

Web Appendix to  
‘Evaluation and Comparison of Food Records, Recalls, and Frequencies for Energy and  
Protein Assessment Using Recovery Biomarkers’

Ross L. Prentice et al

This appendix provides calibration equations for energy, protein, and protein density assessment in similar format to Table 4 in the main paper, for subsets of the Nutrition and Physical Activity Assessment Study (NPAAS) defined by race/ethnicity (white, black, Hispanic), and by body mass index (<25.0, 25.0-29.9, ≥30.0).

Web Table 1. Calibration Equation Coefficients ( $\beta$ ), Standard Errors (SE), and Percent of Biomarker Variation Explained ( $R^2$ ) Stratified by Race/Ethnicity

Variable	FFQ			4DFR			24HR		
	$\beta$	SE	$R^2$	$\beta$	SE	$R^2$	$\beta$	SE	$R^2$
<b>Energy</b>									
White Women									
Intercept	7.614	0.009		7.589	0.010		7.602	0.009	
Log-Energy	0.062	0.025 <sup>a</sup>	5.8	0.221	0.037 <sup>a</sup>	13.7	0.147	0.032 <sup>a</sup>	6.5
BMI	0.014	0.002 <sup>a</sup>	25.1	0.014	0.001 <sup>a</sup>	25.2	0.014	0.001 <sup>a</sup>	27.5
Age	-0.010	0.001 <sup>a</sup>	11.3	-0.009	0.001 <sup>a</sup>	9.0	-0.010	0.001 <sup>a</sup>	10.3
(Total) <sup>b</sup>			42.1			48.0			44.3
Black Women									
Intercept	7.599	0.020		7.591	0.020		7.597	0.019	
Log-Energy	0.023	0.030	1.8	0.038	0.057	0.0	-0.042	0.059	3.0
BMI	0.000	0.003 <sup>a</sup>	19.4	0.010	0.003 <sup>a</sup>	21.1	0.009	0.003 <sup>a</sup>	18.9
Age	-0.011	0.003 <sup>a</sup>	13.4	-0.011	0.003 <sup>a</sup>	13.4	-0.011	0.003 <sup>a</sup>	12.7
(Total) <sup>b</sup>			34.6			34.5			34.6
Hispanic Women									
Intercept	7.557	0.019		7.539	0.020		7.545	0.020	
Log-Energy	0.077	0.035 <sup>a</sup>	6.0	0.099	0.082	12.4	0.050	0.074	6.4
BMI	0.015	0.002 <sup>a</sup>	39.1	0.014	0.003 <sup>a</sup>	31.0	0.015	0.003 <sup>a</sup>	35.4
Age	-0.006	0.003	2.8	-0.004	0.004	1.4	-0.005	0.004	1.7
(Total) <sup>b</sup>			47.9			44.7			43.6
<b>Protein</b>									
White Women									
Intercept	4.258	0.017		4.224	0.015		4.267	0.015	
Log-Protein	0.169	0.042 <sup>a</sup>	9.3	0.565	0.053 <sup>a</sup>	33.1	0.437	0.053 <sup>a</sup>	21.2
BMI	0.010	0.003 <sup>a</sup>	5.4	0.010	0.002 <sup>a</sup>	4.7	0.010	0.003 <sup>a</sup>	5.4
Age	-0.011	0.003 <sup>a</sup>	5.3	-0.007	0.002 <sup>a</sup>	1.8	-0.011	0.002 <sup>a</sup>	4.7
(Total) <sup>b</sup>			19.9			39.6			31.4
Black Women									
Intercept	4.124	0.046		4.090	0.042		4.105	0.041	
Log-Protein	0.081	0.061	4.9	0.187	0.119	2.5	0.119	0.156	0.2
BMI	0.013	0.006 <sup>a</sup>	8.8	0.014	0.006 <sup>a</sup>	10.8	0.013	0.006 <sup>a</sup>	9.1
Age	-0.012	0.006	3.6	-0.014	0.006 <sup>a</sup>	4.8	-0.012	0.006	4.2
(Total) <sup>b</sup>			17.3			18.1			13.5
Hispanic Women									
Intercept	4.177	0.035		4.164	0.033		4.192	0.034	
Log-Protein	0.112	0.059	5.0	0.365	0.121 <sup>a</sup>	14.7	0.336	0.118 <sup>a</sup>	13.2
BMI	0.014	0.005 <sup>a</sup>	15.2	0.014	0.004 <sup>a</sup>	13.4	0.015	0.004 <sup>a</sup>	15.8
Age	-0.013	0.007 <sup>a</sup>	5.2	-0.010	0.006	3.3	-0.009	0.006	2.4
(Total) <sup>b</sup>			25.4			31.3			31.5

Web Table 1 (continued).

Variable	FFQ			4DFR			24HR		
	$\beta$	SE	R <sup>2</sup>	$\beta$	SE	R <sup>2</sup>	$\beta$	SE	R <sup>2</sup>
<b>Protein Density</b>									
White Women									
Intercept	2.651	0.017		2.670	0.016		2.692	0.018	
Log-Protein Density	0.284	0.088 <sup>a</sup>	3.6	0.490	0.080 <sup>a</sup>	12.4	0.453	0.086 <sup>a</sup>	9.2
BMI	-0.003	0.003	0.4	-0.002	0.003	0.3	-0.004	0.003	0.5
Age	-0.002	0.003	0.1	-0.0005	0.003	0.0	-0.002	0.003	0.3
(Total) <sup>b</sup>			4.1			12.7			10.0
Black Women									
Intercept	2.534	0.044		2.528	0.043		2.519	0.044	
Log-Protein Density	0.218	0.161	2.8	0.276	0.169	4.2	0.043	0.191	0.1
BMI	0.004	0.006	0.5	0.003	0.006	0.3	0.005	0.006	1.0
Age	0.002	0.007	0.1	0.001	0.006	0.0	0.001	0.007	0.0
(Total) <sup>b</sup>			3.4			4.5			1.1
Hispanic Women									
Intercept	2.600	0.036		2.635	0.037		2.634	0.039	
Log-Protein Density	0.479	0.174 <sup>a</sup>	13.3	0.632	0.210 <sup>a</sup>	13.7	0.318	0.164	8.7
BMI	-0.001	0.005	0.0	0.002	0.005	0.5	0.0001	0.005	0.1
Age	-0.009	0.007	2.7	-0.010	0.007	3.8	-0.008	0.007	2.4
(Total) <sup>b</sup>			15.9			17.9			11.2

BMI, body mass index; FFQ, food frequency questionnaire; 4DFR, four-day food record; 24HR, 24-hour dietary recall

Numbers of women contributing to the FFQ, 4DFR, and 24HR energy analyses are 268, 268, 266, white; 79, 79, 79, black; and 55, 55, 54, Hispanic. Corresponding numbers for protein analyses are 284, 284, 282, white; 82, 82, 81, black; and 63, 63, 62, Hispanic. Protein density numbers are 264, 264, 262, white; 77, 77, 77, black; and 54, 53, 53, Hispanic.

<sup>a</sup>Coefficient differs from zero at p=0.05 significance level

<sup>b</sup>Total – percent of log-biomarker variation explained by all variables. See Table 4 footnote for explanation of R<sup>2</sup> calculations.

Web Table 2. Calibration Equation Coefficients ( $\beta$ ), Standard Errors (SE), and Percent of Biomarker Variation Explained ( $R^2$ ) Stratified by Body Mass Index

Variable	FFQ			4DFR			24HR		
	$\beta$	SE	$R^2$	$\beta$	SE	$R^2$	$\beta$	SE	$R^2$
<b>Energy</b>									
Body Mass Index < 25.0									
Intercept	7.646	0.025		7.609	0.026		7.630	0.025	
Log-Energy	0.068	0.032 <sup>a</sup>	1.8	0.228	0.050 <sup>a</sup>	12.4	0.186	0.050 <sup>a</sup>	4.3
BMI	0.020	0.004 <sup>a</sup>	15.4	0.018	0.004 <sup>a</sup>	12.8	0.021	0.004 <sup>a</sup>	16.4
Age	-0.008	0.002 <sup>a</sup>	7.8	-0.008	0.002 <sup>a</sup>	6.9	-0.008	0.002 <sup>a</sup>	8.4
Black	0.013	0.041		-0.002	0.039		0.011	0.040	
Hispanic	-0.079	0.038 <sup>a</sup>	2.2 <sup>b</sup>	-0.070	0.036	1.6 <sup>b</sup>	-0.074	0.037 <sup>a</sup>	1.9 <sup>b</sup>
Other Minority	-0.024	0.053		-0.016	0.050		-0.020	0.051	
(Total)			27.1			33.7			31.1
Body Mass Index 25.0 – 29.9									
Intercept	7.611	0.019		7.600	0.020		7.614	0.019	
Log-Energy	0.049	0.032	3.5	0.131	0.065 <sup>a</sup>	8.5	0.051	0.053	1.8
BMI	0.019	0.006 <sup>a</sup>	17.8	0.018	0.006 <sup>a</sup>	14.2	0.019	0.006 <sup>a</sup>	17.0
Age	-0.008	0.002 <sup>a</sup>	8.9	-0.008	0.002 <sup>a</sup>	8.5	-0.009	0.002 <sup>a</sup>	9.5
Black	-0.018	0.039		-0.022	0.037		-0.038	0.036	
Hispanic	0.007	0.040	0.2 <sup>b</sup>	0.015	0.040	0.5 <sup>b</sup>	0.007	0.041	1.0 <sup>b</sup>
Other Minority	-0.003	0.101		-0.003	0.101		-0.013	0.102	
(Total)			30.4			31.7			29.3
Body Mass Index $\geq$ 30.0									
Intercept	7.629	0.018		7.618	0.018		7.625	0.017	
Log-Energy	0.042	0.025	5.7	0.112	0.040 <sup>a</sup>	7.3	0.061	0.036	6.5
BMI	0.012	0.002 <sup>a</sup>	18.1	0.012	0.002 <sup>a</sup>	18.9	0.012	0.002 <sup>a</sup>	19.2
Age	-0.013	0.002 <sup>a</sup>	16.5	-0.012	0.002 <sup>a</sup>	14.2	-0.011	0.002 <sup>a</sup>	13.6
Black	-0.053	0.025 <sup>a</sup>		-0.052	0.024 <sup>a</sup>		-0.046	0.024	
Hispanic	-0.105	0.032 <sup>a</sup>	4.7 <sup>b</sup>	-0.119	0.030 <sup>a</sup>	6.4 <sup>b</sup>	-0.107	0.030 <sup>a</sup>	5.5 <sup>b</sup>
Other Minority	-0.105	0.091		-0.109	0.089		-0.098	0.086	
(Total)			45.0			46.8			44.8

Web Table 2 (continued).

Variable	FFQ			4DFR			24HR		
	$\beta$	SE	R <sup>2</sup>	$\beta$	SE	R <sup>2</sup>	$\beta$	SE	R <sup>2</sup>
<b>Protein</b>									
Body Mass Index < 25.0									
Intercept	4.242	0.048		4.179	0.041		4.236	0.043	
Log-Protein	0.178	0.052 <sup>a</sup>	8.5	0.643	0.069 <sup>a</sup>	35.1	0.537	0.074 <sup>a</sup>	22.9
BMI	0.004	0.008	0.3	0.002	0.007	0.0	0.003	0.007	0.2
Age	-0.011	0.004 <sup>a</sup>	4.4	-0.008	0.003 <sup>a</sup>	2.3	-0.012	0.003 <sup>a</sup>	4.9
Black	-0.097	0.080		-0.154	0.066 <sup>a</sup>		-0.125	0.071	
Hispanic	-0.116	0.069	1.9 <sup>b</sup>	-0.088	0.057	2.6 <sup>b</sup>	-0.129	0.060 <sup>a</sup>	2.8 <sup>b</sup>
Other Minority	-0.027	0.100		0.031	0.084		-0.056	0.090	
(Total)			15.0			40.0			30.8
Body Mass Index 25.0 – 29.9									
Intercept	4.190	0.037		4.176	0.035		4.217	0.036	
Log-Protein	0.121	0.055 <sup>a</sup>	8.2	0.438	0.094 <sup>a</sup>	23.4	0.311	0.092 <sup>a</sup>	10.8
BMI	0.007	0.011	1.1	0.004	0.010	0.3	0.006	0.010	0.8
Age	-0.012	0.005 <sup>a</sup>	5.2	-0.009	0.004 <sup>a</sup>	2.1	-0.013	0.004 <sup>a</sup>	5.4
Black	-0.098	0.077		-0.099	0.068		-0.153	0.070 <sup>a</sup>	
Hispanic	-0.001	0.080	1.5 <sup>b</sup>	0.001	0.074	1.8 <sup>b</sup>	-0.014	0.077	3.9 <sup>b</sup>
Other Minority	0.015	0.168		0.053	0.156		-0.012	0.162	
(Total)			16.0			27.7			21.0
Body Mass Index ≥ 30.0									
Intercept	4.270	0.037		4.262	0.036		4.284	0.035	
Log-Protein	0.100	0.047 <sup>a</sup>	7.7	0.278	0.078 <sup>a</sup>	11.8	0.326	0.081 <sup>a</sup>	15.7
BMI	0.014	0.004 <sup>a</sup>	6.5	0.014	0.004 <sup>a</sup>	5.5	0.012	0.004 <sup>a</sup>	4.3
Age	-0.013	0.004 <sup>a</sup>	4.0	-0.012	0.004 <sup>a</sup>	3.3	-0.010	0.004 <sup>a</sup>	2.1
Black	-0.137	0.055 <sup>a</sup>		-0.153	0.050 <sup>a</sup>		-0.133	0.051 <sup>a</sup>	
Hispanic	-0.084	0.064	3.3 <sup>b</sup>	-0.086	0.060	4.6 <sup>b</sup>	-0.040	0.062	3.5 <sup>b</sup>
Other Minority	-0.057	0.191		-0.075	0.186		0.007	0.184	
(Total)			21.5			25.3			25.7

Web Table 2 (continued).

Variable	FFQ			4DFR			24HR		
	$\beta$	SE	R <sup>2</sup>	$\beta$	SE	R <sup>2</sup>	$\beta$	SE	R <sup>2</sup>
<b>Protein Density</b>									
Body Mass Index < 25.0									
Intercept	2.567	0.045		2.604	0.044		2.608	0.045	
Log-Protein Density	0.510	0.117 <sup>a</sup>	9.9	0.579	0.105 <sup>a</sup>	15.1	0.492	0.101 <sup>a</sup>	10.3
BMI	-0.023	0.008 <sup>a</sup>	5.6	-0.019	0.007 <sup>a</sup>	4.8	-0.023	0.007 <sup>a</sup>	5.9
Age	-0.005	0.003	0.9	-0.003	0.003	0.5	-0.005	0.003	1.0
Black	-0.092	0.074		-0.148	0.070 <sup>a</sup>		-0.152	0.072 <sup>a</sup>	
Hispanic	-0.047	0.066	1.2 <sup>b</sup>	-0.042	0.064	2.3 <sup>b</sup>	-0.060	0.065	2.7 <sup>b</sup>
Other Minority	-0.070	0.093		-0.011	0.090		-0.069	0.092	
(Total)			17.6			22.7			19.9
Body Mass Index 25.0 – 29.9									
Intercept	2.585	0.038		2.605	0.037		2.608	0.040	
Log-Protein Density	0.263	0.141	3.8	0.436	0.140 <sup>a</sup>	9.9	0.276	0.140 <sup>a</sup>	3.8
BMI	-0.014	0.012	2.9	-0.006	0.012	1.6	-0.012	0.012	2.3
Age	-0.002	0.005	0.1	0.002	0.005	0.3	-0.002	0.005	0.1
Black	-0.079	0.075		-0.095	0.072		-0.101	0.074	
Hispanic	-0.048	0.084	1.4 <sup>b</sup>	-0.068	0.083	2.0 <sup>b</sup>	-0.048	0.084	2.3 <sup>b</sup>
Other Minority	-0.111	0.208		-0.082	0.201		-0.163	0.206	
(Total)			8.1			13.7			8.5
Body Mass Index ≥ 30.0									
Intercept	2.640	0.039		2.671	0.039		2.687	0.040	
Log-Protein Density	0.312	0.108 <sup>a</sup>	6.2	0.433	0.112 <sup>a</sup>	8.6	0.428	0.125 <sup>a</sup>	6.9
BMI	0.003	0.005	0.0	0.001	0.004	0.0	0.002	0.005	0.0
Age	0.001	0.004	0.1	0.001	0.004	0.1	-0.002	0.004	0.0
Black	-0.074	0.055		-0.105	0.054		-0.106	0.054	
Hispanic	-0.008	0.069	1.2 <sup>b</sup>	0.010	0.068	2.7 <sup>b</sup>	0.016	0.070	2.8 <sup>b</sup>
Other Minority	-0.008	0.196		-0.007	0.192		-0.004	0.195	
(Total)			7.6			11.4			9.8

BMI, body mass index; FFQ, food frequency questionnaire; 4DFR, four-day food record; 24HR, 24-hour dietary recall

The numbers of women contributing to the FFQ, 4DFR, and 24HR analyses among women having BMI < 25.0 are 165, 165, 165; among women having 25.0 ≤ BMI ≤ 29.9 are 97, 97, 97; and among women having BMI ≥ 30.0 are 153, 153, 150. Corresponding numbers of women for protein are 177, 177, 177 for BMI < 25.0; 106, 106, 106 for 25.0 ≤ BMI ≤ 29.9; and are 160, 160, 156 for BMI ≥ 30.0. Numbers for

protein density are 163, 163, 163 for BMI < 25.0; 97, 96, 97 for  $25.0 \leq \text{BMI} \leq 29.9$ ; and 148, 148, 145 for BMI  $\geq 30.0$ .

<sup>a</sup>Coefficient significantly differs from zero at  $p=0.05$  significance level

<sup>b</sup>Percent of variation in log-biomarker attributable to overall race/ethnicity classification. See Table 4 footnote for explanation of  $R^2$  calculations.