eAppendix

Bias Adjustment

Let x be the monitor pressure (in mm Hg), x^* be the true pressure (or the more accurate meter pressure, which is assumed to be true), and ε be the systematic error arising from measuring with the less accurate monitor. Then

$$x \equiv x^* + \varepsilon \tag{1}$$

Suppose that the distribution of the errors ε conditional on x^* are normally distributed with mean µ and variance σ^2. Furthermore, assume that both the mean (μ) and standard deviation (σ) of the normal distribution for a particular x^* are linear in x^*. That is

$$\mu = mx^* + c$$

$$\sigma = px^* + d$$

Then

$$f(\varepsilon \mid x^*) = \frac{1}{\sqrt{2\Pi\left(px^* + d\right)^2}} \exp\left(- \frac{\left[\varepsilon - \left(mx^* + c\right)\right]^2}{2\left(px^* + d\right)^2} \right) \tag{2}$$

where m, c, p, and d fully parameterize this conditional, normal distribution. Performing maximum likelihood estimation on the data from the validity study, we obtain the following parameter estimates (standard errors in parenthesis):

$\hat{m}$ = −0.0151923 (0.0004225)

$\hat{c}$ = 2.344279 (0.0814004)

$\hat{p}$ = −0.0051017 (0.0003233)

$\hat{d}$ = 3.291946 (0.0611373)

All estimates are significant at the 1% level (p-values in Stata are 0.000). These estimates indicate the following:

1. The negative $\hat{m}$ indicates that, on average, the systematic error decreases with increasing true pressure. (That is, on average, a person with hypertension has an error which is more negative compared to a person with no hypertension.) The observed monitor pressures have negative errors when true pressure is < 154.31 ($x^* = -\frac{\hat{c}}{\hat{m}}$), zero error when true pressure = 154.31, and positive errors when true pressure is > 154.31.
2. The negative $\hat{p}$ indicates that the standard deviation of the error decreases with increasing true pressure.

The log likelihood from performing maximum likelihood estimation under different assumptions is tabulated below. Comparing the different models, it is clear that the form chosen above (the one with the highest log likelihood) has the best fit among them.

Distributional form of ε	**Mean**	**Variance**	**Log Likelihood**
Normal, Conditional on x^*	Linear in x^*	Linear in x^*	-14083.813
Normal, Conditional on x^*	Linear in x^*	Constant	-14199.657
Normal, Conditional on x	Linear in x	Linear in x	-14203.203
Normal, Conditional on x	Linear in x	Constant	-14290.249
Normal, Unconditional	Constant	Constant	-14761.244

However, when measuring pressure in the field, one only observes the measured value x and not the true unobserved value x^*. Thus, an adjustment must be made to the measured value x to obtain the true value. From equation (1), in expectation,

$$x = E[x^*] + E[\varepsilon] \qquad (3)$$

But given equation (2),

$$E[\varepsilon] = E[E[\varepsilon \mid x^*]] = E[mx^* + c] = mE[x^*] + c$$

where the first equality holds by the law of iterated expectations. Substituting in (3) for $E(\varepsilon)$ and rearranging the terms we get

$$E[x^*] = \frac{x-c}{1+m}$$

Therefore, using the parameters estimated above, the adjustment to be made to obtain the expected true value x^* from an observed measured value x is

$$E\left[x^*\right] = \frac{x - \hat{c}}{1 + \hat{m}} \approx \left(1.015427 \times x\right) - 2.380443$$

eTable 1. Food/Caffeine/Smoking 30 Minutes Prior to Blood Pressure Measurement

	Add Health, Wave IV (2008)					NHANES (2007-8)				
	n	Systolic BP[a]	(95% CI)	Diastolic BP[a]	(95% CI)	n	Systolic BP[b]	(95% CI)	Diastolic BP[b]	(95% CI)
Food/caffeine/smoking										
None[c]	10137	125	124, 125	79	79, 80	551	113	112, 115	68	66, 69
Some	4014	125	124, 126	80	79, 80	182	115	113, 117	66	64, 68
Food										
No	10831	125	125, 125	79	79, 80	570	114	112, 115	68	67, 69
Yes	3356	125	124, 126	79	79, 80	163	115	112, 117	66	63, 68
Caffeine										
No	12140	125	124, 125	79	79, 80	726	114	113, 115	67	66, 68
Yes	2093	126	125, 127	80	80, 81	7	122	113, 131	66	61, 72
Smoking										
No	13676	125	124, 125	79	79, 80	711	114	113, 115	67	66, 68
Yes	535	127	125, 128	80	79, 82	22	118	114, 122	67	60, 73

[a] Means (95% CI) weighted to be representative of adolescents in grades 7-12 in the U.S. during the1994-95 school year.

[b]Weighted means (95% CI).

[c]No food, caffeine or smoking in past 30 minutes.

eTable 2.Terminal Digit Preference of Blood Pressure, Add Health Wave IV (2008)

	Systolic BP Measure			Diastolic BP Measure		
Terminal Digit	**1 %[a]**	**2 %[a]**	**3 %[a]**	**1 %[a]**	**2 %[a]**	**3 %[a]**
0	10.5	10.7	10.7	10.4	10.7	10.5
1	10.1	9.9	10.0	9.4	9.4	9.3
2	10.2	9.8	9.8	10.9	11.0	11.2
3	10.4	10.2	9.6	11.4	10.6	11.1
4	10.0	10.5	10.3	10.2	9.6	9.8
5	9.7	9.5	9.9	9.6	9.6	9.7
6	9.8	10.0	10.0	9.3	10.0	9.9
7	9.8	9.5	10.0	9.8	9.7	9.5
8	10.1	10.0	9.9	9.6	9.8	9.5
9	9.5	10.0	9.9	9.5	9.6	9.7
Pearson χ^2	12.49	19.26	11.71	67.90	44.99	61.76
P value	0.187	0.023	0.230	<0.001	<0.001	<.0001
DPS[b]	1.0	1.2	0.9	2.2	1.8	2.1

[a]Unweighted percents; n=15,347.

[b]DPS = digit preference score (see methods).

eTable 3. Accuracy of Monitor Pressure, by Meter Pressure (mm Hg), Add Health Wave IV (2008)

		Bias (mm Hg)[a]			Relative Bias (%)[b]		
Meter pressure (mm Hg)	n	Median	Mean	Std	Median	Mean	Std
280	409	-1.70	-1.79	1.78	-0.60%	-0.64%	0.64%
260	415	-1.30	-1.34	1.89	-0.50%	-0.51%	0.73%
240	418	-1.10	-1.20	1.89	-0.46%	-0.50%	0.79%
220	431	-1.10	-1.26	2.15	-0.50%	-0.57%	0.98%
200	451	-1.10	-1.38	2.16	-0.55%	-0.69%	1.08%
180	465	-0.70	-0.57	2.66	-0.39%	-0.31%	1.48%
160	480	-0.30	-0.06	2.69	-0.19%	-0.03%	1.68%
140	491	0.00	0.28	2.65	0.00%	0.20%	1.89%
120	502	0.40	0.71	2.59	0.33%	0.60%	2.16%
100	513	0.60	1.30	3.27	0.59%	1.30%	3.27%
80	516	0.75	1.23	2.74	0.95%	1.53%	3.42%
60	512	0.70	1.30	2.73	1.16%	2.17%	4.53%
40	458	0.90	1.55	2.53	2.24%	3.86%	6.28%

[a]Bias = monitor pressure - meter pressure; Negative bias indicates underestimation and positive bias indicates overestimation.
[b]Relative bias = 100 $\times$ (Bias $\div$ meter pressure).

eTable 4. Reliability of Resting, Seated Blood Pressure, Add Health Wave IV (2008)

Pressure		Variance Between-Participant	Between-Visit	Within-Visit	Total	ICC[a]	(95% CI)
Systolic BP	1	127.770	67.622		195.392	0.65	0.54, 0.76
	2	136.420	43.293		179.713	0.75	0.67, 0.84
	3	114.190	56.712		170.902	0.66	0.55, 0.78
	1-3	123.420	15.059	43.909	182.388	0.67	0.59, 0.75
	Mean[b]	124.890	28.934		153.824	0.81	0.74, 0.88
Diastolic BP	1	56.2668	37.7294		93.996	0.59	0.46, 0.72
	2	68.2485	44.7751		113.024	0.60	0.47, 0.73
	3	67.6312	29.0477		96.679	0.69	0.59, 0.80
	1-3	64.9698	18.8493	18.9748	102.7939	0.63	0.53, 0.72
	Mean[b]	67.2055	30.4655		97.671	0.68	0.57, 0.79

[a]ICC (95% CI) = intraclass correlation coefficient (95% confidence interval).
[b]Averaged over measures 2-3 according to Joint National Committee (JNC) 7 recommendations. This is the measure made available to Add Health users in the publicly disseminated dataset.

eTable 5. Mean Blood Pressure by Field Interviewer's (FI) and Participant's Gender and Race, Add Health (Wave IV)

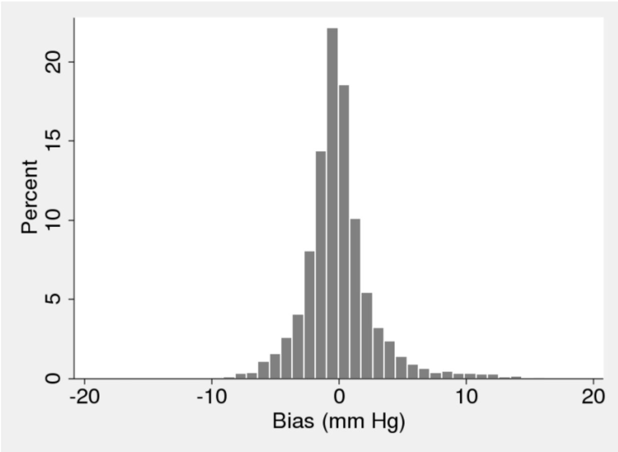
	n	Systolic BP[a]	(95% CI)	Diastolic BP[a]	(95% CI)
FI female					
Participant female	6527	120	119, 121	77	76, 77
Participant male	5600	130	129, 130	82	81, 82
FI male					
Participant female	711	120	119, 121	77	76,78
Participant male	779	130	128, 131	81	80, 82
By race					
FI white, non-Hispanic					
Participant white, non-Hispanic	5523	125	124, 125	79	79, 80
Participant black, non-Hispanic	1404	127	126, 128	80	79, 81
Participant Hispanic /Latino	981	124	123, 125	79	78, 80
Participant Asian/PI, non-Hispanic	378	123	120, 126	79	77, 82
Participant other/multiracial	530	125	124, 127	80	79, 81
FI black, non-Hispanic					
Participant white, non-Hispanic	1222	125	124, 126	79	78, 80
Participant black, non-Hispanic	985	126	125, 127	80	79, 81
Participant Hispanic /Latino	466	126	124, 128	79	77, 81
Participant Asian/PI, non-Hispanic	107	125	115, 135	81	75, 86
Participant other/multiracial	153	123	121, 126	79	76, 81
FI other					
Participant white, non-Hispanic	565	123	122, 125	78	77, 79
Participant black, non-Hispanic	262	127	123, 130	80	78, 82
Participant Hispanic /Latino	536	124	121, 126	79	77, 80
Participant Asian/PI, non-Hispanic	285	126	124, 128	80	79, 82
Participant other/multiracial	167	125	120, 130	80	76, 84

[a]Means (95% CI) weighted to be representative of adolescents in grades 7-12 in the U.S. during the1994-95 school year.

eTable 6. Participant Characteristics, Ages 24-32 Years

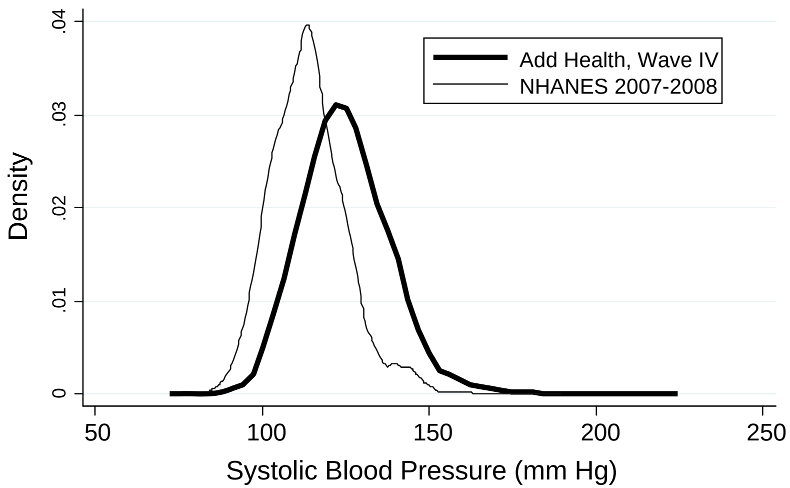
	Add Health, Wave IV (2008)[a]			NHANES (2007-8)[a]			American Community Survey (2008)		
	n	Mean or %[b]	95% CI	n	Mean or %[c]	95% CI	n	Mean or %[c]	95% CI
Age (years); mean	14252	28	28, 29	733	28	28, 28	306837	28	28, 28
Male, %	6683	51	49, 52	363	51	46, 56	151455	51	51, 51
Race/ethnicity, %									
White, non-Hispanic	7636	66	60, 72	287	62	50, 73	195554	60	59, 60
Black, non-Hispanic	2837	15	11, 19	160	13	9, 18	32116	13	13, 13
Asian/PI, non-Hispanic	813	3	2, 5	---	---	---	17576	5	5, 5
Hispanic	2027	11	8, 15	258	19	14, 26	53229	20	20, 20
Foreign-born, %	870	4	3, 6	185	19	13, 26	52401	19	19, 19
Education[d], %									
< High School	1100	9	8, 11	194	19	15, 24	36333	14	13, 14
High school/GED	2279	18	16, 20	178	22	18, 27	72287	25	25, 26
Some college/ AA	6298	43	41, 45	212	31	26, 37	97718	32	32, 32
4-Year college	4572	30	27, 33	149	28	21, 35	100499	29	29, 29
Household income ≤ $20,000, %	1527	12	11, 14	143	15	11, 20	31891	12	12, 12
Uninsured, %	2927	22	21, 24	285	31	25, 37	77504	28	28, 29

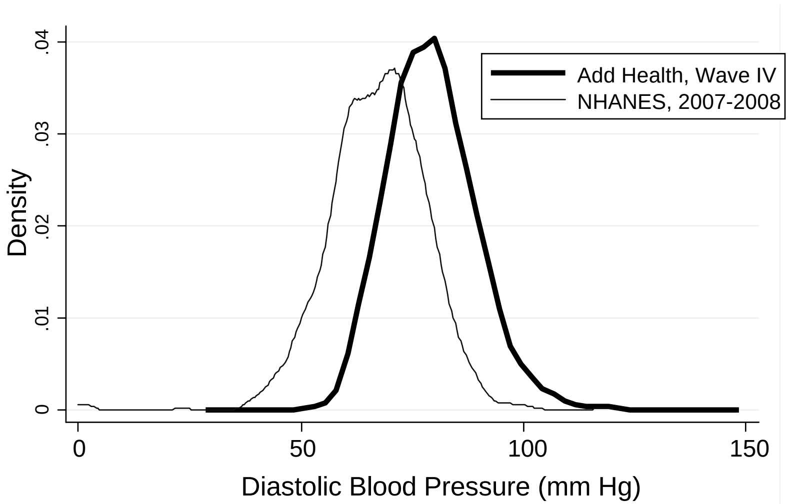
[a]With valid blood pressure data.
[b]Means, percents (95% CI) weighted to be representative of adolescents in grades 7-12 in the U.S. during the1994-95 school year.
[c]Weighted percents (95% CI).
[d]GED = General Educational Development or high school equivalency degree; AA = Associate's Degree.



eFigure 1. Frequency distribution of the monitor pressure - meter pressure difference (bias, mm Hg). Add Health, Wave IV (2008).

eFigure 2. Distribution of Systolic and Diastolic Blood Pressures in Add Health Wave IV (2008) and NHANES (2007-2008), Ages 24-32.


Density
0
.01
.02
.03
.04
50
100
150
200
250
Systolic Blood Pressure (mm Hg)
Add Health, Wave IV
NHANES 2007-2008



Add Health, Wave IV
NHANES, 2007-2008
Density
0
.01
.02
.03
.04
0
50
100
150
Diastolic Blood Pressure (mm Hg)