**Selection of skeletal sites for DXA assessment informed by:**

- Clinical question

- Physical habitus and ability to tolerate required positioning for DXA scan

- Availability of adequate reference data for the DXA platform (Hologic vs. GE Lunar) and the age, sex, and population ancestry of study population

- Table 1 may be useful aid in selection of skeletal sites for DXA assessment

**Analysis and Reporting**

Under 18 years:

- DXA BMC and aBMD should be reported as Z-scores for to age and sex

- aBMD by DXA underestimates true volumetric BMD in participants with short stature or pubertal delay and overestimates volumetric BMD in those with tall stature or advanced puberty. Therefore, best practice is to adjust aBMD Z-scores for size in these situations.

-- Multiple methods exist, no gold standard

-- Choice of method is dependent on DXA platform (Hologic vs GE Lunar) and preference of investigator

- Both the reference data set used to calculate Z-scores, absolute values and the method for size adjustment should be reported when presenting study data

Note: Date of birth, sex assigned at birth, gender identity, race and ethnicity demographic information should be collected for all DXA encounters. Please refer to the [General Core CRF](https://www.commondataelements.ninds.nih.gov/sites/nindscde/files/Doc/SharedForms/F1807_General_Core.docx) for additional instruction on collecting this information.

1. Height (cm):
2. Weight (kg):
3. Ambulatory Status:

Able to ambulate independently (no help from another person) w/ or w/o device

With assistance (from person)

Unable to ambulate

Unknown

1. Does the participant have any implanted or attached hardware that might interfere with the scan analysis (GT, CGM, insulin pump, surgical implant, jewelry, etc.)?

No

Yes

* 1. If YES, what:
  2. If YES, location:

1. Has the participant received IV or PO contrast in the past 7 days?

No

Yes

1. Has the participant received PO calcium supplement in the past 24 hours?

No

Yes

**SCAN Details**

1. DXA make/model:

GE Lunar Prodigy

GE Lunar iDXA

Hologic Horizon

Hologic Discovery

Hologic QDR 4500

Hologic Delphi

Other, specify:

1. Software version:
2. Scan date:
3. Analysis date:
4. Body sites scanned:

Whole body

Whole body less head BMC:

Whole body less head aBMD:

Lumbar spine

L1-L4 BMC:

L1-L4 aBMD:

L1-L4 BMAD:

Was Trabecular Bone Score Performed?  No  Yes

If YES,TBS:

Hip (proximal femur)

Side:  Right  Left  Bilateral

Total hip BMC:

Total hip aBMD:

Femoral neck BMC:

Femoral neck aBMD:

Forearm

Side:  Right  Left  Bilateral

Distal 1/3 radius BMC:

Distal 1/3 radius aBMD:

Ultradistal radius BMC:

Ultradistal radius aBMD:

Lateral distal femur

Side:  Right  Left  Bilateral

R1 BMC:

R1 aBMD:

R2 BMC:

R2 aBMD:

R3 BMC:

R3 aBMD:

Lateral spine for vertebral fracture analysis (IVA, DVA)

**Table 1: Skeletal Site for DXA selection**

| **Age** | **Standard Scan Sites** | **Alternative Scan Sites** |
| --- | --- | --- |
| **1-3 years** | *AP Lumbar spineI*  - Do not order if lumbar spine scoliosis, spinal hardware | *ForearmI*  - Consider when lumbar spine cannot be obtained |
| **3-5 yrs** | *AP Lumbar spineI*  - Do not order if lumbar spine scoliosis, spinal hardware | *Whole body (less head)I*  - Recommended if participant is able to cooperate for longer scan time  - Do not order if scoliosis, contractures, unable to lay supine, or indwelling orthopedic hardware  *ForearmI*  - Recommended if standard sites cannot be assessed  - Consider if an assessment of cortical (distal 1/3 radius) or trabecular (ultra-distal radius) bone is specifically desired  *Lateral distal femurI*  - Consider when standard sites cannot be assessed  - Consider when assessment of distal femur aBMD is desired |
| **5-18 yrs** | *AP Lumbar Spine*  - Do not order if lumbar spine scoliosis or spinal hardware  *Whole body*  - Do not order if scoliosis, contractures, unable to lay supine, or indwelling orthopedic hardware | *Hip*  - Recommended in pubertal adolescents when DXA monitoring into adulthood is expected  - Do not order in participants/subjects with hip dysplasia, prior osteotomy or hardware  *Forearm*  Recommended when:  - Other sites cannot be assessed  - If an assessment of cortical (distal 1/3 radius) or trabecular (ultra-distal radius) bone is specifically desired  *Lateral distal femurI*  Recommended in:  - Non-ambulatory participants 6-18 years of age when standard sites cannot be assessed  - Participants where an assessment of distal femur aBMD is desired |
| **> 18 yrs** | *AP Lumbar Spine*  - Do not order if lumbar spine scoliosis or spinal hardware  *Hip*  - Do not order in participants with hip dysplasia, prior osteotomy or hardware | *Whole body*  *-* Consider if whole body assessment of BMC is desired  - Do not order if scoliosis, contractures, unable to lay supine, or indwelling orthopedic hardware  *Forearm*  Recommended when:  - Other sites cannot be assessed  - If an assessment of cortical (distal 1/3 radius) or trabecular (ultra-distal radius) bone is specifically desired |
| **Recommended regions of interest (ROI) for clinical evaluation**:  AP Lumbar Spine: “Total” (L1-L4)  Whole Body: “Subtotal” (total body less head)  Hip: “Total” (total hip), “Neck” (femoral neck)  Forearm: “1/3” (distal 1/3 radius) – cortical rich, “ultradistal” – trabecular rich  I scans that require special operator expertise, check with DXA lab before ordering | | |

Recorder Signature: Date:

## General Instructions

This form contains data elements that correspond to parameters assessed using dual energy x-ray absorptiometry (DXA) to evaluate bone health of participants.

Important note: None of the data elements included on this CRF Module are classified as Core (i.e., strongly recommended for all mitochondrial disease clinical studies to collect). All data elements are classified as Supplemental and should only be collected if the research team considers them appropriate for their study.

Please see the Data Dictionary for element classifications.

Specific Instructions

Please see the Data Dictionary for definitions for each of the data elements included in this CRF Module.

* DXA Date Performed – Date/time should be recorded to the level of granularity known (e.g., year, year and month, complete date plus hours and minutes, etc.) and in an unambiguous format acceptable to the study database like DD-MMM-YYYY. When date/time data are prepared for aggregation or sharing, they should be converted to the format specified by [ISO 8601](https://www.iso.org/iso-8601-date-and-time-format.html);  YYYY-MM-DD T:hh:mm:ss.
* T-scores – Calculating is not appropriate for certain pediatric populations.

References

**Helpful references for Performing and Analyzing Densitometry Data**

**Key References:**

International Society for Clinical Densitometry (2019, June). Skeletal Health Assessment In Children from Infancy to Adolescence. Retrieved 31JUL2023 from [**https://iscd.org/learn/official-positions/pediatric-positions/**](https://iscd.org/learn/official-positions/pediatric-positions/)

Weber DR, Boyce A, Gordon C, Högler W, Kecskemethy HH, Misra M, Swolin-Eide D, Tebben P, Ward LM, Wasserman H, Shuhart C, Zemel BS. The Utility of DXA Assessment at the Forearm, Proximal Femur, and Lateral Distal Femur, and Vertebral Fracture Assessment in the Pediatric Population: 2019 ISCD Official Position. J Clin Densitom. 2019 Oct-Dec;22(4):567-89.

**Additional References:**

**Reference data for age- and size-adjusted lumbar spine and total body bone densitometry up to the age of 20 years for GE/Lunar and Hologic Platforms:**

**Predication equations for size- and body composition-adjusted TBLH-BMC measurements:**

Crabtree NJ, Shaw NJ, Bishop NJ, Adams JE, Mughal MZ, Arundel P, Fewtrell MS, Ahmed SF, Treadgold LA, Högler W, Bebbington NA, Ward KA; ALPHABET Study Team. Amalgamated Reference Data for Size-Adjusted Bone Densitometry Measurements in 3598 Children and Young Adults-the ALPHABET Study. J Bone Miner Res. 2017 Jan;32(1):172-80.

**Reference data for ultradistal radius in children 6-19 years for Hologic platform:** Kindler JM, Kalkwarf HJ, Lappe JM, Gilsanz V, Oberfield S, Shepherd JA, Kelly A, Winer KK, Zemel BS. Pediatric Reference Ranges for Ultradistal Radius Bone Density: Results from the Bone Mineral Density in Childhood Study. J Clin Endocrinol Metab. 2020 Oct 1;105(10):e3529-e3539.

**Reference data for children 1-5 years for lumbar spine, distal forearm, and whole-body subtotal (ages ≥ 3 years) BMC and aBMD for Hologic Platforms:** Kalkwarf HJ, Shepherd JA, Fan B, Sahay RD, Ittenbach RF, Kelly A, Yolton K, Zemel BS. Reference Ranges for Bone Mineral Content and Density by Dual Energy X-Ray Absorptiometry for Young Children. J Clin Endocrinol Metab. 2022 Aug 18;107(9) :e3887-e3900.

**Reference data set for trabecular bone score for children 5-20 years for Hologic platform:**

Kalkwarf HJ, Shepherd JA, Hans D, Gonzalez Rodriguez E, Kindler JM, Lappe JM, Oberfield S, Winer KK, Zemel BS. Trabecular Bone Score Reference Values for Children and Adolescents According to Age, Sex, and Ancestry. J Bone Miner Res. 2022 Apr;37(4):776-85.

**Reference data for lumbar spine BMAD in children 5-19 years for Hologic platform:**

Kindler JM, Lappe JM, Gilsanz V, Oberfield S, Shepherd JA, Kelly A, Winer KK, Kalkwarf HJ, Zemel BS. Lumbar Spine Bone Mineral Apparent Density in Children: Results From the Bone Mineral Density in Childhood Study. J Clin Endocrinol Metab. 2019 Apr 1;104(4):1283-92.

**Reference data for children 5-20 years BMC and aBMD of the total body, lumbar spine, hip, and forearm for Hologic Platform:**

**Equations for determing height Z-score adjusted BMC and aBMD Z-scores:**

Zemel BS, Kalkwarf HJ, Gilsanz V, Lappe JM, Oberfield S, Shepherd JA, Frederick MM, Huang X, Lu M, Mahboubi S, Hangartner T, Winer KK. Revised reference curves for bone mineral content and areal bone mineral density according to age and sex for black and non-black children: results of the bone mineral density in childhood study. J Clin Endocrinol Metab. 2011 Oct;96(10):3160-9.

**Reference data for children for children 5-18 years for lateral distal femur for Hologic platform:**

Zemel BS, Stallings VA, Leonard MB, Paulhamus DR, Kecskemethy HH, Harcke HT, Henderson RC. Revised pediatric reference data for the lateral distal femur measured by Hologic Discovery/Delphi dual-energy X-ray absorptiometry. J Clin Densitom. 2009 Apr-Jun;12(2):207-18.