UK Biobank

Imaging modality DXA

Version 1.0

http://www.ukbiobank.ac.uk/

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This document details the procedure for the DXA performed at an Imaging assessment centre for UK Biobank.

Contents

1. Introduction

1.1: This manual details the procedure for the DXA measurement at a UK Biobank Imaging Assessment Centre.

Table 1: Sequence of assessment visit

	Visit station	Assessments undertaken
1	Reception	• Welcome & registration • Generating a USB key for Participants
2	Eligiblity Section	• Eligibility questionnaire • Consent
3	Imaging scans	• Cardiac MRI scan • Body MRI scan • Brain MRI scan • DXA scan of whole body, bone and joint • 12-lead ECG • Carotid ultrasound
4	Touchscreen	• Touchscreen questionnaire • Hearing Test • Cognitive function tests
5	Interview & blood pressure	• Interviewer questionnaire • Blood pressure measurement • Measurement of arterial stiffness
6	Physical measurements	• Height (Standing and Sitting) • Hip & Waist measurement • Weight and Bio-impedance measurement • Hand-grip strength • Ultrasound Bone Densitometry • Spirometry (Lung function test)
7	Sample collection & exit	• Blood, urine and saliva sample collection

1.2: At the start of their visit, each participant is issued with a USB key at the Reception station. This contains Participant ID, name, date of birth and gender. As the participant progresses between stations the USB key acts as an identifying token. The USB key is encrypted so can only be read by assessment centre computers. None of the participant's

test data is transferred to the USB key. At the end of the assessment visit all identifying data on the USB key is removed.

1.3: This procedure is performed by a radiographer who has received suitable training and has been granted the relevant module permissions.

2. Equipment Preparation

The iDXA instrument is calibrated to a manufacturer's phantom (GE-Lunar, Madison, WI) and undergoes a daily QC procedure. Periodic assessment of QC reports is undertaken to ensure long-term stability.

3. Participant Preparation

The participant is prepared as per point 1 above, and the DXA procedure is explained. An explanation of the physical positions required and the nature of each individual scan is explained as the assessment proceeds. Scan acquisition may be repeated as appropriate, as detailed below.

4. DXA modality measurement (GE-Lunar iDXA)

- *Whole body:* The participant is asked to lie flat on their back on the DXA couch for the whole body scan.

- *Lumbar spine:* The participant's lower legs are placed on a polystyrene block, bringing the hips and knees to 80 degrees flexion. The lumbar spine is then scanned. Up to three attempts at correct placement of the starting position are permitted.

- *Hip:* The participant's foot, with leg straight, is strapped against a support to ensure correct orientation of the hip. Each hip is scanned. Up to three attempts are permitted to establish correct placement.

- *Knee:* A high resolution image of each knee is performed.

- *Lateral spine:* A high resolution image of the spine (from L4 to T4) in the lateral plane is acquired with the participant lying on their side.

- *Analysis:* Scans at the whole body, lumbar spine and hip sites are analysed by the radiographer at, or soon after, acquisition to generate all numerical measures of bone mass and body composition. Images (whole body, hip, knee, AP lumbar spine and lateral thoraco-lumbar spine) are provided without further analysis for future analysis by researchers.

5. Download/transfer of data

Numerical measures of bone area, bone mineral content and bone mineral density, together with measures of lean and fat mass (for whole body scans only), are directly transferred from the DXA instrument to UK Biobank servers. These data require no post-processing. High resolution images of hips, knees, whole body, AP lumbar spine and lateral thoraco-lumbar spine are exported as Dicom files.

6. QC protocol

All operators undergo standardised central training and scans are performed according to standard operating procedures. Every scan acquisition is assessed in real time by the operator for completeness, movement artefact and presence of any foreign bodies. Findings are recorded and amalgamated into the dataset. Each scan is analysed with optimisation of markers. As part of the pilot phase the first 2000 participant scans were assessed by the acquiring radiographer and by a single experienced senior operator. The intraclass correlation coefficient for measures such as hip bone mineral density was 0.99 demonstrating excellent agreement. A similar “gold standard” assessment of 50 participant scans is undertaken monthly by the same single experienced senior operator and any discrepancies in artefact reporting, analysis or patient positioning are fed back to the technician staff, with retraining if necessary.

7. Data collected

The following data were collected and are available in Showcase:

Bone size, mineral and density by DXA (71 data-fields):

Field ID	Description
23220	Arm BMC (bone mineral content) (left)
23305	Head bone area
23222	Arm BMC (bone mineral content) (right)
23317	Arms combined bone area
23221	Arm BMD (bone mineral density) (left)
23313	Arm bone area (left)
23223	Arm BMD (bone mineral density) (right)
23314	Arm bone area (right)
23224	Arms BMC (bone mineral content)
23309	Ribs bone area
23225	Arms BMD (bone mineral density)
23311	Spine bone area
23302	Femur lower neck BMD (bone mineral density) (left)
23304	Trunk bone area
23206	Femur lower neck BMD (bone mineral density) (right)
23307	Pelvis bone area

23294	Femur lower neck BMD (bone mineral density) T-score (left)
23318	Legs combined bone area
23207	Femur lower neck BMD (bone mineral density) T-score (right)
23315	Leg bone area (left)
23299	Femur neck BMD (bone mineral density) (left)
23316	Leg bone area (right)
23208	Femur neck BMD (bone mineral density) (right)
23300	Femur neck BMD (bone mineral density) T-score (left)
23209	Femur neck BMD (bone mineral density) T-score (right)
23290	Femur shaft BMD (bone mineral density) (left)
23210	Femur shaft BMD (bone mineral density) (right)
23303	Femur shaft BMD (bone mineral density) T-score (left)
23211	Femur shaft BMD (bone mineral density) T-score (right)
23291	Femur total BMD (bone mineral density) (left)
23212	Femur total BMD (bone mineral density) (right)
23293	Femur total BMD (bone mineral density) T-score (left)
23213	Femur total BMD (bone mineral density) T-score (right)
23295	Femur troch BMD (bone mineral density) (left)
23214	Femur troch BMD (bone mineral density) (right)
23298	Femur troch BMD (bone mineral density) T-score (left)
23215	Femur troch BMD (bone mineral density) T-score (right)
23292	Femur upper neck BMD (bone mineral density) (left)
23216	Femur upper neck BMD (bone mineral density) (right)
23296	Femur upper neck BMD (bone mineral density) T-score (left)
23217	Femur upper neck BMD (bone mineral density) T-score (right)
23297	Femur wards BMD (bone mineral density) (left)
23218	Femur wards BMD (bone mineral density) (right)
23301	Femur wards BMD (bone mineral density) T-score (left)
23219	Femur wards BMD (bone mineral density) T-score (right)
23306	Head BMC (bone mineral content)
23226	Head BMD (bone mineral density)
23203	L1-L4 BMC (bone mineral content)
23204	L1-L4 BMD (bone mineral density)
23205	L1-L4 BMD (bone mineral density) T-score
23320	Leg BMC (bone mineral content) (left)
23228	Leg BMC (bone mineral content) (right)
23227	Leg BMD (bone mineral density) (left)
23229	Leg BMD (bone mineral density) (right)
23230	Legs BMC (bone mineral content)
23231	Legs BMD (bone mineral density)
23308	Pelvis BMC (bone mineral content)
23232	Pelvis BMD (bone mineral density)
23310	Ribs BMC (bone mineral content)
23233	Ribs BMD (bone mineral density)
23312	Spine BMC (bone mineral content)
23234	Spine BMD (bone mineral density)

23235	Total BMC (bone mineral content)
23236	Total BMD (bone mineral density)
23237	Total BMD (bone mineral density) (left)
23238	Total BMD (bone mineral density) (right)
23239	Total BMD (bone mineral density) T-score
23240	Trunk BMC (bone mineral content)
23241	Trunk BMD (bone mineral density)
23242	Trunk BMD (bone mineral density) (left)
23243	Trunk BMD (bone mineral density) (right)

Body composition by DXA (49 data-fields):

Field ID	Description
23244	Android bone mass
23245	Android fat mass
23246	Android lean mass
23247	Android tissue fat percentage
23248	Android total mass
23249	Arm fat mass (left)
23253	Arm fat mass (right)
23250	Arm lean mass (left)
23254	Arm lean mass (right)
23251	Arm tissue fat percentage (left)
23255	Arm tissue fat percentage (right)
23252	Arm total mass (left)
23256	Arm total mass (right)
23257	Arms fat mass
23258	Arms lean mass
23259	Arms tissue fat percentage
23260	Arms total mass
23261	Gynoid bone mass
23262	Gynoid fat mass
23263	Gynoid lean mass
23264	Gynoid tissue fat percentage
23265	Gynoid total mass
23200	L1-L4 area
23201	L1-L4 average height
23202	L1-L4 average width
23266	Leg fat mass (left)
23270	Leg fat mass (right)
23267	Leg lean mass (left)
23271	Leg lean mass (right)
23268	Leg tissue fat percentage (left)
23272	Leg tissue fat percentage (right)
23269	Leg total mass (left)
23273	Leg total mass (right)

23274	Legs fat mass
23275	Legs lean mass
23276	Legs tissue fat percentage
23277	Legs total mass
23278	Total fat mass
23279	Total fat-free mass
23280	Total lean mass
23281	Total tissue fat percentage
23282	Total tissue mass
23283	Total total mass
23284	Trunk fat mass
23285	Trunk lean mass
23286	Trunk tissue fat percentage
23287	Trunk total mass
23288	VAT (visceral adipose tissue) mass
23289	VAT (visceral adipose tissue) volume