

**DOCUMENTATION**

**for**

**ANKLE BRACHIAL INDEX**  
**(ABI)**

**in**

**MIDUS 3**  
**BIOMARKER PROJECT**  
**(P4)**

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## INTRODUCTION

This document provides an overview of the Ankle Brachial Index (ABI) data collected in the MIDUS 3 (M3) Biomarker Project (P4) data. This document describes the ABI protocol and measures.

Administrative and computed variables are also identified and information about the construction and usage of these variables is included.

Data users are also encouraged to review the M3 Biomarker (P4) Readme Data File Notes. This document provides information about naming conventions, as well as administrative and filter variables included in the data file. It also includes information about how we handled missing values and other issues that arose over the course of the study. For example, there are instances when variables were added or sections of an instrument were expanded for data entry purposes to accommodate additional information provided by the respondent.

This document will be periodically revised and updated as more information is gathered and as researchers continue to work with the MIDUS 3 Biomarker data. If there are suggestions or comments, please submit a message through the MIDUS HelpDesk (<http://midus.wisc.edu/helpdesk.php>).

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## Section A: OVERVIEW OF DATA FILE AND COLLECTION PROTOCOL

The Ankle Brachial Index (ABI) is the ratio of systolic blood pressure in the arteries (typically measured at the ankle) to the brachial (upper arm) systolic blood pressure. [Ankle Brachial Index Collaboration, 2008]. These ratios assess the quality of the blood supply to each leg. Lower than normal values of ABI in one or more legs reflects stenoses in peripheral arteries, and is typically indicative of atherosclerotic disease. Since atherosclerosis is generally not confined to one vascular bed, low ABI is predictive of cardiovascular risk in general [Newman et al., 1993; Doobay & Anand, 2005]. Low ABI is correlated with atherosclerotic disease in other vascular beds, such as the carotid and coronary arteries [Zheng et al; McDermott et al. 2006], and even predicts risk for incident coronary events [Weatherly et al. 2007] and incident stroke [Abbott et al., 2001; Murabito et al., 2003]. Generally, an ABI of 0.8 or less is considered low. The ABI was added at the first wave of MIDUS Refresher Biomarker data collection and has been extended into the M3 wave.

The MIDUS Biomarker Project (P4) assesses Ankle Brachial Index using the Summit Doppler Vantage ABI™ system via blood pressure cuffs placed in four locations while the participant is lying down. At the end of a 5-minute resting period, the four cuffs are activated in rotation (right arm, right ankle, left arm, left ankle) with the device automatically inflating the cuff, measuring systolic pressure and deflating the cuff. A copy of the tracking form used to document completion of the protocol is included in Section B and a copy of the data collection protocol is in Section C.

The ABI assessment was included in the MIDUS Biomarker protocol for the Refresher as a pilot project conducted only at Site 1 (UCLA). At M3 this assessment was expanded to all three sites. The following describes the summary measures reported and the data collection protocol.

As described in the “MIDUS 3 Biomarker Project (P4) Readme Data File Notes”, naming convention organizes variables according to data type or the method used for data collection. Following this convention, the first three characters of the ABI data are “C4C”.

### Data Documentation

The following data are obtained during this protocol and reported separately for the right and left side

- Blood Pressure (BP) – Systolic BP as measured by the Vantage system at the ankle and upper arm (brachial) on the right and left sides.
- Ankle Brachial Index – ratio of ankle/brachial BP.
- The Vantage ABI™ automatically calculates the ABI for both sides. The right and left ABI are both calculated using the higher of the two brachial pressures (Summit Doppler Vantage ABI User Manual MAN0030A, p. 16). Thus,
  - ABI for a given side is *not* calculated if the ankle BP is missing on that side.
  - ABI is calculated for a given side if the ankle BP is available for that side and at least one brachial BP is available.

If a BP is missing, or ABI is not computed when a value would be expected, it is due to either a technical (software or equipment) problem or a respondent health issue that prohibits placement of a BP cuff in the desired location (i.e. amputation, removal of lymph nodes due breast cancer etc.). See below for more information.

The data file also includes the following flag/filter variables which can be used to select the subset of cases for which ABI data is available. There are also code variables indicating whether the protocol was completed and if there were any problems when running the protocol.

- C4CABIAVAIL – indicates the scope of data available for a given participant (Yes – Both, Yes – Left Only, Yes – Right Only, None – Neither)
- C4C1 – indicates whether the assessment was completed on Day 1 or Day 2 of the visit.
- C4C4 – A Yes/No variable indicating whether the participant is missing a limb or not, and if yes which limb
  - If a limb is missing the assessment is not done on that side.

The ABI data appear in the data file immediately after the Gait data.

## References

Abbott RD, Rodriguez BL, et al. Ankle-brachial blood pressure in elderly men and the risk of stroke: The Honolulu Heart Program. *Journal of Clinical Epidemiology* 54 (2001) 973–978

Ankle Brachial Index Collaboration, et al. Ankle-brachial index combined with Framingham Risk Score to predict cardiovascular events and mortality: a meta analysis. *JAMA*. 2008; Jul 9; 300(2): 197-208.

Doobay AV and Anand S. Sensitivity and specificity of the ankle-brachial index to predict future cardiovascular outcomes. A systematic review. *Arterioscler Thromb Vasc Biol*. 2005;25:1463-1469

McDermott MM, Liu K, Criqui MH, et al. Ankle-brachial index and subclinical cardiac and carotid disease. The Multi-Ethnic Study of Atherosclerosis. *Amer J Epidemiol* 2005; 162:33–41.

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Newman AB, Siscovick DS, Manolio TA, et al. Ankle-arm index as a marker of atherosclerosis in the Cardiovascular Health Study. *Circulation* 1993, 88:837-845.

Weatherly BD, Nelson JJ, Heiss G, et al. The association of the ankle-brachial index with incident coronary heart disease: the Atherosclerosis Risk In Communities (ARIC) Study, 1987–2001. *BMC Cardiovascular Disorders* 2007, 7:3 doi:10.186/1471-2261-7-3.

Zheng Z-J, Sharrett AR, Chambless LE, et al. Associations of ankle-brachial index with clinical coronary heart disease, stroke and preclinical carotid and popliteal atherosclerosis: The Atherosclerosis Risk in Communities (ARIC) Study. *Atherosclerosis* 131 (1997) 115–125.

## Section B: ANKLE BRACHIAL INDEX TRACKING FORM

# MIDUS-3 BIOMARKER STUDY

## ANKLE BRACHIAL INDEX (ABI) PROCEDURE TRACKING FORM

ID: # \_\_\_\_\_ SITE # \_\_\_\_\_

Q1. DAY COLLECTED: (CHECK ONE) ☐ DAY 1 ☐ DAY 2 [C4C1]

Q2. VISIT DATE: \_\_\_\_ / \_\_\_\_ / \_\_\_\_

Q3. TIME: \_\_\_\_: \_\_\_\_ AM/PM (CIRCLE ONE) [C4C3]

Q4. IS PARTICIPANT MISSING ANY LIMB? (CHECK ONE) ☐ YES (GO TO Q4a) ☐ NO (GO TO Q5) [C4C4]

Q4a. WHICH LIMBS ARE MISSING? (CHECK ALL THAT APPLY) [C4C4ARA]

[C4C4ARA] ☐ RIGHT ARM ☐ RIGHT LEG [C4C4ARL]

[C4C4ALA] ☐ LEFT ARM ☐ LEFT LEG [C4C4ALL]

IF MISSING A LIMB ON ONE SIDE, CONTINUE WITH THE OTHER SIDE (GO TO Q5).

IF MISSING A LIMB ON BOTH SIDES, GO TO Q6.

Q5. RESULTS:

RIGHT	LEFT
ABI ____ . ____ [C4C5ABIR]	ABI: ____ . ____ [C4C5ABIL]
ARM mmHg: [C4C5BR]	ARM mmHg: [C4C5BL]
ANK mmHg: [C4C5AR]	ANK mmHg: [C4C5BR]

Q6. WAS ABI COMPLETED? (CHECK ONE) ☐ YES (GO TO Q7) ☐ NO (GO TO Q6a) [C4C6]

Q6a. IF NO, EXPLAIN: \_\_\_\_ [C4C6AC] \_\_\_\_\_

Q7. WERE THERE ANY PROBLEMS RUNNING THE PROTOCOL? (CHECK ONE) ☐ YES (GO TO Q7a) ☐ NO (END)

[C4C7]

Q7a. IF YES, EXPLAIN: \_\_\_\_ [C4C7AC] \_\_\_\_\_

## Section C: ANKLE BRACHIAL INDEX PROTOCOL



# **Ankle-Brachial Index MIDUS 3 (Midlife in the US) Study Manual of Procedures**

## **Overview**

The goal of this procedure is to measure ankle-brachial index (ABI) in MIDUS 3 participants, using the Vantage ABI device manufactured by Summit Doppler. ABI can be an indication of peripheral vascular disease and is most prevalent in people who are older; those with diabetes are at particular risk.

## **Visit Preparation**

In preparation for the visit, ensure that the following supplies are available:

- Vantage ABI device, along with four designated cuffs
- A suitable bed and pillow, covered with appropriate linen
- Disinfecting wipes
- MIDUS 3 Ankle Brachial Index (ABI) Procedure Tracking Form
- USB drive designated for this measurement

## **Measuring ABI**

Outlined below are the standard steps for completing the ABI measurement. Details and troubleshooting suggestions can be found in the Vantage User Manual [http://www.summitdoppler.com/site/files/969/110955/379258/533522/Summit\\_Doppler\\_Vantage\\_ABI\\_User\\_Manual\\_MAN0030A.pdf](http://www.summitdoppler.com/site/files/969/110955/379258/533522/Summit_Doppler_Vantage_ABI_User_Manual_MAN0030A.pdf)

The order of measurements is determined by the software in the system. The right side will be done first, followed by the left side. ABI ratios are provided for each side of the body.

1. Fill in the Administrative information at the top and questions 1-3
  - a. Visit Date is the Day 1 date, regardless of which day the ABI is performed. Enter the Day 1 date at this question.
2. Administer the eligibility questionnaire.
  - a. If the participant is missing a limb on one side proceed with the measurement on the other side
  - b. If the participant is missing a limb on both sides the participant is not eligible for ABI measurement, follow instructions on the form and do not proceed with the measurement.
3. Ask the participant to remove socks and shoes. If the participant's shirt does not have loose fitting sleeves that allows placement of the cuff directly on skin, ask the participant to change into a gown (pants do not need to be removed).
4. Have the participant lay down on the exam bed. It is important for participants' feet to be in the same horizontal plane as their hearts. Most participants will find it comfortable to use a pillow for head support.

5. Place the cuffs snugly on the arms and ankles. For proper placement, the tubing connection should be at the top or upper edge of the cuff. Follow the guide on the cuff for the correct location of the tubing on the artery.
  - a. If the participant is unable to wear a blood pressure cuff in a given location (i.e. breast cancer survivor may have had lymph nodes removed from arm) do not measure ABI on that side. The Index value is only valid if a measurement is obtained from both locations on a given side.
5. Once the participant is correctly placed for the measurement, tell the participant to rest quietly for **5 minutes**. Explain that there should be little talking during this period and the measurement. If possible, leave the room to allow the participant to rest quietly.
6. Once the rest period is completed, come back to the room and inform the participant the measurement process will begin.
7. Turn on the Vantage (press the ON/OFF gray circular button). Hoses should already be connected. If not, connect as described in the manual and indicated on the back of the unit.
8. Input the participant ID which also becomes the file name. M3 ABI files are named according to the following format: 70(Site #)ABI(Participant ID #)  
Example: 702ABI12345.
  - Touch 'MENU'
  - Touch 'MENU OPTIONS'
  - Touch 'NEW EXAM'
  - Enter the participant ID on the keypad
  - Touch 'DONE'; the device will return to the main display screen
9. Confirm that the PVR waveform is turned off. If it is turned off, a large 'X' will appear next to 'PVR' between the arm and ankle measures on the display screen. If the display is not the 'X'; do the following:
  - Touch 'MENU' at the bottom right
  - Touch 'SYSTEM SETTINGS' at the top
  - Touch 'WAVEFORMS' at the bottom until the value is 'OFF'
10. Confirm that the Auto Inflation is set to '2'. This permits the arm and ankle cuff on one side of the body to be inflated at the same time. Check the settings by doing the following:
  - Touch 'MENU' at the bottom right
  - Touch 'SYSTEM SETTINGS' at the top
  - Touch 'AUTO INFLATION' until the value is '2'
11. Tell the participant you will be starting the measurement. On the main display screen, touch 'START'. The Vantage will begin inflation on the right side. Remind the participant to remain still.
12. The Vantage will automatically deflate the cuffs on the right side and conduct the full measurement on the left side.
13. Once the cuffs on the left side deflate, review the display to determine if there were any problems with obtaining ABI measurement:

- If the measurement is successful, the values for the ABI, Brachial (ARM) and Ankle (ANK) on the right and left sides will display.
    - Record the ABI, ARM, and ANK numbers for Right and Left in the table at Q5 on the ABI tracking form.
  - If one of the following is displayed, check the manual or adjust the cuffs as indicated below and then repeat the measurement.
    - **L ↑** indicates the pressure limit should be increased; refer to page 15 of the manual to modify the settings and re-measure the specific site
    - **L ↓** indicates the pressure limit should be decreased; refer to page 15 of the manual to modify the settings and re-measure the specific site
    - **NA** - indicates the signal was not usable, probably due to participant movement. Ensure the cuffs are placed appropriately and retake the measurements
    - **AR** - indicates abnormal result were detected. Ensure the cuffs are placed appropriately and retake the measurements
  - Note that all trials, regardless of completeness, should be saved after each run. When errors are encountered, let the machine complete all four cuffs, save the exam, then re-run the protocol from the beginning a subsequent time, making adjustments as needed using the guidelines above.
    - All trials are saved so that at least one exam is run all the way through in the event that a subsequent trial fails or has less data than a previous trial.
  - Once a successful result is obtained
    - Record the Brachial, Ankle and Index numbers at Q5 on the form.
    - Select Yes, at Q7 and describe the problem in the space provided
14. Once all measurements are taken, remove all cuffs from the participant's limbs.
15. After completing all tasks with the participant for the day, transfer the data file to the USB drive:
- *BE SURE THE USB MEMORY STICK IS PLUGGED INTO THE SYSTEM PRIOR TO DOWNLOADING*
  - Go to 'EXAM MANAGEMENT'
  - Touch the exam completed
  - Touch 'EXPORT'