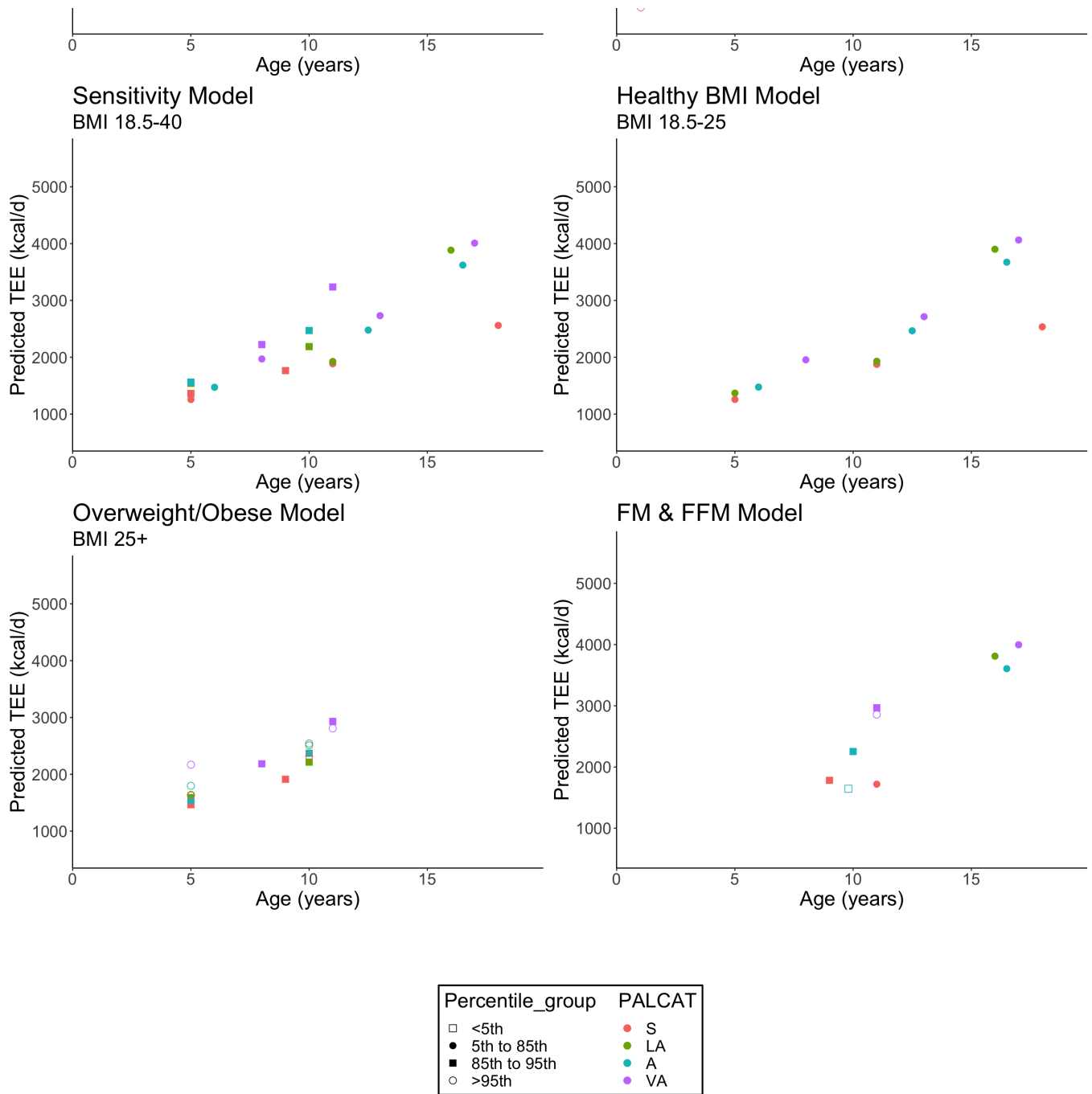
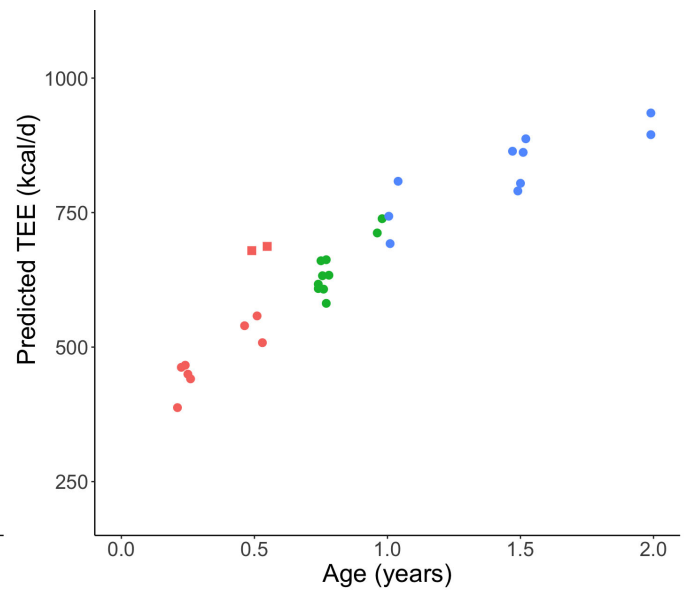
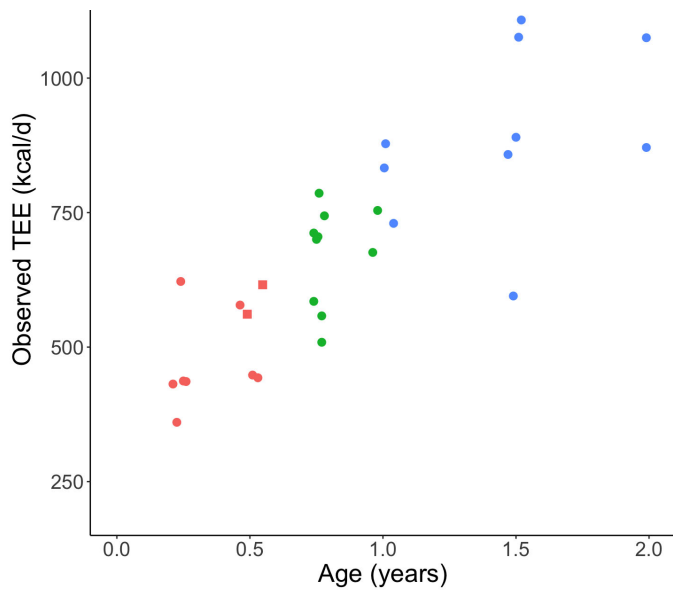


Figure 3.4: Predicted Plot, Child Boy 3-18

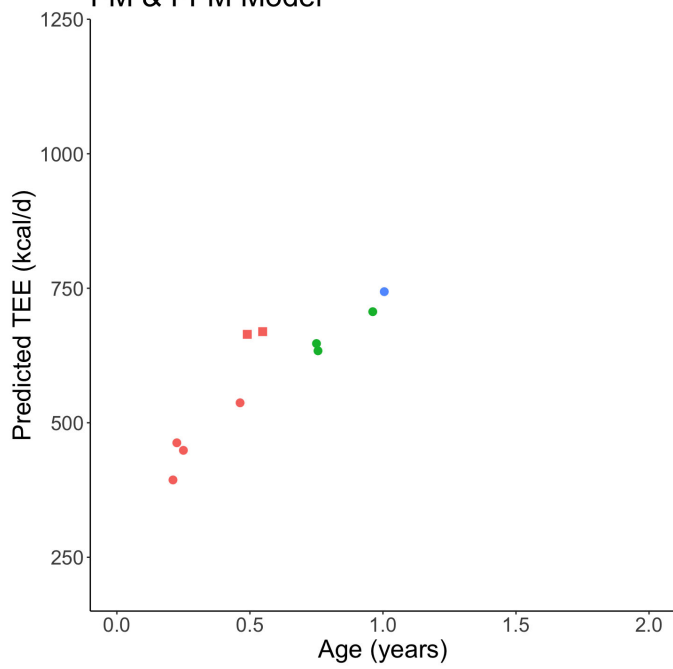
3.5 Child Girls 0-2

This plot is for girls age 0-2. Note that "Percentile Group" here refers to the weight/length percentiles.





FM & FFM Model



Weight Only Model

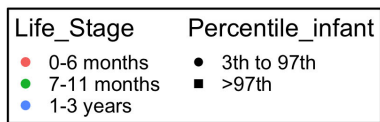
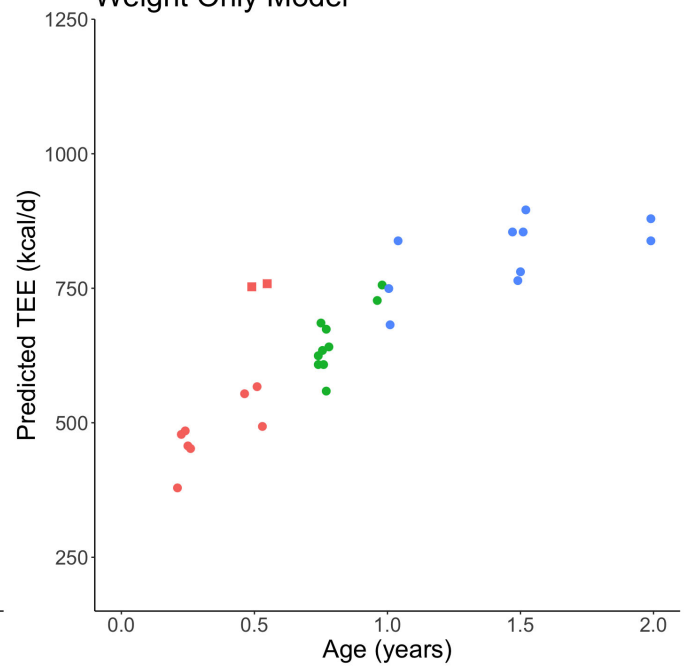


Figure 3.5: Predicted Plot, Child Girl 0-2

3.6 Child Boys 0-2

This plot is for boys age 0-2. Note that “Percentile Group” here refers to the weight/length percentiles.

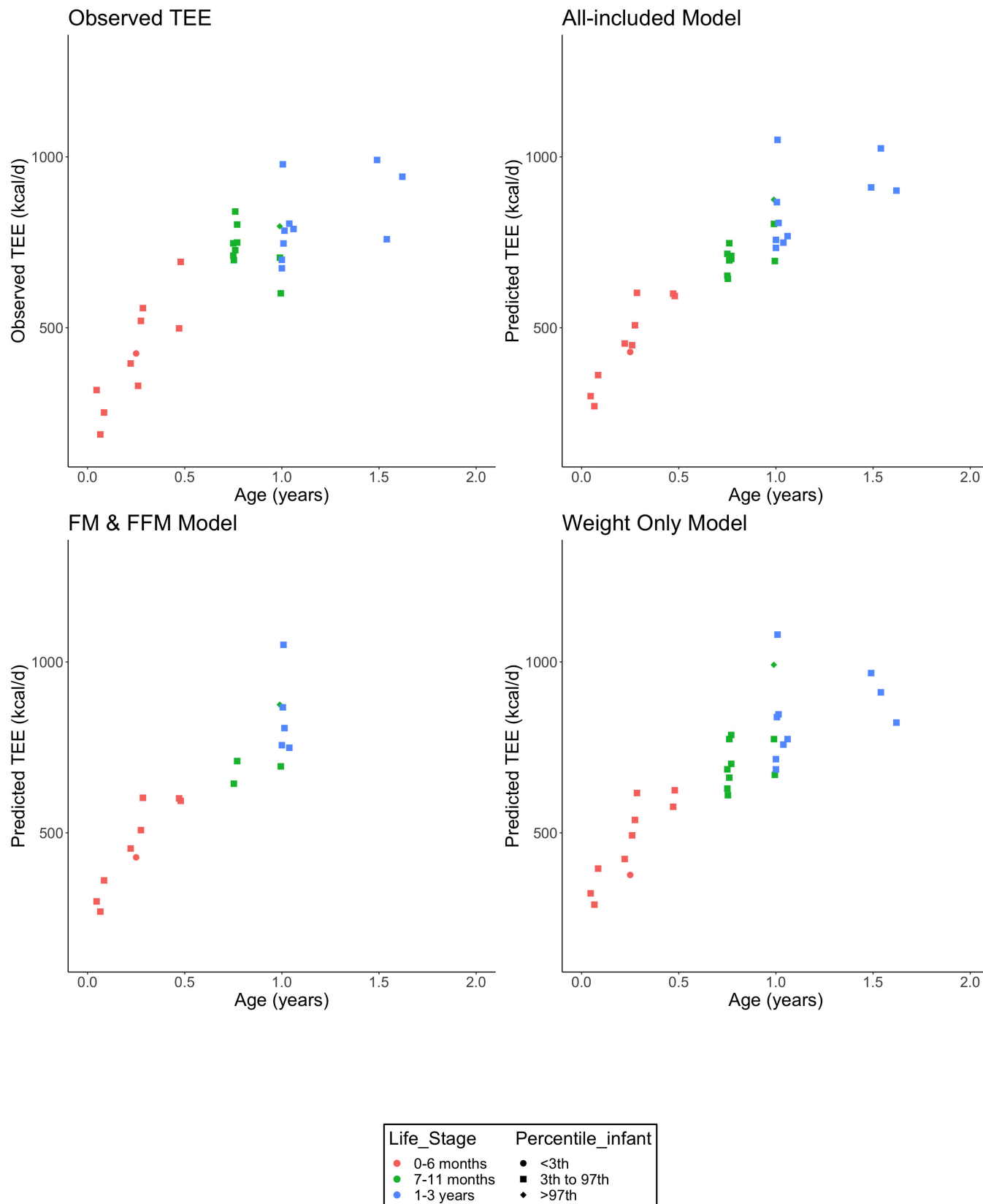


Figure 3.6: Predicted Plot, Child Boy 0-2

3.7 Pregnancy

This plot is for pregnant women.

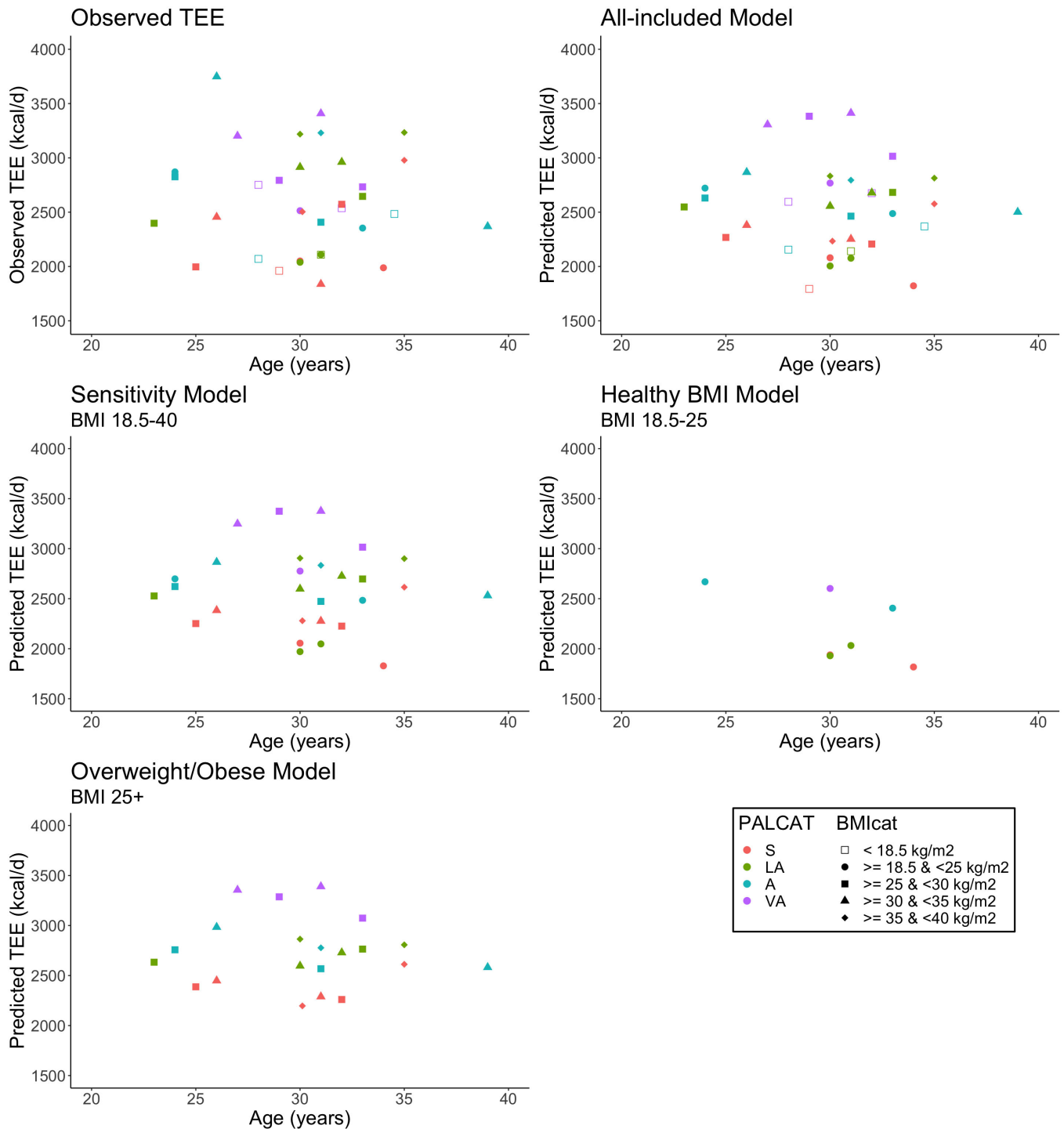


Figure 3.7: Predicted Plot, Pregnancy

4 External Validation

This section validates the TEE equations in the report “DRI-energy-MI-glm.html” by utilizing external data from the literature. The workgroup provided external data in “Data extraction combined FINAL 081122.xlsx”.

While the data pulled here from the literature are study-level data representing averages we use these data to represent an “average person” as if it were individual-level. We then use the TEE equations developed from the full set of individual data (as shown in DRI-energy-MI-glm.html) to predict TEE based on these average age, height, weight, PAL values.

4.1 Data Import and Stats

- Data set: "Data extraction combined FINAL 081122.xlsx"

Here we import the dataset and filter out the rows with missing values for the relevant columns. Data are required for TEE, age, sex, height, and weight. (Analysis is performed with and without complete data for PAL below.) After that, we change the columns which need to be numeric (from character).

If Height or weight are missing, but BMI is present, then height was calculated from weight and BMI, or weight was calculated from height and BMI.

We put here summary stats for the relevant variables.

	Complete (N=54)	Incomplete (N=104)	Overall (N=158)
Gender			
Female	32 (59.3%)	67 (64.4%)	99 (62.7%)
Male	22 (40.7%)	37 (35.6%)	59 (37.3%)
Age			
Mean (SD)	30.7 (18.5)	26.8 (16.6)	28.2 (17.3)
Median [Min, Max]	31.9 [6.50, 94.0]	28.9 [0.271, 73.3]	29.9 [0.271, 94.0]
Weight			
Mean (SD)	68.1 (25.9)	60.8 (26.4)	63.5 (26.4)
Median [Min, Max]	67.4 [22.4, 162]	65.5 [6.41, 140]	67.0 [6.41, 162]
Missing	0 (0%)	9 (8.7%)	9 (5.7%)
Height			
Mean (SD)	159 (24.9)	154 (27.7)	156 (26.7)
Median [Min, Max]	165 [24.0, 182]	164 [61.3, 182]	165 [24.0, 182]
Missing	0 (0%)	9 (8.7%)	9 (5.7%)
BMI			
Mean (SD)	25.2 (7.70)	23.7 (5.84)	24.3 (6.55)
Median [Min, Max]	23.7 [15.1, 60.3]	23.9 [14.4, 52.4]	23.8 [14.4, 60.3]
Missing	0 (0%)	2 (1.9%)	2 (1.3%)
TEE			
Mean (SD)	2520 (675)	2330 (727)	2390 (713)
Median [Min, Max]	2540 [1510, 4370]	2230 [441, 4130]	2320 [441, 4370]
Missing	0 (0%)	1 (1.0%)	1 (0.6%)
PAL			
Mean (SD)	1.71 (0.172)	1.63 (0.102)	1.70 (0.167)
Median [Min, Max]	1.71 [1.19, 2.21]	1.63 [1.48, 1.75]	1.70 [1.19, 2.21]
Missing	0 (0%)	98 (94.2%)	98 (62.0%)

4.2 Predictions from GLM

4.2.1 Completed PAL

We first look only at the data has PAL in the dataset (n=54 of 148). We calculate each “average person’s” predicted TEE based on their age, height, weight, sex, PAL group using the equations found in the report “Multiple Imputation GLM Results”. We used the primary models including all weight groups.

After calculating the TEE estimates, we compare with the observed TEE, using a diagonal line as reference:

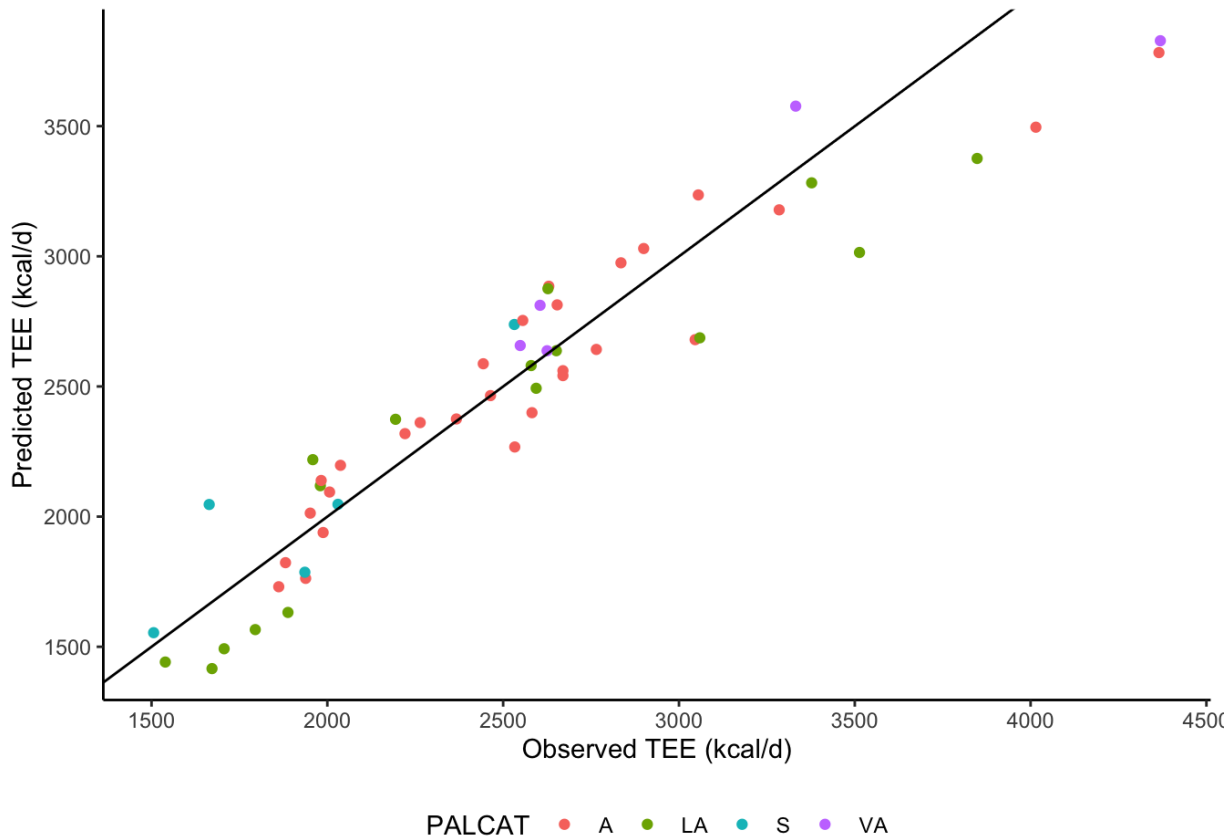


Figure 4.1: Completed PAL

Here are the model-fits based on R-squared, Pearson r correlation, MSE, RMSE, and MAPE.

BGMW	n	R2	r	MSE	RMSE	MAPE (%)
Boy	8	0.90	0.96	95651.47	309.28	7.90
Girl	7	0.82	0.97	56812.37	238.35	10.38
Man	14	0.85	0.93	45699.40	213.77	6.00
Woman	25	0.85	0.94	44940.87	211.99	6.83

Here are the summary statistics broken down by strata (Boy, Girl, Man, Woman):

	Boy (N=8)	Girl (N=7)	Man (N=14)	Woman (N=25)	Overall (N=54)
as.factor(Gender)					
Female	0 (0%)	7 (100%)	0 (0%)	25 (100%)	32 (59.3%)
Male	8 (100%)	0 (0%)	14 (100%)	0 (0%)	22 (40.7%)
Age					
Mean (SD)	11.3 (4.95)	9.99 (3.67)	40.7 (18.9)	37.1 (14.3)	30.7 (18.5)
Median [Min, Max]	9.45 [6.50, 18.6]	8.40 [6.70, 16.3]	39.6 [19.0, 94.0]	35.4 [21.9, 94.0]	31.9 [6.50, 94.0]

	Boy (N=8)	Girl (N=7)	Man (N=14)	Woman (N=25)	Overall (N=54)
Weight					
Mean (SD)	49.6 (26.2)	43.9 (24.1)	78.2 (12.7)	75.2 (25.6)	68.1 (25.9)
Median [Min, Max]	40.6 [24.5, 88.4]	30.1 [22.4, 85.8]	74.2 [65.0, 105]	67.3 [53.9, 162]	67.4 [22.4, 162]
Height					
Mean (SD)	148 (23.5)	141 (20.8)	175 (5.62)	158 (28.2)	159 (24.9)
Median [Min, Max]	140 [126, 181]	131 [122, 175]	177 [167, 182]	164 [24.0, 170]	165 [24.0, 182]
BMI					
Mean (SD)	20.8 (5.04)	20.5 (6.14)	25.4 (3.31)	27.9 (9.36)	25.2 (7.70)
Median [Min, Max]	19.9 [15.5, 27.4]	17.4 [15.1, 33.0]	24.4 [21.9, 33.8]	24.2 [20.9, 60.3]	23.7 [15.1, 60.3]
TEE					
Mean (SD)	2750 (1020)	2190 (602)	2830 (572)	2370 (552)	2520 (675)
Median [Min, Max]	2300 [1860, 4370]	1890 [1540, 3050]	2640 [1940, 4370]	2260 [1510, 3850]	2540 [1510, 4370]
PAL					
Mean (SD)	1.84 (0.156)	1.81 (0.221)	1.66 (0.130)	1.67 (0.161)	1.71 (0.172)
Median [Min, Max]	1.77 [1.69, 2.07]	1.72 [1.62, 2.21]	1.70 [1.36, 1.90]	1.69 [1.19, 1.98]	1.71 [1.19, 2.21]
PALCAT					
A	6 (75.0%)	3 (42.9%)	7 (50.0%)	12 (48.0%)	28 (51.9%)
VA	2 (25.0%)	0 (0%)	1 (7.14%)	2 (8.00%)	5 (9.26%)
LA	0 (0%)	4 (57.1%)	4 (28.6%)	8 (32.0%)	16 (29.6%)
S	0 (0%)	0 (0%)	2 (14.3%)	3 (12.0%)	5 (9.26%)

4.2.2 Estimated PAL

The majority of the missing entries in the original data set come from the variable **PAL**, the physical activity level. We will estimate and impute these values (**PAL_{est}**) using the Schofield equations for BMR. We know these equations are only estimates but are sufficient for these purposes to determine the average PAL level.

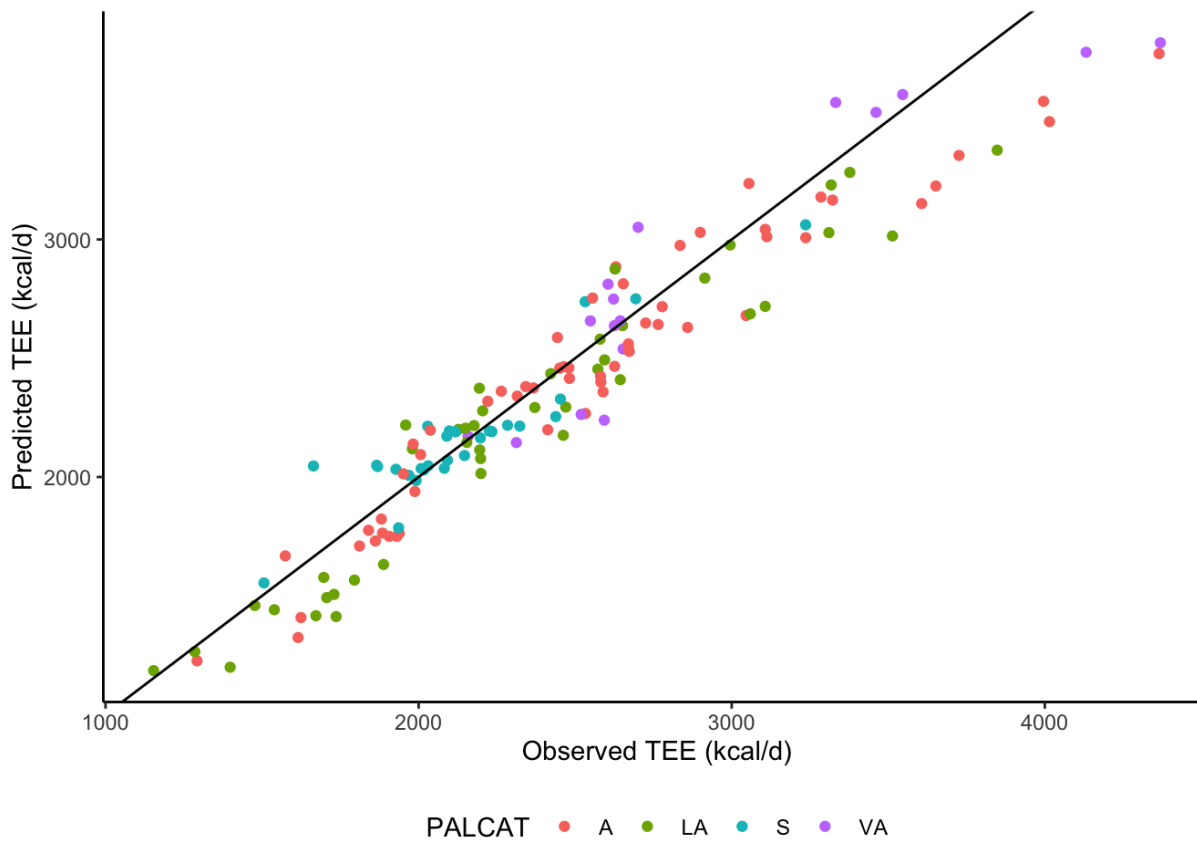


Figure 4.2: Estimated PAL

Model fit for each strata are reported here. These models are only performed on 144 of the 158 because we didn't include the 4 infant data (0 to 2) due to small samples, and 9 rows were missing height and weight, and 1 was missing TEE.

BGMW	n	R2	r	MSE	RMSE	MAPE (%)
Boy	21	0.92	0.96	61755.86	248.51	7.72
Girl	20	0.87	0.97	35342.89	188.00	8.01
Man	32	0.82	0.92	49684.74	222.90	5.57
Woman	71	0.82	0.93	28833.66	169.80	5.46

	Boy (N=21)	Girl (N=20)	Man (N=32)	Woman (N=71)	Overall (N=144)
as.factor(Gender)					
Female	0 (0%)	20 (100%)	0 (0%)	71 (100%)	91 (63.2%)
Male	21 (100%)	0 (0%)	32 (100%)	0 (0%)	53 (36.8%)
Age					
Mean (SD)	9.97 (4.68)	9.53 (4.14)	39.7 (16.6)	34.7 (11.9)	28.7 (16.8)
Median [Min, Max]	8.50 [3.00, 18.6]	8.10 [3.00, 18.0]	35.5 [19.0, 94.0]	33.7 [19.4, 94.0]	30.0 [3.00, 94.0]
Weight					
Mean (SD)	40.2 (22.4)	37.3 (19.3)	82.5 (11.9)	71.7 (19.0)	64.7 (24.8)
Median [Min, Max]	30.0 [16.4, 88.4]	29.3 [15.9, 85.8]	82.7 [65.0, 107]	67.3 [38.5, 162]	67.2 [15.9, 162]

	Boy (N=21)	Girl (N=20)	Man (N=32)	Woman (N=71)	Overall (N=144)
Height					
Mean (SD)	140 (24.9)	135 (21.1)	176 (4.38)	162 (16.9)	158 (22.2)
Median [Min, Max]	133 [100, 181]	129 [103, 175]	177 [167, 182]	165 [24.0, 170]	165 [24.0, 182]
BMI					
Mean (SD)	18.7 (3.91)	18.9 (4.36)	26.6 (3.38)	27.0 (6.77)	24.6 (6.54)
Median [Min, Max]	16.7 [14.4, 27.4]	17.2 [14.9, 33.0]	26.0 [21.9, 34.9]	24.3 [20.9, 60.3]	24.0 [14.4, 60.3]
TEE					
Mean (SD)	2410 (884)	1970 (525)	3040 (532)	2330 (399)	2450 (636)
Median [Min, Max]	1990 [1290, 4370]	1840 [1150, 3050]	3030 [1940, 4370]	2230 [1510, 3850]	2420 [1150, 4370]
PAL					
Mean (SD)	1.84 (0.156)	1.81 (0.221)	1.66 (0.130)	1.67 (0.161)	1.71 (0.172)
Median [Min, Max]	1.77 [1.69, 2.07]	1.72 [1.62, 2.21]	1.70 [1.36, 1.90]	1.69 [1.19, 1.98]	1.71 [1.19, 2.21]
Missing	13 (61.9%)	13 (65.0%)	18 (56.3%)	46 (64.8%)	90 (62.5%)
PALCAT					
A	15 (71.4%)	9 (45.0%)	15 (46.9%)	19 (26.8%)	58 (40.3%)
VA	6 (28.6%)	0 (0%)	4 (12.5%)	6 (8.45%)	16 (11.1%)
LA	0 (0%)	11 (55.0%)	8 (25.0%)	23 (32.4%)	42 (29.2%)
S	0 (0%)	0 (0%)	5 (15.6%)	23 (32.4%)	28 (19.4%)