Body Composition

2.1

User's Guide

Manual Revision Date:
September 11, 2009

Table of Contents

Indications for Use:

Calculation and Historical Tracking of:

- Actual Impedance
- Actual Phase Angle (PA)
- Estimated Body Fat (FAT)
- Estimated Fat Free Mass (FFM)
- Estimated Total Body Water (TBW)
- Estimated Intra-Cellular Water (ICW)
- Estimated Extra-Cellular Water (ECW)
- Estimated Basal Metabolic Rate (BMR)
- Estimated Daily Energy Expenditure (DEE)
- Actual Body Mass Index (BMI)

Intended Population:

BC is intended only for use on normally healthy adults and adolescents age 3-94. The prediction equations used by the BC software assume that the person being tested has not had either arm or leg amputated.

It is not intended to be used to diagnose, treat, or cure any disease or medical condition.

Contraindications:

No known contraindications exist.

Warnings:

The BC software provides body composition estimates based on the electrical characteristics measured by a Bioelectrical Impedance Analyzer (BIA). BIAs work by introducing an alternating current (AC) signal into the body and then measuring how that signal is affected by the body. This device should not be used on subjects with any implantable electronic devices such as pacemakers or implantable cardioverter-defibrillators (ICD)'s.

Women who use this device should not be pregnant or suspected of being pregnant. Besides increased inaccuracy of readings in this condition, the effects of measurement on the fetus are unknown.

Precautions:

Using the BC software to evaluate individuals outside of the above intended population or failing to follow the subject preparation and testing procedures detailed in the documentation for your Bioelectrical Impedance Analyzer could adversely effect the body composition estimates provided by this application.

Installation Guide

Following these instructions will assist you in getting BC installed. If the user guide for your analyzer contains a section on installation, please read it before continuing these instructions. It might have information on settings required to take full advantage of the features of your analyzer.

1. Insert the disc that was supplied with this manual into your CD-ROM drive. If the installation will not start automatically please do the following:

    a) Click the "Start" Button
    b) Click "Run"
    c) In the "Open" box type D:\setup.exe
    d) D:\ is the assigned drive letter for your CD-ROM drive if different please change to the correct
    e) drive letter. Examples: E:\setup.exe, F:\setup.exe, G:\setup.exe, Etc...
    f) Click "OK" when complete

2. When the setup program is successfully launched an introduction page will appear. Click "Next".

3. Select Your Unit: By default, the Quantum II is selected. If you do not see your analyzer's model listed, select the Quantum-II. Click "Next".

4. Select Actions: Here you have the option to install the BC software and view the documents after the installation is complete. Click "Next".

5. Ready to install: To complete the installation process, Click "Install".

6. BC installation wizard has launched. The setup program will collect information from you before performing the installation. Click "Next".

7. Setup Type: Most people will select "Standard". If you select "Advanced", you will have the ability to change various defaults, like the default folder that the databases will be stored in. Click "Next".

8. Select Destination Location:
   By default the path is: "C:\Program Files\RJL Systems\BC (Body Composition)". Click "Next".

9. Start Menu Folder: The default folder name is: "RJL Systems". Click "Next".

10. Ready to Install: To install BC Click "Install".

11. When installation is complete a folder will open containing this manual and additional information. When done viewing please close the window and click "Finish" to close the installation program.

Using the Program

Entering Patient Data (Subject Input)

(1) If a database is open, its name will appear here.

This section is automatically opened when the program is started. If this is not the first time the program has been used, then the most recently used database is automatically reopened. If a database is open, its name will appear in the title bar of the main window. (1) If this is the first time that BC has been used, you will need to create a new database or open an existing one before processing body composition data.
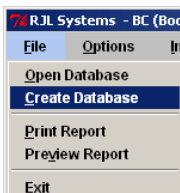
Select "Create Database" to create a new database for patient data.
To open a different database that has already been created, select "Open Database" from the "File" menu.

Searching for a patient

To search for a specific individual within a database, type part (or all) of the person's name in the boxes under "Search for a Patient" located in the upper-left area of the window, (2) and then click the "Search" button. (3) To see all of the patients in the current database, click the "Show All" (4) button.

The program will display the name of each patient who matched the search next to a folder icon in the blue box found on the lower-left section of the window. Every test date for a patient will be listed below his or her name.

To review a pre-existing test, double-click on the test date in the blue box. (5) This updates all of the fields on the right side of the window with the information that was previously entered for the test.

Double-clicking on the patient's name in the blue box will fill in the First name, Last name, and Subject ID fields of the input form. This feature exists to help reduce the risk of typographical errors. The program relies on the fact that every test record for the same patient will have EXACTLY the same First name, Last name, and Subject ID. If there are differences in any of these three fields between two tests for the same patient, the program will assume that the records are actually for two different people, and will separate the records according to their differences.

Entering Data for a Patient

The right side of the window is for entering and viewing the data that is directly measured from the patient.

To the right is an example of what the input area would look like after being filled in.

Note that the Subject ID field is blank. This is an optional field. Many large clinics and hospitals assign patients an ID number for tracking purposes. That number could be entered into this field.

When entering a new test, the program will automatically assign it the current date and time. If the test was actually performed on a previous date, click on the box displaying the date. This will open a new window, which will allow the date and time of the record to be changed.

Click here to change the test date   (You may not have this button)

Drop-downs for selecting units.

Activity Level

(special notes about the test go here)   Gender

If the BC software was installed with support for one of our serial-equipped analyzers, there will be a button on the right, labeled "Get Values from Unit," which would automatically retrieve the resistance and reactance values from the analyzer. If not, then the values will have to be entered manually. Even if the button appears, manually entering the resistance and reactance values is always an available option.

Select a Daily Activity Level

The "Daily Activity Level" describes the amount of physical work associated with the individual's typical daily routine. It is important to select an activity level that is appropriate to the amount of activity that the person sees on *an average daily basis.* This is used to help estimate the person's Daily Energy Expenditure (DEE), or the number of calories the person needs to consume to keep their weight stable. Right-clicking on the Activity Level drop-down will open a new window containing the following descriptions to help choose the most appropriate activity level.

BC uses different names for the activity levels than earlier editions of software from RJL Systems. The older names are listed in parenthesis.

- Very Light (No Exercise)

  Seated and standing activities, painting, driving, laboratory work, typing, sewing, ironing, cooking, playing cards, playing a musical instrument.

- Light (Some Exercise)

  Walking on a level surface at 2.5 to 3 mph (4 - 4.8 kph), garage work, carpentry, restaurant trades, house-cleaning, child care, golf, sailing, table tennis.

- Moderate (Moderate Exercise)

  Walking 3.5 to 4 mph (5.6 - 6.5 kph), weeding and hoeing, carrying a load, cycling, skiing, tennis, dancing.

- Heavy (Athletic)

  Walking with a load uphill, tree felling, heavy manual digging, basketball, climbing, football, soccer.

- Exceptional (Elite Athlete)

  Extremely strenuous physical activity.

Frame Size and Calculated Target Weight

Select the size of the person's frame with the drop-down menu on the right. (6) For help in choosing the appropriate frame size for an individual, right-click on the drop-down menu.

The Subject Input tab has an entry field on the far right for the patient's target weight. If this field is empty when the test is saved or updated, it will be automatically set to the target weight as calculated by the chosen formula. If the Hamwi Ideal Weight Equations are selected, the calculated target weight may need to be adjusted to account for the individual's frame size. If so, this adjustment is automatically done for you. (See the section *Target Weight Formula* on page 16 for more information.)

There are two methods commonly used for determining frame size for an individual:

- Method 1: First, measure the patient's height in either inches or centimeters. Next, use a measuring tape to measure the circumference of the patient's wrist. Divide the patient's height by the wrist circumference. If the result is greater than 10.4, the patient has a small frame. If it is less than 9.6, the patient has a large frame. If the result is between 9.6 and 10.4, select a medium frame.

- Method 2: Have the patient wrap the thumb and forefinger of one hand around the wrist of the other hand. If the thumb and forefinger overlap, the person has a small frame. If the tips of the thumb and forefinger touch, the person has a medium frame. If there is a gap between the thumb and forefinger, the person has a large frame.

Once adjusted for the person's frame size, the value calculated for the person's target weight should be reasonable. However, it is possible that the calculated value may not match clinical expectations. In these cases, it may be desirable to manually specify a target weight.

Notice that the label on the target weight box (7) is different from the one on the previous page. If the test record is saved with an empty "Chosen Goal Weight," the program will automatically choose one, based on the person's height, gender, and frame size. If that happens, the program will replace the label above the target weight box with "Calculated Target Wt."

If the target weight is being calculated from a "desired" BMI, it is **NOT** compensated for frame size.

Saving, Updating, or Deleting Patient Test Records

When all of the information for a new test has been entered, click the "Save new test" button. Every time this button is clicked, a new test is added to the database. If, on the other hand, a pre-existing record is currently open, and changes have been made that need to be saved, then click the "Update test" button to make the changes permanent.

If a test exists in the database that needs to be deleted, select it by double-clicking on the date of the test in the blue box on the left. Review the information in the input form to verify that the record does, indeed, need to be deleted, and then click the "Delete test" button to delete it.

If all tests for a patient need to be deleted, select each test, one-by-one, and delete each test individually.

Changing Algorithm Settings

BC gives users the ability to use different formulas to calculate the body composition and other parameters. To make these adjustments, you will need to go to the "Algorithms" menu. (shown at right)
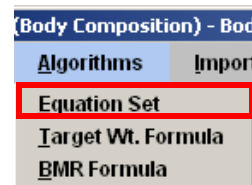
Changing Equation Sets

Many researchers have developed equations for estimating peoples' body composition using bioelectrical impedance analysis. Some of these equations were developed from a general population of average people. Other equations were developed from studies which only evaluated people of a certain ethnicity or people with a specific medical condition. In other cases, researchers have taken equations which were developed for one population and evaluated them for accuracy in a different group of people. In some cases, the equations worked well in the new group. In other cases, they did not.

For your convenience, we have collected some of these published equations into "sets" which BC can use to estimate body composition. Abstracts for the published papers describing the development and/or validation of the prediction equations can be found in the "References" section near the back of this manual.

 To change the equation set, select "Equation Set" from the Algorithms menu. Click the radio button for the desired set of equations, and click the "Ok" button. **The selected equation set will be the default until it is changed again.**

Changing the equation set will cause the body composition results to be calculated differently.

The "Help" button at the bottom of the window will display the following descriptions of the equation sets:
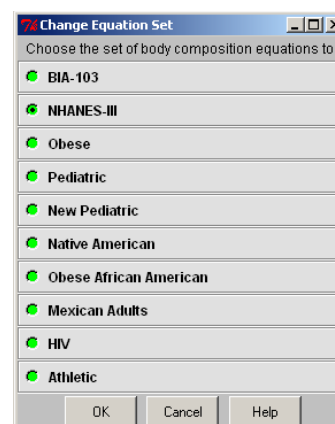
Equation Set Descriptions

- NHANES-III
  This is a general-population equation set, and is the default upon installation. The equations for fat, FFM, and TBW were first published in 2002. A large population was used to develop these equations. (1829 people) Further, the equations were validated against records contained within the NHANES-III published dataset. People involved in either the development or validation of the equations were in the 12 - 94 year age range.

- Obese
  A common complaint about using Bioelectrical Impedance Analysis in obese populations is that equations developed for the general population tend to under-estimate body fat in people who are obese. (BMI > 30) The equations for fat and FFM in this equation set were developed strictly from an obese population.

- Pediatric
  Most studies that develop body composition equations strictly study adult (and/or teenage) populations. The equation for estimating FFM (and fat) in this equation set was developed from a population of children aged 9-14.

(Continued on the next page)

- BIA-103
  This equation set is preserved for historical purposes. Its inclusion allows users of our older body composition software to upgrade to BC and continue to use the same prediction equations.

- New Pediatric
  The study which produced the equations for FFM and fat which were selected for this equation set is somewhat more recent than the Pediatric equation set above, and it had a much larger range of ages. The children studied to develop these equations were aged 3.9 - 19.3.

  Further, a second study was done which validated these equations in a population of overweight and obese children.

- Native American
  These equations were developed from a study of Pima Indians.

- Obese African American
  The FFM and fat equations in this set were validated in a study which looked at obese African American women.

- Mexican Adults
  These equations were developed from a study of Mexican men and women.

- HIV
  The fat and FFM equations in this set were among those examined in a study which evaluated the performance of using BIA to estimate body composition in patients with AIDS wasting. These equations were found to be among the best performers.

- Athletic
  Just as people complain about BIA underestimating body fat in obese individuals, people tend to complain that BIA overestimates body fat in highly athletic individuals. The equations in this set were validated for use in athletic populations in at least two separate studies.

- All Body Types
  This equation set automatically adjusts the equations for fat and fat-free mass to account for body type. Therefore, you should achieve good results whether the individual being tested is athletic, obese, or run-of-the-mill average.

Target Weight Formula

BC 2.0 provides the ability to select the method used to calculate a default "target weight" if one was not specified on the "Subject Records" page. There are two options:

Hamwi Ideal Weight Equations

The default in a newly-installed copy of BC 2.0 is to use the Hamwi equations, which were the only option in version 1.0. These formulas (shown below) assume the individual has a medium frame. If he or she has a small frame, BC will subtract 10% from the value calculated, or add 10% for a large frame.
(see *Frame size and Calculated Target Weight)*

- Males: target weight (Lbs) = 6 * (height (inches) - 60) + 106

- Females: target weight (Lbs) = 5 * (height (inches) - 60) + 100

Target Weight from a "Desired" BMI value

Now, BC provides the option of calculating target weight based on a "goal" BMI value. In other words, "Given the individual's height, how much would they weigh if their BMI were the specified value?" The default "desired" BMI is 23.

If you change the selected target weight formula in BC, your selection will become the default until you change it back.

Basal Metabolic Rate

BC 2.0 provides the following two methods for estimating Basal Metabolic Rate (BMR):

Harris-Benedict

In BC 1.0, the Harris-Benedict formulas were the only supported method for estimating BMR. These formulas are shown below.

- Males: $BMR = 13.8 \times Weight_{kg} + 5.0 \times Height_{cm} - 6.8 \times Age + 66.5$

- Females: $BMR = 9.6 \times Weight_{kg} + 1.8 \times Height_{cm} - 4.70 \times Age + 655.1$

BMR from FFM

Recently, a published paper was brought to the attention of RJL Systems (see the References section) which developed prediction equations for estimating BMR from an individual's Fat-Free Mass. If this option is selected, the FFM value predicted by the current equation set will be used to estimate BMR.

If you change the selected target weight formula in BC, your selection will become the default until you change it back.

Test Results
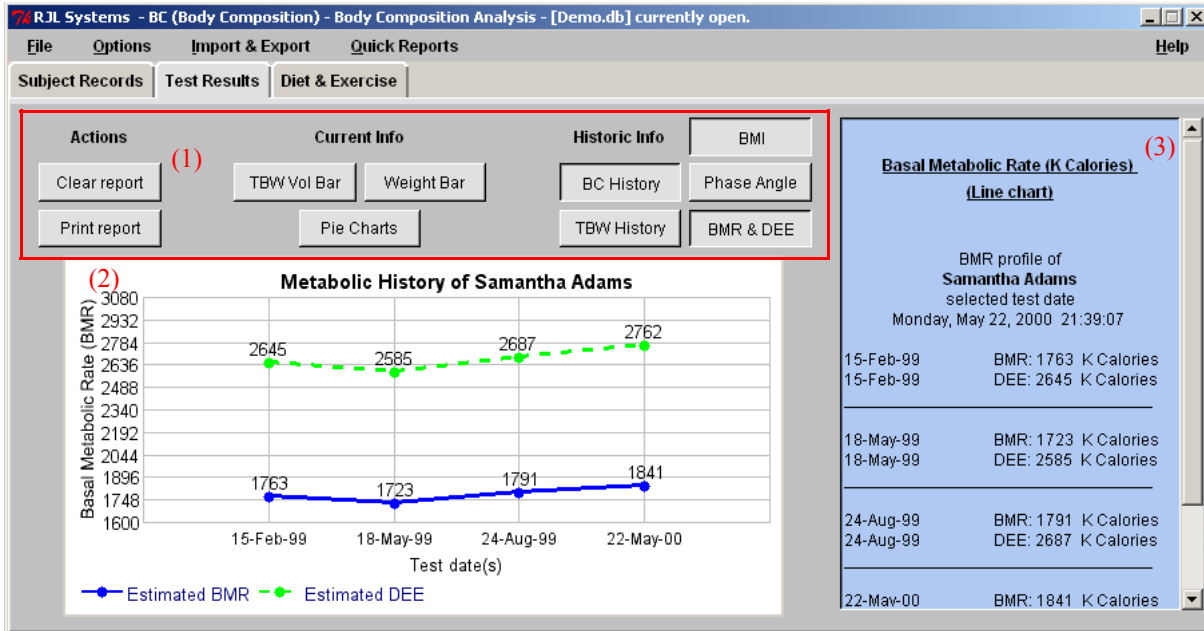
The Test Results page is where all of the charts and graphs to show the patient's body composition, fluid status, and history are collected. Near the top is a collection of buttons, each representing a different graph that the program can generate. (1) Clicking on one of these buttons will display the associated graph and mark the graph for inclusion in the printed report.

Also in this area is a button labeled "Print report" which causes the program to generate a report and send it to the printer.

Notice that three of the buttons appear pressed-in, "History," "BMI," and "BMR & DEE." These three graphs are now selected to be printed in the report. To deselect the currently selected graph, simply click the button for that graph again. In the above image, since the BMR & DEE graph is currently being displayed, (2) clicking the button labeled "BMR & DEE" will deselect the graph. If the "History" graph was no longer desired, its button would have to be clicked twice: once to display the graph, and once more to deselect it.

On the right side of the window is a blue box. (3) This box is updated every time a graph is selected for display. It will numerically display the information that is in the graph. For example, since the "BMR & DEE" graph is currently displayed above, the blue box currently shows the patient's BMR (Basal Metabolic Rate) and DEE (Daily Energy Expenditure) history.

Average Ranges

File   Options   Algorithms   Import & Export   Quick Reports   Help

Subject Records | Test Results | Average Ranges | Diet & Exercise

The tables shown below illustrate how Samantha Adams compares to other American females in the 20 to 29 year range. These values are average ranges, only. They do not necessarily reflect ideal or healthy values. For further information, please refer to the section on Average Ranges in your user's guide.

Print report

☑ Include Averages

Weight / Volume

	Current	Average Range	Note
Weight	166 Pounds	110.7 - 180.8	Within Average by 14.8 Pounds
FAT	45.7 Pounds	28.2 - 75.4	Within Average by 17.5 Pounds
FFM	120.3 Pounds	80.0 - 107.8	Above Average by 12.5 Pounds
TBW	41.1 Liters	26.9 - 36.5	Above Average by 4.6 Liters
ICW	21.5 Liters	15.1 - 19.1	Above Average by 2.4 Liters
ECW	19.7 Liters	11.8 - 17.4	Above Average by 2.3 Liters

Percentage of Total Weight

	Current	Average Range	Note
FAT	27.5 %	26.4 - 41.8	Within Average by 1.1 %
FFM	72.5 %	58.2 - 73.6	Within Average by 1.1 %
TBW	54.6 %	43.2 - 54.8	Within Average by 0.2 %
ICW	28.5 %	23.0 - 30.4	Above Average by 21.8 %
ECW	26.1 %	20.1 - 24.7	Below Average by 0.4 %

Other Information

	Current	Average Range	Note

Percentage of Fat Free Mass

	Current	Average Range	Note
TBW	75.4 %	73.0 - 75.8	Within Average by 0.4 %

The Average Ranges page illustrates how the person's calculated values compare to those of other people of the same gender and age group. In each table is a column labeled "Note", which indicates whether the calculated value is above, within, or below the average range. These messages are not at all meant to be interpreted as being diagnostic in nature. These tables are provided simply for informational purposes, to show how the current individual compares to other individuals.

In the upper-right corner is a checkbox which controls whether the average ranges are printed in the report (see the sample report at the end of the manual) Also in the upper-right corner is a "Print report" button, which will send the report to the printer.

All of the average range values are included near the end of this manual in the section labeled "Average Ranges."

Diet & Exercise
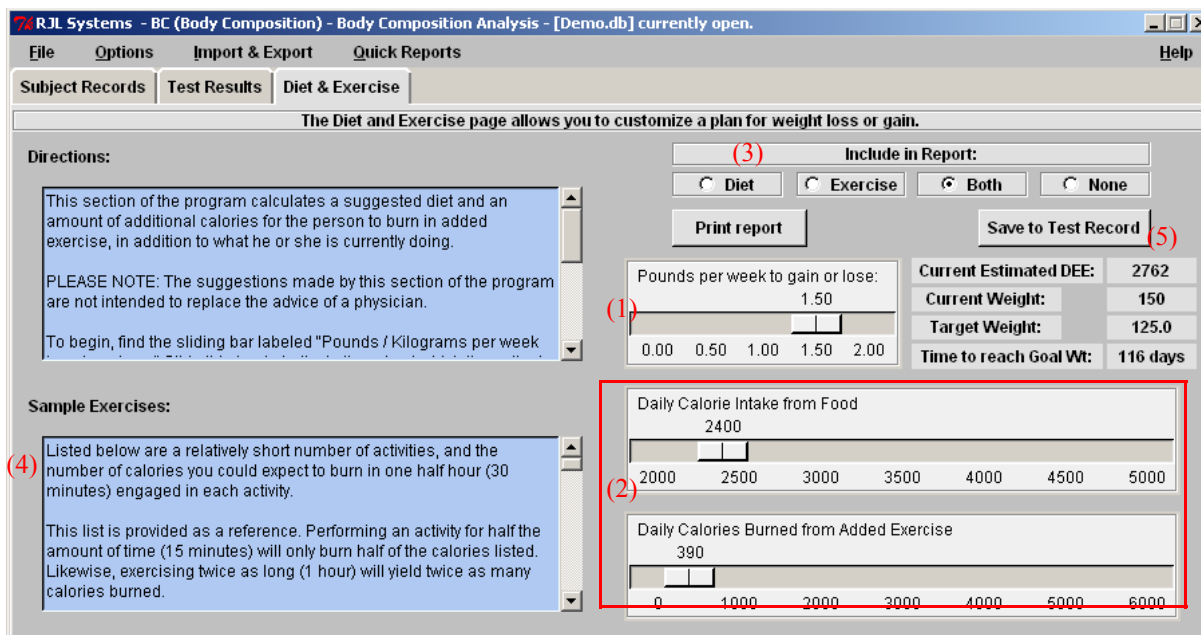
This section of the program allows you to choose an amount of weight to gain or lose per week, and calculates the required number of food calories and exercise to achieve the goal weight change.

PLEASE NOTE: The suggestions made by this section of the program are not intended to replace the advice of a physician.

To begin, find the sliding bar labeled "Pounds per week to gain or lose." (1) If the current patient's weight was entered in kilograms, this sliding bar will be labeled "Kilograms per week to gain or lose." Slide this bar to indicate the rate at which the patient should change his or her weight. The maximum allowable rate of weight change is two (2) pounds (0.9 kg) per week, as this is the maximum rate for safe weight loss or weight gain.

If further adjustment of the Calorie Intake or Added Exercise amounts is desired, these sliding bars may be adjusted. (2) Note that adjusting one will update the other, so as to maintain the rate of change that was set. Once the sliding bars have been set, click the "Include Diet & Exercise in Report" checkbox. (3) A diet plan and the sample exercises displayed in the lower left corner of the window (4) will now be included within the report when printed.

To save the recommendations on this page to the patient's test record, click the "Save to Test Record" button. (5)

Configuring the Report Layout (Report Options)

Date and time format

This message will be printed at the top of the first page of every report.
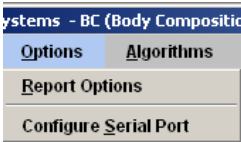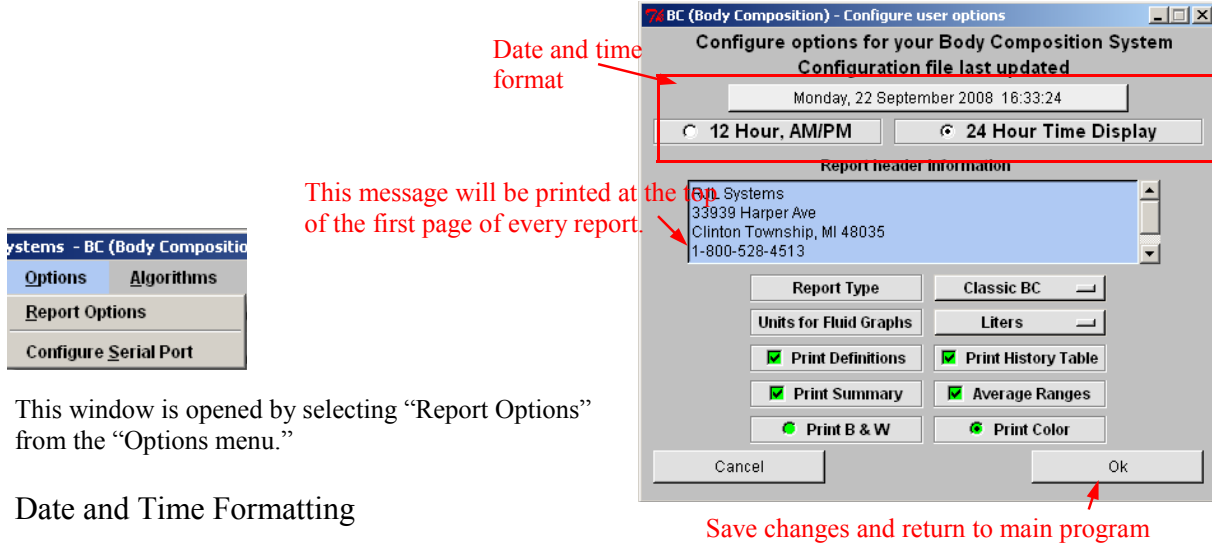
This window is opened by selecting "Report Options" from the "Options menu."

Save changes and return to main program

Date and Time Formatting

In the upper-left corner of this window, the current date and time is displayed using the current selected format. To change the format used for the date and time, click on one of the radio buttons in this area:

- US date and time—12-hour formatting of time
- Universal date and time—24-hour formatting of time

Report Header

The report header contains information that will be printed at the top of the first page of every report. The current text for the report header is displayed in a box in the middle of the left side of this window, under "Report header information." To replace the message in the box, highlight the text currently being displayed and press the delete key. Then, type the desired message. Generally, people will enter the name and contact information for the clinic and the doctor.

Report Settings

Near the bottom of this window is a section with a few options for report settings. They are explained below:

- Report Type — Starting with version 2.1, BC offers multiple report types, or styles. This drop-down menu allows the user to select the report type to be used.
  - The report style which has always been a part of BC is called "Classic BC", and is selected by default.
  - The "Streamlined Delta" report is more compact than "Classic BC", and was developed at the request of, and with input from, the Bariatric community.

- Units for Fluid Graphs — Fluids can be shown in liters, pints, kilograms, or pounds.

- Print Definitions — If selected, approximately one page of definitions will be added to the printed report, describing what all of the values are. No interpretation of the calculated values is provided.

- Print History Table (Yes / No) — This option controls whether or not, in addition to any selected graphs, a numeric, tabular history gets included in the printed report. Depending on the report type (see above) selected, the history table may list all values from all of the tests in the database for the current individual, or it may just show the amount of change between the current test and the person's previous and initial tests.

- Print Summary — If on, a table containing all of the calculated values will be added to the report. (See the sample report at the end of the manual.)

- Average Ranges — If on, a table containing average ranges for people of the same gender and age group as the current individual will be added to the report. (See the sample report at the end of the manual.)

- Print B & W / Print Color — Like a black & white television, black and white printers will automatically convert any colors in a document into shades of gray. And like a television, a printer will sometimes turn two very different colors into exactly the same shade of gray. Unfortunately, unlike a television, printers do not have a setting to adjust the contrast within the document. If printing a report with "Print Color" selected results in a graph where one line or pie slice is indistinguishable from the next, select "Print B & W" to have the BC program choose its own shades of gray. Print Color is the default, and will not harm anything if printing to a black and white printer. Changing this option is only necessary if using a black and white printer results in an unreadable graph, or to force a color printer to only print in black and white in order to save color ink. (Note that this can also be done through the printer settings.)

Quick Reports

Body Composition Analysis
Quick Reports
Create Quick Report — Save the current Report Options and the selected graphs for use as a Quick Report.
Print Quick Report ▶ — Select a Quick Report for printing.
Delete Quick Report ▶ — Delete a Quick Report.
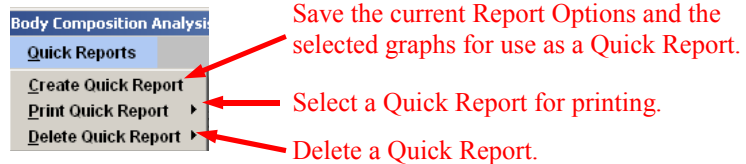
Quick Report Layouts are designed to eliminate the tedious task of selecting the same charts over and over. This feature enables the user to build reports specific to different practitioners, or for specific purposes (I.e. initial patient reports, follow-up reports, reports for inclusion in patient files, etc). Quick Reports are easy to use, and makes the process of printing reports time efficient.

Creating a Quick Report

To create a Quick Report, first verify that all settings under Report Options are set as desired, and then select the charts to be included. Next, select "Create Quick Report" from the Quick Reports menu. A new window will appear, asking for a name for the new report. Type in a name for the report and click "OK".

Printing a Quick Report

To use a Quick Report, once a test record has been selected (or saved), go to "Print Quick Report" under the Quick Reports menu, and select which report to use. The report will be automatically printed using the settings and charts that were selected when the Quick Report was created.

Deleting a Quick Report

Once a Quick Report is no longer needed, or if an error was made in its creation, it can be deleted by selecting the report name from "Delete Quick Report" under the Quick Reports menu. Please note that once a Quick Report has been created, it cannot be edited. If you wish to edit a previously created Quick Report, you must delete it and recreate it from scratch.

Printing From the Quantum-III

When installing BC, if the Setup program was told that you will be using the Quantum-III analyzer, the Print Monitor for the Quantum-III would also have automatically been installed. This program will automatically run every time you log into your computer. You can tell that the RJL Print Monitor is running by looking for the RJL icon in the Windows system tray. If, at any time the monitor is not running, it can be started by going to:
"Start Button" -> "Programs" -> "RJL Systems" -> "RJL Print Monitor"
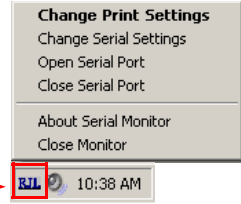
Configuring the Print Monitor

Before using the Print monitor for the first time, it may be necessary to verify the settings of the Print Monitor. To do this, right-click on the Print Monitor's icon in the System Tray to display the menu above.

Selecting "Change Print Settings" opens the window shown to the right. Here is a rundown on what the settings mean:

- Printing Program—This is the program that will be used to print the report. This should be set to the location of the main program file for BC.
- Printing Command—This command is sent to the above program, along with the data and remaining settings, to tell it to print. For printing reports from the Q3 using BC, this setting should always be set to "Q3PRINT".

- Database—Before printing a report, the record will first be saved to this database. This field must contain the complete location to a valid database. Otherwise, the report will not print.
- Quick Report—This is the name of the layout that will be used by BC to print the report.
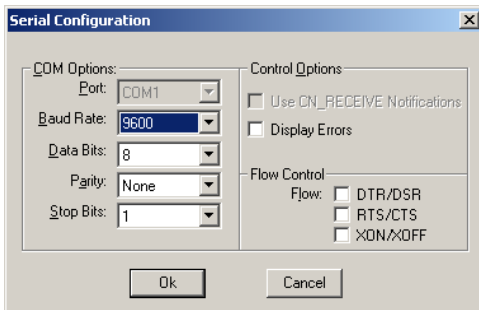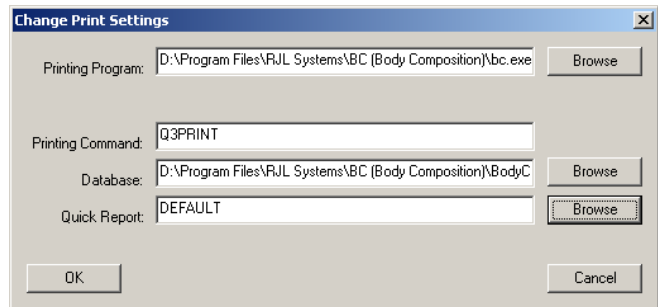
The serial port settings must be configured so that the Quantum-III can communicate with your PC. In general, every setting (except for Port) should be set as shown on the left. To get to this window, select "Change Serial Settings" from the Print Monitor's menu.

The Port drop-down menu will list all serial ports (also known as COM ports) identified on your computer. Many computers will skip port numbers, so identifying which port to use may initially be difficult. One rule of thumb to follow is that if using a regular serial cable to connect to the unit, you will likely want to select a port in the COM1 - COM4 range. If there is a USB cable involved, such as if you are using the RF Link to print wirelessly, the port you want will most likely be COM5 or higher.

Note that the Port drop-down box is grayed-out in the picture above. This means that the port is currently open, and cannot be changed. If this occurs, close the port from the monitor's menu before going to "Change Serial Settings", make the desired changes, and then reopen the port.

The Print Monitor MUST have a port open in order to receive data from the Quantum-III.

Importing and Exporting Patient Records

The "Import & Export" menu is one that most people will seldom use. It allows patient records to be imported from our older MS-DOS based programs, (Weight Manager and Fluid & Nutrition Analysis) and allows patient records in the current BC database to be sent to either a spreadsheet or to a different BC database.

Import patient records from Weight Manager and FNA databases.

Send BC records to a spreadsheet or a different BC database.
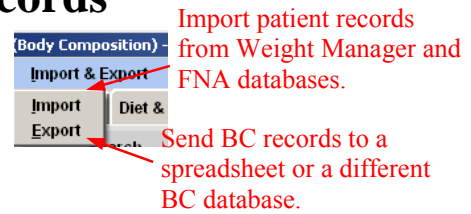
Importing Records

Selecting "Import" from the "Import & Export" menu will open the window seen to the right.

Available drive letters

List of found Databases

Status

Importing from Weight Manager (WM) or Fluid & Nutrition (FNA)

In order to import a database from either of the WM or FNA programs, it must be installed on the same computer as the BC software.

To begin, click the letter of the drive on which WM or FNA was installed (usually C:). Any WM or FNA databases that were found will be displayed in the upper box. If either program was not found on the selected drive, a message to that effect will be displayed in the status window.

(You may not have this button)
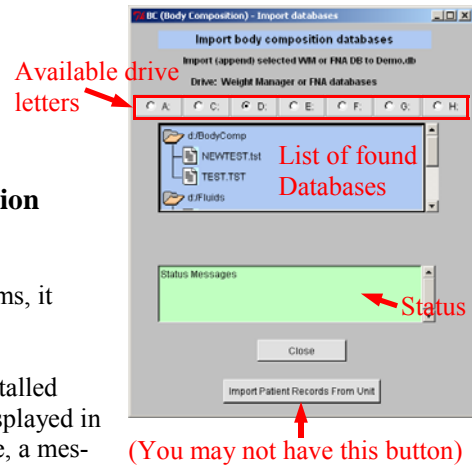
Scroll through the list of databases found, if necessary to find the one to import. Double-click on the desired database to import its records into the currently selected BC database. Be careful not to double-click on the database more than once. If this happens, two (or more) copies of every record will ultimately be imported into the BC Database because the software does not check for duplicates.

Importing from a Quantum Desktop

Some of our analyzers are capable of temporarily storing patient data. If the BC software was installed with support for these analyzers, there will be a button at the bottom of the window labeled "Import Patient Records from Unit." If an analyzer is attached to the computer when this button is clicked, any records stored on it will be imported into the current database. When the process is complete, the status window will be updated, indicating how many test records were retrieved.

Exporting Records

To export records from the current database, select "Export" from the "Import & Export" menu. In the window that opens, (shown at right) select whether to copy the entire database, all tests for the currently selected patient, or just the current selected test.

Copy how much?

To where?
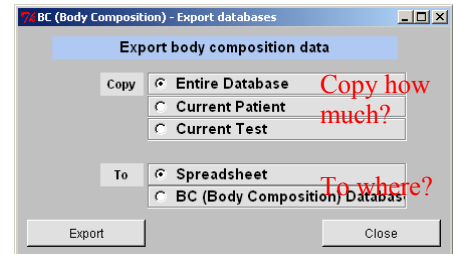
Next, select whether to send the test records to a spreadsheet or to a different database. If they are sent to a spreadsheet, the calculated body composition and fluid values will also be copied. If copying records to a different BC database, however, please be careful. If the destination database already contains some (or all) of the records being copied, it will result in duplicate records.

To perform the desired export, click the "Export" button. A window will appear asking for the name of the destination database or spreadsheet. Make the desired selection and click the "Save" button. A message box will appear when the process is complete.

Copying Databases from Cyprus or LeanBody to BC

The "Import Database" function built into BC is intended to convert data from RJL Systems' old MS-DOS based programs "Fluid and Nutrition Analysis" and "Weight Manager". It does not allow you to import data from either Cyprus or LeanBody. However, because BC is backwards-compatible with the database formats used by these programs, migrating your data from Cyprus or LeanBody into BC is as simple as copying your databases into the folder that BC reads its databases from. This document provides an overview of the steps involved.

The directions in this document assume that all RJL Systems software was installed in the default locations, and that the default database folders are being used. If you have staff who are responsible for managing your computer, they may have placed the programs and database files in non-standard locations. It is recommended that you consult your computer management staff before requesting assistance from RJL Systems.

By default, Cyprus (for example) normally expects to find its databases in the folder:
"C:\Program Files\RJL Systems\Cyprus\BodyComp\".
BC looks for them in "C:\Program Files\RJL Systems\BC (Body Composition)\BodyComp\".
Please note that, depending on the version of Windows on your computer and your display settings, the images shown below may look differently than what you see on your screen.

Step 1: Open a "My Computer" Window
Depending on the settings on your computer, the icon to open a "My Computer" window will either be on the desktop or in the "Start Menu."
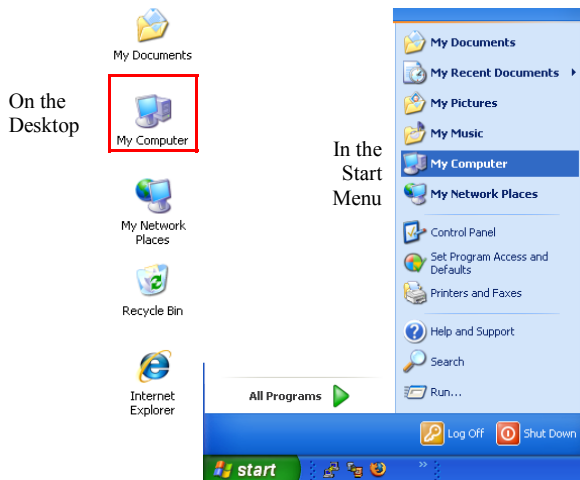
Step 2: Open the System Disk
The name and drive letter assigned to your system disk may vary, but usually it is the "C:" drive. In the image below, it is "D:".
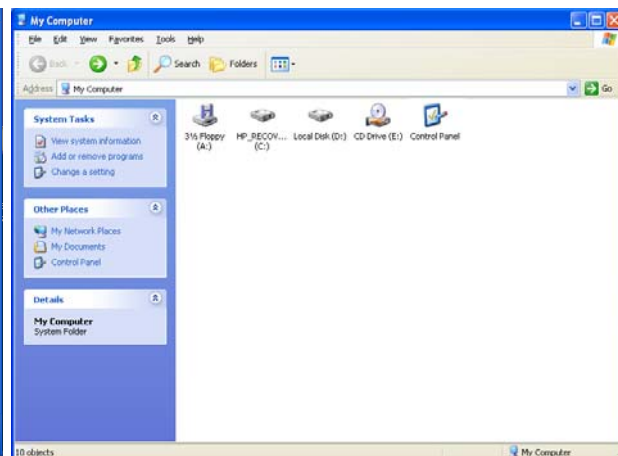
Step 3: Open the Folder Containing the Old Database(s)
Once you have opened the disk, open the "Program Files" folder. Then open the "RJL Systems" and then "Cyprus" (or "LeanBody") folders. Finally, open the "BodyComp" folder. Normally, the icons will be listed in alphabetical order, with the folders listed before regular files. If, at any time, the window says that the contents of the folder are hidden, click the link that says "Show the contents of this folder" to see the icons.
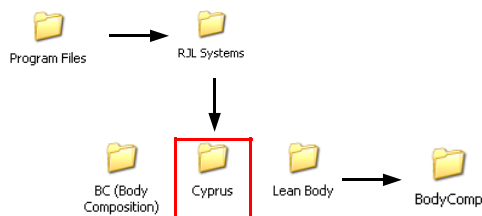
The progression to get to the folder containing the databases.

These files are hidden.

This folder contains files that keep your system working properly. You should not modify its contents.

Show the contents of this folder
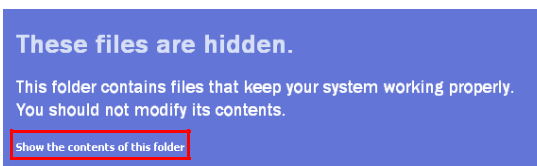
If you see a message saying that Windows is hiding the contents of a folder, click the indicated link to see the files and folders.

images   config.data   Demo.db   Patients.db

Scan with ClamWin Free Antivirus
Open With ▶
StuffIt ▶
Add to archive...
Add to "BodyComp.rar"
Compress and email...
Compress to "BodyComp.rar" and email
Add to Zip
Zip and E-Mail BodyComp.zip
Send To ▶
Cut
Copy
Create Shortcut
Delete
Rename
Properties
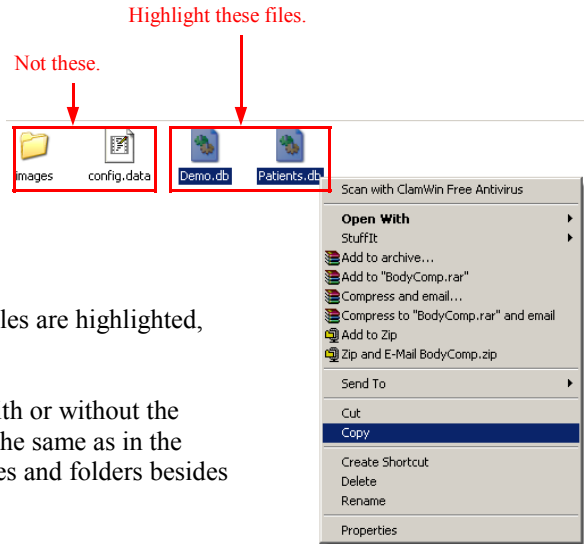
Step 4: Copy the Databases

Use your mouse to highlight the database files. Once the files are highlighted, right-click on one and select "Copy" from the menu.

Depending on your computer's settings, they may show with or without the ".db" at the end of the file names, but the icons should be the same as in the picture. The BodyComp folder will likely contain other files and folders besides the databases. Only copy the databases.

Step 5: Navigate to the BC Database Folder

Press the "Back" button twice to get back to the contents of the RJL Systems folder. Next, double-click on the BC folder. Finally, Double-click on the "BodyComp" folder.

BodyComp
File   Edit   View   Fav
Back ▾

BC (Body Composition)   Cyprus   Lean Body → BodyComp

View ▶
Arrange Icons By ▶
Refresh
Customize This Folder...
Paste
Paste Shortcut
Undo Rename   Ctrl+Z
New ▶
Properties
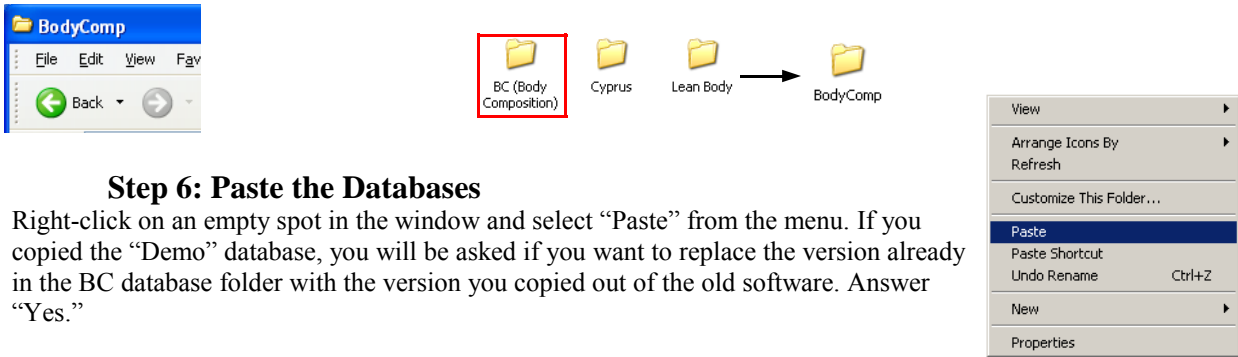
Step 6: Paste the Databases

Right-click on an empty spot in the window and select "Paste" from the menu. If you copied the "Demo" database, you will be asked if you want to replace the version already in the BC database folder with the version you copied out of the old software. Answer "Yes."

Your old data will now be accessible from BC. Close the "My Computer" window and open BC. Follow the procedures in the BC manual for opening a database to select one of the databases you just copied.

Changing Serial Port Options

If BC was installed with support for serial-attached units, (e.g. Quantum Desktop) then the dialog shown at the right would be used to set up communication with the unit. To open this window, select "Configure Serial Port" from the Options menu.

To show a list of serial ports installed on your computer, click on the Port drop-down menu. It is important to select the same port that the serial cable is connected to, and that no other programs are attempting to access that port at the same time.
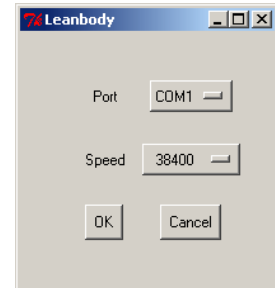
The Speed drop-down menu sets the communication rate between the BC program and the unit. The correct value for this setting will be specified in the documentation for your unit.

Serial Error Messages

Port Error
"Could not open specified port."
A message may appear stating "Could not open specified port." This message would indicate that either some other program is currently using that serial port, or BC has been configured to use a serial port not present on your computer. To remedy this problem, either close whichever program currently has the serial port open, or choose a different port.

Until this problem is resolved, BC will be unable to communicate with your unit. However, resistance and reactance values may still be entered manually.

Communication Error
"Could not communicate with unit."

This message indicates that the port was opened correctly, but communication could not be established with the unit. Please make sure that the unit is turned on and connected to your computer with the serial cable. In addition, check that the correct port has been selected and that the selected speed matches what is stated in the documentation for your unit.

Frequently Asked Questions

How do I measure frame size?

There are two methods for measuring frame size:

- **The Precise Method**
  First, measure the patient's height. Next, use a measuring tape to measure the circumference of the patient's wrist. (make sure to use the same units for both measurements. Do not mix inches and centimeters.) Divide the height by the wrist circumference. If the result is greater than 10.4, the patient has a small frame. If it is less than 9.6, the patient has a large frame. Otherwise, the patient has a medium frame.

- **The Easy Method**
  A simpler, albeit less precise, method is to have the patient wrap the thumb and forefinger of one hand around the wrist of the other hand. If the thumb and forefinger overlap, the person has a small frame. If the tips of the thumb and forefinger touch, the person has a medium frame. If there is a gap, the person has a large frame.

How is target weight calculated?

On the subject input form, you can choose to either enter in your own value for target weight, or you can allow the software to calculate one for you. By default, the formulas that the software uses to calculate target weight are called the "Hamwi Ideal Weight Equations" which are as follows:

- **For Males**
  Target weight = 106 + 6 x ((height in inches) - 60)

- **For Females**
  Target weight = 100 + 5 x ((height in inches) - 60)

Once you have a target weight, if the patient has a small frame, adjust it for the patient's frame size. If the patient has a large frame, add 10% to get the final value. If the patient has a small frame, subtract 10%.

BC 2.0 also has the ability to calculate target weight based on a "desired" BMI. Using this method, the program answers the question, "How much would this person weigh if they changed their weight so their BMI was XX?" (You can specify your own "desired BMI".)

What do the Daily Activity Levels mean?

The "Daily Activity Level" describes the amount of physical work associated with the individual's typical daily routine. It is important to select an activity level that is appropriate to the amount of activity that the person sees on *an average daily basis.* This is used to help estimate the person's Daily Energy Expenditure (DEE), or the number of calories the person needs to consume to keep their weight stable. Right-clicking on the Activity Level drop-down will open a new window containing the following descriptions to help choose the most appropriate activity level.

BC uses different names for the activity levels than earlier editions of software from RJL Systems. The older names are listed in parenthesis.

- <u>Very Light</u> (No Exercise)
  Seated and standing activities, painting, driving, laboratory work, typing, sewing, ironing, cooking, playing cards, playing a musical instrument

- <u>Light</u> (Some Exercise)
  Walking on a level surface at 2.5 to 3 mph (4 - 4.8 kph), garage work, carpentry, restaurant trades, house-cleaning, child care, golf, sailing, table tennis

- <u>Moderate</u> (Moderate Exercise)
  Walking 3.5 to 4 mph (5.6 - 6.5 kph), weeding and hoeing, carrying a load, cycling, skiing, tennis, dancing

- <u>Heavy</u> (Athletic)
  Walking with a load uphill, tree felling, heavy manual digging, basketball, climbing, football, soccer

- <u>Exceptional</u> (Elite Athlete)
  Extremely strenuous physical activity.

What do the Results Mean?

- **FAT**
  Fat is the energy storage of the body. Everybody needs fat in their bodies, but it is important not to have too much.

- **Fat Free Mass (FFM)**
  This value is, literally, what would be left after all fat was removed from the body. Many people also refer to FFM as Lean Body Mass (LBM).

- **Lean Dry Mass (LDM)**
  Lean Dry Mass is the non-water portion of Fat-Free Mass, or Lean Mass. It can also be accurately called "Fat-Free Solids", "Lean Dry Weight", or "Dry Lean". By definition, to calculate LDM, simply subtract TBW from FFM. I.e.: LDM = FFM − TBW.

  Example 1:
  To envision what LDM is, picture a T-Bone steak. While the majority of it is meat, (i.e.: muscle) it also contains fat, the bone, and connective tissues which attach the muscle to the bone. Next, trim the fat from the imaginary steak. For the sake of argument, let us say that we are able to remove exactly 100% of the fat. What will be left (the meat, bone, and connective tissues) is the FFM of the steak.

  Now, freeze-dry the steak. Depending on the temperature of the freeze-drier, the rate at which the steak is cooled, and how long it is allowed to freeze-dry, it is possible to extract 100% of the water in the steak. By doing this, not only is all of the extra-cellular water removed, but all of the intra-cellular water is removed, as well. This process destroys the cells.

  Once the steak has been completely dried, allow it to return to room temperature. It will now be considerably smaller than it was initially, and completely solid. This is Lean Dry mass.

  Example 2:
  For another, more human example of what Lean Dry Mass is, look at a mummy from ancient Egypt. During the embalming and preservation process, the Egyptian priests covered the Pharoah's body in chemicals which, over time, dissolved all of the fat and extracted all of the water. This was done to prevent the body from rotting and to prevent insects from consuming it. Because the mummified body contains no fat or water, the mummy is 100% Lean Dry Mass.

- **Total Body Water (TBW)**
  Literally, the total amount of water in the body. Since fat is essentially 0% water, TBW is entirely contained within FFM.

- **Intra-Cellular Water (ICW)**
  This is the portion of Total Body Water that is located within the body's cells.

- **Extra-Cellular Water (ECW)**
  This is the portion of Total Body Water that is located outside of the body's cells. Examples of where ECW is found include, but are not limited to: blood plasma, spinal fluid, joint fluids, and edema.

- **Target Weight**
  If you and your patient know how much he/she should weigh, this value can be manually entered. Otherwise, it is calculated using a set of standardized formulas. These formulas are on page 13 of this manual.

- **Body Mass Index (BMI)**
  A person's BMI is equal to their weight in kilograms divided by their height in meters, squared. BMI is commonly used as an indicator of whether someone is overweight. It is important to note, however, that somebody who is "overweight" may not necessarily be "over-fat". A 5'10", 300 pound couch potato and a 5'10", 300 pound bodybuilder will have exactly the same BMI.

$$\text{BMI} = \frac{\text{Weight}_{(kg)}}{\text{Height}^2_{(meters)}}$$

- **Basal Metabolic Rate (BMR)**
  Basal Metabolic Rate is the number of calories that a person will use per day, by virtue of simply being alive (i.e., lying still and breathing).

  By default, (unless the setting has been changed) the Harris-Benedict formulas for BMR are used. These formulas are as follows:

$$\text{BMR}_{(female)} = 655.1 + (9.6 \times \text{weight}_{(kg)}) + (1.8 \times \text{height}_{(cm)}) - (4.7 \times \text{age}_{(years)})$$

$$\text{BMR}_{(male)} = 66.5 + (11.8 \times \text{weight}_{(kg)}) + (5.0 \times \text{height}_{(cm)}) - (6.8 \times \text{age}_{(years)})$$

  BMR can also be calculated based on the person's estimated FFM.

- **Daily Energy Expenditure (DEE)**
  People generally do not lay in bed all day, doing nothing but breathing. To estimate how many calories a person actually burns in a day, the program will adjust the BMR based on what you entered as the person's daily activity level.

Resistance, Reactance, Impedance, and Phase Angle

When explaining these concepts, it is common to use water flowing through a pipe as an analogy for electricity flowing through a circuit. The power supply (battery, wall outlet, etc) can be thought of as a pump. Water moving through the pipe represents the flow of the electric current. The path that electricity takes as it flows through an object or circuit is the pipe. The pressure created by the pump is the voltage.

In order to have a working circuit, electricity must be able to flow out of one terminal/end of the power supply and eventually make it back to the other terminal, making a loop as shown in the picture below.

Circuit

Power Supply /
Pump
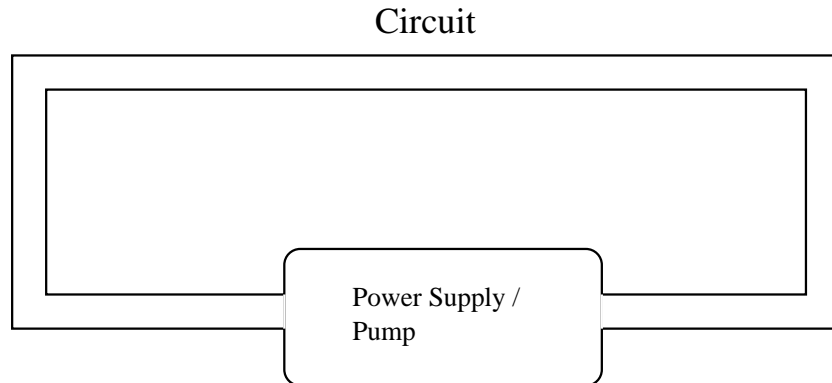
Direct Current vs. Alternating Current

In the above picture, imagine that water is being pumped out the right side of the pump, flows through the circuit, and re-enters the left side of the pump. If the current (flowing water) always goes in this direction, that is what is known as "Direct Current". A battery provides a direct current.

Now imagine that the direction that the water flows in the pipe changes regularly. For a brief period, the current flows out the right side of the pump, counter-clockwise through the circuit, and into the left side of the pump. Then, it reverses direction, flowing out the left side of the pump and into the right. This is an "Alternating Current". Typically, the current changes direction smoothly, in a "sinusoidal" pattern, as shown in the diagram below. Wall outlets are an example of a supply of an alternating current.
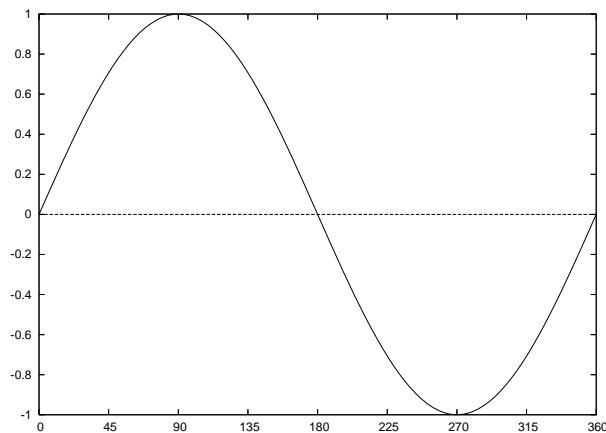
The diagram above shows the current making one complete cycle. The number of cycles that the current goes through per second is known as its "frequency" and is expressed in "Hertz" (abbreviated as "Hz"). Power coming from a wall outlet oscillates (changes direction) at 60 cycles per second, or 60 Hz. The signal used by a Bioelectrical Impedance Analyzer is typically around 50,000 Hz.

Resistance

A "resistor" is something that restricts the flow of electric current. Continuing with the example of water flowing through a pipe, a resistor can be thought of as a spot where the pipe is thinner, or constricted, as in the diagram below. Because the pipe is thinner, water cannot flow through it as quickly. This effect of restricting an electric current is known as "resistance," and is measured in "Ohms".

Resistor

Pipe

Current Flow ⟶

Reactance

In a circuit with a Direct Current, resistance is the only effect that opposes the flow of electric current. An Alternating current encounters a second form of opposition — "reactance". Reactance is caused by *capacitors*. Because reactance is a form of opposition to current, it is also measured in "Ohms".

A capacitor is something that is able to temporarily store an electric charge. Again continuing with the water analogy, think of a capacitor as a reservoir, or chamber, with a rubber diaphragm or balloon stretched across it. Capacitors are rated for how much charge they can store per unit of voltage. This ratio is called "capacitance," and is expressed in terms of "Farads".

Capacitor

Rubber Diaphragm

Pipe

Current Flow ⟶
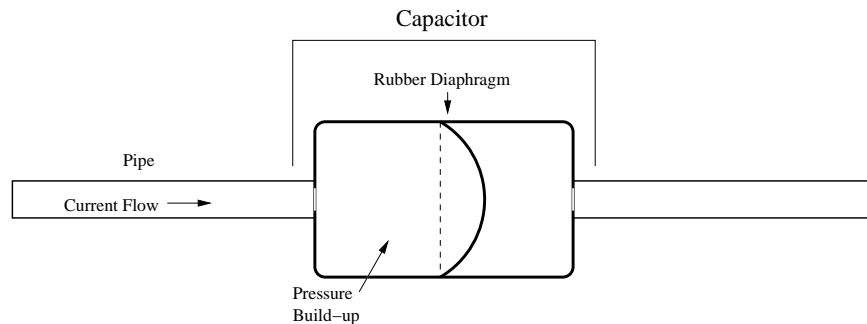
Pressure
Build–up

As water flows into the reservoir from the left, the diaphragm begins to fill and pressure builds in front of it. As this happens, the water on the right side of the diaphragm is forced out. If the direction of the current does not change, the pressure in front of the diaphragm will eventually build to the point where it equals the pressure in the pipe, and the water will stop flowing.

With an alternating current, the pump is first moving water into the left side of the reservoir and out of the right. When it changes direction, the pump moves water into the right side of the reservoir and out the left.

When the pump changes direction, the diaphragm helps move the water by pushing it out of the reservoir. That is, until the diaphragm is back in its normal, relaxed, position. Then, once again, the pump has to work against the diaphragm, building pressure in the reservoir until the direction changes again.

Thus, the capacitor spends half the time helping the alternating current and the other half hindering it. *The measure of how much the capacitor helps and hinders the current is what is known as "**reactance"**.* The amount of reactance caused by a capacitor is affected by both its capacitance and the frequency of the current.

Impedance

Impedance measures the combined effect of resistance and reactance to oppose an alternating current. It, too, is expressed in "Ohms". Resistance, reactance, and impedance all relate to each other as sides of aright triangle, as shown below. To calculate impedance from resistance and reactance, one would use the Pythagorean Theorem, which is:

$$\text{impedance} = \sqrt{\text{resistance}^2 + \text{reactance}^2}$$

Phase Angle

As shown in the diagram above, "Phase Angle" is the angle between impedance and resistance. The formula for calculating phase angle from resistance and reactance is below.
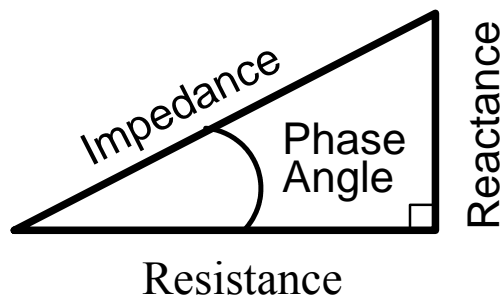
Diagram showing the relationship
between Resistance, Reactance,
Impedance and Phase Angle

Phase angle is normally expressed in degrees. If your calculator is in "radian mode" instead of "degree mode", convert the angle from radians to degrees by multiplying it by 57.2958 ($180 / \pi$).

In a circuit with no reactance, the current is at its highest when the voltage is at its highest. Using the water example, when the pump is applying the maximum pressure, the water is going the fastest. When there is reactance in a circuit, the current is "shifted" from the voltage. In other words, the high point of the current no longer corresponds to when the voltage is at its maximum. As mentioned in the section on reactance, this occurs because the capacitor spends half the time helping the alternating current and the other half hindering it.

The graph below illustrates a phase shift, or phase angle, of 15 degrees.
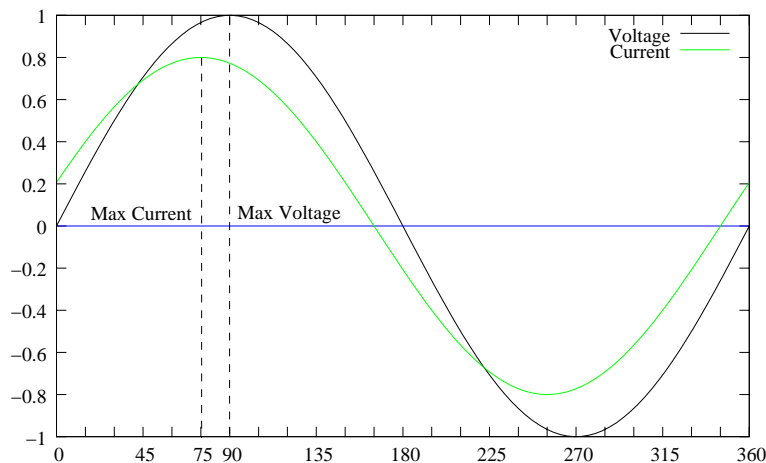
References

References for FAT & FFM in the NHANES-III equation set and TBW in the NHANES-III, Pediatric, and Obese equation sets:

Development of bioelectrical impedance analysis prediction equations for body composition with the use of a multicomponent model for use in epidemiologic surveys.
Sun SS, Chumlea WC, Heymsfield SB, Lukaski HC, Schoeller D, Friedl K, Kuczmarski RJ, Flegal KM, Johnson CL, Hubbard VS.
American Journal of Clinical Nutrition. (2003) 77, 331-40

Lifespan Research Center, Department of Community Health, Wright State University School of Medicine, Dayton, OH 45420, USA. shumei.sun@wright.edu

BACKGROUND: Previous studies to develop and validate bioelectrical impedance analysis (BIA) equations to predict body composition were limited by small sample sizes, sex specificity, and reliance on reference methods that use a 2-component model. OBJECTIVE: This study was designed to develop sex-specific BIA equations to predict total body water (TBW) and fat-free mass (FFM) with the use of a multicomponent model for children and adults. DESIGN: Data from 5 centers were pooled to create a sample of 1474 whites and 355 blacks aged 12-94 y. TBW was measured by dilution, and FFM was estimated with a multicomponent model based on densitometry, isotope dilution, and dual-energy X-ray absorptiometry. RESULTS: The final race-combined TBW prediction equations included stature(2)/resistance and body weight (R(2) = 0.84 and 0.79 and root mean square errors of 3.8 and 2.6 L for males and females, respectively; CV: 8%) and tended to underpredict TBW in black males (2.0 L) and females (1.4 L) and to overpredict TBW in white males (0.5 L) and females (0.3 L). The race-combined FFM prediction equations contained the same independent variables (R(2) = 0.90 and 0.83 and root mean square errors of 3.9 and 2.9 kg for males and females, respectively; CV: approximately 6%) and tended to underpredict FFM in black males (2.1 kg) and females (1.6 kg) and to overpredict FFM in white males (0.4 kg) and females (0.3 kg). CONCLUSION: These equations have excellent precision and are recommended for use in epidemiologic studies to describe normal levels of body composition.

Body composition estimates from NHANES III bioelectrical impedance data.
Chumlea WC, Guo SS, Kuczmarski RJ, Flegal KM, Johnson CL, Heymsfield SB, Lukaski HC, Friedl K, Hubbard VS.
International Journal of Obesity. (2002) Dec;26(12):1596-609.

Department of Community Health, Wright State University School of Medicine, Dayton, Ohio, USA.

BACKGROUND: Body composition estimates for the US population are important in order to analyze trends in obesity, sarcopenia and other weight-related health conditions. National body composition estimates have not previously been available. OBJECTIVE: To use transformed bioelectrical impedance analysis (BIA) data in sex-specific, multicomponent model-derived prediction formulae, to estimate total body water (TBW), fat-free mass (FFM), total body fat (TBF), and percentage body fat (%BF) using a nationally representative sample of the US population. DESIGN: Anthropometric and BIA data were from the third National Health and Nutrition Examination Survey (NHANES III; 1988-1994). Sex-specific BIA prediction equations developed for this study were applied to the NHANES data, and mean values for TBW, FFM, TBF and %BF were estimated for selected age, sex and racial-ethnic groups. RESULTS: Among the non-Hispanic white, non-Hispanic black, and Mexican-American participants aged 12-80 y examined in NHANES III, 15 912 had data available for weight, stature and BIA resistance measures. Males had higher mean TBW and FFM than did females, regardless of age or racial-ethnic status. Mean TBW and FFM increased from the adolescent years to mid-adulthood and declined in older adult age groups. Females had higher mean TBF and %BF estimates than males at each age group. Mean TBF also increased with older age groups to approximately 60 y of age after which it decreased. CONCLUSIONS: These mean body composition estimates for TBW, FFM, TBF and %BF based upon NHANES III BIA data provide a descriptive reference for non-Hispanic whites, non-Hispanic blacks and Mexican Americans in the US population.

Reference for the ICW & ECW prediction equations used in all equation sets:

Accuracy of bioelectrical impedance analysis in estimation of extracellular space in healthy subjects and in fluid retention states.
Sergi G, Bussolotto M, Perini P, Calliari I, Giantin V, Ceccon A, Scanferla F, Bressan M, Moschini G, Enzi G.
Annals of Nutrition and Metabolism (1994) 38, 158-65

Department of Internal Medicine, University of Padova, Italy.

Bioelectrical impedance analysis (BIA) is a noninvasive method recently introduced for body fluid evaluation in healthy subjects. The purpose of this paper is to verify the reliability of bioelectrical measurements in extracellular water (ECW) prediction in healthy subjects and in fluid retention states. We studied 40 subjects (19 males and 21 females) aged 21-81 years; 22 were healthy subjects, 12 were affected by chronic heart failure, and 6 by chronic renal failure. In all subjects resistance (R) and reactance (Xc) at 1 and 50 kHz corrected for height were compared with ECW measured by the bromide dilution method. Our results suggested a different behavior of the current in fluid-retention states with respect to healthy subjects. ECW was best predicted by resistance at 1 kHz corrected for height, group (considered as dummy variable), weight and gender ($R2 = 0.89$, $p < 0.001$, SEE = 1.7 liters). The bioelectrical impedance analysis at 50 kHz explained the 89% of ECW variability when resistance and reactance corrected for height are considered with gender group and weight ($R2 = 0.89$, $p < 0.001$, SEE = 1.7 liters). In conclusion, the bioelectrical method at 1 kHz can be considered sufficiently accurate in ECW prediction in healthy subjects and in fluid retention states. Also, the bioelectrical impedance analysis at 50 kHz is useful for predicting ECW, but this role must be further investigated.

Reference for the FAT & FFM prediction equations used in the Obese equation set:

Lean body mass estimation by bioelectrical impedance analysis: a four-site cross-validation study.
Segal KR, Van Loan M, Fitzgerald PI, Hodgdon JA, Van Itallie TB.
American Journal of Clinical Nutrition (1988) 47, 7-14

Division of Pediatric Cardiology, Mount Sinai School of Medicine, New York, NY 10029.

This study validated further the bioelectrical impedance analysis (BIA) method for body composition estimation. At four laboratories densitometrically-determined lean body mass (LBMd) was compared with BIA in 1567 adults (1069 men, 498 women) aged 17-62 y and with 3-56% body fat. Equations for predicting LBMd from resistance measured by BIA, height, weight, and age were obtained for the men and women. Application of each equation to the data from the other labs yielded small reductions in R values and small increases in SEEs. Some regression coefficients differed among labs but these differences were eliminated after adjustment for differences among labs in the subjects' body fatness. All data were pooled to derive fatness-specific equations for predicting LBMd: the resulting R values ranged from 0.907 to 0.952 with SEEs of 1.97-3.03 kg. These results confirm the validity of BIA and indicate that the precision of predicting LBM from impedance can be enhanced by sex- and fatness-specific equations.

Reference for the FAT & FFM equations used in the Pediatric equation set:

Body composition determination in children using bioelectrical impedance.
Cordain L, Whicker RE, Johnson JE.
Growth, Development, & Aging (1988) 52, 37-40

Department of Exercise and Sport Science, Colorado State University, Fort Collins 80523.

Estimation of body composition by measurement of tetrapolar bioelectrical resistive impedance (R) is a technique only recently validated in adults. To evaluate this technique in children, 16 girls aged 11.6 +/- 0.9 yr (mean +/- SD) and 14 boys aged 12.5 +/- 1.0 yr were assessed for fat free mass (FFM) by hydrostatic weighing, total body potassium (TBK) by whole body counting of 40K, and R by an electrical impedance plethysmograph. Significant relationships (P less than 0.001) were demonstrated between TBK and ht2/R (r = 0.92), and FFM and ht2/R (r = 0.83). The reliability coefficient for the impedance measurements was r = 0.97. The following equation describes FFM in the present group of children: FFM (kg) = 6.86 + 0.81 x (ht2/R), r = 0.83, P less than 0.001, SEE = 4.08. These data suggest that impedance measurements are valid and reliable predictors of FFM in pediatric populations.

Reference for the FAT & FFM equations used in the Native American equation set:

Body composition in Pima Indians: validation of bioelectrical resistance.
Rising R, Swinburn B, Larson K, Ravussin E.
Am J Clin Nutr. 1991 Mar;53(3):594-8.

Clinical Diabetes and Nutrition Section, National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health, Phoenix, AZ 85016.

To assess the validity of bioelectrical resistance (BR) in an obese population, body composition was determined by both hydrostatic weighing and by BR in 156 Pima Indian volunteers representing a wide range of body weight (46.1-202.6 kg) and body composition (11-52% fat). A predictive equation was derived by use of data on height, BR, weight, age, and sex from 130 randomly selected volunteers and was applied to the remaining 26 volunteers. When compared with the manufacturer's software, the new equation increased correlations with hydrostatic weighing for predicting percent body fat and fat-free mass (FFM) from 0.70 to 0.92 and 0.79 to 0.97, respectively. The manufacturer's software underestimated FFM by 5.3 +/- 8.6 kg (P less than 0.05) when compared with FFM derived from hydrostatic weighing whereas the new equation improved the accuracy to -0.1 +/- 3.3 kg (NS). There were no significant effects of fluid intake (700 mL) or breakfast consumption on body composition as determined by BR. BR represents a simple and accurate way to assess body composition in Pima Indians with our newly derived equation.

References for the FAT & FFM equations used in the New Pediatric equation set:

Usefulness of bioelectric impedance and skinfold measurements in predicting fat-free mass derived from total body potassium in children.
Schaefer F, Georgi M, Zieger A, Schärer K.
Pediatr Res. 1994 May;35(5):617-24.

University Children's Hospital, Heidelberg, Germany.

Despite the increasing use of tetrapolar whole-body bioelectric impedance (BI) analysis in the assessment of body composition, its usefulness in estimating fat-free mass (FFM) has not been evaluated in comparison with conventional skinfold anthropometry in children. We therefore compared 1) the intraobserver and interobserver reproducibility of BI and skinfold measurements and the derived FFM estimates, and 2) the predictability of FFM as calculated from measurements of total body potassium (TBK) using 40K spectrometry by equations based on either BI or skinfold measurements in 112 healthy children, adolescents, and young adults aged 3.9 to 19.3 y. A best-fitting equation to predict TBK-derived FFM from BI and other potential independent predictors was developed and cross validated in two randomly selected subgroups of the study population by stepwise multiple regression analysis. Although the technical error associated with BI measurements was much smaller than that of skinfold measurements, the reproducibility of BI-derived FFM estimates (intraobserver coefficient of variation [CV], 0.39%; interobserver CV, 1.23%) was only slightly better than that of FFM estimates obtained by use of weight and two skinfold measurements (0.62% and 1.39%, respectively). The cross validation procedure yielded the following best-fitting prediction equation: FFM = 0.65 x (height2/impedance) + 0.68 x age + 0.15 (R2 = 0.975, root mean square error = 1.98 kg, CV = 5.8%, 95% limits of agreement = -11.1% to +12.4%). Conventional anthropometry, using published equations to estimate FFM from skinfolds, slightly over-estimated TBK-derived FFM, but predicted FFM with precision similar to the best-fitting equation involving BI. Previously published FFM equations incorporating BI predicted TBK-drived FFM with variable predictive precision and accuracy.

Predictive validity of four bioelectrical impedance equations in determining percent fat mass in overweight and obese children.
Cleary J, Daniells S, Okely AD, Batterham M, Nicholls J.
J Am Diet Assoc. 2008 Jan;108(1):136-9.

Department of Clinical Nutrition, Wollongong Hospital, Wollongong, NSW, Australia.

Bioelectrical impedance equations are frequently used by food and nutrition professionals to estimate percent fat mass in overweight and obese children. However, it is not known whether they are accurate for such children, as they have been primarily developed for children of varying body weights. The aim of this cross-sectional study was to evaluate the predictive validity of four previously published prediction equations developed for the pediatric population, among a sample of overweight and obese children. Thirty overweight or obese children (mean age=7.57+/-1.28 years) underwent measurement of fat mass, percent fat mass, and fat-free mass using dual-energy x-ray absorptiometry (DEXA) and bioelectrical impedance analysis (BIA). Impedance values from the BIA were entered into the four prediction equations and Pearson correlations used to determine the significance of associations between each of the BIA prediction equations and DEXA for percent fat mass, fat mass, and fat-free mass. For percent fat mass, paired t tests were used to assess differences between the methods and the technique of Bland and Altman was used to determine bias and error. Results showed that the mean percent fat mass as determined by DEXA for this age group was 40.79%. In comparison with other BIA prediction equations, the Schaefer equation had the closest mean value of 41.98%, and was the only equation not to significantly differ from the DEXA (P=0.121). This study suggests that the Schaefer equation is the only accurate BIA prediction equation for assessing percent fat mass in this sample of overweight and obese children from primarily white backgrounds.

Reference for the TBW equation used in the New Pediatric, Native American, Obese African American, Mexican Adult, HIV, Athletic, and All Body Types equation sets:

Is the impedance index (ht2/R) significant in predicting total body water?
Kushner RF, Schoeller DA, Fjeld CR, Danford L.
Am J Clin Nutr. 1992 Nov;56(5):835-9.

Clinical Nutrition Research Unit, University of Chicago, IL.

We investigated the general utility of bioelectrical impedance analysis (BIA) and the implications of BIA theory in populations of various ages from infancy to adulthood by developing a single impedance equation. Four subject data sets representing 62 adults, 37 prepubertal children, 44 preschool children, and 32 premature low-birth-weight neonates were combined. Subjects were randomly divided into a development group (n = 116) and a cross-validation group (n = 59). The single best predictor of total body water (TBW) was height2/resistance (ht2/R), which explained 99% of the variation in TBW (SEE = 1.67 kg). The addition of weight reduced the SEE to 1.41 kg. A significant bias was only seen in the preschool children. These results were confirmed in the cross-validation group and the best prediction formula was TBW = 0.59 ht2/R + 0.065 wt + 0.04. We conclude that the impedance index (ht2/R) is a significant predictor of TBW and that there is some improvement in prediction of TBW by inclusion of a weight term.

References for the FFM equation used in the Mexican Adult equation set:

Body fat measurement by bioelectrical impedance and air displacement plethysmography: a cross-validation study to design bioelectrical impedance equations in Mexican adults.
Macias N, Alemán-Mateo H, Esparza-Romero J, Valencia ME.
Nutr J. 2007 Aug 15;6:18.

Centro de Investigación en Nutrición y Salud, Instituto Nacional de Salud Pública. Universidad 655, Santa Maria Ahuacatitlan, CP 62508, Cuernavaca, México. nmacias@insp.mx

BACKGROUND: The study of body composition in specific populations by techniques such as bio-impedance analysis (BIA) requires validation based on standard reference methods. The aim of this study was to develop and cross-validate a predictive equation for bioelectrical impedance using air displacement plethysmography (ADP) as standard method to measure body composition in Mexican adult men and women. METHODS: This study included 155 male and female subjects from northern Mexico, 20-50 years of age, from low, middle, and upper income levels. Body composition was measured by ADP. Body weight (BW, kg) and height (Ht, cm) were obtained by standard anthropometric techniques. Resistance, R (ohms) and reactance, Xc (ohms) were also measured. A random-split method was used to obtain two samples: one was used to derive the equation by the "all possible regressions" procedure and was cross-validated in the other sample to test predicted versus measured values of fat-free mass (FFM). RESULTS AND DISCUSSION: The final model was: FFM (kg) = 0.7374 * (Ht2 /R) + 0.1763 * (BW) - 0.1773 * (Age) + 0.1198 * (Xc) - 2.4658. R2 was 0.97; the square root of the mean square error (SRMSE) was 1.99 kg, and the pure error (PE) was 2.96. There was no difference between FFM predicted by the new equation (48.57 +/- 10.9 kg) and that measured by ADP (48.43 +/- 11.3 kg). The new equation did not differ from the line of identity, had a high R2 and a low SRMSE, and showed no significant bias (0.87 +/- 2.84 kg). CONCLUSION: The new bioelectrical impedance equation based on the two-compartment model (2C) was accurate, precise, and free of bias. This equation can be used to assess body composition and nutritional status in populations similar in anthropometric and physical characteristics to this sample.

References for the FFM equations used in the Obese African American equation set:

Validation of tetrapolar bioelectrical impedance method to assess human body composition.
Lukaski HC, Bolonchuk WW, Hall CB, Siders WA.
J Appl Physiol. 1986 Apr;60(4):1327-32.

This study was conducted to validate the relationship between bioelectrical conductance (ht2/R) and densitometrically determined fat-free mass, and to compare the prediction errors of body fatness derived from the tetrapolar impedance method and skinfold thicknesses, relative to hydrodensitometry. One-hundred and fourteen male and female subjects, aged 18-50 yr, with a wide range of fat-free mass (34-96 kg) and percent body fat (4-41%), participated. For males, densitometrically determined fat-free mass was correlated highly ($r = 0.979$), with fat-free mass predicted from tetrapolar conductance measures using an equation developed for males in a previous study. For females, the correlation between measured fat-free mass and values predicted from the combined (previous and present male data) equation for men also was strong ($r = 0.954$). The regression coefficients in the male and female regression equations were not significantly different. Relative to hydrodensitometry, the impedance method had a lower predictive error or standard error of the estimates of estimating body fatness than did a standard anthropometric technique (2.7 vs. 3.9%). Therefore this study establishes the validity and reliability of the tetrapolar impedance method for use in assessment of body composition in healthy humans.

Comparison of body composition methods in obese African-American women.
Newton RL Jr, Alfonso A, York-Crowe E, Walden H, White MA, Ryan D, Williamson DA.
Obesity (Silver Spring). 2006 Mar;14(3):415-22.

Pennington Biomedical Research Center, Louisiana State University, 6400 Perkins Road, Baton Rouge, LA 70808, USA. NewtonRL@pbrc.edu

OBJECTIVE: To compare the accuracy of percentage body fat (%BF) estimates between bioelectrical impedance analysis (BIA) and DXA in obese African-American women. RESEARCH METHODS AND PROCEDURES: Fifty-five obese African-American women (mean age, 45 years; mean BMI, 38; mean %BF, 48%) were studied. BF was assessed by both BIA (RJL Systems BIA 101Q; RJL Systems, Clinton Township, MI) and DXA (Hologic QDR-2000 Bone Densitometer; Hologic Inc., Bedford, MA). Generalized and ethnicity- and obese-specific equations were used to calculate %BF from the BIA. Bland-Altman analyses were used to compare the agreement between the BIA and the DXA, with the DXA serving as the criterion measure. RESULTS: Two of the generalized equations provided consistent estimates across the weight range in comparison with the DXA estimates, whereas most of the other equations increasingly underestimated %BF as BF increased. One of the generalized and one of the ethnicity-specific equations had mean differences that were not significantly different from the DXA value. DISCUSSION: The findings show that the Lukaski equation provided the most precise and accurate estimates of %BF in comparison with the QDR 2000 and provide preliminary support for the use of this equation for obese African-American women.

References for the FFM equations used in the HIV equation set:

Theory and Validation of the Tetrapolar Bioelectrical Impedance Method to Assess Human Body Composition.
HC Lukaski and WW Bolonchuk
In Vivo Body Composition Studies, London: The Institute of Physical Sciences in Medicine, 1986, pp 410-414.

Comparison of total body potassium with other techniques for measuring lean body mass in men and women with AIDS wasting.
Corcoran C, Anderson EJ, Burrows B, Stanley T, Walsh M, Poulos AM, Grinspoon S.
Am J Clin Nutr. 2000 Oct;72(4):1053-8.

Neuroendocrine Unit and the General Clinical Research Center, Massachusetts General Hospital, Harvard Medical School, Boston, MA 02114, USA.

BACKGROUND: Lean body mass is an important predictor of survival and functional status in patients with AIDS wasting. The bias between different techniques for assessing body composition in AIDS wasting is not known. DESIGN: We compared total body potassium (TBK) with fat-free mass (FFM) determined by dual-energy X-ray absorptiometry (DXA), bioelectrical impedance analysis (BIA), and skinfold-thickness measurement (SKF) in 132 patients (63 men, 69 women) with AIDS wasting (weight < 90% of ideal body weight, or weight loss > 10% of original, or both). None of the subjects exhibited clinical lipodystrophy. Comparisons were made by using different BIA equations. RESULTS: Lean body mass determined by DXA was highly correlated with TBK in men (r = 0.79, P: < 0.0001) and women (r = 0.84, P: < 0.0001). FFM(BIA) and FFM (DXA) were significantly different (P: < 0.01 in men and P: < 0.0001 in women). The difference between FFM (DXA) and FFM(BIA) was significantly greater with greater weight and body fat, particularly in HIV-infected women (r = -0.39, P: = 0.001 for weight; r = -0.60, P: < 0.0001 for fat). The comparability of FFM and fat mass determined by DXA and BIA was dependent on the specific BIA equation used. Among men, no single BIA equation was more highly predictive of fat mass and FFM in comparison with DXA. CONCLUSIONS: The differences between DXA, BIA, and SKF in the determination of fat mass and FFM are significant in patients with AIDS wasting. BIA overestimates FFM compared with DXA in those with greater body fat. Standard BIA equations may not accurately estimate FFM and fat mass in men and women with AIDS wasting.

Reference for the optional FFM-based BMR equation available to all equation sets:

Differences in resting metabolic rate between paraplegic and able-bodied subjects are explained by differences in body composition.
Buchholz AC, McGillivray CF, Pencharz PB.
Am J Clin Nutr. 2003 Feb;77(2):371-8.

Department of Nutritional Sciences, University of Toronto, Ontario.

BACKGROUND: Little is known about the relation between body composition and energy metabolism in paraplegia. OBJECTIVE: We investigated the relation between body composition and energy metabolism in healthy paraplegics as compared with able-bodied control subjects. We hypothesized that paraplegics would have lower fat-free mass (FFM), body cell mass (BCM), resting metabolic rate (RMR), and thermic effect of feeding (TEF). DESIGN: This cross-sectional study included 34 control subjects and 28 paraplegics (mean age: 29.1 +/- 7.6 and 33.9 +/- 9.2 y, respectively) with body mass indexes (in kg/m(2)) of 23.5 +/- 1.8 and 24.3 +/- 6.0, respectively. We measured RMR and TEF with indirect calorimetry, total body water with deuterium dilution, and extracellular water with corrected bromide space. We calculated FFM (total body water/0.732) and BCM [(total body water - extracellular water)/0.732]. RESULTS: FFM was higher in control subjects than in paraplegics (77.2 +/- 7.2% and 69.2 +/- 8.7%, respectively; P = 0.0002), as were BCM (47.4 +/- 6.7% and 35.9 +/- 8.1%, respectively; P < 0.0001) and RMR (7016 +/- 935 and 6159 +/- 954 kJ/d, respectively; P = 0.0007). FFM was the single best predictor of RMR in both groups (r(2) = 0.83 for control subjects and 0.70 for paraplegics, P < 0.0001 for both). RMR adjusted for FFM did not differ significantly between control subjects and paraplegics (6670 +/- 504 and 6588 +/- 501 kJ/d, respectively). TEF also did not differ significantly between control subjects and paraplegics (6.25 +/- 2.2% and 5.53 +/- 1.8% of energy intake, respectively). CONCLUSIONS: FFM, BCM, and RMR, but not obligatory TEF, are lower in paraplegics than in control subjects. RMR does not differ between control and paraplegic subjects after adjustment for FFM, indicating similar metabolic activity in the fat-free compartment of the body.

Reference for the "Activity Factor" multiplier to calculate DEE from BMR in all equation sets:

Recommended Dietary Allowances, 10th Edition.
National Academy Press 1989-1999.
ISBN: 0-309-04633-5

This book is also available online via the National Academy Press website at:
http://books.nap.edu/catalog/1349.html

The relevant section on activity factors to calculate Daily Energy Expenditure from Basal Metabolic Rate is contained in pages 27-29.

References for the FAT & FFM prediction equations used in the Athletic and All Body Types equation sets:

Lean body mass estimation by bioelectrical impedance analysis: a four-site cross-validation study.
Segal KR, Van Loan M, Fitzgerald PI, Hodgdon JA, Van Itallie TB.
American Journal of Clinical Nutrition (1988) 47, 7-14

Division of Pediatric Cardiology, Mount Sinai School of Medicine, New York, NY 10029.

This study validated further the bioelectrical impedance analysis (BIA) method for body composition estimation. At four laboratories densitometrically-determined lean body mass (LBMd) was compared with BIA in 1567 adults (1069 men, 498 women) aged 17-62 y and with 3-56% body fat. Equations for predicting LBMd from resistance measured by BIA, height, weight, and age were obtained for the men and women. Application of each equation to the data from the other labs yielded small reductions in R values and small increases in SEEs. Some regression coefficients differed among labs but these differences were eliminated after adjustment for differences among labs in the subjects' body fatness. All data were pooled to derive fatness-specific equations for predicting LBMd: the resulting R values ranged from 0.907 to 0.952 with SEEs of 1.97-3.03 kg. These results confirm the validity of BIA and indicate that the precision of predicting LBM from impedance can be enhanced by sex- and fatness-specific equations.

Effect of obesity on bioelectrical impedance.
Gray DS, Bray GA, Gemayel N, Kaplan K.
Am J Clin Nutr. 1989 Aug;50(2):255-60.

Department of Medicine, University of Southern California, Los Angeles.

The purpose of this study was to validate the use of bioelectrical impedance in assessing human body composition and to explore the use of this technique in obesity. Eighty-seven adults varying widely in body composition (range: 8.8-59.0% body fat) underwent measurement of bioelectrical impedance and underwater weighing (density). Fat-free mass determined from density (FFMd) was compared with FFM estimated from bioelectric impedance according to previously published regression equations. Correlation coefficients were high at all levels of body fat (0.94-0.99) but impedance equations overestimated FFM compared with FFMd in subjects greater than 42% body fat. This effect was greatest in subjects greater than 48% body fat and a regression equation was derived for determination of FFM for these subjects. These data confirm the excellent agreement between body composition determined from bioelectrical impedance and density but suggest that caution should be used in applying existing regression equations to very obese subjects.

References for the FAT & FFM prediction equations used in the Athletic and All Body Types equation sets:
(Continued)

Body composition by x-ray absorptiometry and bioelectrical impedance in female runners.
Pichard C, Kyle UG, Gremion G, Gerbase M, Slosman DO.
Med Sci Sports Exerc. 1997 Nov;29(11):1527-34.

Orthopedic Department, Geneva University Hospital, Switzerland. pichard@cmu.unige.ch

Body composition interests athletes since athletic performance is influenced by and dependent on the proportion and total amount of fat-free mass (FFM) and fat mass. The use of bioelectrical impedance (BIA) has increased recently since portable instruments make the measurements easy to execute and relatively inexpensive. The purpose of this study was to test the degree of relationship between FFM and fat mass calculated in elite female runners with 12 different BIA formulas reported in the literature and measured by dual-energy x-ray absorptiometry (DXA). The present study shows that body composition by BIA is valid in female runners. Prediction equations used to calculate FFM and fat mass must be appropriate for this population subgroup and validated against other methods, such as DXA and hydrodensitometry. Those formulas that performed well in the controls gave poor results in the female runner and vice versa. The below average fat mass noted in female runners suggests that prediction equations for untrained women with average fat mass are inappropriate. The formula by RJL Systems-2 for women: FFM = 5.091 + 0.6483.height2/resistance + 0.1996.weight gave best predictions of FFM in female runners. Further research is necessary to validate BIA prediction formulas in other athletes.

Validity of bioelectrical impedence equations for estimating fat-free weight in high school female gymnasts.
Eckerson JM, Evetovich TK, Stout JR, Housh TJ, Johnson GO, Housh DJ, Ebersole KT, Smith DB.
Med Sci Sports Exerc. 1997 Jul;29(7):962-8.

Exercise Science Department, Creighon University, Omaha, NE 68178, USA.

The present study examined the validity of bioelectrical impedence (BIA) equations for estimating fat-free weight (FFW) in female gymnasts by comparing the values to those obtained from underwater weighing (UWW). Ninety-seven female Caucasian high school gymnasts (mean age +/- SD = 15.7 +/- 1.1 yr) participated in the study. FFW from UWW was calculated from percent fat using the revised formula of Brozek et al. (mean FFW +/- SD = 43.8 +/- 4.5 kg) and the age-specific constants of Lohman (mean FFW +/- SD = 44.8 +/- 4.6 kg). Cross-validation analyses included examination of the constant error (CE), SEE, r, and total error (TE). The results indicated similar trends between equations when based on either the Brozek or Lohman conversions; however, the CE, SEE, and TE values were consistently lower for the majority of the equations using the revised formula of Brozek et al. Based upon the results of the cross-validation analyses, the equation of Houtkooper et al. and the interlaboratory equations of Van Loan et al. and Lohman, which resulted in identical TE values of 2.4 kg are recommended for use with young high school gymnasts.

Average Ranges

American Population Body Composition Averages from the NHANES-III Data Set

Introduction

The purpose of this document is to provide the statistical averages of the body composition of average Americans and provide reference averages with which an individual may be compared to the population examined in NHANES-III.

Scope

The following tables illustrate the average ranges for various body composition and electrical properties of Americans, as examined in NHANES-III. The tables DO NOT illustrate "ideal" or "target" values. Furthermore, the tables may show values that are considered to be "unhealthy" by medical professionals. The purpose of this document is strictly limited to providing a reference of the population examined in NHANES-III.

Methods

The NHANES-III data set contains (among many other values) height, weight, age, gender, resistance, and reactance data. Using the same methods of Chumlea, et al. [2], these values were used to estimate various body composition and electrical properties of each individual. The formulas used are contained in the "NHANES-III" equation set provided in RJL Systems' software. [1,2,3]

Usage Instructions

The tables in this document contain the mean (the center of the average range) and standard deviation (the variance, +/-, of the average range) for each value. To find an average range, first find the section for the appropriate gender and age range. (eg: Males aged 20-29) Next, locate the column for the value of interest, (eg: FAT % of weight) and note the mean and standard deviation values. Add the standard deviation to the mean to get the high end of the average range. Subtract the standard deviation from the mean to get the low end. Using the above example, the average range for body fat percentage for 20-29 year old American males is 16.8% - 29.8%.

[1]   Shumei S Sun, W Cameron Chumlea, Steven B Heymsfield, Henry C Lukaski, Dale Schoeller, Karl Friedl, Robert J Kuczmarski, Katherine M Flegal, Clifford L Johnson, and Van S Hubbard *Development of bioelectrical impedance analysis prediction equations for body composition with the use of a multicomponent model for use in epidemiologic surveys*Am J Clin Nutr 2003;77:331-40.

[2]   WC Chumlea, SS Guo, RJ Kuczmarski, KM Flegal, CL Johnson, SB Heymsfield, HC Lukaski, K Friedl and VS Hubbard *Body composition estimates from NHANES III bioelectrical impedance data/fRInternational Journal of Obesity (2002) 26, 1596-1609*

[3]   Giuseppe Sergi, et. al. *Accuracy of Bioelectrical Impedance Analysis in Estimation of Extracellular Space in Healthy Subjects and in Fluid Retention States.* Annals of Nutrition and Metabolism (1994) 38, 158-165

Male Age Groups 10 19. (n=1379)

Description:	Age	Height cm	Weight kg	Weight lbs	Resistance	Reactance	Phase Angle	Dissipation	TBW_liters	TBW % Wt	TBW % FFM	ICW_liters	ICW % Wt	ICW % FFM
Means	15.4	168.7	64.3	141.8	514.3	72.5	8.0	7.3	38.1	60.2	74.7	22.9	36.4	45.1
+/- Std Dev	2.3	10.6	17.1	37.7	72.5	10.5	1.0	1.2	8.1	5.9	1.0	4.1	3.9	1.9

Description:	ICW % TBW	ECW_liters	ECW % Wt	ECW % FFM	ECW % TBW	FAT_kg	FAT_lbs	FAT % Wt	FFM_kg	FFM_lbs	FFM % Wt	BMR_Kcal	BMI
Means	60.4	15.3	23.8	29.5	39.6	13.2	29.2	19.4	51.1	112.6	80.6	1693.1	22.4
+/- Std Dev	2.4	4.0	2.6	1.8	2.4	8.3	18.2	7.4	10.9	24.0	7.4	265.2	4.7

Male Age Groups 20 29. (n=1553)

Description:	Age	Height cm	Weight kg	Weight lbs	Resistance	Reactance	Phase Angle	Dissipation	TBW_liters	TBW % Wt	TBW % FFM	ICW_liters	ICW % Wt	ICW % FFM
Means	24.5	173.8	77.4	170.6	479.9	74.1	8.7	6.6	43.6	57.1	74.5	25.8	33.9	44.3
+/- Std Dev	2.8	7.8	17.3	38.0	61.9	10.9	0.9	0.7	7.3	5.1	0.8	3.7	3.2	1.3

Description:	ICW % TBW	ECW_liters	ECW % Wt	ECW % FFM	ECW % TBW	FAT_kg	FAT_lbs	FAT % Wt	FFM_kg	FFM_lbs	FFM % Wt	BMR_Kcal	BMI
Means	59.4	17.8	23.2	30.2	40.6	18.8	41.3	23.3	58.7	129.3	76.7	1836.9	25.5
+/- Std Dev	1.5	3.6	2.2	1.1	1.5	9.2	20.2	6.5	10.0	22.0	6.5	256.3	4.9

Male Age Groups 30 39. (n=1383)

Description:	Age	Height cm	Weight kg	Weight lbs	Resistance	Reactance	Phase Angle	Dissipation	TBW_liters	TBW % Wt	TBW % FFM	ICW_liters	ICW % Wt	ICW % FFM
Means	34.3	174.8	81.6	180.0	469.2	70.7	8.5	6.8	45.4	56.2	74.4	26.7	33.2	43.9
+/- Std Dev	2.8	7.6	17.0	37.6	63.3	10.6	0.9	0.7	7.5	4.8	0.8	3.8	3.0	1.2

Description:	ICW % TBW	ECW_liters	ECW % Wt	ECW % FFM	ECW % TBW	FAT_kg	FAT_lbs	FAT % Wt	FFM_kg	FFM_lbs	FFM % Wt	BMR_Kcal	BMI
Means	59.0	18.7	23.1	30.5	41.0	20.5	45.2	24.4	61.1	134.8	75.6	1833.9	26.6
+/- Std Dev	1.4	3.7	2.1	1.1	1.5	8.7	19.2	5.8	10.3	22.8	6.2	253.7	5.0

Male Age Groups 40 49. (n=1155)

Description:	Age	Height cm	Weight kg	Weight lbs	Resistance	Reactance	Phase Angle	Dissipation	TBW_liters	TBW % Wt	TBW % FFM	ICW_liters	ICW % Wt	ICW % FFM
Means	43.9	174.3	83.7	184.4	462.5	67.1	8.2	7.1	46.0	55.5	74.4	26.9	32.6	43.7
+/- Std Dev	2.8	7.6	16.7	36.8	62.3	10.9	1.0	0.8	7.4	4.6	0.8	3.7	2.8	1.2

Description:	ICW % TBW	ECW_liters	ECW % Wt	ECW % FFM	ECW % TBW	FAT_kg	FAT_lbs	FAT % Wt	FFM_kg	FFM_lbs	FFM % Wt	BMR_Kcal	BMI
Means	58.7	19.1	22.9	30.7	41.3	21.8	48.0	25.4	61.9	136.4	74.6	1794.2	27.5
+/- Std Dev	1.4	3.7	2.0	1.1	1.5	8.5	18.6	5.8	10.2	22.4	5.8	250.8	4.9

Male Age Groups 50 59. (n=792)

Description:	Age	Height cm	Weight kg	Weight lbs	Resistance	Reactance	Phase Angle	Dissipation	TBW_liters	TBW % Wt	TBW % FFM	ICW_liters	ICW % Wt	ICW % FFM
Means	54.4	174.5	84.1	185.5	463.6	62.6	7.6	7.6	46.1	55.3	74.3	26.8	32.2	43.3
+/- Std Dev	2.8	6.9	16.3	36.0	66.1	10.8	0.9	1.0	7.3	4.6	0.8	3.6	2.8	1.2

Description:	ICW % TBW	ECW_liters	ECW % Wt	ECW % FFM	ECW % TBW	FAT_kg	FAT_lbs	FAT % Wt	FFM_kg	FFM_lbs	FFM % Wt	BMR_Kcal	BMI
Means	58.3	19.3	23.1	31.0	41.7	22.1	48.7	25.6	62.0	136.8	74.4	1729.7	27.6
+/- Std Dev	1.6	3.7	2.1	1.2	1.6	8.3	18.3	5.8	9.9	21.8	5.8	243.7	4.8

Male Age Groups 60 69. (n=1055)

Description:	Age	Height cm	Weight kg	Weight lbs	Resistance	Reactance	Phase Angle	Dissipation	TBW_liters	TBW % Wt	TBW % FFM	ICW_liters	ICW % Wt	ICW % FFM
Means	64.3	172.5	81.7	180.2	471.3	59.6	7.1	8.2	44.6	55.0	74.4	25.9	32.0	43.3
+/- Std Dev	2.9	7.1	15.0	33.1	69.4	10.8	0.9	1.1	7.0	4.6	0.9	3.5	2.7	1.3

Description:	ICW % TBW	ECW_liters	ECW % Wt	ECW % FFM	ECW % TBW	FAT_kg	FAT_lbs	FAT % Wt	FFM_kg	FFM_lbs	FFM % Wt	BMR_Kcal	BMI
Means	58.2	18.7	23.0	31.1	41.8	21.8	48.1	26.1	59.9	132.1	73.9	1619.5	27.4
+/- Std Dev	1.6	3.6	2.2	1.3	1.6	7.7	16.9	5.8	9.4	20.8	5.8	227.6	4.4

Male Age Groups 70 79. (n=724)

Description:	Age	Height cm	Weight kg	Weight lbs	Resistance	Reactance	Phase Angle	Dissipation	TBW_liters	TBW % Wt	TBW % FFM	ICW_liters	ICW % Wt	ICW % FFM
Means	73.6	171.2	77.5	170.9	480.4	55.1	6.4	9.1	42.9	55.7	74.5	24.7	32.2	43.1
+/- Std Dev	2.6	7.1	14.1	31.2	67.9	11.2	1.0	1.5	6.7	4.6	0.9	3.3	2.7	1.4

Description:	ICW % TBW	ECW_liters	ECW % Wt	ECW % FFM	ECW % TBW	FAT_kg	FAT_lbs	FAT % Wt	FFM_kg	FFM_lbs	FFM % Wt	BMR_Kcal	BMI
Means	57.9	18.1	23.5	31.4	42.1	20.0	44.1	25.3	57.5	126.8	74.7	1491.9	26.4
+/- Std Dev	1.9	3.5	2.3	1.4	1.9	7.0	15.5	5.8	9.1	20.0	5.8	216.3	4.2

Male Age Groups 80 89. (n=472)

Description:	Age	Height cm	Weight kg	Weight lbs	Resistance	Reactance	Phase Angle	Dissipation	TBW_liters	TBW % Wt	TBW % FFM	ICW_liters	ICW % Wt	ICW % FFM
Means	82.8	169.5	72.6	160.1	494.3	50.2	5.7	10.2	40.6	56.4	74.6	23.3	32.4	42.9
+/- Std Dev	2.5	6.8	12.3	27.0	70.9	9.8	0.9	1.6	6.0	4.9	1.0	2.9	2.7	1.4

Description:	ICW % TBW	ECW_liters	ECW % Wt	ECW % FFM	ECW % TBW	FAT_kg	FAT_lbs	FAT % Wt	FFM_kg	FFM_lbs	FFM % Wt	BMR_Kcal	BMI
Means	57.5	17.3	24.0	31.7	42.5	18.1	39.9	24.4	54.5	120.1	75.6	1352.6	25.2
+/- Std Dev	1.9	3.2	2.6	1.6	1.9	6.6	14.5	6.1	8.0	17.6	6.1	190.6	3.8

Male Age Groups 90 99. (n=32)

Description:	Age	Height cm	Weight kg	Weight lbs	Resistance	Reactance	Phase Angle	Dissipation	TBW_liters	TBW % Wt	TBW % FFM	ICW_liters	ICW % Wt	ICW % FFM
Means	90.0	167.1	65.1	143.5	517.2	49.6	5.4	10.9	37.5	58.1	74.7	21.6	33.6	43.2
+/- Std Dev	0.0	8.6	12.1	26.7	84.0	11.3	1.2	1.9	6.0	6.0	1.6	3.0	3.7	1.9

Description:	ICW % TBW	ECW_liters	ECW % Wt	ECW % FFM	ECW % TBW	FAT_kg	FAT_lbs	FAT % Wt	FFM_kg	FFM_lbs	FFM % Wt	BMR_Kcal	BMI
Means	57.8	15.9	24.5	31.5	42.2	15.0	33.0	22.2	50.2	110.6	77.8	1188.4	23.3
+/- Std Dev	2.1	3.1	2.9	1.7	2.1	7.2	14.6	7.2	8.0	17.7	7.2	190.3	3.6

Female Age Groups 10 19. (n=1448)

Description:	Age	Height cm	Weight kg	Weight lbs	Resistance	Reactance	Phase Angle	Dissipation	TBW_liters	TBW % Wt	TBW % FFM	ICW_liters	ICW % Wt	ICW % FFM
Means	15.3	160.6	59.5	131.2	606.5	81.4	7.5	7.7	30.0	51.6	74.3	16.4	28.4	40.8
+/- Std Dev	2.3	7.2	15.0	33.0	76.5	12.6	0.8	1.4	4.5	6.3	1.5	1.9	4.1	1.7

Description:	ICW % TBW	ECW_liters	ECW % Wt	ECW % FFM	ECW % TBW	FAT_kg	FAT_lbs	FAT % Wt	FFM_kg	FFM_lbs	FFM % Wt	BMR_Kcal	BMI
Means	54.9	13.6	23.2	33.5	45.1	19.2	42.3	30.6	40.3	88.9	69.4	1443.7	23.0
+/- Std Dev	2.1	2.7	2.4	1.8	2.1	9.9	21.9	8.2	6.0	13.3	8.2	147.4	5.2

Female Age Groups 20 29. (n=1511)

Description:	Age	Height cm	Weight kg	Weight lbs	Resistance	Reactance	Phase Angle	Dissipation	TBW_liters	TBW % Wt	TBW % FFM	ICW_liters	ICW % Wt	ICW % FFM
Means	24.5	161.6	66.1	145.8	585.2	81.6	7.8	7.4	31.7	49.0	74.4	17.1	26.7	40.4
+/- Std Dev	2.9	7.0	15.9	35.0	79.6	12.7	0.8	0.8	4.8	5.8	1.4	2.0	3.7	1.5

Description:	ICW % TBW	ECW_liters	ECW % Wt	ECW % FFM	ECW % TBW	FAT_kg	FAT_lbs	FAT % Wt	FFM_kg	FFM_lbs	FFM % Wt	BMR_Kcal	BMI
Means	54.3	14.6	22.4	34.0	45.7	23.5	51.8	34.1	42.6	94.0	65.9	1465.3	25.3
+/- Std Dev	1.9	2.8	2.3	1.6	1.9	10.7	23.6	7.7	6.3	13.9	7.7	156.6	5.8

Female Age Groups 30 39. (n=1632)

Description:	Age	Height cm	Weight kg	Weight lbs	Resistance	Reactance	Phase Angle	Dissipation	TBW_liters	TBW % Wt	TBW % FFM	ICW_liters	ICW % Wt	ICW % FFM
Means	34.5	161.7	73.0	160.9	556.4	76.9	7.7	7.5	33.6	47.3	74.6	17.9	25.4	39.9
+/- Std Dev	2.9	7.1	19.4	42.8	77.9	12.5	0.9	0.8	5.5	6.1	1.2	2.3	3.9	1.6

Description:	ICW % TBW	ECW_liters	ECW % Wt	ECW % FFM	ECW % TBW	FAT_kg	FAT_lbs	FAT % Wt	FFM_kg	FFM_lbs	FFM % Wt	BMR_Kcal	BMI
Means	53.5	15.7	21.9	34.7	46.5	27.9	61.6	36.6	45.1	99.4	63.4	1484.7	27.9
+/- Std Dev	2.0	3.3	2.3	1.6	2.0	13.1	28.8	8.0	7.4	16.4	8.0	189.7	7.2

Female Age Groups 40 49. (n=1248)

Description:	Age	Height cm	Weight kg	Weight lbs	Resistance	Reactance	Phase Angle	Dissipation	TBW_liters	TBW % Wt	TBW % FFM	ICW_liters	ICW % Wt	ICW % FFM
Means	43.8	161.5	74.7	164.6	555.8	75.3	7.6	7.6	33.8	46.2	74.5	17.9	24.6	39.6
+/- Std Dev	2.8	6.6	17.8	39.2	84.1	13.2	0.8	0.9	5.4	5.1	1.3	2.2	3.3	1.5

Description:	ICW % TBW	ECW_liters	ECW % Wt	ECW % FFM	ECW % TBW	FAT_kg	FAT_lbs	FAT % Wt	FFM_kg	FFM_lbs	FFM % Wt	BMR_Kcal	BMI
Means	53.2	15.9	21.6	34.9	46.8	29.3	64.6	38.0	45.4	100.1	62.0	1457.0	28.6
+/- Std Dev	1.9	3.2	2.0	1.6	1.9	11.7	25.8	6.8	7.1	15.8	6.8	174.5	6.6

Female Age Groups 50 59. (n=907)

Description:	Age	Height cm	Weight kg	Weight lbs	Resistance	Reactance	Phase Angle	Dissipation	TBW_liters	TBW % Wt	TBW % FFM	ICW_liters	ICW % Wt	ICW % FFM
Means	54.3	160.8	75.4	166.2	553.0	70.2	7.1	8.2	33.8	45.8	74.6	17.8	24.2	39.4
+/- Std Dev	2.8	6.6	17.9	39.5	83.6	12.5	0.9	1.0	5.4	5.2	1.3	2.2	3.4	1.5

Description:	ICW % TBW	ECW_liters	ECW % Wt	ECW % FFM	ECW % TBW	FAT_kg	FAT_lbs	FAT % Wt	FFM_kg	FFM_lbs	FFM % Wt	BMR_Kcal	BMI
Means	52.8	16.1	21.6	35.2	47.2	30.1	66.3	38.6	45.3	99.9	61.4	1412.9	29.1
+/- Std Dev	2.0	3.2	2.0	1.7	2.0	11.8	26.0	7.0	7.1	15.7	7.0	176.1	6.6

Female Age Groups 60 69. (n=1031)

Description:	Age	Height cm	Weight kg	Weight lbs	Resistance	Reactance	Phase Angle	Dissipation	TBW_liters	TBW % Wt	TBW % FFM	ICW_liters	ICW % Wt	ICW % FFM
Means	64.3	159.0	71.7	158.0	564.2	68.0	6.7	8.6	32.5	46.1	74.7	17.1	24.4	39.5
+/- Std Dev	2.8	6.9	15.6	34.5	84.8	12.9	0.9	1.3	4.9	4.9	1.5	2.1	3.1	1.5

Description:	ICW % TBW	ECW_liters	ECW % Wt	ECW % FFM	ECW % TBW	FAT_kg	FAT_lbs	FAT % Wt	FFM_kg	FFM_lbs	FFM % Wt	BMR_Kcal	BMI
Means	52.9	15.4	21.7	35.2	47.1	28.2	62.2	38.3	43.4	95.8	61.7	1327.0	28.4
+/- Std Dev	2.0	2.9	2.0	1.7	2.0	10.3	22.6	6.6	6.5	14.3	6.6	155.0	5.9

Female Age Groups 70 79. (n=817)

Description:	Age	Height cm	Weight kg	Weight lbs	Resistance	Reactance	Phase Angle	Dissipation	TBW_liters	TBW % Wt	TBW % FFM	ICW_liters	ICW % Wt	ICW % FFM
Means	73.9	157.5	68.2	150.4	562.7	62.4	6.2	9.4	31.8	47.4	75.0	16.7	25.0	39.5
+/- Std Dev	2.8	6.6	14.7	32.4	83.0	12.2	1.0	1.4	4.9	5.3	1.4	2.0	3.3	1.6

Description:	ICW % TBW	ECW_liters	ECW % Wt	ECW % FFM	ECW % TBW	FAT_kg	FAT_lbs	FAT % Wt	FFM_kg	FFM_lbs	FFM % Wt	BMR_Kcal	BMI
Means	52.7	15.1	22.4	35.4	47.3	25.8	56.9	36.8	42.4	93.4	63.2	1245.8	27.5
+/- Std Dev	2.0	2.9	2.3	1.7	2.0	9.6	21.1	6.9	6.4	14.1	6.9	147.4	5.5

Female Age Groups 80 89. (n=477)

Description:	Age	Height cm	Weight kg	Weight lbs	Resistance	Reactance	Phase Angle	Dissipation	TBW_liters	TBW % Wt	TBW % FFM	ICW_liters	ICW % Wt	ICW % FFM
Means	83.0	155.1	61.8	136.2	579.6	58.1	5.6	10.4	29.8	48.9	75.2	15.7	25.9	39.7
+/- Std Dev	2.6	6.8	11.7	25.8	80.1	11.9	0.9	1.6	4.1	5.2	1.6	1.7	3.2	1.6

Description:	ICW % TBW	ECW_liters	ECW % Wt	ECW % FFM	ECW % TBW	FAT_kg	FAT_lbs	FAT % Wt	FFM_kg	FFM_lbs	FFM % Wt	BMR_Kcal	BMI
Means	52.9	14.1	23.0	35.5	47.1	22.2	48.9	35.0	39.6	87.3	65.0	1137.1	25.7
+/- Std Dev	2.0	2.5	2.4	1.8	2.0	7.7	17.0	6.9	5.3	11.8	6.9	118.8	4.5

Female Age Groups 90 99. (N=44)

Description:	Age	Height cm	Weight kg	Weight lbs	Resistance	Reactance	Phase Angle	Dissipation	TBW_liters	TBW % Wt	TBW % FFM	ICW_liters	ICW % Wt	ICW % FFM
Means	90.0	153.5	53.7	118.4	597.2	53.7	5.0	11.6	28.0	52.6	75.2	14.8	27.9	39.9
+/- Std Dev	0.0	5.2	8.3	18.3	85.6	11.0	0.7	1.7	3.5	5.8	1.9	1.5	3.2	1.3

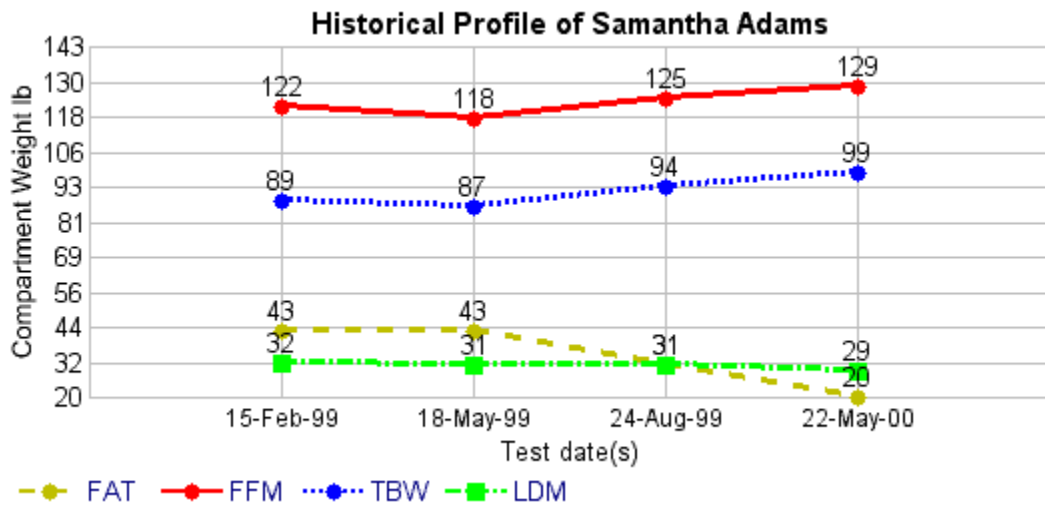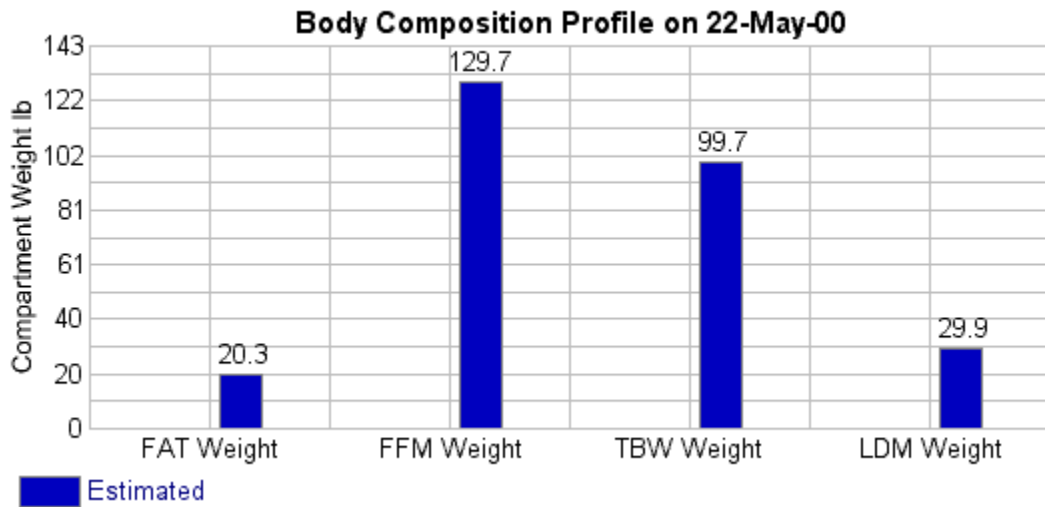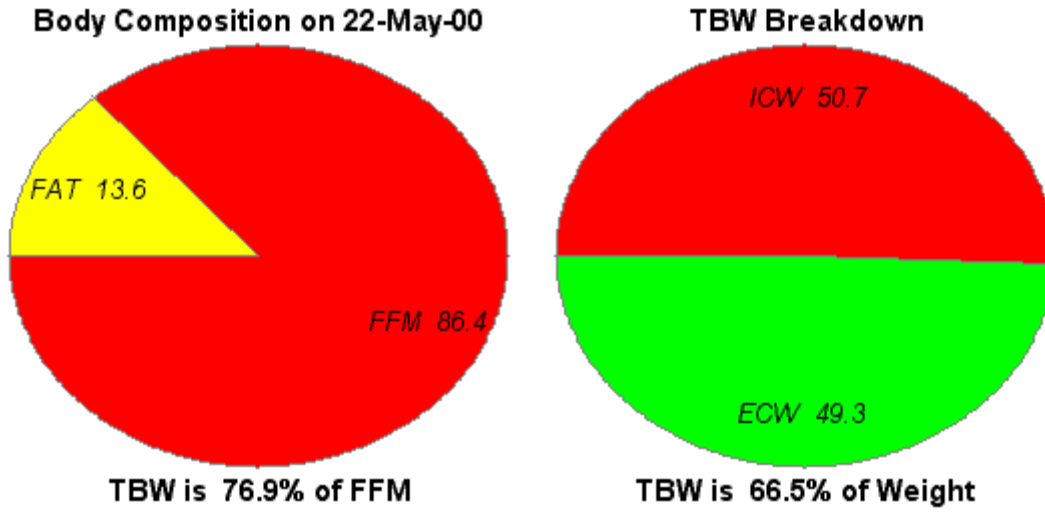| Description:	ICW % TBW	ECW_liters	ECW % Wt	ECW % FFM	ECW % TBW	FAT_kg	FAT_lbs	FAT % Wt	FFM_kg	FFM_lbs	FFM % Wt	BMR_Kcal	BMI
Means	53.0	13.2	24.7	35.4	47.0	16.6	36.6	30.1	37.1	81.8	69.9	1023.9	22.8
+/- Std Dev	2.1	2.1	3.0	2.1	2.1	6.1	13.5	7.4	4.2	9.2	7.4	82.9	3.5

Sample Report

This section of the manual contains a sample report. This printed report contains all charts, graphs and information that could possibly go into a report. The majority of reports printed from BC will only contain a subset of what is available, and may therefore be significantly shorter.
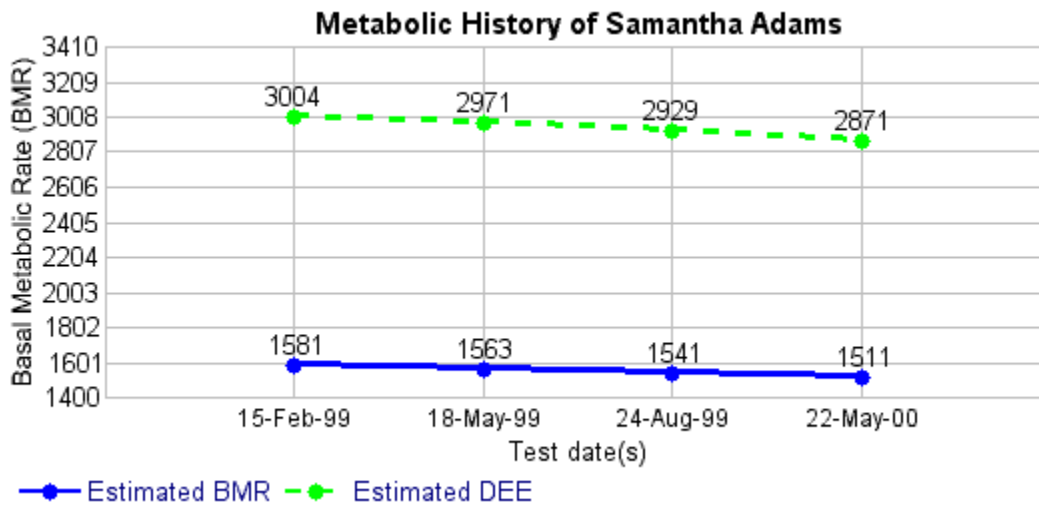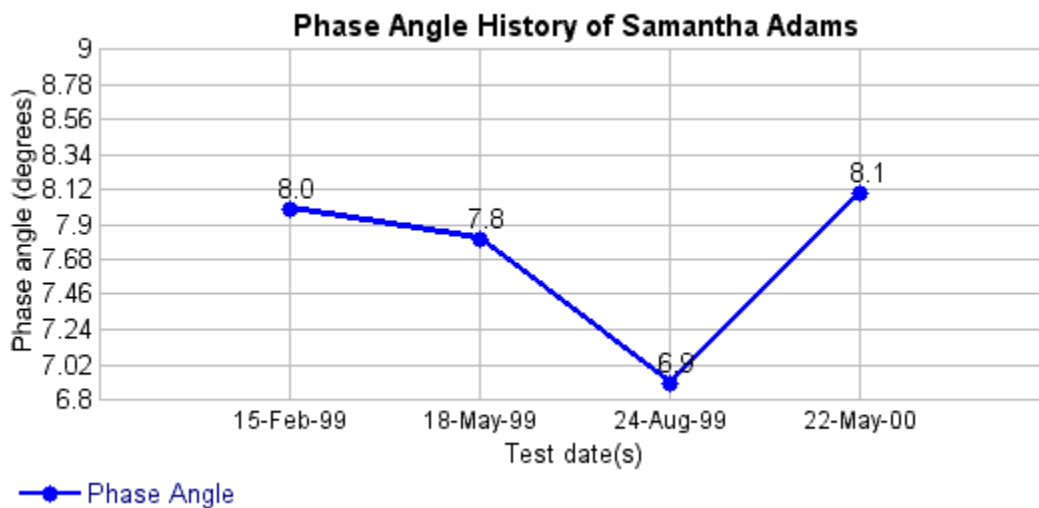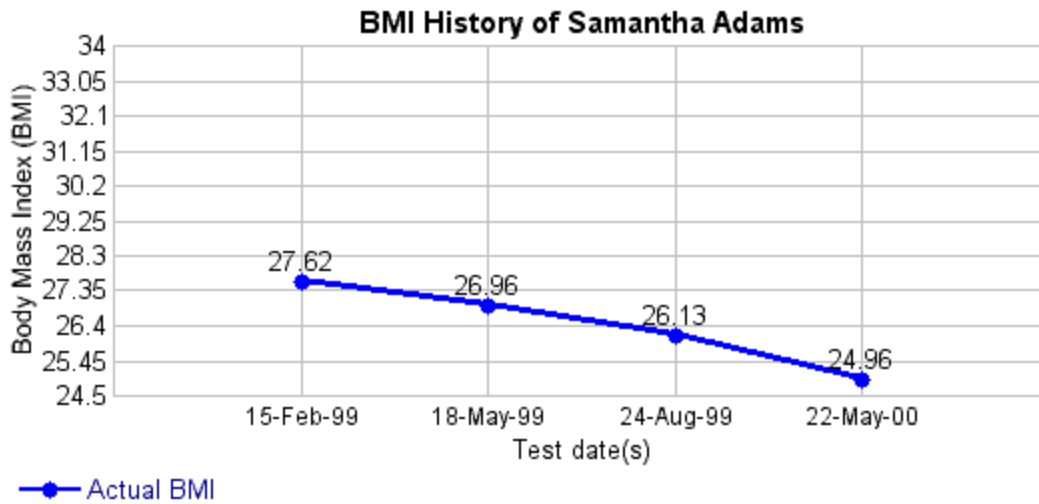
Body Composition Report created by

Delete this message and enter your own personalized report header information using your name or the name of your institution as the first line.

BIA Results:	Female	Name:	Samantha Adams
Height in:	65	Date:	Wednesday, 1 October 2008 12:17:12
Weight lb:	150	Database:	D:/Program Files/RJL Systems/BC2.1/BodyComp/Demo.db
Age:	20	Subject ID:	
Chosen Goal Wt.	125.0 lb	Record date:	22/05/2000 21:39:07
BMI:	24.96	Equation Set:	NHANES-III
Resistance:	350	Reactance:	50 ohms
Phase angle:	8.1	Impedance:	353.6

Current Test Data					
	Amount	**% of Weight**			
Fat	20.3 Pounds	13.6 %			
Fat-Free Mass (FFM)	129.7 Pounds	86.4 %	**% of FFM**		
Lean Dry Mass (LDM)	29.9 Pounds	20.0 %	23.1 %		
Total Body Water (TBW)	45.2 Liters	66.5 %	76.9 %	**% of TBW**	
Intra-Cellular Water (ICW)	22.9 Liters	33.7 %	39.0 %	50.7 %	
Extra-Cellular Water (ECW)	22.3 Liters	32.8 %	37.9 %	49.3 %	

BMI 24.96		**Basal Metabolic Rate (BMR)** 1511 kCal
Phase Angle 8.1		**Daily Energy Expenditure (DEE)** 2871 kCal

Average Ranges for Females age 20 - 29					
	Amount				
Weight	110.7 - 180.8 Pounds	**% of Weight**			
Fat	28.2 - 75.4 Pounds	26.4 - 41.8 %			
Fat-Free Mass	80.0 - 107.8 Pounds	58.2 - 73.6 %	**% of FFM**		
Total Body Water	26.9 - 36.5 Liters	43.2 - 54.8 %	73.0 - 75.8 %	**% of TBW**	
Intra-Cellular Water	15.1 - 19.1 Liters	23.0 - 30.4 %	38.9 - 41.9 %	52.4 - 56.2 %	
Extra-Cellular Water	11.8 - 17.4 Liters	20.1 - 24.7 %	32.4 - 35.6 %	43.8 - 47.6 %	

BMI 19.5 - 31.1		**Basal Metabolic Rate** 1308.7 - 1621.9
Phase Angle 7.0 - 8.6		

Please note that these ranges are average values taken from a treatment of the NHANES-III survey data. They are not to be interpreted as being "ideals" and may not necessarily reflect values that are generally considered "healthy".

Body Composition on 22-May-00

FAT 13.6
FFM 86.4

TBW is 76.9% of FFM

TBW Breakdown

ICW 50.7
ECW 49.3

TBW is 66.5% of Weight

Body Composition Profile on 22-May-00

Compartment Weight lb

Compartment	Value
FAT Weight	20.3
FFM Weight	129.7
TBW Weight	99.7
LDM Weight	29.9

■ Estimated

Historical Profile of Samantha Adams

Compartment Weight lb

Test date(s)	15-Feb-99	18-May-99	24-Aug-99	22-May-00
FFM	122	118	125	129
TBW	89	87	94	99
FAT	43	43	31	20
LDM	32	31	31	29

—●— FAT —●— FFM ····●···· TBW —■— LDM

BMI History of Samantha Adams

Phase Angle History of Samantha Adams

Metabolic History of Samantha Adams

Fluid Compartment Profile on 22-May-00

Total body water compartment history

Fluid Historical Profile of Samantha Adams
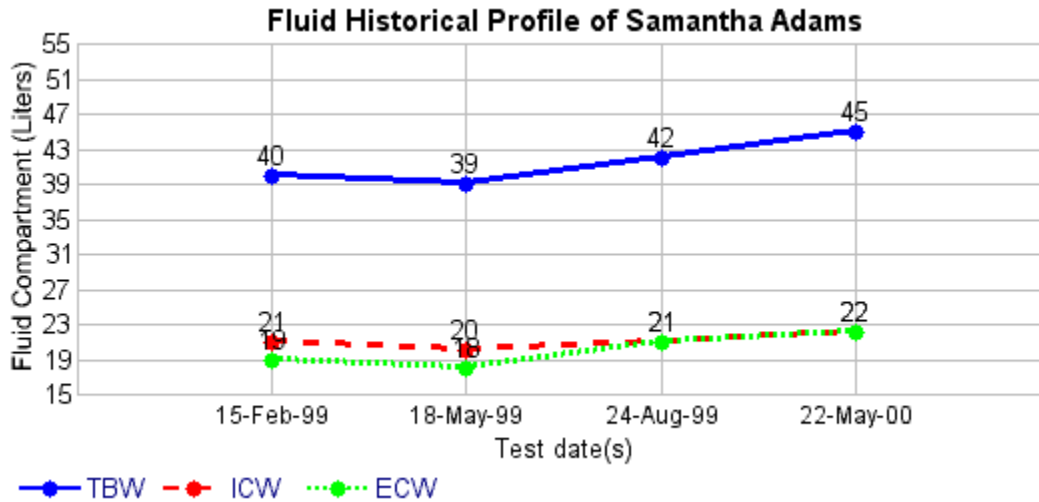
Date:	15-Feb-99	18-May-99	24-Aug-99	22-May-00
Height (in):	65.00	65.00	65.00	65.00
Weight (lb):	166.00	162.00	157.00	150.00
Age:	20	20	20	20
Resistance:	425.0	444.0	388.0	350.0
Reactance:	60.0	61.0	47.0	50.0
Actual BMI:	27.62	26.96	26.13	24.96
Actual phase:	8.0	7.8	6.9	8.1
Estimated BMR:	1581	1563	1541	1511
% ideal FAT:	20.6	20.6	20.6	20.6
% estimated FAT:	26.2	26.6	20.3	13.6
Wt estimated FAT:	43.5	43.1	31.9	20.3
% estimated FFM:	73.8	73.4	79.7	86.4
Wt estimated FFM:	122.5	118.9	125.1	129.7
% WT estimated TBW:	54.1	53.8	59.9	66.5
Liters estimated TBW:	40.7	39.5	42.7	45.2
% TBW estimated ICW:	51.7	52.1	50.3	50.7

Liters estimated ICW:	21.1	20.6	21.5	22.9
% TBW estimated ECW:	48.3	47.9	49.7	49.3
Liters estimated ECW:	19.7	18.9	21.2	22.3

Diet and Exercise

Based on your daily activity level, it is estimated that you require **2871** calories of food to keep your weight stable.

It is recommended that you lose **25.00 lb** of body fat, at a rate of **1.00 lb per week**. To do this through diet alone, you would have to reduce your food intake to **2371** calories per day. If, on the other hand, you were to exercise regularly, you would not need such a restrictive diet to achieve the same rate of weight loss. At **1.00 lb per week**, it should take you **175 days** to reach your target.

If your exercise program is done consistently, (every other day) then your BMR and daily energy expenditure will improve, thereby increasing the efficiency of burning calories.

Ideally, most of the weight you lose will be fat. It is normal to lose some excess water, especially during the initial phase of your diet and/or exercise program. This may cause fluctuations in your Total Body Water and Fat Free Mass. A regular exercise program and sensible diet will produce an increase in muscle and decrease Body Fat throughout your weight loss program.

When a weight management program is created with the BC program, it involves an AVERAGE daily number of calories that will need to be burned through additional exercise and an AVERAGE daily intake. If you work twice as hard one day, you can take the next day off. If you consume more calories than recommended one day, you can compensate by cutting back even further the next. For best results, however, it is recommended that you be as consistent as possible with your diet and exercise programs.

To help manage your weight, a sample diet of **2600 Calories** has been prepared for you, as well as a recommendation that you get an average of **229 Calories** of additional exercise on a daily basis.

	Calories burned per				
Exercise	**10 Minutes**	**20 Minutes**	**30 Minutes**	**60 Minutes**	**120 Minutes**
bicycling, 10-11.9 mph, leisure, slow, light effort	68	136	204	409	818
stretching, hatha yoga	28	56	85	170	340
weight lifting (free weight, nautilus or universal-type), power lifting or body building, vigorous effort	68	136	204	409	818
weight lifting (free, nautilus or universal-type), light or moderate effort, light workout, general	34	68	102	204	409
aerobics, general	73	147	221	443	886
aerobics, high impact	79	159	238	477	954
aerobics, low impact	56	113	170	340	681
running, 6 mph (10 min/mile)	113	227	340	681	1363
basketball, non-game, general	68	136	204	409	818
football, touch, flag, general	90	181	272	545	1090
golf, walking and carrying clubs	51	102	153	306	613
hockey, ice	90	181	272	545	1090
soccer, casual, general	79	159	238	477	954

walking, 3.0 mph, level, moderate pace, firm surface	37	75	112	225	450
swimming, leisurely, not lap swimming, general	68	136	204	409	818
Elliptical Trainer (Light workout)	90	181	271	543	1087
Elliptical Trainer (Moderate workout)	113	226	340	680	1360
Elliptical Trainer (Vigorous workout)	136	272	408	816	1632

DAILY DIET PLAN

The following diet plan and sample menu is based on the American Heart Association, the American Cancer Society and the Surgeon General's National Dietary Guidelines. It is high in carbohydrates and fiber, low in fat, low in salt (less than 3000 mg sodium) and provides over 100% of the RDA of essential nutrients.

SAMPLE MEAL PLAN FOR 2600 CALORIES

50 % Carbohydrate (331 gm.) 30 % Fat (77 gm.)
20 % Protein (130 gm.)   65 Additional Calories

Meal		Servings from Each Food Group					
		S	P	F/V	M	F	Additional
Breakfast	1/2 Cup Bran Flakes	1					
	1/2 Banana			1			
	1 English Muffin	2					
	2 Tsp. Margarine					2	
	1 Cup Skim/Lowfat Milk				1		
	1/2 Grapefruit			1			
	Coffee						
	1 Tbl. Jelly						49
Lunch	4 Slice Whole Wheat Bread	4					
	4 Oz. Sliced Chicken		4				
	6 Tsp. Diet Mayonnaise					1 49/50	
	Carrot/Celery Sticks						
	1 Orange			1			
	1 Cup Skim/Lowfat Milk				1		
Dinner	4 Oz. Broiled Whitefish		4				
	2/3 Cup Rice	2					
	1 Small Dinner Roll	1					
	2 Tsp. Margarine					2	
	1/2 Cup Peas	1					
	1 Cup Carrots			2			
	1 Cup Skim/Lowfat Milk				1		
	1 Tossed Salad and Diet Dressing						
Snack	2 Slice Whole Wheat Bread	2					
	1 Oz. Lowfat Cheese		1				
	1 Tsp. Mayonnaise					1	
	1 Apple			1			
	1 Cup Orange Juice			2			

S = Starches
P = Protein
F/V = Fruits/Vegetables
M = Milk
F = Fats/Oils

FOOD GROUPS

PROTEIN GROUP (Meat/Poultry/Seafood/Dried Beans and Peas/Eggs)

Foods from this group provide an excellent source of the B vitamins, iron and key minerals. They are high in protein and generally low in carbohydrates (except the dried beans and peas). You are allowed 9 serving(s) from this group each day. A serving has approximately 75 calories, 7 grams protein, and 5 grams fat.

BEST CHOICES	CHOOSE LESS OFTEN (higher in fat and salt)
1 oz. chicken or turkey	Fatty cuts of meat
1 oz. fish - all types	- (brisket, corned beef, steak)
1/4 Cup dried beans, peas	Ham, deviled ham, organ meats,
1 oz. lean beef, veal, pork or lamb	luncheon meats, sausage,
1 oz. lowfat luncheon meat	eggs (yolk), Peanut Butter
1/2 Cup Lowfat Cottage Cheese	High Fat Cottage Cheese
	and Most Cheeses

STARCHES/GRAIN GROUP (Pasta/Cereals/Starchy Vegetables)

Foods from this group provide an excellent source of fiber, B vitamins, and iron. They are high in carbohydrates, the best fuel for muscle. They are usually low in fat and cholesterol. You are allowed 13 serving (s) from this group each day. A serving has approximately 80 calories, 15 grams carbohydrate, 3 grams protein, and a trace of fat.

BEST CHOICES	CHOOSE LESS OFTEN (higher in fat and salt)
1 Slice Whole Grain Bread	Butter Rolls
1/2 Bagel or English Muffin	Croissants
2 Breadsticks, 1 Bun, 1/2 6" Pita Bread	Muffins, Doughnuts
1/2 Cup Bran Cereals	Granola-Type Cereals
1/2 Cup Cooked Cereals	French Fried Potatoes
8 Animal Crackers, 5 Vanilla Wafers	Potato Chips
3 Cups Popcorn - Air Popped	Cheese Crackers
1/2 Cup Pasta/Noodles	Butter Crackers
1/3 Cup Rice, 1/2 Cup Corn or Peas	Corn Chips
1 Cup Squash	Microwave Popcorn
1/2 Cup Clear Soup with Vegetables	Cream Soups
3/4 Cup Ready-to-eat Unsweetened Cereal	Presweetened Cereals
1/3 Cup Cooked Peas, Beans or Lentils	Stuffing
1 Small Baked Potato, 1/2 Cup Mashed Potato	

FRUITS/VEGETABLES GROUP

Foods from this group provide an excellent source of fiber, vitamins, and minerals. They are a good source of vitamin A and C. They are also high in carbohydrates, and usually low in fat and salt. You are allowed 8 serving(s) from this group each day. A serving of fruit has approximately 60 calories and 15 grams carbohydrate. A serving of vegetables has approximately 25 calories, 5 grams carbohydrate and 2 grams protein.

BEST CHOICES	CHOOSE LESS OFTEN (higher in fat and salt)
All fresh fruits and vegetables	Fruit Drinks
1 Serving : 1 piece fresh fruit (medium)	Avocados
or 1/2 Cup fresh fruit juice	Olives
1/2 Cup cooked vegetables	Coconut
1 Cup raw vegetables	Breaded or Fried Vegetables

FATS/OILS GROUP

Foods from this group provide an excellent source of vitamin A and E. Some fat is needed each day, however most diets are too high in fat. You are allowed 6 serving(s) from this group each day. A serving of fat has approximately 45 calories and 5 grams of fat.

BEST CHOICES (tends to lower blood cholesterol)	CHOOSE LESS OFTEN (tends to raise blood cholesterol)
Monosaturated/Polyunsaturated Fats:	Saturated Fats:
1 Tsp. Soft Margarine or Mayonnaise	Butter, Bacon
1 Tsp. Oil - Safflower, Sunflower, Corn, Soybean, Sesame, Olive	Coconut Oil
6 Almonds, 20 Small Peanuts	Cream, Cream Cheese
2 Whole Pecans, 10 Small Olives	Lard, Shortening
2 Tsp. Mayonnaise based Salad Dressing	Salt Pork
1 Tbl. Reduced Calorie Salad Dressing	Gravy
2 Tbl. Reduced Calorie Margarine	
1 Tbl. Light Cream Cheese	

MILK/DAIRY GROUP

Foods from this group provide an excellent source of calcium, phosphorus, riboflavin, vitamin A and vitamin D. They are high in protein and carbohydrate. You are allowed 3.0 serving(s) from this group each day. Each serving has approximately 80 calories, 12 grams carbohydrate and 8 grams protein.

BEST CHOICES	CHOOSE LESS OFTEN (higher in fat)
1 Cup Skim or Lowfat Milk	Whole Milk, Half and Half
1 Cup Lowfat/Nonfat Buttermilk or Yogurt	Whole Milk/Sweetened Yogurt
1 oz. Evaporated Skim Milk	Sweetened Condensed Milk
4 oz. Nonfat Frozen Yogurt	Ice Cream

ADDITIONAL CALORIES GROUP

Foods from this group usually contain larger amounts of sugar and fat and therefore are higher in calories. Most of these foods should be avoided by weight conscious individuals and diabetics. You are allowed 65 additional calories each day. You may choose to have more servings from the above groups.

LOW IN CALORIES (less than 100 calories)	**HIGH IN CALORIES** (more than 100 calories)
1 Tsp. Sugar.................14	12 oz. Light Beer.................100
5 Lifesavers.................39	1 Cake Doughnut...................105
1 Tbl. Jelly.................49	1/12 of Cake - Angel Food Cake....126
3 Small GingerSnaps..........50	1 Small Chocolate Brownie.........130
2 Sugar Wafers...............53	1 oz. Tortilla Chips..............139
1/2 Cup Gelatin Dessert......71	12 oz. Soft Drink.................150
3.5 oz. Wine.................80	1.02 oz. Chocolate Candy Bar......160
1 Medium Oatmeal Cookie......80	1 Small Slice Sponge Cake.........196
1/2 Cup Vanilla Ice Cream....92	1 Small Slice Cheesecake..........257
	1 Cup 16% Fat Vanilla Ice Cream...379

FREE FOODS GROUP

Foods in this group, in general, have less than 20 calories per serving. Use moderation when including them in your daily diet.

Bouillon/Broth
Diet Soft Drinks
Carbonated Water/Club Soda
1 Tbl. Cocoa Powder
Nonstick Vegetable Pan Spray
Butter Buds
1/2 Cup Unsweetened Cranberries
1/2 Cup Unsweetened Rhubarb
1 Cup Alfalfa Sprouts, Bean Sprouts, Cabbage, Celery, Cucumber, Green Onion
Hot Pepper, Mushrooms, Parsley, Radishes, Tomato
Salad Greens
1 Tbl. Barbeque Sauce
1 Tbl. Catsup
Oil-Free Salad Dressing
1 Tbl. Steak Sauce
Seasonings, Spices, Herbs, and Flavoring Extracts