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Longitudinal Aging Study in India: Biomarker Data Documentation

David E. Bloom, Perry Hu, P. Arokiasamy, Arun Risbud, T.V. Sekher, S.K. Mohanty, Varsha Kale, Jennifer O'Brien, Sandy Chien, and Jinkook Lee

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LABOR AND POPULATION

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1. Introduction

The Longitudinal Aging Study in India (LASI) is designed to be a nationally representative study of the physical, financial, and social well-being of India's 45+ population. The instrument is designed to be comparable to the Health and Retirement Study (HRS), which is a model for several studies across the world. This harmonization in instruments allows for cross-national comparative studies. In addition to a harmonized set of core questions, the instrument also reflects circumstances specific to Indian culture and institutions.

The LASI instrument has three components: (1) the household survey, which is completed by a key household informant; (2) the individual survey, administered to all age-eligible household members (and their spouses, regardless of age); and (3) the biomarker collection, which includes: anthropometric measures, blood pressure readings, vision and physical functioning tests, and collection of dried blood samples (DBS).

Direct assessment of biomarkers, which can yield objective health measures, is particularly important in India. Despite improvements in access to health care, undiagnosed diseases are quite common, especially among people characterized by low socioeconomic status (SES) (Lee et al., 2012). Relative to younger population, the elderly population is at a greater risk of developing undiagnosed diseases, as it is excluded from the nascent health insurance plan for the poor, which covers only those aged 65 or younger. Education, an important determinant for identifying health problems, is particularly low among the elderly in India (Arokiasamy et al., 2012). Therefore, to better understand the health conditions of the elderly in India, direct assessment of biomarkers is critical.

This report describes the following:

- Data collection protocol, including sample sizes and response rate;
- Laboratory protocol for the DBS assays (with the description of our quality control protocol) and the results of validation study; and
- The distributional characteristics of biomarker data, the list of biomarker variables available in public data file, and the application procedure to obtain restricted biomarker data file.

2. Biomarker Collection

2.1 Protocol

To ensure consistency across fieldworkers, IIPS led and coordinated a training program (Training of the Trainers, ToT) for researchers from the Population Research Councils (PRC) during the period August 29th to September 9th, 2010. Members of the HRS survey research team from the University of Michigan also provided guidance and support for this training. The agenda for the workshop included presentations on the study design, the importance of aging research in India, and the global context of the project, as well as a module-by-module review of the instrument and plan for how to administer the biomarker module.

PRC researchers trained at the ToT meeting then returned to their individual states, where they trained their state-based interview teams. Each state had eight interview teams, composed of four members each: two men and two women. For the biomarker module and the more culturally-sensitive questions, teams, comprised of males and females, were instructed to practice gender-matched interviewer conditions. As part of the state-level training, each state team also conducted 50 pretests.

See Appendix A for the biomarker protocol distributed to the interviewers.

2.2 Sample Design and Completion Rate

The LASI pilot survey was conducted in 2010 in four India states— Punjab and Rajasthan in the north, and Karnataka and Kerala in the south. The survey was fielded in the dominant language of each state. These four states were chosen to capture the demographic, economic, health, and cultural diversity of India.

The sampling plan was based on the 2001 Indian Census. Two districts were randomly chosen from each of the four states. Within these districts, eight primary sampling units (PSUs) were chosen to be included in the study. PSUs were stratified across urban and rural districts within each state to capture a variety of socioeconomic conditions. Rural PSUs with fewer than 500 households were then selected through a two-stage sampling procedure, while urban PSUs and rural PSUs with more than 500 households were selected through a three-stage procedure.

Eligible households were defined as those with at least one member aged 45 years or above. Eligible individuals were those in selected households who were 45 years of age or older or who were married to an individual of that age. LASI randomly sampled 1,546 households from these stratified PSUs, and among them, members of 950 households were interviewed. Among these households, LASI collected data from 1,683 individuals from October to December in 2010.

Among the 1,683 individuals, 1,311 respondents completed the biomarker module (77.9% biomarker module completion rate). The biomarker module could be completed at any time during the interview; in fact, respondents could complete the biomarker module even before starting the individual interview. This happened in 64 cases, and for these respondents we have no individual interview information. We did not include these 64 cases in our file.

Table 1 below shows the completion rate for each task the respondent was asked to complete in the biomarker interview. The difficulty and effort required by these tasks varied. For timed walks, only individuals aged and older were considered eligible for this measure, but 133 age-ineligible respondents also participated in timed walks. These ineligible respondents are not included in the table.

For the collection of dried blood spots (DBS), the respondents had to provide separate consent to enable researchers to prick their finger and place five drops of blood on a card. The starting response rate for DBS collection is 77.5%. In the case of Karnataka, researchers struggled to collect blood from the respondents. It was later noted that many of these respondents hail from district of Bellary, and the calluses on the respondents' hands from heavy mining work made it difficult to puncture the skin and draw blood. Table 1 also shows different completion rates by state.

Table 1. Completion Rate for Biomarkers

	All Rs		Punjab		Rajasthan		Kerala		Karnataka	
Total N	1683	%	402	%	417	%	462	%	402	%
Blood Pressure/Pulse	1305	78%	309	77%	315	76%	365	79%	316	79%
Height	1311	78%	309	77%	321	77%	365	79%	316	79%
Weight	1311	78%	309	77%	321	77%	365	79%	316	79%
Waist Circumference	1310	78%	309	77%	321	77%	365	79%	315	78%
Hip Circumference	1310	78%	309	77%	321	77%	365	79%	315	78%
Timed Walks*	294	65%	69	64%	77	64%	88	59%	60	80%
Vision	1310	78%	309	77%	321	77%	365	79%	315	78%
Grip Strength	1309	78%	308	77%	321	77%	365	79%	315	78%
Balance Test (semi tandem)	1308	78%	307	76%	321	77%	365	79%	315	78%
Lung Function	1311	78%	309	77%	321	77%	365	79%	316	79%
Dried Blood Sample	1305	78%	306	76%	321	77%	364	79%	314	78%

*Timed Walks: R is eligible if age is 60+. Percentage is based on respondents who are age 60+.

3. Methods of Dried Blood Spot (DBS) Based Biomarkers

3.1 Selection of DBS-based biomarkers

C-reactive protein (CRP)

There is strong evidence to suggest that chronic inflammation plays an important role in the process of aging and age-related diseases (Singh & Newman 2011). Persistently elevated level of CRP, a biomarker for systemic inflammation, is associated with increased risk of cardiovascular disease, functional decline, and higher mortality in older adults (Figaro et al. 2006; Fulop et al. 2010; Lindahl et al. 2000). Therefore, the DBS-based CRP assay has been increasingly incorporated into community-based surveys as a marker of cardiac health.

Epstein-Barr virus (EBV) antibody titer

Primary EBV infection occurs during the first few months or years of life in developing countries (Dinand & Arya 2006). Adequate cell-mediated immune function is critical for maintaining the virus in a latent state over the lifetime of an individual. Impaired cell-mediated immune function can allow EBV to reactivate and release viral antigens into blood circulation, leading to EBV antibody production (Glaser et al 1991). Therefore, EBV antibody titer has been used as a measure of cellular immune function rather than as a marker for the presence of EBV infection. Previous studies in developing countries have demonstrated a linkage between a higher degree of psychosocial stress and lower levels of cell-mediated immune function, measured by increased EBV antibody levels (McDade et al 2000; Panter-Brick et al 2008).

Hemoglobin (Hb)

Anemia remains a common medical condition in less developed countries. It is indicated by decreased Hb concentrations and can predict mortality, morbidity (Guralnik et al 2004; Tolentino & Friedman 2007), and functional decline such as lower extremity muscle strength, mobility difficulty, and difficulties with basic and instrumental activities of daily living (Penninx et al 2004).

3.2 Assay methodology of DBS-based biomarkers

CRP assay

CRP concentrations in DBS specimens were measured using validated ELISA method (McDade et al 2004). The detection limit of this CRP assay is 0.028 mg/L. The intra-assay coefficient of variation (CV) is reported to be 5.8% and the inter-assay CV is 8.2%.

EBV antibody assay

EBV antibody titers in DBS specimens were measured using validated ELISA method (McDade et al 2000). Intra-assay CV of the assay is 5.6% and inter-assay CV is 7.7%. Different from venous-based method, the DBS-based assay typically reports results in enzyme units, instead of actual antibody titers.

Hb assay

Hemoglobin levels were measured using an ELISA protocol, based on the method by O'Broin and Gunter (O'Broin & Gunter 1999). Across the range of the assay, the between-assay CVs for low, mid, and high control concentrations are 7.7%, 4.8%, and 6.2%, respectively.

4. Validation of DBS-based Assays

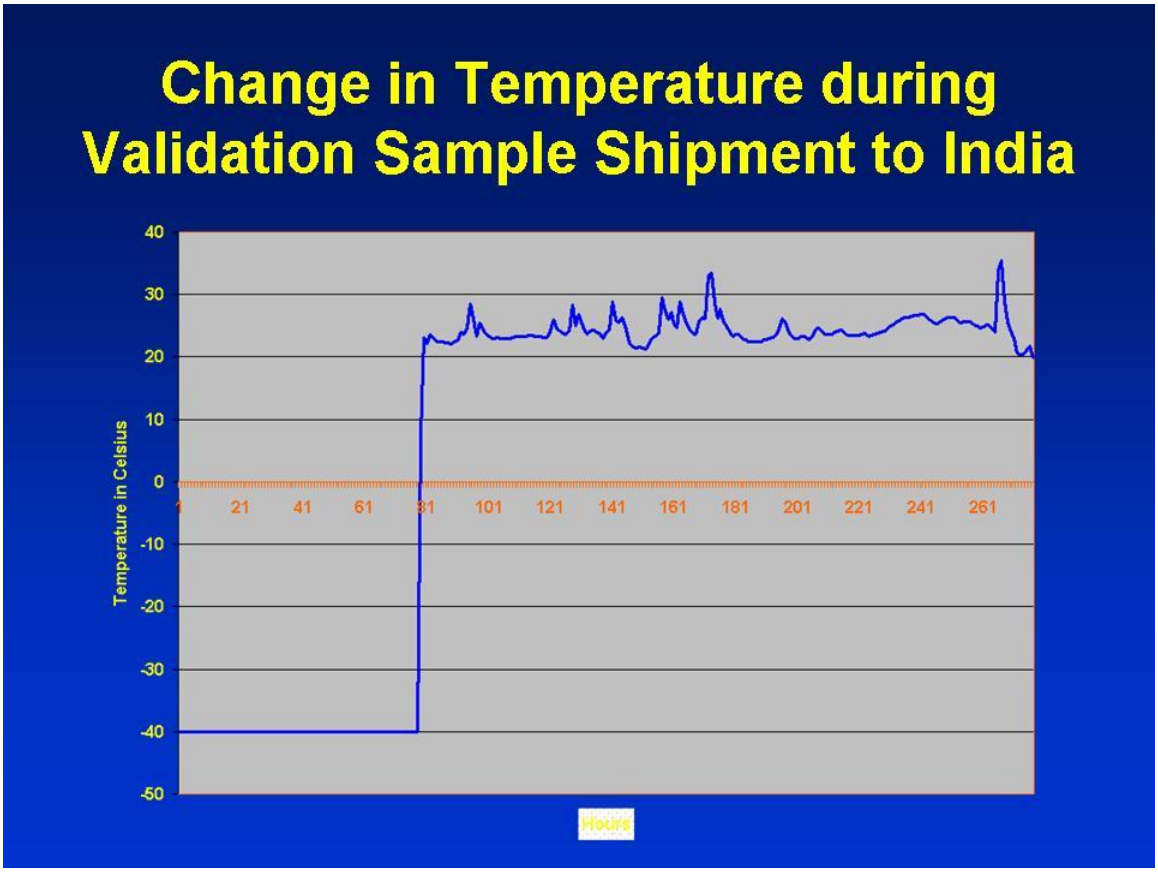
For the DBS-based bioassays, LASI collaborated with the National AIDS Research Institute (NARI) in Pune, India. NARI is part of the laboratory network that has been performing DBS-based assays for the World Health Organization (WHO)'s Study on Global AGEing and Adult Health (SAGE) project. As a result, select personnel at NARI had already been trained in DBS-based assays by Dr. Sharon Williams of Purdue University. However, additional training was carried as a quality-control measure.

NARI followed the validated assay protocols without further modifications and used the reagents from the same manufacturers specified in the protocols. All assay reagents were purchased through local vendors in India.

The USC/UCLA Center on Biodemography and Population Health (CBPH) prepared validation samples for the LASI validation study. Venous specimens were collected from 50 volunteers. Based on the previous validation work done by USC/UCLA CBPH, DBS cards were created from venous blood, with five blood spots on each card. Serum samples were sent to the UCLA Clinical Laboratory for venous blood based assays and one set of DBS cards was sent to the laboratory at Department of Laboratory Medicine, University of Washington (UW) for DBS-based assays.

Two sets of DBS cards were sent to NARI through World Courier, a commercial shipping company. A temperature monitor was included in the package that contained DBS validation samples, which recorded temperature inside the shipping box once every two hours. The subsequent analysis of the data from the temperature monitor showed that the duration of shipment was approximately 162 hours and temperature was maintained at less than -40^{o}C during the shipment from Los Angeles to Pune, India (Figure 1).

Figure 1. Change in Temperature During Validation Sample Shipment to India



Pre-tests, including validation samples, were conducted at the NARI laboratory in August of 2012. The goals of the pre-tests include:

1) Evaluate the technical skills of trained laboratory personnel, including transfer of knowledge and skills to those technicians in these laboratories who did not participate in the original training organized by WHO;
2) Verify that correct equipment was being used for the planned bioassays;
3) Verify that correct test reagents and supplies were being used;
4) Evaluate general conditions of the laboratory (e.g., adequate work space, proper temperature control); and
5) Evaluate the reliability and validity of the assay results from the NARI laboratory.

The detailed schedule for the pre-test is shown in Table 2.

Table 2. Pre-test schedule for LASI

	C-reactive protein (CRP) assay	Epstein-Barr virus (EBV) antibody assay	Hemoglobin assay
Day 1	Inspection of general laboratory working environment, equipment, and reagents and other supplies. Sample preparation for the next day.	Inspection of general laboratory working environment, equipment, and reagents and other supplies. Sample preparation for the next day.	Inspection of general laboratory working environment, equipment, and reagents and other supplies. Measured hemoglobin levels on 20 validation samples and 4 additional samples from local volunteers.
Day 2	Measured CRP levels on 22 validation samples and 5 additional samples from local volunteers.	Measured EBV antibody levels on 20 validation samples and 4 additional samples from local volunteers.	Measured hemoglobin levels on 33 validation samples and 4 samples from the same local volunteers, using different dried blood spot (DBS) standard specimens.
Day 3	Measured CRP levels on 20 validation samples and 5 samples from the same local volunteers.	Measured EBV antibody levels on 1 validation samples and 4 samples from the same local volunteers.	Measured hemoglobin levels on 34 validation samples and 4 samples from the same local volunteers, using different DBS standard specimens.
Day 4	Measured CRP levels on 7 validation samples and 4 samples from the same local volunteers.	Measured EBV antibody levels on 1 validation samples and 4 samples from the same local volunteers.	Measured hemoglobin levels on 34 validation samples and 4 samples from the same local volunteers, and finalized which DBS standards would be used for LASI study samples.
Day 5	Review of pre-test results with local laboratory personnel and plan for subsequent quality control during testing of LASI study samples.	Review of pre-test results with local laboratory personnel and plan for subsequent quality control during testing of LASI study samples.	Review of pre-test results with local laboratory personnel and plan for subsequent quality control during testing of LASI study samples.

Validation results for CRP assay

During the LASI pre-test, NARI's CRP results on 32 validation samples were compared with DBS-based values from UW. The correlation coefficient was 0.95. The average difference was 1.75 mg/L (standard deviation: 1.81 mg/L). LASI also measured 10 validation samples from local volunteers twice during the pre-test. The correlation coefficient between the test-retest values

was 0.998. The average difference in absolute values was 0.62 mg/L (standard deviation: 0.64 mg/L).

Validation results for EBV antibody assay

During the LASI pre-test, NARI's EBV antibody results on 19 validation samples were compared with venous-based values from UCLA Clinical Laboratory. Because the venous-based assay had an upper detection limit of 750 for EBV titer, 8 validation samples with titers above 750 were assigned a value of 800 for the purpose of calculation. The Pearson's correlation coefficient between NARI's DBS values and venous-based ones was 0.80. The Spearman's (non-parametric) correlation coefficient was 0.89. Because the DBS results were reported in units different from venous-based assay (enzyme unit for DBS-based assay and actual titer for venous-based assay), the difference in absolute values cannot be calculated.

Validation results for Hb assay

Thirty-three validation samples had matching results from NARI and UCLA Clinical Laboratory. The Pearson's correlation coefficient was 0.78. In general, NARI had higher Hb values than venous-based results. The average difference was 0.55 gram/dL (median: 0.59 gram/dL; standard deviation: 0.86 gram/dL).

5. Ongoing Quality Control for DBS-based Assays

The LASI research teams maintained regular communication with NARI throughout the DBS testing period. The assay results were reviewed on biweekly basis initially, and then monthly. The assay parameters that were examined included coefficients of variation (CVs), concentrations of controls/calibrators, R-squares (goodness-of-fit for the standard curves), and extreme values. All study samples with CVs greater than 10% were re-tested, except for high CVs for CRP assay when the average CRP concentrations were less than 0.2 mg/L. LASI also tested validation samples periodically to monitor for possible laboratory drift in assay results over time. Note that all LASI samples were measured in duplicate.

Ongoing quality control for CRP assay, using validation samples

LASI included 5 validation samples on each microplate for the first 10 microplates that measured study samples, followed by 8 validation samples every 150 study samples. The correlation coefficients between LASI and UW results ranged from 0.94 to 1.00 (see Table 3), and the correlation coefficients between LASI DBS and UCLA serum-based values were from 0.98 to 1.00 (see Table 4).

Table 3. Correlation coefficients between LASI and University of Washington dried blood based C-reactive protein results on validation samples by microplate numbers

Microplate number	Correlation coefficient
5	0.99
6	1.00
7	0.95
8	0.99
9	0.99
10	0.99
11	1.00
12	1.00
13	0.96
14	0.94
15	0.99
19	1.00
23	0.99
27	0.98
31	0.98
35	0.99
39	0.95
43	0.98

Table 4. Correlation coefficients between LASI dried blood spot based C-reactive protein results and serum-based values on validation samples by microplate numbers

Microplate number	Correlation coefficient
23	0.99
27	0.99
31	1.00
35	0.98
39	0.99
43	0.99

Ongoing quality control for EBV antibody assay, using validation samples

LASI included one validation sample on each microplate that measured study samples. All validation samples used were from 3 individuals, with low, middle, or high EBV antibody level respectively. The inter-assay CVs for low, middle, and high levels were 4.3%, 2.3%, and 6.6%, respectively. For the details of the quality control results, see Table 5.

Ongoing quality control for Hb assay, using validation samples

LASI included 2 validation sample on each microplate for the first 4 microplates that measured study samples, then one validation sample on each microplate subsequently. All validation samples used were from 3 individuals. Two of these validation samples had normal Hb concentrations, while the third had low Hb concentration. The inter-assay CVs ranged from 5.1% to 8.1%. For details of the quality control results, see Table 6.

Table 5. Results of repeated measurement of Epstein-Barr virus (EBV) antibody titer on validation samples

Validation sample ID	R-square (goodness-of-fit of the standard curves)	Average EBV antibody titer (enzyme unit)	Coefficient of variation (%)
10038	0.98	163.7	0.2
	0.99	184.9	0.7
	0.99	159.1	3.2
	0.99	165.8	2.4
	0.99	188.5	3.7
	0.99	159.8	4.0
	0.99	170.8	2.0
	0.99	150.6	0.6
	0.99	144.6	0.9
	0.99	150.2	1.4
	0.99	152.2	1.3
	0.99	164.5	0.5
	0.99	166.1	0.2
	0.97	175.1	3.0
	0.99	166.9	0.2
	0.99	171.1	1.8
	0.99	161.7	3.2
	1.00	163.9	9.7
	1.00	164.9	0.5
	0.99	173.6	1.5
10063	1.00	43.7	0.4
	1.00	45.9	1.4
	1.00	41.8	1.6
	1.00	46.8	4.6
	1.00	45.3	0.1
	1.00	44.8	5.9
	1.00	43.6	3.1
	1.00	40.8	1.3
	1.00	44.7	1.6
10069	1.00	85.5	4.6
	1.00	83.8	2.0
	1.00	87.4	0.5
	0.99	85.7	0.1
	0.96	83.9	1.3
	0.97	82.0	1.7

Table 6. Results of repeated measurement of hemoglobin (Hb) level on validation samples

Validation sample ID	R-square (goodness-of-fit of the standard curves)	Average Hemoglobin Concentration (g/dL)	Coefficient of variation (%)
10041	0.99	14.1	6.5
	0.99	14.8	7.3
	0.97	13.8	3.8
	0.97	14.5	0.9
	0.98	14.1	3.5
	0.98	14.6	0.9
	0.99	14.1	2.9
	0.98	14.8	1.4
	1.00	13.6	2.7
	0.99	15.5	0.9
	0.97	16.0	1.4
	0.95	15.6	0.5
	0.97	15.7	0.5
10003	0.98	14.6	0.6
	0.97	14.6	4.3
	0.98	15.3	0.3
	1.00	14.7	0.8
	0.97	14.0	3.8
	0.99	15.3	0.6
	0.97	11.6	5.7
	0.97	15.1	3.1
	0.98	13.9	2.8
	0.97	15.3	2.0
	0.99	13.3	0.9
	0.99	15.6	4.6
	0.98	15.0	3.8
	0.96	12.5	7.6
10001	0.97	14.3	4.8
	0.99	11.1	0.5
	0.99	11.9	1.0
	0.99	10.6	4.4
	0.99	11.0	7.8
	0.98	11.0	6.1
	0.99	10.5	4.8
	0.99	11.7	1.7
	missing	12.3	5.7
	0.99	10.8	4.3

6. Data Description

Herein we describe the results of the LASI biomarker testing. We start with a table of descriptive statistics (Table 7) and a table of population frequencies below and above standard cutoffs (Table 8). We then plot empirical densities together with histograms (see Appendix B: Figure 2 – 22).

There are three measures of systolic blood pressure and diastolic blood pressure. Findings show a mean systolic blood pressure of 133 with a median of 129. Some 31% of the LASI pilot population has systolic above the cutoff of 140. The diastolic mean is 85, with a median of 83. Only 31% has a reading over the cutoff of 90.

Findings also show a mean and median height of 157 cm, and weight has a mean of 54 kg, with a median 55 kg. Mean BMI is 22 kg/m2, but there are 29% of women and 20% of men with BMI 25 and over, indicating overweight. There are 8% of women and 3 % of men with BMI 30 and over, so obesity is low. There are 21% of women and 25 % of men with BMI under 18.5 (underweight).

The mean waist circumference of the LASI sample is 82 cm and the mean hip circumference is 88 cm. There are few outliers with really small numbers.

The timed walk test has a mean of 7.3 seconds, with a median 6.5 seconds. Only the respondents who are 60 and older are eligible for this measure, but 133 age-ineligible respondents participated in timed walk. These ineligible respondents are not included in the summary statistics.

There are two types of vision tests. One test assess near visual acuity while the other tests distance visual acuity. The distance vision test has a mean of 0.56 for left eye and 0.57 for right eye. The near vision test has a mean of 0.31 for left eye and 0.32 for right eye.

The mean grip strength is 19.19 kg for left hand and 20.75 kg for right hand, with the same median. There are 91% of respondents who are able to hold semi-tandem stand for a full 10 seconds. Those who were able to complete semi-tandem stand were asked to complete additional balance tests.

The mean FVC (forced vital capacity) is 1.43 liter, with a median of 1.38 liter. There are some recording errors that are out of range. These records are not included in the sample.

The mean CRP is 2.69 mg/L, and the median 1.64 mg/L. The distribution of CRP and log CRP look fairly standard, as indicated by the density plots below. Most of the distributions look reasonable, with very few outliers. The log of CRP looks far more symmetric than levels of CRP.

The mean EBV is 113.18 mg/L, and the median is 108.54 mg/L. Mean hemoglobin measure is 14.1 g/dL, and the median is the same. Using the standard cutoffs of 12.0 g/dL for women and 13.0 g/dL for men, 25% of women and 14% of men have low hemoglobin levels.

For list of variables in the file, please see Appendix C.

Table 7. Descriptive statistics for biomarkers

	N	Mean (SD)	Median	Ranges
Systolic Blood Pressure (mmHg)	1276	132.21 (1.05)	129.5	(80.67-222.67)
Diastolic Blood Pressure (mmHg)	1276	84.93 (0.48)	83.67	(53-156)
Height (cm)	1309	157.62(0.30)	157	(125-188.4)
Weight (kg)	1291	54.34(0.55)	55	(28-105)
BMI (kg/m2)	1291	21.86(0.20)	21.85	(11.65-65.79)
Waist (cm)	1270	82.23(0.64)	84	(28-152)
Hip (cm)	1271	88.47(0.59)	90	(24.4-163)
Timed Walk (seconds)*	272	7.30(0.33)	6.5	(3-19.5)
Vision Test- Distance (left)	1204	.56(0.02)	0.5	(0-2)
Vision Test- Distance (right)	1202	.57(0.02)	0.5	(0-2)
Vision Test- Near (left)	1204	.31(0.01)	0.25	(0-1.8)
Vision Test- Near (right)	1201	.32(0.01)	0.25	(0-1.8)
Grip Strength -Left (kg)	1222	19.19(0.52)	19	(0-58)
Grip Strength -Right (kg)	1222	20.75(0.54)	20	(0-55)
Balance Test-hold for 10 sec**	1235	.91(0.01)	1	(0-1)
Lung Function - FVC	842	1.43(0.04)	1.38	(0.11-4.67)
CRP (mg/L)	1263	2.69(0.11)	1.64	(0.05-19.21)
EBV (mg/L)	1293	113.18(2.7)	108.54	(8.21-320.52)
Hemoglobin (g/dL)	1232	14.11(0.12)	14.16	(5.97-22.6)

*Timed Walk: R is eligible if R's age is 60 and older
**Balance Test: 1.yes/0.No: if R holds for 10 seconds

Table 8. Percent high risk for biomarkers

	Cutoff	Percent
Systolic Blood Pressure (mmHg)	>=140 mmHg	30.80%
Diastolic Blood Pressure (mmHg)	>=90 mmHg	31.55%
BMI-Underweight (kg/m^2)	<=18.5 kg/m2	M: 25.18% F: 21.34%
BMI-Overweight (kg/m^2)	>=25 kg/m2	M: 20.00% F: 29.27%
BMI-Obese (kg/m^2)	>=30 kg/m2	M:2.86% F: 8.21%
CRP (mg/L)	>3 (mg/L)	29.64%
Hemoglobin (g/dL)	<13 g/dL <12 g/dL	M: 14.29% F:24.86%

7. Procedure for Receiving Restricted Biomarker Data

7.1. Introduction

Although some LASI datasets are *unrestricted* (i.e., freely available through the internet or from LASI staff on condition that the researcher not attempt to identify individual respondents), other LASI datasets are *restricted*, and are available only under specific contractual conditions. The remainder of this document describes those conditions.

The restrictions exist because the LASI staff members take the promise of respondent anonymity very seriously. Our respondents provide us with large amounts of information about their lives, and respond at several points in time (LASI is a *longitudinal* or *panel* study). This enormous amount of information at several time-points greatly increases the likelihood that an individual (or family, household, employer, or pension benefit provider) can be identified, which is not the case with a one-time, small sample survey. We have tried to minimize the danger of breaches of respondent anonymity in both unrestricted and restricted datasets by aggregating critical variables such as geographic location and occupation/industry up to less specific levels than those provided by the respondent. We have also devised the contractual procedure described below to ensure that restricted datasets are released only to persons who meet stringent conditions designed to protect the anonymity of respondents.

Violations of respondent anonymity, or of the procedures designed to ensure that such violations do not occur, would be very costly. They would violate the privacy of respondents and the trust they have placed in LASI to protect their anonymity. Such violations would also inflict an enormous loss on the entire research community, since they undermine the willingness of individuals to participate in surveys and of government agencies to provide data about respondents that can be merged with the survey data. Because the potential damage is so great, the procedures outlined below are particularly strict.

The following materials have been developed by the LASI Core Team in an effort to permit dissemination of LASI datasets to the maximum number of responsible researchers while satisfying its own concerns about respondent anonymity and the requirements of agencies that supplied some of the data. Each application for access to LASI Restricted Datasets will be reviewed by the LASI Core Team (a group consisting of LASI team members and affiliates), for conformance with the spirit and letter of the requirements outlined in these materials, and no Restricted Data will be distributed without the approval of the Team.

7.2. Outline of Requirements

Researchers may be eligible to receive LASI Restricted Datasets **only** if and when they meet **all** of the following requirements:

7.2.1. Affiliation with an institution with a DHHS-certified Human Subjects Review Process or ICMR-certified Ethics Approval

The institution with which the researcher is affiliated must have obtained an *Assurance of Compliance* from the Office for Human Research Protections (OHRP) of the Department of Health and Human Services (DHHS) **OR** equivalent approval from the Indian Council of Medical Research (ICMR). Only persons with permanent, faculty-level appointments at such institutions may receive LASI Restricted Datasets.

Note: Under the DHHS human subjects protection regulations (45 C.F.R. 46.103), every institution engaged in human subjects research that is funded or conducted by DHHS must obtain an Assurance Of Compliance approved by OHRP. This Assurance of Compliance, when granted, is called a *Federal-Wide Assurance*.*

We acknowledge that there are institutions that have not received such certifications, and that some legitimate researchers may be excluded from access under this condition. Researchers who fall into this category may contact the LASI Core Team, which will consider and vet alternative human subjects protection arrangements on a case-by-case basis.

7.2.2. Current Receipt of Federal Research Funds from the United States Government of the Government of India

The person(s) primarily responsible for the research project using LASI Restricted Data (the "Restricted Data Investigator" in these documents) must be a **current** recipient, as a Principal Investigator or Co-Principal Investigator, of research funds from an agency of the United States government OR the Indian government.

As researchers will notice, the primary sanction available to LASI for violations of the Agreement by researchers, is notification of the violations (through the National Institute on Aging) to the appropriate United States government funding agency, with a possible recommendation of termination of current, and denial of future, research funding to the investigators. Similar actions will be taken with the Indian government (through the Ministry of Health and Family Welfare). These sanctions presumably have greatest salience to persons with current US or Indian federal research funding, and therefore we are initially limiting eligibility to receive Restricted Data to persons with such grants or contracts. If in the future we are able to develop alternative sanctions (security deposits, financial liability of institutions receiving Restricted Data), we will consider providing access to persons who do not have current United States government or Indian government research funding.

If you do not have funding from the governments of the United States or India at the time you begin the process of applying for access to LASI Restricted Data **BUT** are applying for such research funds for the purpose of using the Restricted Data, all aspects of the application process except contract signing and proof of a federal research award, can be completed pending a decision on your proposal. If you do get the United States government research award, the Agreement signing can then go forward. The LASI Core Team will be willing to make a written statement to your sponsor that, on the basis of the materials you have provided us to date, you will receive the Restricted Data after completion of the contractual conditions.

We acknowledge that there are institutions that have not received such federal funding and are not applying for it, and that some legitimate researchers may be excluded from access under this condition. Researchers who fall into this category may contact the LASI Core Team, which will consider and vet alternative funding arrangements on a case-by-case basis.

7.2.3. Research Proposal

Applicants for LASI Restricted Data must provide to LASI staff a short (1-3 page) research proposal that includes a synopsis (or a full statement, if necessary) of your research goals, and specifies:

- The types of variables from LASI Restricted Datasets you intend to use in your research; and
- Why you believe the unrestricted versions of those variables, if any, are not adequate for your research purposes.

For each research project proposed, applicants must provide:

- Project Title
- Project Executive Summary (one paragraph abstract of research goals)
- Study Team Details - for each study team member, defined as anyone who will have access to the restricted data, provide Name, Role on Project, Contact Information (Complete business street address, Email, Telephone)

7.2.4. Restricted Data Protection Plan

Examine Developing a Data Protection Plan (courtesy of University of Michigan) and investigate the mechanisms that are available to you to meet its requirements at the site(s) at which the Restricted Data will be managed, analyzed, and stored. This may require some discussion with computing personnel at your institution, and perhaps even obtaining permission to acquire special hardware or software.

Once you have assured yourself that you can meet the requirements set forth in both documents, draft your Restricted Data Protection Plan and send a copy to LASI as specified in Section III.D. below. LASI staff will examine the draft plan, and may require some amendments. (Note: do not be surprised if your Plan requires revision before it can be approved.)

Take careful note that the Restricted Data Protection Plan must define and treat variables/fields **derived** from the original Restricted Dataset as Restricted Data.

It is possible for a variable derived from original restricted data to be later reclassified as unrestricted, and even included in future releases of unrestricted datasets with appropriate credit to the creator. The LASI Core Team will consider requests from researchers to reclassify derived restricted variables. Such requests for reclassification should explain why you believe that the derived variables do not significantly increase the risk of identification of individual persons, families, households, employers, and benefit providers, compared to other unrestricted data; are accompanied by the computer code used to create the derived variables, and documentation of the rationale and the analytic utility of the derived variables; and include

a data file containing LASI ids, the original restricted and unrestricted variable(s) used to create the derived variables, and the derived variables.

(Aggregate statistical summaries of data and analyses, such as tables and regression formulae, are not "derived variables" in the sense used in the Agreement, and are not subject to the requirements of the Restricted Data Protection Plan and the Agreement.)

7.2.5. Human Subjects Review

The chairperson of your institution's Institutional Review Board/Human Subjects Review Committee must certify that the Board/Committee has reviewed and approved your Restricted Data Protection Plan (and the portions of your Research Plan that deal with respondent anonymity and data security, if any), in accordance with the standards and procedures used for ***live human subjects***. Expedited review is acceptable. No exemptions, such as for "secondary data analysis", may be used in this aspect of the human subjects review. LASI respondents are indeed live human subjects, and LASI will be going back to them for more data in the future. The enclosed *Certification of Human Subjects Review* form should be used for the certification. Because the IRB/HSRC review at your institution must include the Research Plan and Restricted Data Protection Plan that ***have been*** approved by LASI, you should not submit your proposal for IRB/HSRC review until you have received the LASI approvals.

7.2.6. Agreement for Use of Restricted Data from the Health and Retirement Study

The Restricted Data Investigator applying for LASI Restricted Data, ***all*** other persons who will have access to the Restricted Data, and a representative of the Receiving Institution, must sign the Agreement for Use of Restricted Data from the Health and Retirement Study. You may wish to submit the blank form of the Agreement in advance to your institutional signatory, to determine whether they are willing to sign it. You should address the following requirements in the Agreement:

1. Restricted Data can be used ***only*** for research and statistical purposes, and the Research Plan must specify ***all*** of the research projects that will make use of the restricted data. It is ***not*** permitted, for example, for a faculty member to obtain the data for her own research project and then "lend" it to a graduate student to do related dissertation research, even if the graduate student is a Research Staff signatory, unless this use is specifically stated in the Research Plan.
2. You must either destroy, or return to LASI, ***all*** versions of the Restricted Data and data derived from it, regardless of the form in which it exists (tapes, hard disk, diskettes, and other physical media) within 24 months, or such other period as is specified in the approved Research Plan, or upon a demand from LASI. Researchers who need additional time should make a formal written request for an extension at least 30 days prior to the expiration date, and LASI will give prompt consideration to such requests. However, neither the initial time period, nor any extension of it, may exceed the time period of the grant or contract under which the data are being analyzed. One implication of the time limits is that you should assure yourself that you have adequate time available to do the data management and analysis you have planned. In brief, you may ***not*** retain ***any*** copies of or data derived from the Restricted Data, after the conclusion of the

contract period. LASI staff will store the physical media containing such data for you, at your request for up to two years, so that it can be available to you if you obtain a second Agreement for further analysis.

3. the Restricted Data Investigator must be a person who is a current Principal Investigator or a Co-Principal Investigator of a current federal agency research grant or contract;
4. the Restricted Data Investigator must be affiliated with the receiving institution with a position or title equivalent to a permanent tenured or tenure-track faculty member;
5. all Co-Investigators and Research Staff must have a formal affiliation with the receiving institution, and must specify that affiliation and job title in the signature blocks of the Agreement and Supplemental Agreement of Research Staff. If new persons become affiliated with the research project, and are to have access to the Restricted Data, an additional Supplemental Agreement of Research Staff must be signed by the new persons and the Restricted Data Investigator, and approved by LASI staff, ***before*** the new person is given access to the Restricted Data.
6. LASI will permit persons who were not original Principal Investigators or Co-Principal Investigators on current federal research grants or contracts, to be added to such a project as a Co-Principal Investigator and to become Co-Investigators on Agreements for the Use of Restricted Data from LASI, **provided** the Principal Investigator of the federal grant or contract signs the Agreement as the Restricted Data Investigator, ***and*** LASI is provided a copy of the federal agency's written approval of the addition of the new Co-Principal Investigator.
7. The National Institute on Aging has indicated a willingness to facilitate the addition of persons as Co-Principal Investigators to existing NIA grants and contracts for purposes of facilitating access to LASI Restricted Datasets. Persons who wish to explore this option should contact:

   John W. R. Phillips, Ph.D.
   Behavioral and Social Research Program, National Institute on Aging
   Gateway Building, Room 533
   7201 Wisconsin Avenue
   Bethesda MD 20892
   Tel: 301-496-3138; Fax: 301-402-0051; Email: John.Phillips@NIH.GOV

8. Your institution must agree to treat violations of this agreement, and allegations of such violations, as violations and allegations of violations of its policies on scientific integrity and misconduct, as to substance, procedures, and penalties.
9. The representative of your institution who signs the Agreement must have the authority to bind the institution contractually.

7.3. Recommended Procedures for Applicants

A. Obtain:

1. The Federal-Wide Assurance number and expiration date for your institution. (This is issued by the United States Department of Health and Human Services Office for Human Research Protections **OR** the equivalent is required for institutions with ICMR clearance;

2. a copy of your current federal research grant OR contract award letter(s), OR the equivalent for institutions with federal funding in India;
3. a copy of your institution's policies and procedures on scientific integrity and misconduct, including the name and address of the person or office responsible for enforcing them; and
4. a copy of your resume or *curriculum vitae*.

B. Write:
1. your Research Plan; and
2. your Restricted Data Protection Plan.

C. Email the items in A. and B. to the LASI Core Team.

D. Complete any additional internal paperwork required by HSPH.

E. Obtain and email to the LASI Core Team (following LASI approval of your Research Plan and Restricted Data Protection Plan):
1. the Certification of Human Subjects Review (based on your submission of your Research Plan and Restricted Data Protection Plan); and
2. a scan of the Agreement for Use of Restricted Data from the LASI Study (both will be countersigned by LASI and one returned to you).

Application emails should be directed to:

David Bloom
Clarence James Gamble Professor of Economics and Demography
Department of Global Health and Population
Harvard School of Public Health
665 Huntington Ave.
Building I 12th Floor, Suite 1202
Boston, MA 02115
E-mail: dbloom@hsph.harvard.edu

7.4. Sanctions for Violation of the Agreement

The Agreement for Use of Restricted Data from the Health and Retirement Study specifies four possible sanctions against researchers who violate the terms of the agreement:
1. denial of all future access to LASI Restricted Data;
2. report of the violation to the Receiving Institution's office responsible for scientific integrity and misconduct, with a request that sanctions be imposed under the institution's scientific integrity and misconduct policy;
3. report of the violation to federal research funding agencies in the United States and India, with a recommendation that all current research funds be terminated, and all future funds be denied, to the Investigator(s) and to all other persons implicated in the violation; and
4. such other remedies as may be available to LASI under United States and Indian law.

When LASI staffs determine that there may have been a violation of the Agreement, LASI will communicate the allegations in writing to the Restricted Data Investigator and offer the investigators an opportunity to respond in writing. LASI may also, at the time the allegations are communicated, demand return and/or destruction of all copies of Restricted Data in the possession of the Investigator(s), Research Staff, and any unauthorized persons, and certification of the return/destruction by the Restricted Data Investigator. If LASI's Core Team determines that the allegations of violations were incorrect, LASI will return any copies of the Restricted Data to the Restricted Data Investigator under the conditions of the original Agreement.

If the LASI Core Team determines that the allegations of violations of the Agreement were in any part correct, it will determine the appropriate sanction. If the sanction includes notification of federal funding agencies with a recommendation to terminate current and deny future federal research funding, the LASI Data Confidentiality will communicate its notification of violations and recommendations to the LASI Program Officer at the National Institute on Aging, who will in turn convey it to appropriate officials within the Government of India.

Acknowledgement*: This data release agreement is based on the procedures outlined by the Health and Retirement Survey team, University of Michigan. We acknowledge their efforts, which have made this agreement possible.*

8. Appendix A: Biomarker Collection Protocol

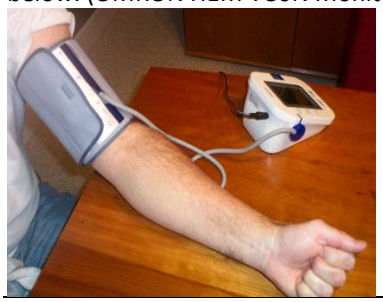
8.1 Blood Pressure and Pulse Rate

Introduction

Blood pressure is taken to assess whether the respondent has raised blood pressure. Raised blood pressure is a risk factor for a number of chronic, non-communicable diseases.

Equipment

To take blood pressure and pulse rates you will need a Blood Pressure Monitor as shown below. (OMRON HEM-780N Monitor)



Preparation

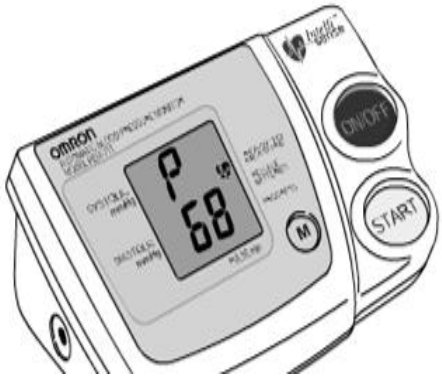
Follow the steps below to prepare the respondent.

Step	Action
1	Tell respondent that you would like to measure their blood pressure and pulse rate using this monitor and cuff which will secure around left arm. You will be taking three separate readings.
2	Ask respondent to sit quietly with their legs uncrossed and relax, with feet flat on the floor.
3	You will be using the left arm unless the person has problems. Roll or push up the respondent's sleeve if necessary and make sure the rolled sleeve is not too tight around the arm and does not constrict the flow of blood.
4	Tell respondent that once the device is placed on the left arm approximately ½ inch above the elbow, she/he will need to keep her/his arm steady and at the level of the heart.

Procedure

Follow the steps below to take and record three blood pressure and pulse readings.

Step	Action
1	Wrap the cuff of the device around the respondent's left arm. Secure with the Velcro strap for a snug fit. **Note:** Do not apply the device over bulky clothing.
2	Have respondent place the arm on a flat surface palm facing up so that the center of the upper arm is at the same height as of the heart. Note: Ask respondent to remain quiet, sit still and not to talk during the measurement. Ask respondent to take 3 deep, slow breaths before you start measuring.
3	Press the START button
4	Wait for the device to finish its measurement before reading and recording the outcome. You do not need to remove the device between readings.

5	Record the: • systolic blood pressure (top number illustration #1) • diastolic blood pressure (lower number illustration #1) • pulse rate (illustration 2).
	 Illustration #1
	 Illustration #2
6	Wait at least 1 minute until next reading. If third reading, go to BM004.
7	Repeat steps 3 through 6 to record the second and third readings. **Note:** Measure each blood pressure and pulse rate reading on the same arm.

8.2 Height, Weight, Waist and Hip Measurements

Introduction	Height, weight, waist and hip circumference measurements are recorded to calculate body mass index (BMI) and to determine a respondent's risk for different health conditions.
Equipment	To physically measure height, weight you will need the following equipment: • stadiometer (height) • weighing scale
General guidelines	Follow the general guidelines below to prepare respondents and take the measurements. • Ask respondents to wear a single layer of clothing. • Ask respondents to remove outer clothing (for example, jackets, jerseys, coats). • Do not attempt any measurements for respondents that: are totally immobile; Cannot stand up on their own (for example person in a wheelchair, person without a leg). • If a respondent is missing a leg but uses a prosthesis, perform all measures. Indicate whether

the weight measurement includes the prosthesis or orthopaedic device. If possible, weigh the prosthesis and indicate that on the questionnaire.

- If a respondent is pregnant perform height measurement only.

Height Follow the steps below to measure height.

Step	Action
1	Select an area where the floor is firm, flat and close to a wall.
2	Have respondent remove any footwear. Barefoot is preferred, but thin stockings/socks are allowed.
3	Ask respondent to stand with their back to a wall or something straight and sturdy, and keep: • step onto the base of the stadiometer • feet together • heels, buttocks, back and head against the wall* • knees straight • Look straight ahead, chin tucked to chest slightly, do not look up. **Note:** make sure that the lower margin of the bony orbit (the bony socket containing the eye) and the upper margin of the external auditory meatus (hole in ear) should be in the same horizontal plane. *Anyone who cannot stand straight in this position, should be positioned vertically so heels and buttocks or head touch the wall.
4	Ask respondent to inhale deeply and maintain full erect position.
5	Stretch top of stadiometer (with level) to topmost point on the head with sufficient pressure to compress the hair.
6	Record height to nearest 0.1 cm.

Weight Follow the steps below to measure weight.

Step	Action
1	Place the weighing scale on the floor on a flat, firm surface. Try to avoid uneven surfaces and soft earth floors.
2	Set the scale within reach of a wall, so that respondents can lean over if they lose their balance.
3	Ask respondents to take off their shoes (socks may remain on) and any heavy accessories. Remove excess or heavy clothing.
4	Check the scale is display is set to zero. Reset if necessary.
5	Ask respondent to step on the scale and: • stand still • face forward • place their arms at their side with palms facing inwards • Not hold onto anything.
6	Read and record weight in kilograms to the nearest 0.1kg.

Waist circumference Follow the steps below to measure waist circumference. Use the space on the questionnaire, labelled as "Notes:" to describe the layers of clothing under the tape during the measurement.

Step	Action

1	Ask person to have only light clothing between the Gulick measuring tape and their skin.
2	Ask respondent to stand with their feet together, arms at their side with palms facing inwards.
3	Ask respondent to feel for the top of the hip bone on both sides, at the level of the waist, and to indicate this to you on their right side.
4	Ask respondent if you can check this. Check the top of the right hip bone, and move the tape to this spot in preparation for recording the measurement. Make sure the tape is parallel to the floor all the way round the body when preparing to make the measurement. That means that it will also touch the top of the hip bone on the respondent's left and right side. Minimize touching the respondent.
5	Ask the respondent to breathe normally and pause at the end of an expiration of a breath when you will take the reading. You will take the reading at the level of the top of the hip bone.
6	Fit the tape snugly, but not so tightly as to compress the belly.
7	Record the reading to the nearest 0.1cm.

Hip circumference

Follow the steps below to measure hip circumference. If you have measured the waist, continue. If you have not measured the waist, follow Q2508 to position the Gulick tape. Use the space on the questionnaire, labelled as "Notes:" to describe the layers of clothing under the tape during the measurement.

Step	Action
1	Make sure the person has minimal clothing on the hips between the tape and skin.
2	Ask respondent to remain standing with their feet together, arms at their side with palms facing inwards.
3	Move the Gulick tape from the waist, to the maximum circumference of the hips.
4	Take the flexible tape measure around the maximum circumference of the respondent's buttocks, being careful to make sure the tape is parallel to the floor all the way round.
5	Fit the tape snugly, but not so tightly as to compress the soft tissue.
6	Record the measurement in centimetres to the nearest 0.1cm.

8.3 Timed Walks

Introduction

Walking speed is predictive of overall health, level of disability, future use of health care and mortality among older people. Walking speed and steadiness declines with age. This decline increases the chances of injury.

Equipment

To measure timed walks, you will need the following:

- 4-metre length space
- stopwatch
- measuring tape
- masking tape.

Preparation

Find a suitable area that is safe, flat and free of any obstructions to conduct the timed walks. Measure out a distance of four meters and mark the start and finish points with a strip of masking tape.

Preparing the respondent

Follow the general guidelines below to prepare respondents and take the measurements.

- Inform respondent that she/he will need to walk a four meter distance once, at a normal walking pace. You will time how long the walk takes with a stop watch.
- Make sure respondent is comfortable walking this distance without risking a fall. Do not perform the task if the respondent:
  cannot walk, even with an aid such as a cane, walker or leaning on a wheelchair;
  suffers from dizziness; and/or
  Has swelling or pain in their knee or hip.
- Ensure that respondent wears appropriate footwear, low heeled shoes or trainers are preferred.
- Explain that you will walk alongside to provide support in case she/he loses balance.
- If respondent uses a cane or another walking aid and would be more comfortable with it, then she/he may use it.

Procedure

Follow the steps below to time and record normal and rapid walks along a measured course.

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td colspan="2">Normal walk</td></tr>
<tr><td>1</td><td>Demonstrate a normal walk first.

<table><tr><th>If respondent</th><th>Then</th></tr><tr><td>Does not understand the instructions</td><td>Demonstrate once more and explain the instructions verbally.</td></tr><tr><td>Still does not understand</td><td>Skip the task.</td></tr></table></td></tr>
<tr><td>2</td><td>Ask respondents to stand with both feet together touching the starting line.</td></tr>
<tr><td>3</td><td>Explain that when you say "begin" you want them to walk:
• To the other end of the course at their usual speed, just as if they were walking down the street to go to the store.
• All the way past the other end of the tape before they stop.</td></tr>
<tr><td>4</td><td>Say "Ready, begin".</td></tr>
<tr><td>5</td><td>Press the START/STOP button on the stopwatch ONLY when either foot is placed down on the floor across the start line.
Note: Walk beside respondents for the length of the walk to provide support in case they lose their balance</td></tr>
<tr><td>6</td><td>Press the START/STOP button to stop timing when the respondent’s whole foot is across the finish line and touches the floor.</td></tr>
<tr><td>7</td><td>Press the LAP/RESET button to reset the stopwatch.</td></tr>
<tr><td>8</td><td>Record the time on the stopwatch.</td></tr>
</table>

8.4 Vision Test

Introduction

Visual acuity is measured in both eyes using distance and near vision charts.

Equipment

To conduct vision tests, you will need the following equipment:

- four meter distance vision Tumbling E Logmar Chart
- 40 cm near vision Tumbling E Logmar Chart

- flexible steel measuring tape
- sticky tape.

Make sure that the surfaces of the eye charts are not scratched or marked - it may damage the lettering on the charts, and the results of the vision test. You may choose to keep the charts in their plastic sheaths for transporting, but remove when doing the testing.

Preparation Follow the general guidelines below to set up the vision tests and prepare respondents.

- Start with distance vision using the 4 metre marked course used for the timed walk.
- Make sure the vision charts are well lit - with natural lighting or indoor lighting as needed.
- Make sure the surface does not reflect glare, making it more difficult for the respondent to see.
- If a respondent uses glasses or contact lenses, conduct the test using them.

Procedure Follow the steps below to set up and conduct distance and near vision tests.

Step	Action
Distance vision	
1	Set up the four meter distance vision Tumbling E Logmar Chart at the starting point of the marked four metre timed walk course. It can be handled with two persons or it should be placed on stand.
2	Ask respondent to stand or sit at the end point of the course.
3	Adjust the chart if necessary to ensure the fourth line on the chart is level with the respondent's eyes.
4	Ask respondent to place her/his left hand in front of her/his left eye.
5	Ask respondent to read out loud every letter she/he can see starting with the large letters and moving progressively to smaller ones. Note: Line by line isolation may be used but not letter by letter.
6	Once the respondent has started a line, she/he should complete the line. If at least three letters are missed on a line and all letters on that line have been attempted, then end the visual acuity measure at that point.
7	Record the smallest line that the respondent can read.
8	Ask respondent to place her/his right hand in front of her/his right eye. Repeat steps 5 to 7.
Step	**Action**
Near vision	
9	Set up the Tumbling E Logmar Chart at eye level and at the 40 cm distance of the attached string on a table or chair. Alternatively, ask respondent to hold the chart at the required distance.
10	Repeat steps 5 to 8.

8.5 Grip Strength

Introduction Hand-grip strength affects every day functions such as raising the body weight or holding heavy objects, and usually declines with age. Decline is also Predictive of Mortality.

Equipment To conduct grip strength tests, you will need a Smedley's hand dynamometer.
You will need to adjust the bar for each respondent's hand. The bar should rest on the middle piece (phalanx) of the index and ring finger.

Preparation Follow the general guidelines below to set up the hand grip tests and prepare respondents.

- Do not perform this task if the respondent's hands or wrists:
  are swollen or inflamed (possibly due to arthritis);
  are in severe pain; and,
  have recently been injured or operated on (in the last 6 months).
- Inform respondent that they will need to squeeze the dynamometer twice with each hand.
- Encourage respondent to remove rings as it may hurt to squeeze the device and may damage the jewellery.
- Explain the test and demonstrate it.
- Explain that it may not feel like the bar is moving at all.

Procedure Follow the steps below to take grip strength measurements.

Step	Action
1	Set the dynamometer to zero (0).
2	Check the fit of the dynamometer to the respondent's hand - adjust by turning the handle to move it up or down - so that the bar should rest on the middle piece (phalanx) of the index and ring finger while the base rests comfortably in the hand.
3	Ask respondent to practice by using her/his left hand to grab the two pieces of metal, keep the upper arm close to her/his body and hold her/his forearm at right angles to the upper arm. (If the left is the dominant hand they can practice with the right hand and then begin the test with the left hand). **Note:** Some older respondents may not be able to hold the device at 90 degrees due to a lack of strength. In this case, allow them to rest their arm on a table or the armrest of a chair.
4	When ready, ask respondent to squeeze the dynamometer with the right hand (or dominant hand) as hard as they can for a few seconds. **Note**: Some respondents raise the forearm when squeezing the dynamometer. Do not allow this to happen. Pay close attention to this and repeat the test if this occurs, alarming a 30second rest.
5	Read the dial at eye level and record strength in kilograms, rounding down to the nearest kilogram. Record '00' wherever an attempt was not made.
6	Set the dynamometer to zero (0), wait for 30 seconds between each try, and repeat the test with the left hand.
7	Repeat steps 2 to 6 for the opposite hand. Alternate hands (unless one hand is injured, if it is wait 30 seconds before 2nd try). You will take a total of 4 readings, two on each hand.

8.6 Balance Test

- **Semi-Tandem**

  Equipment Needed: Stopwatch

  Preparation:
  - Ensure R is wearing appropriate **footwear** (shoes with very low or no heel).
  - Ensure R do not have any problems from recent **surgery, injury or other health conditions** that might prevent you from standing up from a chair and balancing
  - Ensure **floor** is level, preferably has no carpet and firm.

  Procedure:
  - Ask the R to stand up.

- Stand to the side of the respondent.
- Instruct the R to try to stand with the side of the heel of one foot touching the big toe of the other foot for about 10 seconds.
- Instruct the R that he/she may put either foot in front, whichever is more comfortable for him/her.
- Instruct the R that he/she may use his/her arms, bend his/her knees or move the body to maintain balance, but try not to move his/her feet.
- If necessary, provide gentle support to the respondent's arm to help him/her get into the semi-tandem position.
- Instruct the R to try to hold this position until you tell the R to stop.
- Let go of R's arm. Say "Ready, begin". And start the stopwatch immediately.
- Stop the stopwatch and say "Stop" after 10 seconds or when the participant steps out of position or grabs your arm.
- Answer the questions in the box below. If the participant is unable to hold the position for 10 seconds, record the time in seconds to two decimal places in the box below.
- **If R was able to complete the semi-tandem for the full 10 seconds** without stepping out of place or grabbing a hold of anything ◊ Go to Full-Tandem
- **If R was not able to complete the semi-tandem for the full 10 seconds** without stepping out of place or grabbing a hold of anything ◊ Go to Side-by-Side

- **Side-by-Side:**

  Procedure:
  - Ask the R to stand up.
  - Stand to the side of the respondent.
  - Instruct the R to try to stand with feet together, side-by-side for about 10 seconds.
  - Instruct the R that he/she may use his/her arms, bend his/her knees or move the body to maintain balance, but try not to move his/her feet.
  - If necessary, provide gentle support to the respondent's arm to help him/her get into the side-by-side position.
  - Instruct the R to try to hold this position until you tell the R to stop.
  - Let go of R's arm. Say "Ready, begin." And start the stopwatch immediately.
  - Stop the stopwatch and say "Stop" after 10 seconds or when the participant steps out of position or grabs your arm.
  - If the participant is unable to hold the position for 10 seconds, record the time in seconds to two decimal places.

- **Full-Tandem:**

  Eligibility: Balance stand: 30 seconds for Rs age 70+; 60 seconds for Rs age <70

  Procedure:
  - Ask the R to stand up.
  - Stand to the side of the respondent.
  - Instruct the R to try to stand with the heel of one foot in front of and touching the toes of the other foot for about [30/60] seconds. For Rs age 70+, 30 seconds, and for Rs age younger than 70, 60 seconds.
  - Instruct the R that he/she may use his/her arms, bend his/her knees or move the body to maintain balance, but try not to move his/her feet.
  - If necessary, provide gentle support to the respondent's arm to help him/her get into the full-tandem position.
  - Instruct the R to try to hold this position until you tell the R to stop.
  - Let go of R's arm. Say "Ready, begin." And start the stopwatch immediately.
  - Stop the stopwatch and say "Stop" after [30/60] seconds or when the participant steps out of position or grabs your arm.

- If the participant is unable to hold the position for [30/60] seconds, record the time in seconds to two decimal place.

8.7 Lung Function Test

Introduction

Lung function tests are taken to diagnose obstructive and restrictive lung diseases. Spirometry is a common and effective diagnostic test. You will ask the respondent take a deep breath then to blow as long and hard as he/she can into a small tube attached to a machine. The machine measures how long it takes to blow out all the air from the respondent's lungs. The more blocked his/her airways, the longer it takes to blow the air out. Spirometry is the most reliable method of testing lungs. See http://www.spirxpert.com/welcome.htm for more information about spirometry as well as lungs and aging.

Equipment

The following equipment is required for lung function tests:

- spirometer;
- disposable mouthpiece;
- disposable filter; and,
- Nose clip.

PFT values

The table below lists each of the Pulmonary Function Test (PFT) values recorded by the spirometer.

PFT value	Explanation
FVC - Forced Vital Capacity	Maximum volume of air (in litres) forcibly exhaled out of the lungs until no more can be expired.
FEV1 - Forced Expiratory Volume in one second	Volume of air (in litres) forcibly exhaled in the first second.
PEF - Peak Expiratory Flow	Maximum flow generated during expiration performed with maximal force after a full inspiration.
FEV1% - FEV1/FVC	Useful indicator of airflow obstruction.
FEF25-75	The mid-expiratory flow (FEF25-75) is the average expiratory flow over the middle half of the FVC.
FET	Forced Expiratory Time - duration of expiration - target is 6 seconds or longer.

Preparing the participant

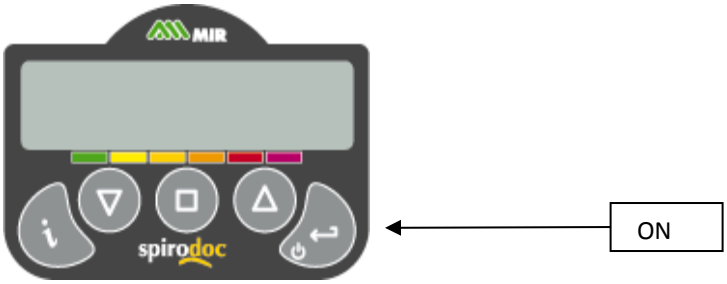
Follow the guidelines below to prepare the respondent for the lung function tests.

- Let a respondent perform at least two test manoeuvres and explain to them how these can be improved. You will need to actively coach the respondent during the test to get the best performance.
- Make sure that the respondent's body and neck remain erect during the manoeuvres, the patient looking straight forward during the entire test without bending over (the latter not only affects the way the trachea is stretched , but may also lead to saliva dripping into the equipment).

Preparation

Follow the steps below to use the spirometer and prepare the participant for the actual test.

Step	Preparation Actions

1	Hold the spirometer in an upright position and press the ON button once to switch on the device.  Calibrate the spirometer device to the respondent. Enter the age, sex, weight and height of the respondent using the buttons and instructions included in the spirometer case.
2	Describe that you are going to measure the health of her/his lungs. Tell the respondent to watch closely as you demonstrate - and that you will then have the respondent practice a number of times.
3	Explain the procedure carefully to the respondent.
4	Demonstrate for the respondent twice using a towel over the hole where the mouthpiece/filter would go. Emphasize that you will use a clean mouthpiece for each person and a good effort is required during the test. Explain that you will use your own mouthpiece to demonstrate but without the nose clip or machine. Using your own mouthpiece: • Take a seated position with chin slightly elevated, neck stretched tall. • Take 3 deep breaths to prepare. Before the 4th deep inhalation, place the mouthpiece to your mouth, inhale deeply and at the end of the inhalation, blow as hard as you can into the mouthpiece until all air is out of your lungs and stomach. • Remain sitting straight during exhalation. This exhalation should take about 6 to 10 seconds. • Take a 20 second break during which you should ask if the respondent has questions. • Demonstrate once more.

Test procedure

Follow the steps below to measure the actual lung function.

Step	Actions
1	Insert a clean disposable filter and mouthpiece into the spirometer.
2	Ask the respondent to sit as erect (straight) as possible. Make sure the respondent is comfortable, and not wearing tight clothing or belts - loosen or remove restrictive clothing.
3	Hold the spirometer in an upright position and press the ON button once to switch on the device.
4	Gently place the nose clip on the respondent's nose to restrict the flow of air through the nose. Ask respondent to gently press against the nose clip to check for leaks. Tell the respondent you will do 2 test trials first to make sure it is done correctly.
5	Remind respondent to elevate the chin and extend the neck high (as if a string is attached to the top of the head and pulled up).
6	Ask the respondent to take 3 long deep breaths.

7	At the fourth breath, ask respondent hold the mouthpiece close to the mouth and encourage a slow, deep breath, as deeply as possible. "Breathe deep, deep, deep, fill your lungs and stomach fully!" At the maximum inhalation, do not make the respondent pause, tell the respondent to seal their lips tightly around the mouthpiece and blow as hard and fast as possible in one continuous blow until there is nothing left to blow out.
8	Encourage the respondent by saying, "blow, blow, blow - keep going - get it all out."
9	Tell the respondent to relax and breath normally. Review the results and provide tips on how the respondent can improve (for example, make sure the lips are sealed tightly before you start blowing - you may need to bite with your teeth on the mouthpiece to help, or don't pause between your maximum inhalation and when you start to blow into the machine, or you must keep blowing until all air is out of your lungs and stomach…)
10	Clear the results on the machine. Repeat steps 5, 6, 7 and 8 above for another practice trial (practice trial 2). After step 8, again tell respondent to relax and breath normally. Give enough time to recover so the respondent performs and does not hyperventilate. Discuss how to improve the results.
11	Now tell the respondent that this time, it is a real test. Encourage the respondent to give a full effort.
12	Repeat steps 5, 6, 7 and 8 above. Afterwards, tell respondent to relax and breath normally.
13	Unacceptable readings will result from a slow start, cough during the blowing, poor effort, early stop (FET less than 6 seconds) or air leak (from nose or mouth around the mouthpiece).
14	If the test was acceptable, • remove the noseclip, and • record the results from the spirometer display in the questionnaire.

8.8 Collection of Dried Blood Spot (DBS) Specimens

Introduction

A finger prick technique is used to draw a blood sample from respondents.

Equipment

You will need the following equipment to conduct the blood tests:

- individual blood kit in a re-sealable plastic (zip lock) bag, including a blood spot card, packet containing 2 gauze pads, alcohol swab, lancet (Monoject - blue and white), desiccant package and humidity indicator card;
- latex gloves; and,
- sharps biohazard container.

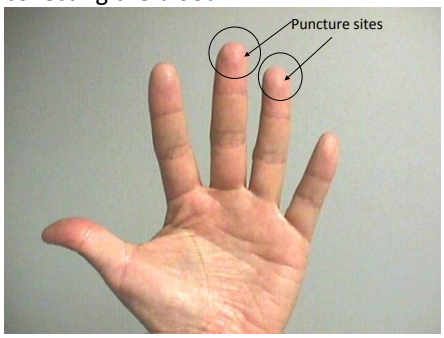
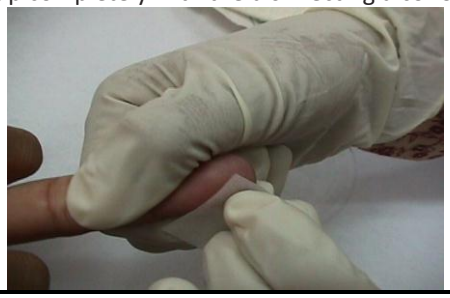
Respondent consent

- Following the procedures used for obtaining individual consent to obtain the consent from respondents before taking blood tests. Use the " Additional Consent for Storage and Future Use of Blood Samples" informed consent form. If the respondent does not provide consent, probe for reasons and answer questions. Explain that obtaining the blood samples will:
  - help to improve planning for providing health care services in the country;
  - help to identify common conditions in the population; and,
  - not jeopardize the respondent in any way.

- If respondent still refuses, explain that this is fine, and continue with the interview by skipping.

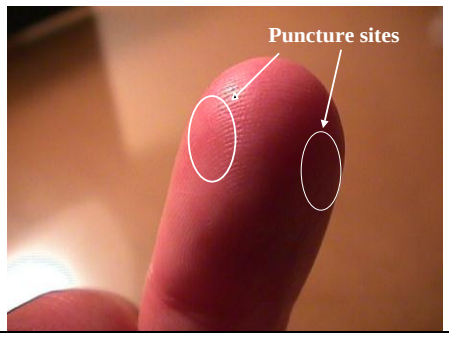
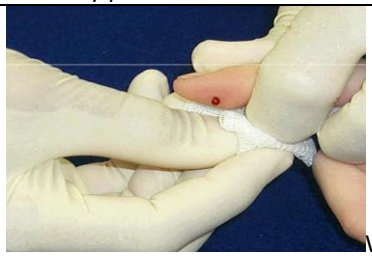
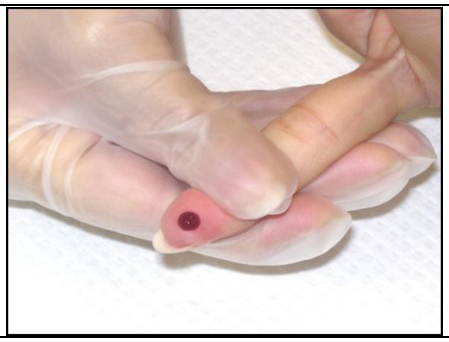
Preparation

Follow the steps below to set up the blood tests and prepare respondents.

Step	Action
1	Ask respondent to wash hands with soap and hot or warm water. Dry hands.
2	Open the plastic bag and remove the blood spot card, packet containing 2 gauze pads, alcohol swab and lancet. Leave the humidity card and desiccant pack inside the plastic bag.
3	Label the blood spot card - leave all blank except: Patient Id. No. - use Household ID number and the respondent's ID number.
4	Put on the latex gloves.
5	If not already sitting, ask respondents to take a seat. Ask respondent which side (right or left) s/he would prefer for the blood sample. Allow arm on selected side to hang down and shake, squeezing hand into a fist, alternating with relaxing, for some time to improve blood flow to the fingers. If the hand is cold, warm the skin by vigorously rubbing the finger, hand and lower arm. This will increase blood flow by and will improve the ease with which a sample can be obtained.
6	Choose a finger on either hand, preferably the third or fourth finger for collecting the blood.  **NOTE:** Avoid using a thumb, little/last finger or heavily calloused fingers. Do not use a finger with a scar, a wound or cut, an infection, swelling, a deformity, or a rash. Also, do not use a finger on which the respondent is wearing a ring, because the ring may disrupt the free flow of blood to the tip of the finger
7	Place the respondent's lower arm and hand on a flat surface. Cleanse the finger tip completely with the disinfecting alcohol swab. Allow the alcohol to air dry.  DO NOT: • prick the finger until the alcohol is completely dry; • blow on the finger to dry the alcohol; or, • Wipe off the alcohol.

Procedure

Follow the steps below to take the blood tests and collect the sample.

Step	Action
1	Remove the lancet needle cover by twisting it in a full circle and then pulling it out. Do not pull out the lancet needle cover without twisting it first as this may cause the needle not to pierce the skin.
2	Make sure that the finger is below the level of the respondent's heart to increase the flow of blood to the finger. Hold the respondent's finger firmly just below the centre of the finger-tip.
3	Press the lancet opening flat and firmly against the finger. The best location is just to the side of the center of finger. 
4	Use the lancet to puncture the skin by placing the blade-slot surface against the area and pressing the trigger. The tip of the blade ejects through the opening, producing a small cut in the skin, and immediately retracts into the device. After puncturing the skin, turn the finger slightly to prevent blood from running into the grooves of the skin. 
5	Release the pressure and allow a full drop of blood to collect on the finger.
6	Carefully place the used lancet in the sharp biohazard container.
7	 When the blood appears, use one of the gauze pads to wipe away the first drop of blood. Dispose of the gauze pad by placing it into the sharps container.
8	Allow a second full drop of blood to pool on the finger tip. Do not let finger touch the ground. 

9	While maintaining a firm grip on the finger, press gently on the side of the finger from which you are taking the blood sample to get a large second drop. Be careful to avoid 'milking' or 'squeezing' the finger as this could affect the test results. Wait until the drop is large enough to fill one of the circles on the blood spot card. Hold the finger over a circle on the blood spot card and let the blood drop freely fall into the center of the circle. In case the blood drop does not fall - lightly touch the filter paper onto the LARGE drop of blood. The card must not be pressed against the puncture site on the finger. Make sure that the respondent's finger does not touch the card at any point when you are collecting the blood spots. It's very important to fill the circle completely. • Apply blood only to one side of the paper. • Do not touch the areas within the circles on the filter paper with gloved or un-gloved hands, before or after specimen collection since skin oils, latex and powder may affect test results.
10	Fill the remaining circles in the same manner with successive blood drops. If necessary, to enhance blood flow, gently apply intermittent pressure to the area surrounding the puncture site to get a third drop. Allow sufficient time for a large blood drop to form before filling a second circle on the filter paper card. Again, avoid milking or squeezing the finger. 
11	There may be times when a drop of blood will not completely fill the circle. If a circle is not completely saturated, the next drop or just a portion of the next drop of blood may be used to saturate the circle if the drop is obtained immediately. If the first drop starts to dry due to any interruption in getting the subsequent drop, you must begin filling another circle. Layering or application of successive drops of blood to a dried or partially dried blood spot causes problems. If a drop falls outside of the circle or is not large enough then let the next drop of blood fall again to the side of the original drop. **Note:** all circles should have uniform blood volume.
12	If the blood stops flowing before you have filled the 5 circles on the blood spot card, or if the amount of blood is insufficient, the skin puncture procedure may be repeated with the respondent's consent on a different finger. Use the Tenderlett lancet (white and red) and extra alcohol wipe provide in your back-up supplies. The Tenderlett has no cover to remove - open the plastic package and follow steps 2-9 above.
13	When all five circles are filled, place the blood spot card on a flat, clean, dry, non-absorbent surface away from direct sunlight to dry until the end of the interview. You can place the card so that the edge of the protective flap rests on the selected surface (that is, facing down) so that the blood spots are not touching the surface.
14	Apply pressure to the fingertip using a gauze pad until bleeding stops.
15	Make sure any bloodied materials (gauze, lancets, gloves) are carefully placed in the sharps biohazard container.

Handling samples Follow the steps below to handle the blood samples.

Step	Action
1	At the end of the interview, place the blood spot card in the re-sealable plastic (zip lock) bag with desiccant package and humidity indicator card. Be careful to not touch the blood spots. Place the bag into the storage box. Store these vertically, do not stack the bags one on top of another. **Note:** While completing the interview and also while transferring the blood spot card to the zip lock bag, ensure nothing touches the blood spots (hands, ground, etc.) until they are placed in the plastic bag.
2	At the end of the interviewing day, clean your hands with soap and water - and dry them. Use gloves to handle the blood spot cards. Making sure not to touch the blood spots, take the cards out of their bags. Lay them flat on a dry, clean, non-absorbent surface away from direct heat or sunlight and allow them to dry for at least 4 hours (for example overnight). Again, lay them with edge of the protective flap down. The cards must be kept clean and dry at all times. Water, dust, sweat from your hands, or other environmental contaminants can affect the test results.
3	Once the blood spot cards are completely dry, place them back into the plastic bags with the desiccant pack and humidity indicator card. Again, clean your hands with soap and water - and dry them completely, and use gloves before touching the cards. Handle the cards touching only the area furthest from the blood spots. Seal the bags.
4	Submit the zip lock bags with the blood spot card, desiccant package and humidity indicator card to your supervisor within three days of collection and specimens reach the freezer at NARI within 7 days of DBS collection. While sending to NARI it should have 3 transmittal sheets. Make sure the samples are not stored in direct sunlight.
5	Monitor the humidity cards daily for signs of the indicator circles turning pink. If the humidity indicator circles begin to turn pink, the desiccant packet and humidity indicator card will need to be replaced immediately. The humidity indicator card allows you to monitor the level of moisture - you can add additional desiccant packets in conditions of high humidity. There are three circles on the humidity indicator card. If the circle in the middle of the card (labelled 30%) turns pink, it indicates a relatively high level of humidity and is a warning to begin to carefully monitor the humidity level. If the middle or top circles (labelled 40%, 50%, and 60% respectively) turns pink, you should replace the desiccant packets in the bag with fresh packets. Replace the humidity indicator card with a fresh card if the circles merge.

9. Appendix B: Graphs for Biomarker Distribution

Figure 2. Systolic Blood Pressure Distribution (mmHg)

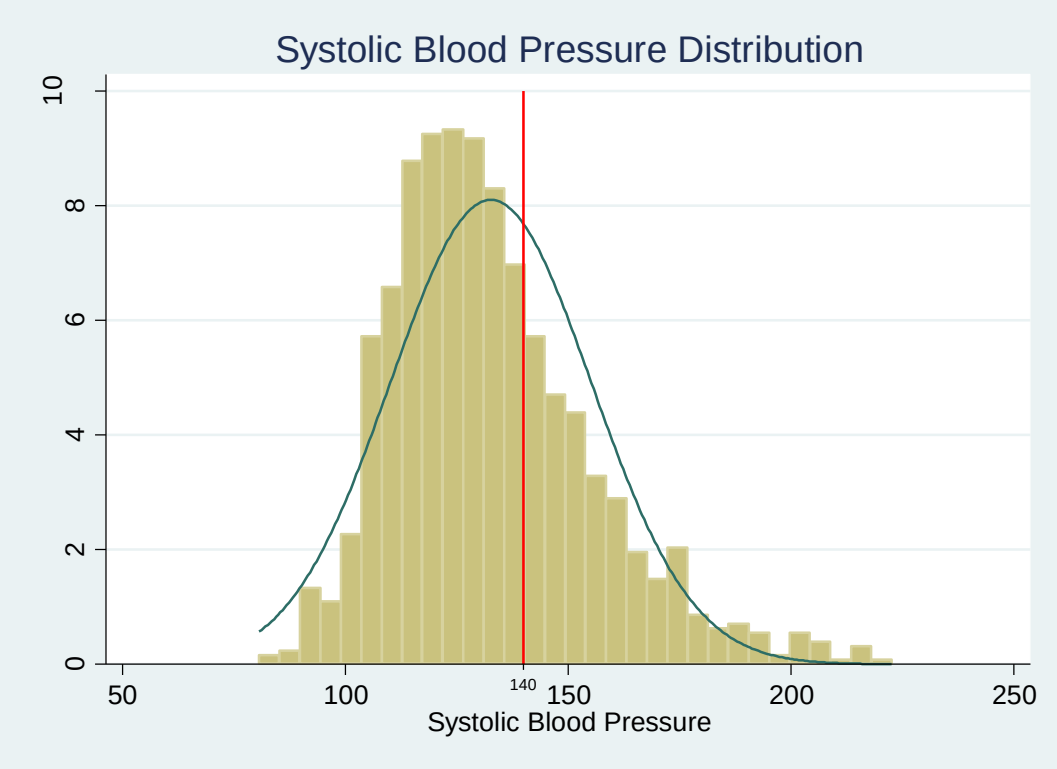


Figure 3. Diastolic Blood Pressure Distribution (mmHg)

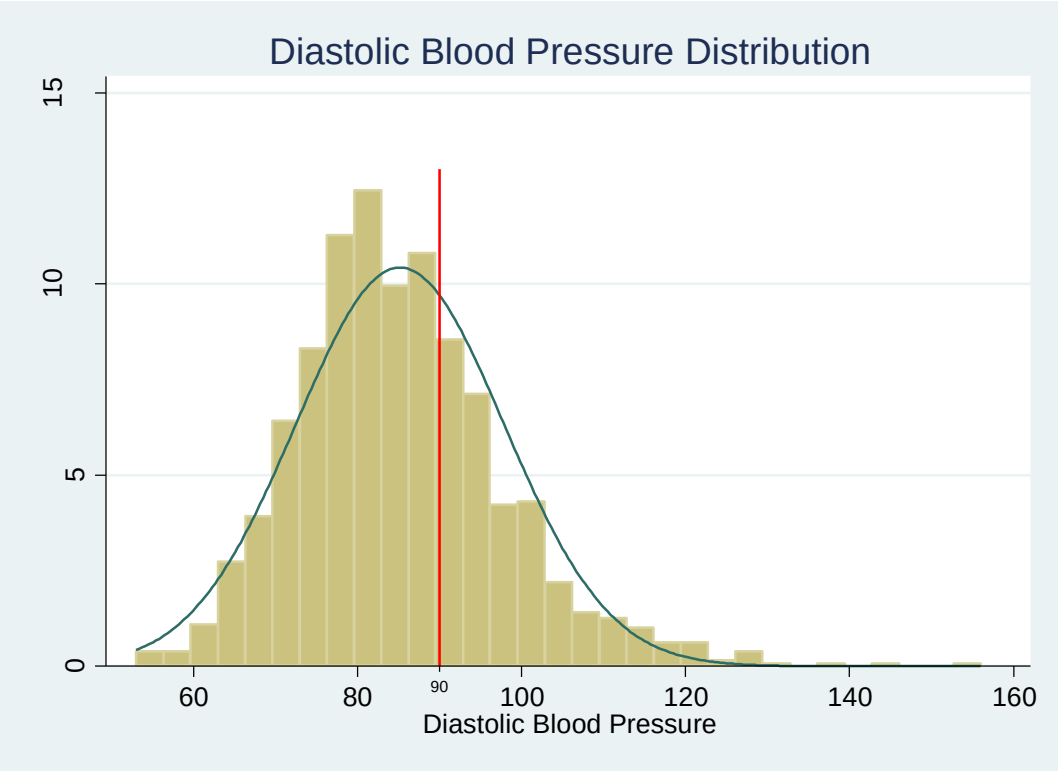


Figure 4. Height Distribution

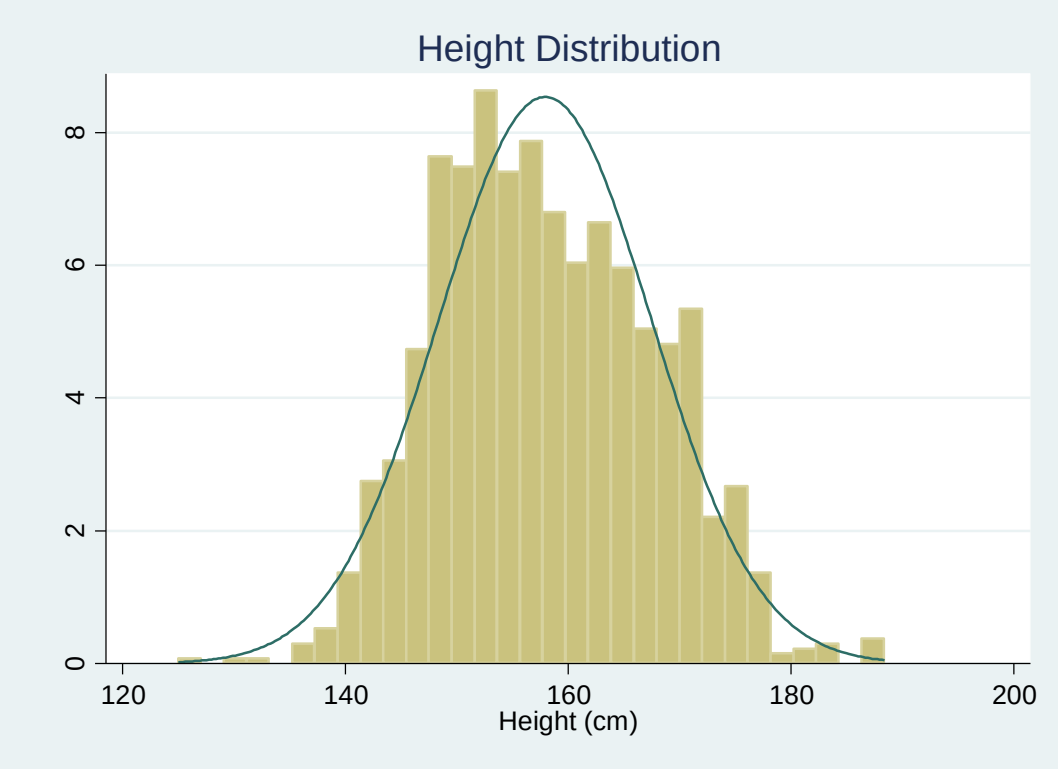


Figure 5. Weight Distribution

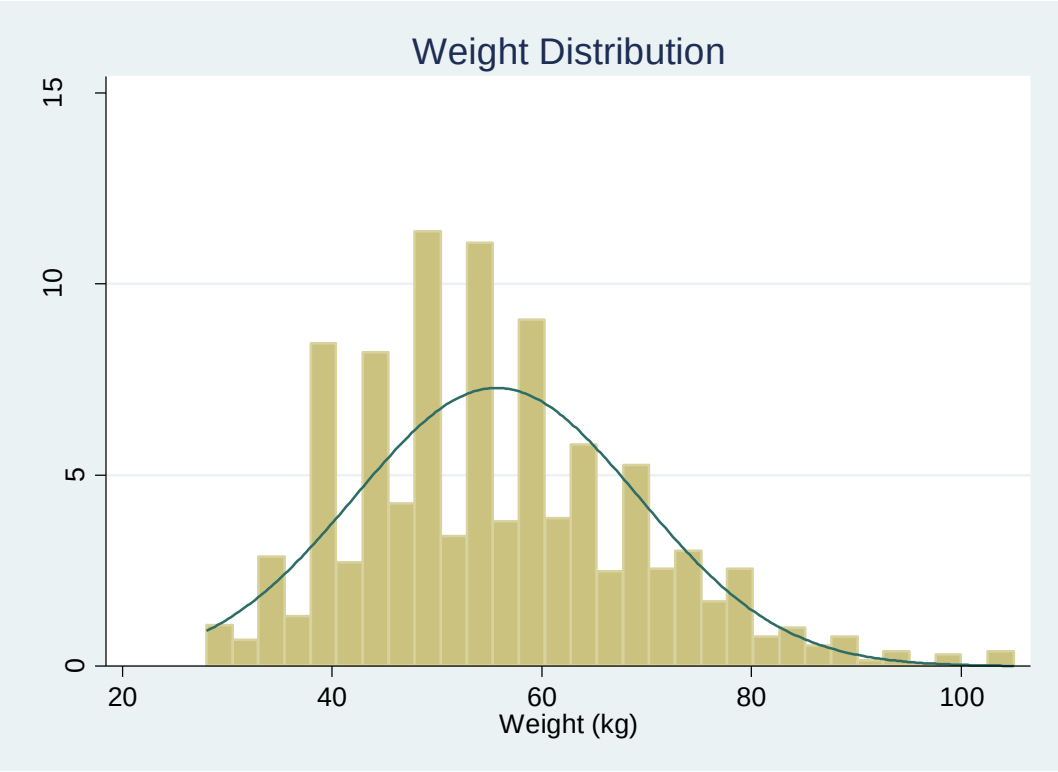


Figure 6. BMI Distribution (kg/m^2)

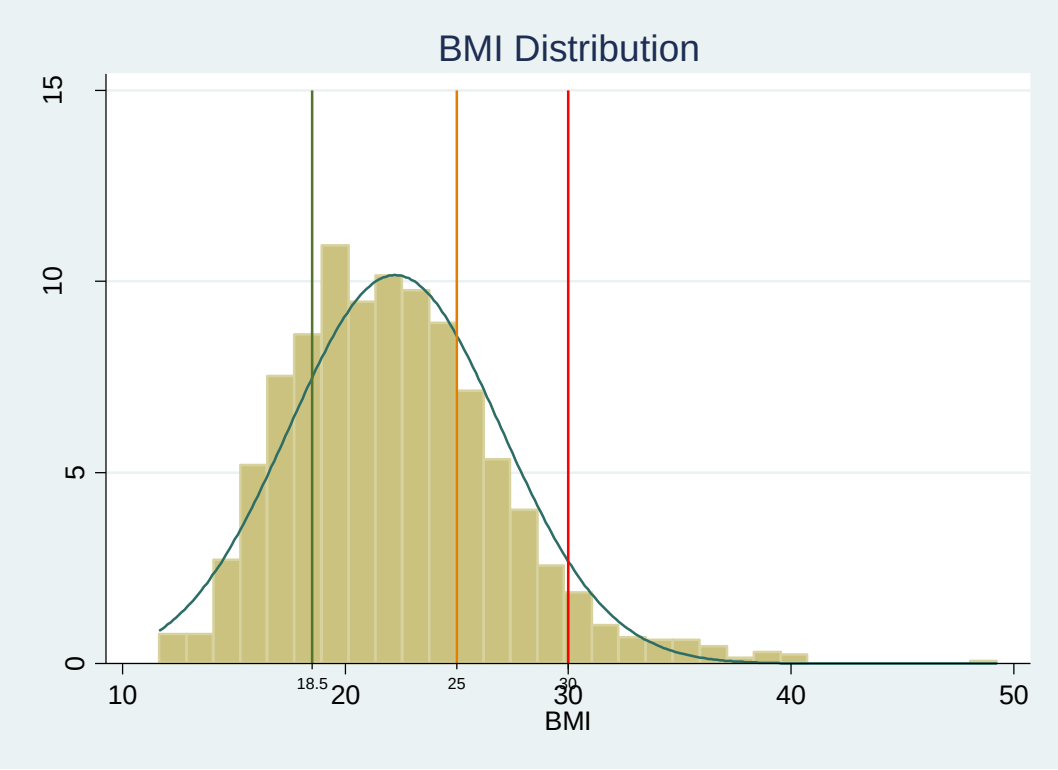


Figure 7. Distribution of waist circumference measurements

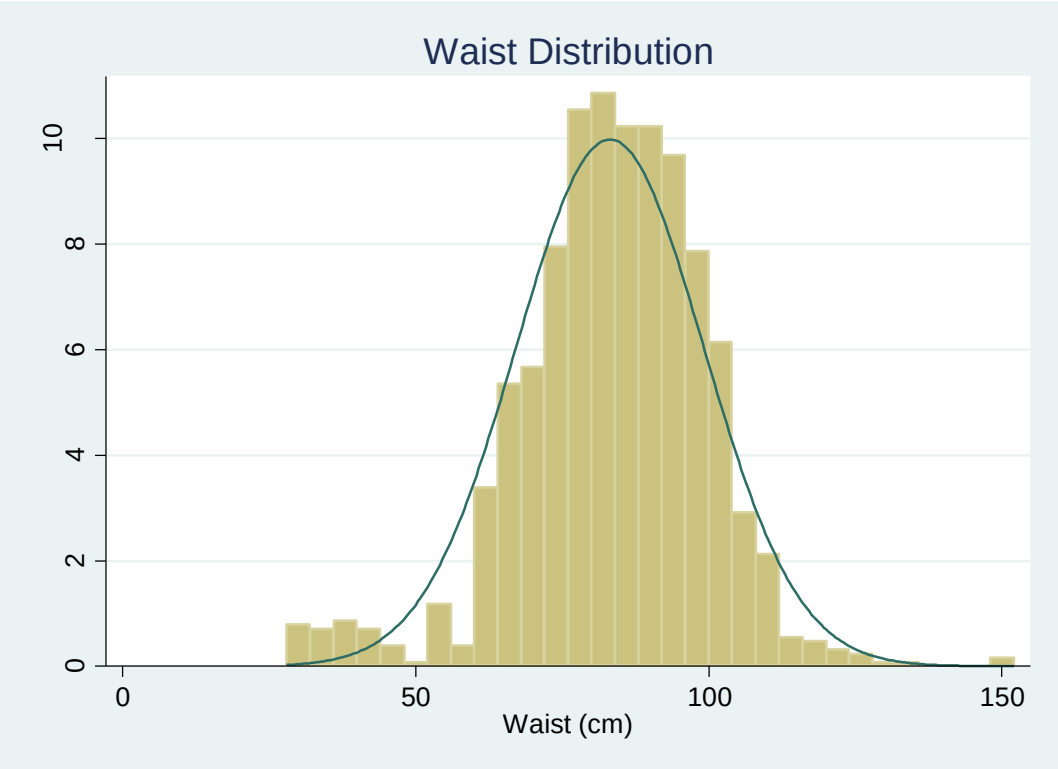


Figure 8. Distribution of hip circumference measurements

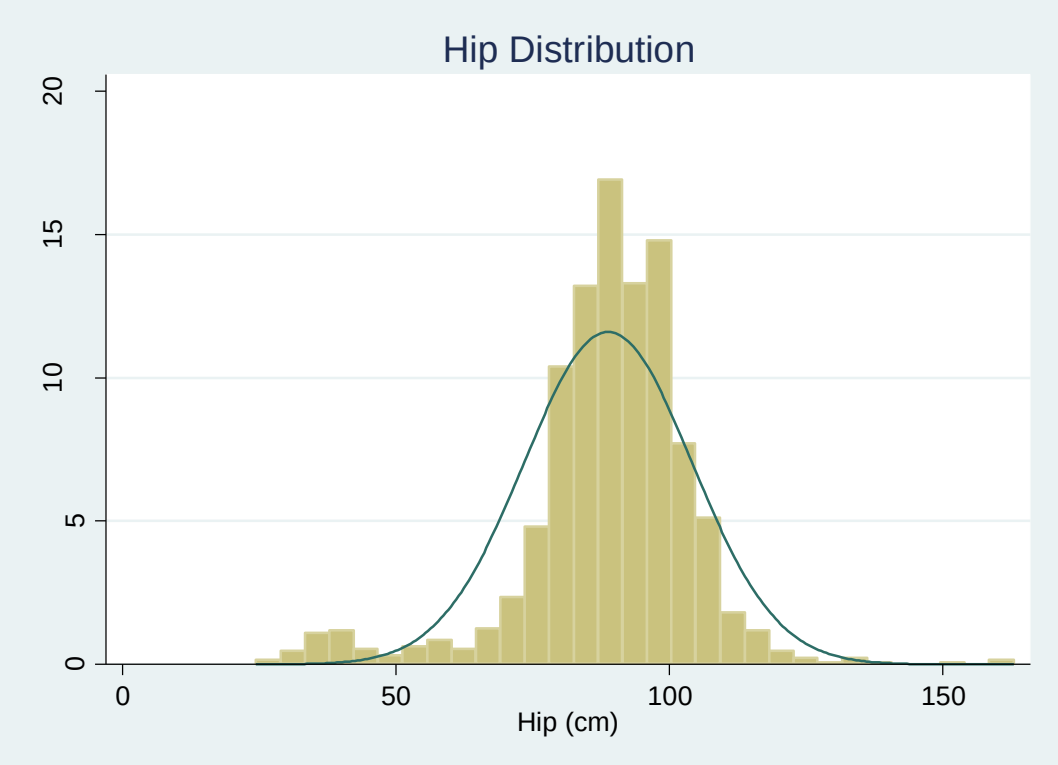


Figure 9. Distribution of timed walk

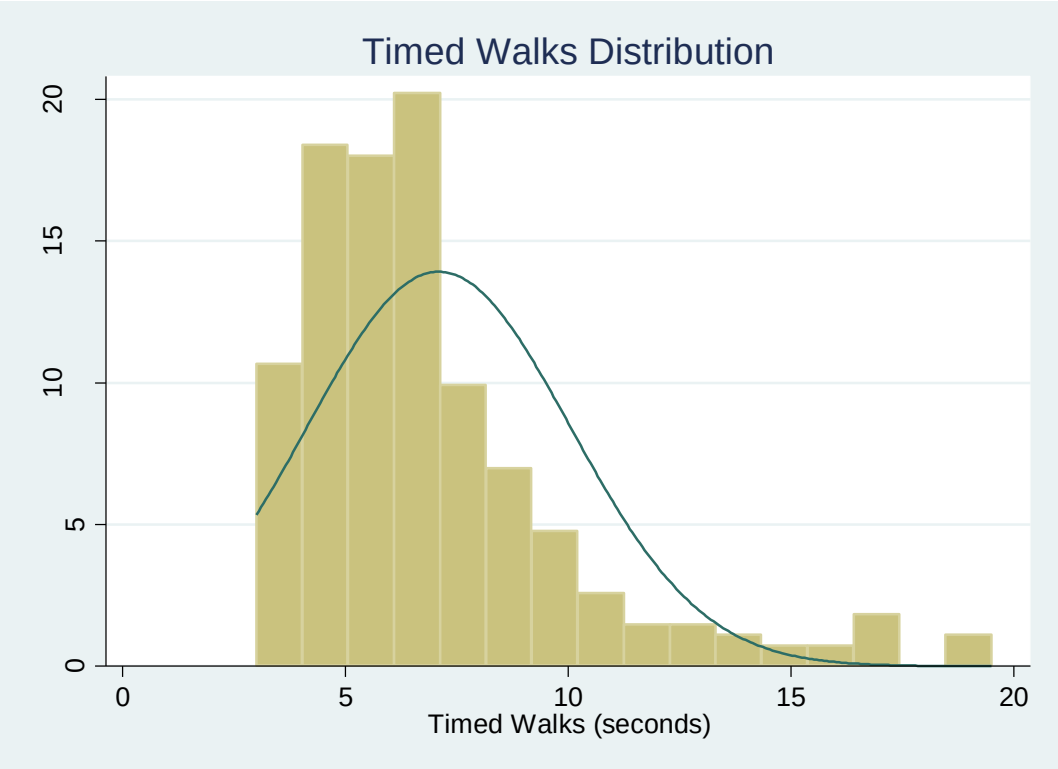


Figure 10. Distribution of Distance Vision: Left

Figure 11. Distribution of Distance Vision: Right

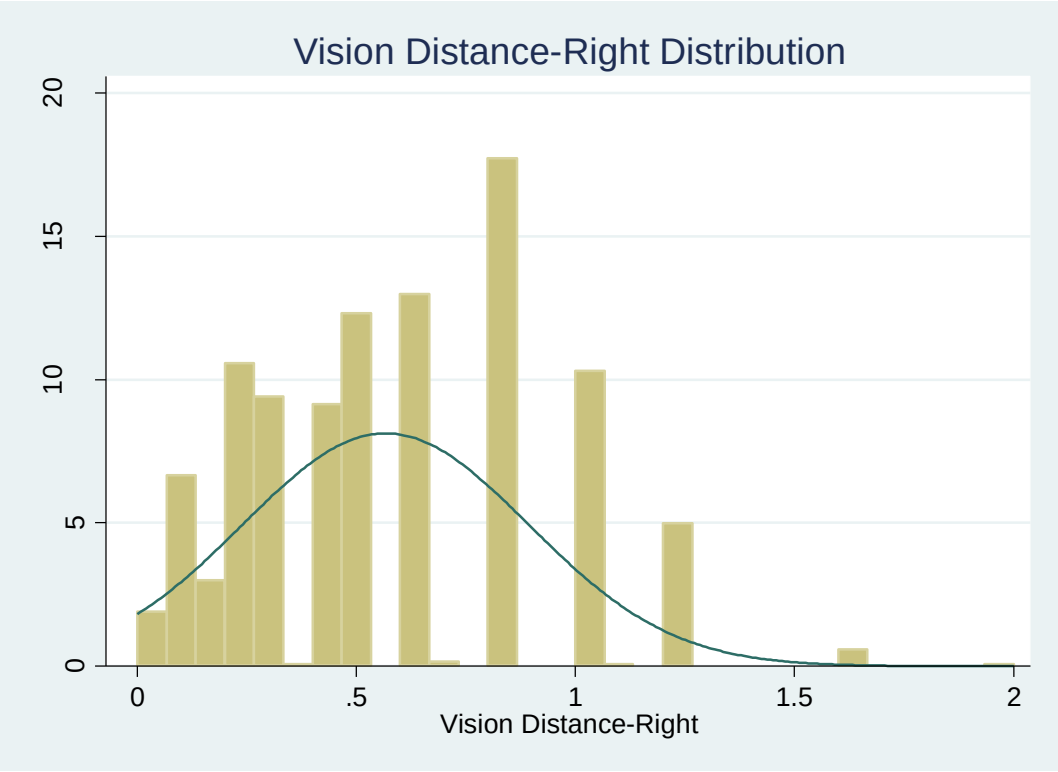


Figure 12. Distribution of Near Vision: Left

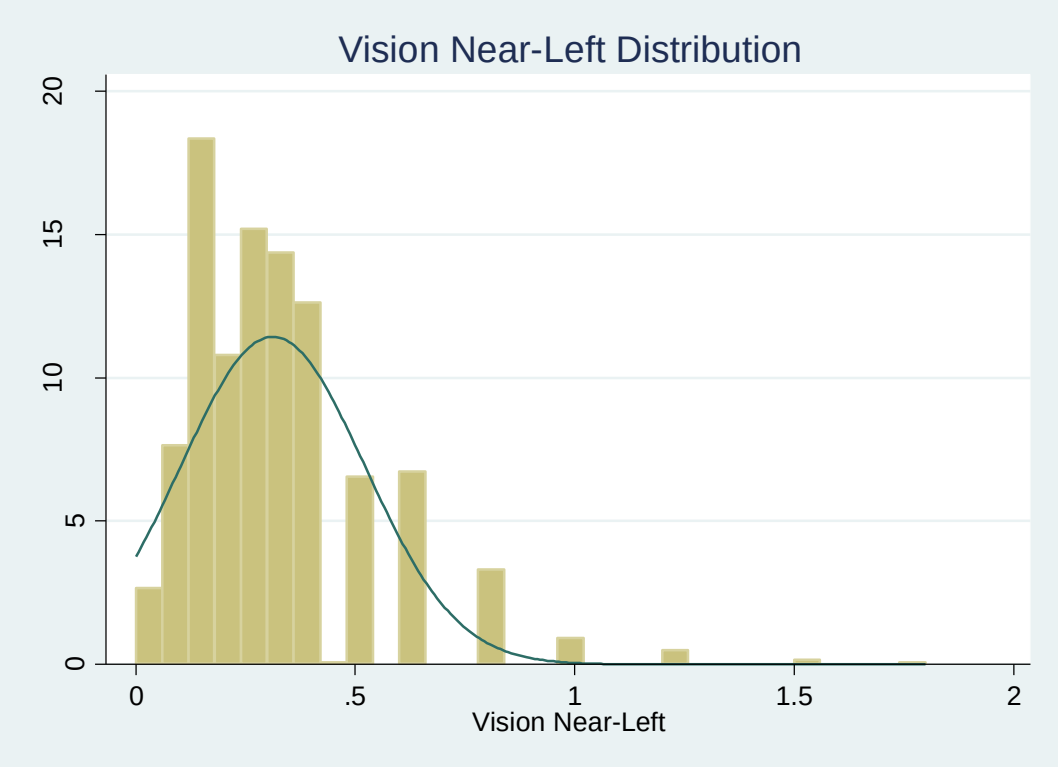


Figure 13. Distribution of Near Vision: Right

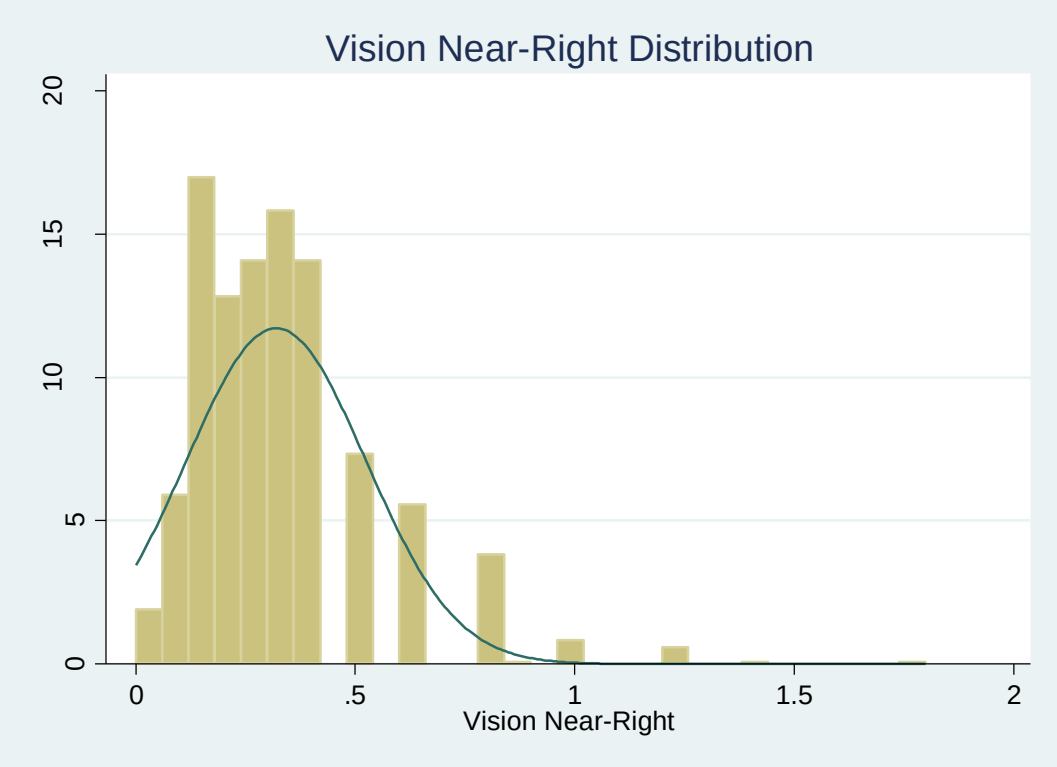


Figure 14. Distribution of Grip Strength-Left Hand

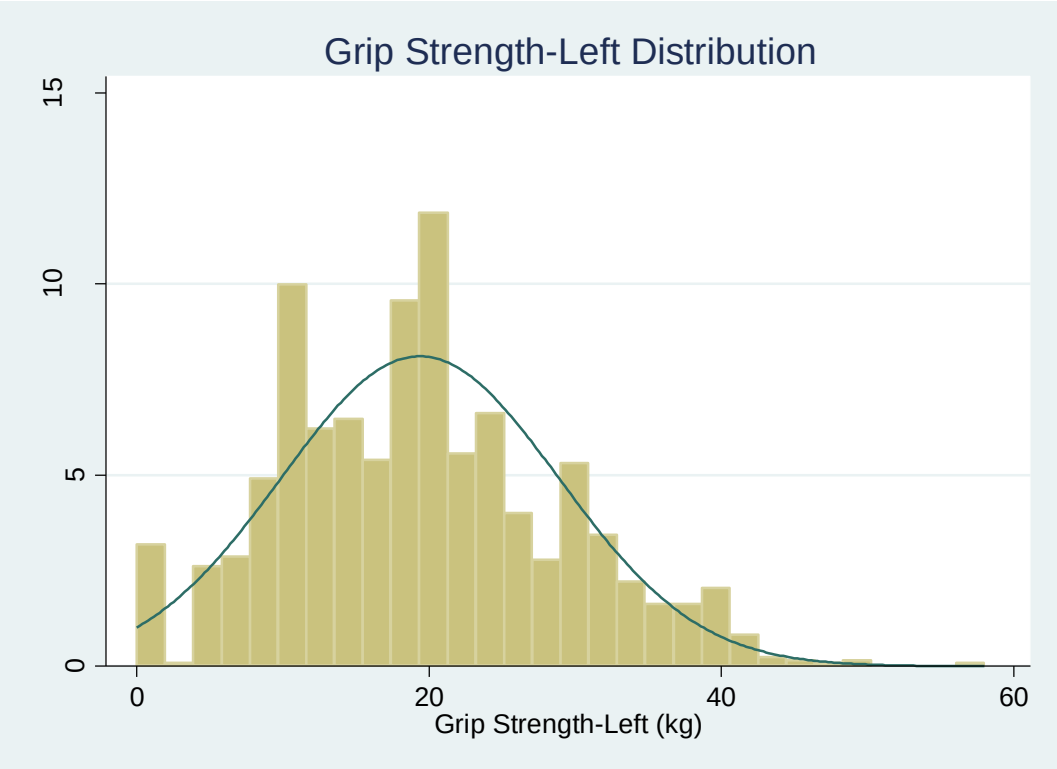


Figure 15. Distribution of Grip Strength-Right Hand

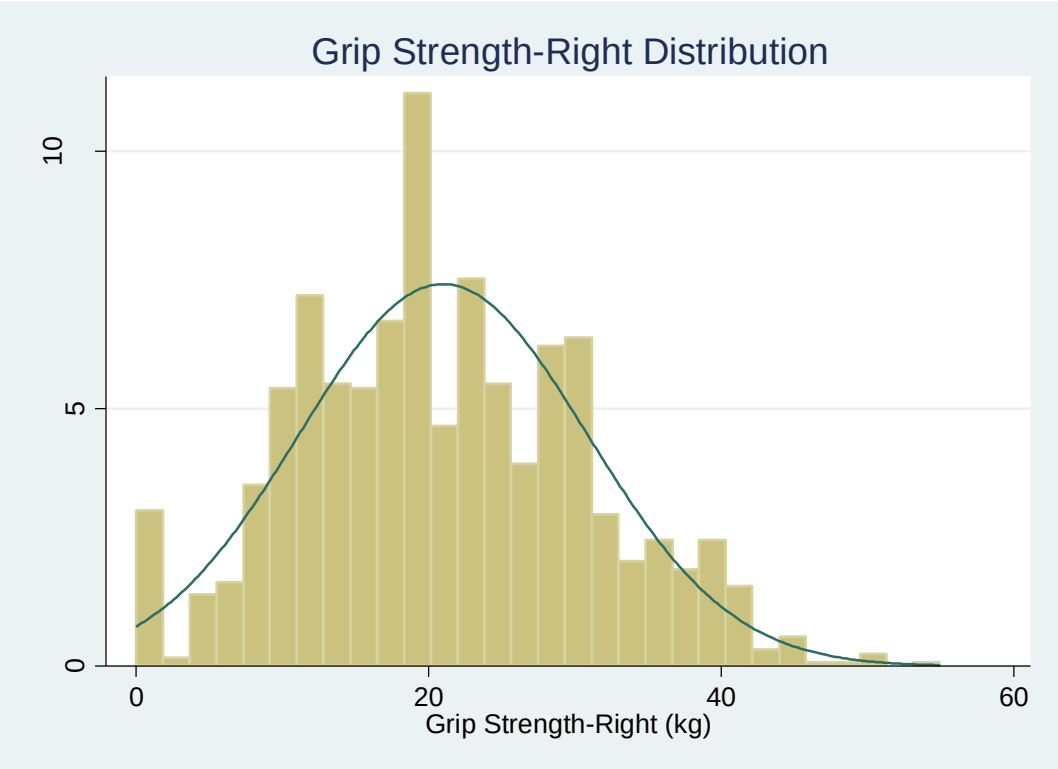


Figure 16. Distribution of FVC (flow volume capacity)

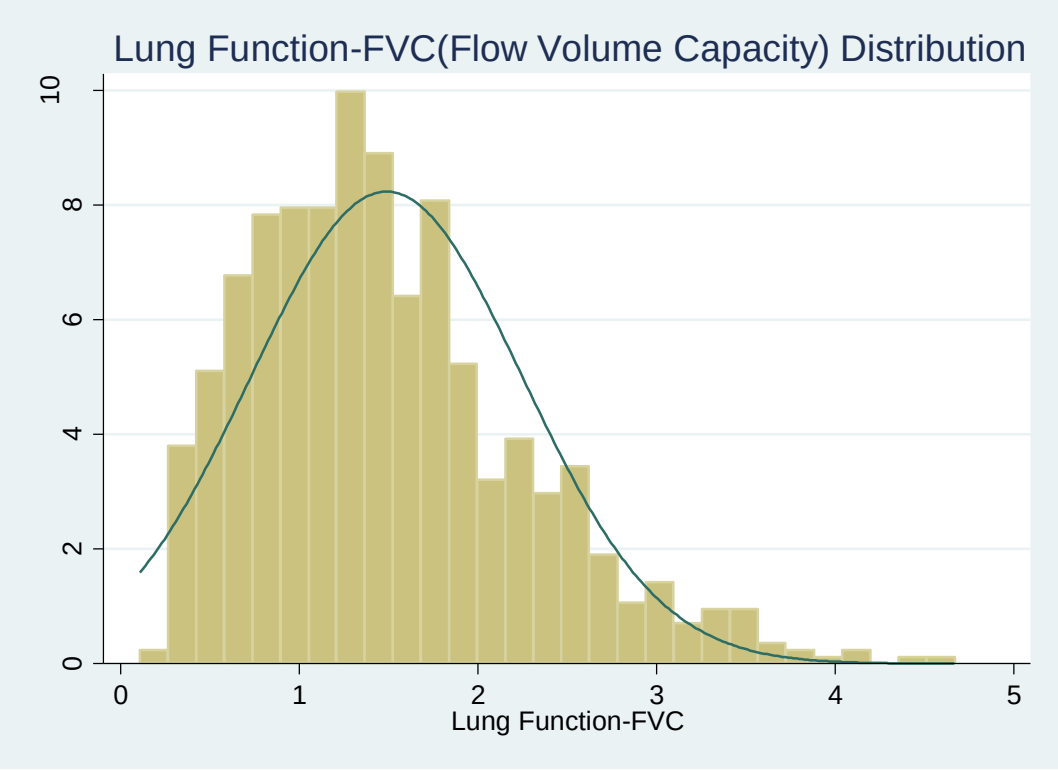


Figure 17. Distribution of PEF (Puff Electronic Force)

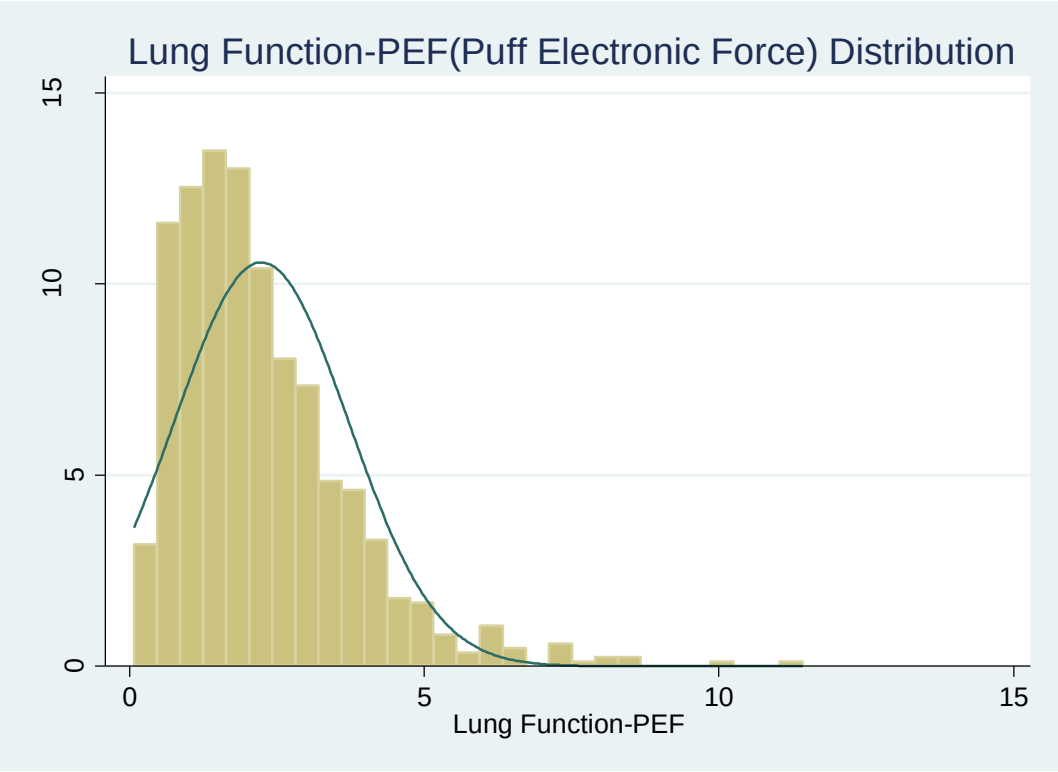


Figure 18. Distribution of CRP

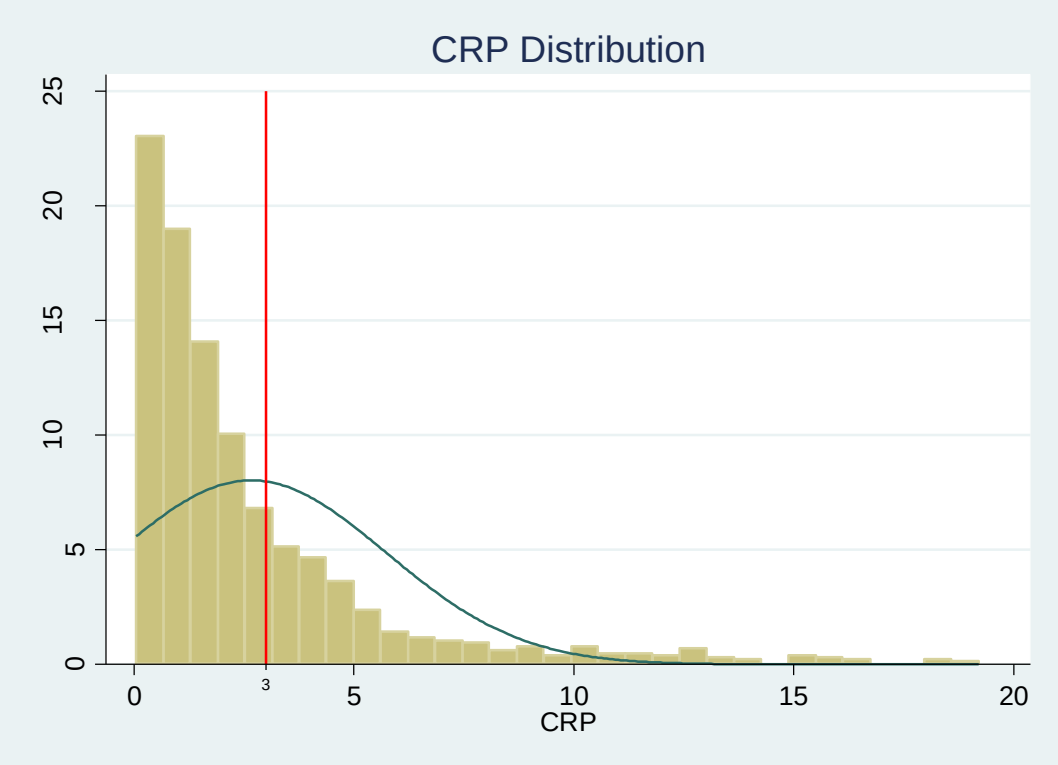


Figure 19. Distribution of Log of CRP

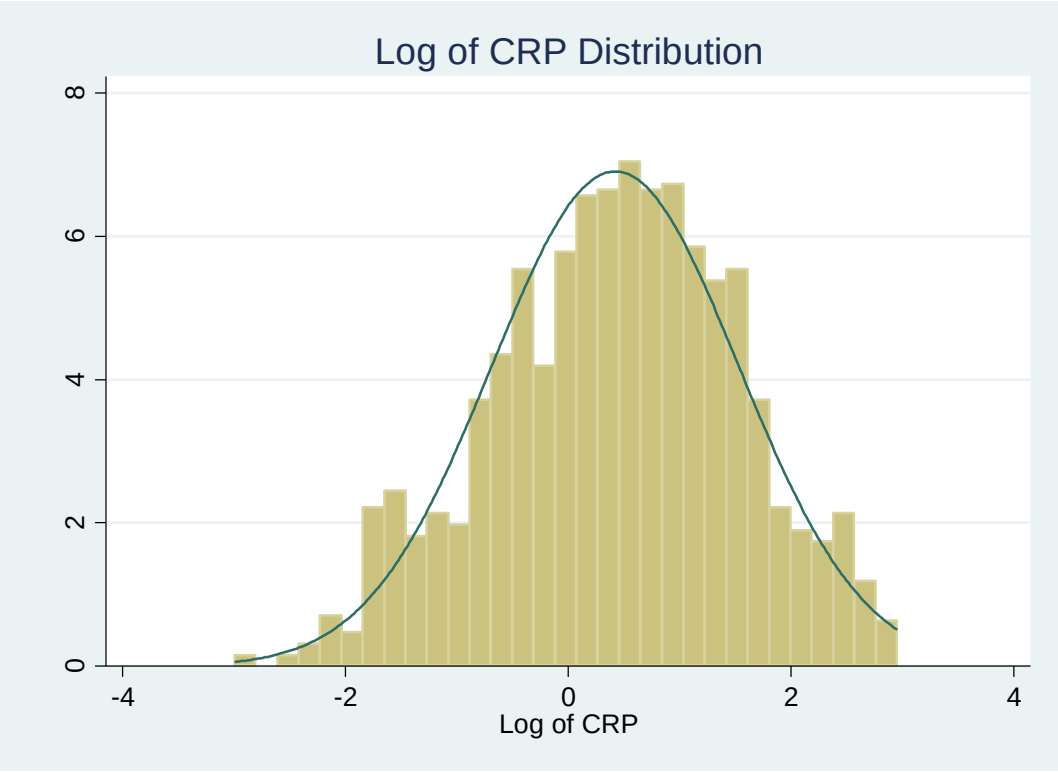


Figure 20. Distribution of EBV

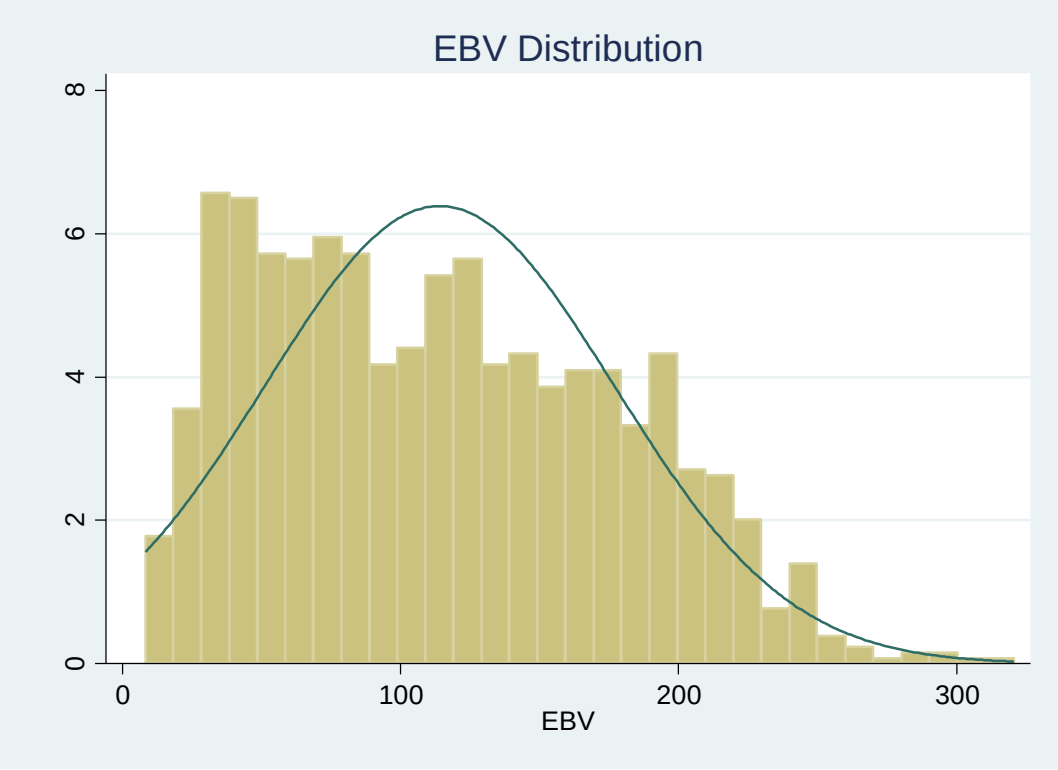


Figure 21. Distribution of Hemoglobin: Male

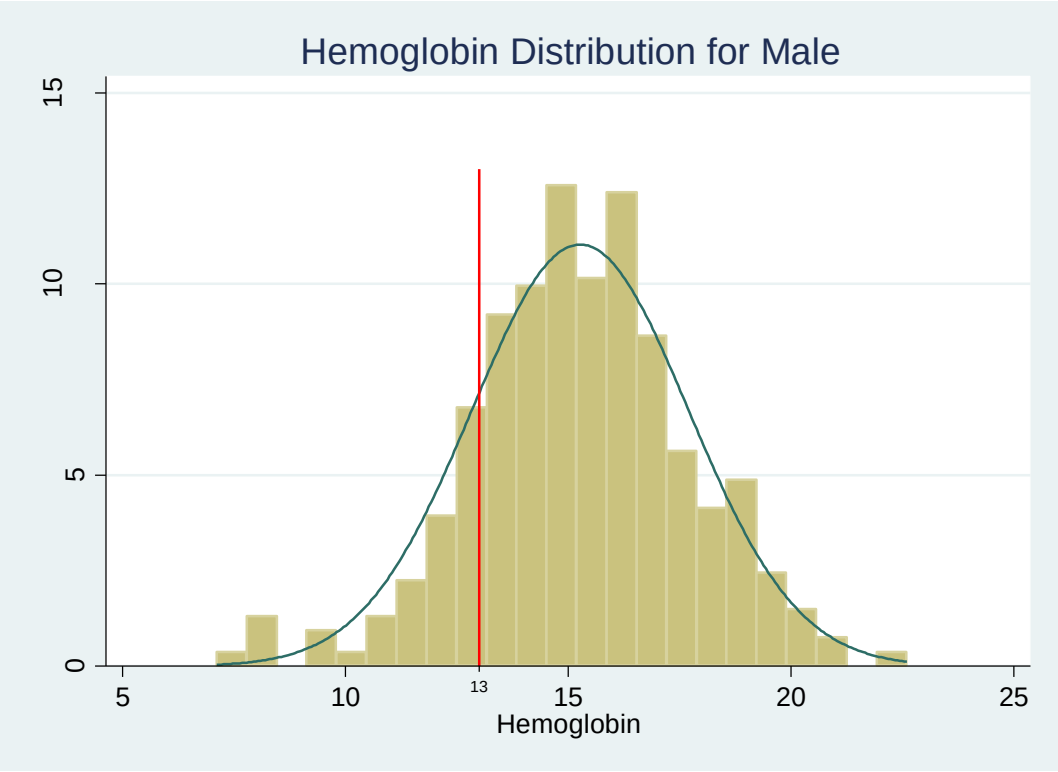
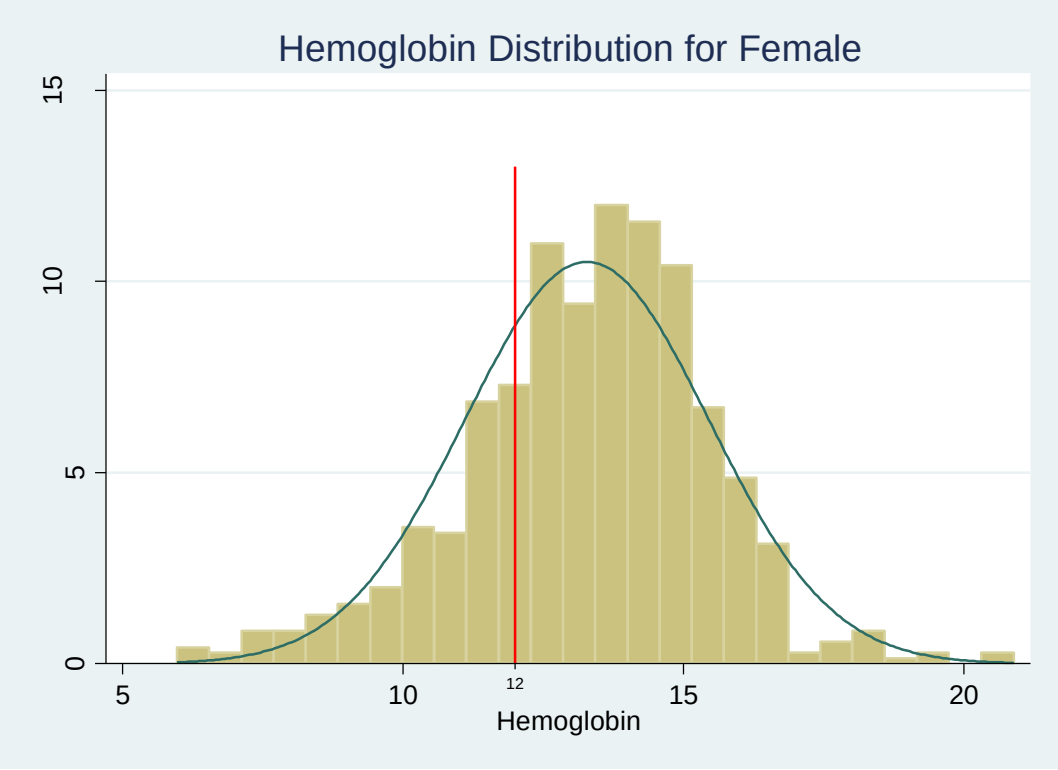


Figure 22. Distribution of Hemoglobin: Female



10. Appendix C: List of Biomarker Variables

Variable	Label
assay_c	CRP Assay
original_c	CRP original or duplicate
validate_c	CRP Validation sample
nari	NARI Code
od1_c	CRP Blank OD 1
od2_c	CRP Blank OD 2
crp1	CRP 1 (mg/L)
crp2	CRP 2 (mg/L)
crpavg	CRP average (mg/L)
cv_c	CRP CV Sample (%)
highcv_c	CRP High CV (>10%)
outhigh_c	CRP out of range High
outlow_c	CRP out of range Low
barcode	ID used in bloodspots
assay_e	EBV Assay
original_e	EBV original or duplicate
validate_e	EBV Validation sample
od1_e	EBV Blank OD 1
od2_e	EBV Blank OD 2
eu1	EBV 1
eu2	EBV 2
euavg	EBV average
cv_e	EBV sample CV %
highcv_e	EBV High CV (>10%)
assay_h	HB Assay
original_h	HB original or duplicate
validate_h	HB Validation sample
od1_h	HB Blank OD 1
od2_h	HB Blank OD 2
hb1	HB 1 (g/dL)
hb2	HB 2 (g/dL)
hbavg	HB average (g/dL)
cv_h	HB sample CV %
highcv_h	HB High CV (>10%)
highhb	HB High HB (20g/dL)
lowhb	HB low HB (6g/dL)
prim_key	primary key
state	state

district	district
psu	psu number
hh	household number
residence	residence
tsstart	timestamp start
tsend	timestamp end
bm_rage	age r
bm_age	confirm age of rage
bm001	blood pressure
bm001_space	suitable space for test
bm002	having a rash, cast, edema (swelling)
bm003	direction of measurement
bm004	safe measurement
bm004_iwer	do iwer feel it would be safe for this respondent to do this measurement
bm005	problem with equipment or supplies
bm005_other	other reasons for not completing the blood pressure measurement
bm006_intro	record measurement in chart
bm006	timing for first measurement in hours
bm006a	timing for first measurement in minutes
bm007	am/pm for first measurement
bm008	first measurement, systolic reading
bm009	first measurement, diastolic reading
bm010	first measurement, pulse
bm011	timing for second measurement
bm011a	timing for second measurement in minutes
bm012	am/pm for second measurement
bm013	second measurement, time of reading
bm014	second measurement, diastolic reading
bm015	second measurement, pulse
bm016	timing for third measurement
bm016a	timing for third measurement in minutes
bm017	am/pm for third measurement
bm018	third measurement, systolic reading
bm019	third measurement, diastolic reading
bm020	third measurement, pulse
bm021	which are was used for measurement
bm022	how compliant was r during measurement
bm023	respondents position for test
bm024	did r smoke, exercise, consume alcohol or food within 30 minutes
bm025	spirometer, disposable mouthpiece, disposable filter, nose clip
bm025_space	suitable space for test

bm026	understand the direction of measurement
bm027	do you feel it would be safe for measurement
bm027_iwer	do iwer feel it would be safe for this respondent to do this measurement
bm028	problem with equipment or supplies
bm028_other	other reasons why didnt r complete the breathing test
bm029_intro	record measurement
bm029	first measurement
bm029a_1_	flow volume capacity
bm029a_2_	flow volume capacity
bm029a_3_	flow volume capacity
bm029a	flow volume capacity
bm029b_1_	flow electronic volume
bm029b_2_	flow electronic volume
bm029b_3_	flow electronic volume
bm029b	flow electronic volume
bm029c_1_	flow electronic volume percentage
bm029c_2_	flow electronic volume percentage
bm029c_3_	flow electronic volume percentage
bm029c	flow electronic volume percentage
bm029d_1_	puff electronic force
bm029d_2_	puff electronic force
bm029d_3_	puff electronic force
bm029d	puff electronic force
bm029e_1_	fef
bm029e_2_	fef
bm029e_3_	fef
bm029e	fef
bm029f_1_	fet
bm029f_2_	fet
bm029f_3_	fet
bm029f	fet
bm030	second measurement
bm031	third measurement
bm032	effort that r put in the test
bm033	r's position for test
bm034	dynamometer, stopwatch
bm034_space	suitable space for test
bm035	any surgery, or any swelling, inflammation, severe pain or injury in hand
bm036	surgery in which hand
bm037	understand the direction of measurement
bm038	safe measurement

bm038_other	other reasons why didn't r complete the breathing test
bm036_iwer	do iwer feel it would be safe for this respondent to do this measurement
bm039	problem with equipment or supplies
bm039_other	other reasons why didn't r complete the hand strength test
bm040	r's dominant hand
bm041_intro	[iwer: record measurement in table below:record measurements to the nearest 0.5
bm041	first measurement
bm042	first measurement
bm043	second measurement
bm044	second measurement
bm045	effort that r put in the test
bm046	rs position for test
bm047	did r rest their arm on a support while performing the test
bm048	r's standing positions
bm048_space	suitable space for test
bm049	any problem from recent surgery, injury or other health condition
bm049_discuss	discussion for physical problem
bm050	understand the direction of measurement
bm051	do you feel it would be safe for measurement
bm051_iwer	do iwer feel it would be safe for this respondent to do this measurement
bm052	problem with equipment or supplies
bm052_other	other reasons why didn't r complete the hand strength test
bm053	did r hold semi-tandem stand for a full 10 seconds
bm053_unable	was r compliant during semi tandem stand
bm054_time	time of tandem stand
bm055	did r use any compensatory movements during semi-tandem stand
bm056	r able to complete the semi tandem for full 10 seconds
bm057	standing with feet together for 10 seconds
bm057_space	suitable space for test
bm058	understand the direction of measurement
bm059	do you feel it would be safe for measurement
bm059_iwer	do iwer feel it would be safe for this respondent to do this measurement
bm060	problem with equipment or supplies
bm060_other	other reason why didn't r complete the side-by-side test
bm061	did r hold side-by-side stand for 10 seconds
bm062_time	amount of time r held stand in seconds
bm063	did r use any compensatory movements during side-by-side stand
bm064	record the type of floor surface
bm064_other	other ways to record the type of floor surface
bm065	how compliant was r during balance measurement
bm066	record eligible time

bm067_space	suitable space for test
bm067	record eligible time
bm068	understand the direction of measurement
bm069	do you feel it would be safe for measurement
bm069_iwer	do iwer feel it would be safe for this respondent to do this measurement
bm070	problem with equipment or supplies
bm070_other	other reasons why didn't r complete the full-tandem test
bm071	did r hold semi-tandem stand for a full 30/60 seconds
bm072_time	amount of time r held stand in seconds
bm073	did r use any compensatory movements during full-tandem stand
bm074	record the type of floor surface
bm074_other	record the type of floor surface
bm075	how compliant was r during balance measurement
bm076	eligibility for walking speed test
bm076_space	suitable space for test
bm077	very short distance comfortably
bm078	very short distance comfortably
bm079	understand the direction of measurement
bm080	do you feel it would be safe for measurement
bm080_iwer	do iwer feel it would be safe for this respondent to do this measurement
bm081	problem with equipment or supplies
bm081_other	other reasons why didn't r complete the walking speed test
bm082_intro	walk along side you the whole time
bm082	first measurement
bm083	second measurement
bm084	record the type of floor surface
bm084_other	other ways to record the type of floor surface
bm085	record the type of aid used
bm085_other	other reasons record the type of aid used
bm086	other reasons record the type of aid used
bm087	vision tests
bm087_space	suitable space for test
bm088	understand the direction of measurement
bm089	do you feel it would be safe for measurement
bm089_iwer	do iwer feel it would be safe for this respondent to do this measurement
bm090	problem with equipment or supplies
bm090_other	other reasons why do you feel it would be safe for measurement
bm091_intro	distance vision
bm091	distance vision - left eye
bm092	distance vision - right eye
bm093_intro	near vision

bm093	near vision - left eye
bm094	near vision - right eye
bm095	how compliant was r during the measurement
bm096	measurement of height
bm096_space	suitable space for test
bm097	understand the direction of measurement
bm098	do you feel it would be safe for measurement
bm098_iwer	do iwer feel it would be safe for this respondent to do this measurement
bm099	why didn't r complete the height measurement
bm099_other	other reasons why didn't r complete the height measurement
bm100_intro	record measurement in table
bm100	first measurement, height
bm101	record the type of floor surface
bm101_other	othe reasons record the type of floor surface
bm102	was r wearing shoes during measurement
bm103	how compliant was r during the measurement
bm104	is r elibible for weight measurement
bm104_space	suitable space for test
bm105	measuring height
bm106	understand the direction of measurement
bm107	do you feel it would be safe for measurement
bm107_iwer	do iwer feel it would be safe for this respondent to do this measurement
bm108	problem with equipment or supplies
bm108_other	other reasons why weren't you able to measure r's weight
bm109_intro	record measurement in table
bm109	first measurement
bm110	record the type of floor surface
bm110_other	other reasons to record the type of floor surface
bm111	was r wearing shoes during measurement
bm112	how compliant was r during the measurement
bm113	waist measurement
bm113_space	suitable space for test
bm114	do you feel you are able to stand while we do this measurement
bm115	understand the direction of measurement
bm116	do you feel it would be safe for measurement
bm116_iwer	do iwer feel it would be safe for this respondent to do this measurement
bm117	problem with equipment or supplies
bm117_other	other reasons why weren't you able to measure r's waist
bm118_intro	record measurement in table
bm118	first measurement
bm119s1	difficulties occured during measurement

bm119s2	difficulties occured during measurement
bm119s3	difficulties occured during measurement
bm119s4	difficulties occured during measurement
bm119s5	difficulties occured during measurement
bm119s6	difficulties occured during measurement
bm119s7	difficulties occured during measurement
bm119_other	other reasons difficulties occured during measurement
bm120	how compliant was r during the measurement
bm121	who completed the measurement
bm122	was r wearing bulky clothing during measurement
bm123	measurement for hip circumference
bm123_space	suitable space for test
bm124	do you feel you are able to stand while we do this measurement
bm125	understand the direction of measurement
bm126	do you feel it would be safe for measurement
bm126_iwer	do iwer feel it would be safe for this respondent to do this measurement
bm127	problem with equipment or supplies
bm127_other	other reasons why weren't you able to measure r's waist
bm128_intro	record measurement in table
bm128	first measurement
bm129s1	difficulties occured during measurement
bm129s2	difficulties occured during measurement
bm129s3	difficulties occured during measurement
bm129s4	difficulties occured during measurement
bm129s5	difficulties occured during measurement
bm129s6	difficulties occured during measurement
bm129s7	difficulties occured during measurement
bm129_other	other reasons difficulties occured during measurement
bm130	how compliant was r during the measurement
bm131	who completed the measurement
bm132	was r wearing bulky clothing during measurement
bm133	blood sample collection
bm133_space	suitable space for test
bm134	understand the direction of measurement
bm135	do you feel it would be safe for measurement
bm135_iwer	do iwer feel it would be safe for this respondent to do this measurement
bm136	problem with equipment or supplies
bm136_other	other reasons why didn't r complete the blood sample test
bm137_intro	collecting the blood sample
bm137	date
bm138	month

bm139	year
bm140	hour
bm140a	minutes
bm141	am/pm
bm142s1	problems occured during the collection of blood sample
bm142s2	problems occured during the collection of blood sample
bm142s3	problems occured during the collection of blood sample
bm142s4	problems occured during the collection of blood sample
bm142s5	problems occured during the collection of blood sample
bm142s6	problems occured during the collection of blood sample
bm142_other	other problems occured during the collection of blood sample
bm143	who pricked the r's finger
bm143_other	other person who pricked the r's finger
bm144	how many circles were filled on the first card
bm146	how many times did the r's figher need to be prick
bm147	how compliant was r during the measurement
bm148	conclusion of biomarker section
hhid	hhid: hh identifier, numeric
bio_wt	state biomarker weight
bio_wt_pooled	pooled biomarker weight

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