

V. Bone Analysis

1) Bone mineral weight and density

1. Dual energy X-ray absorptiometry (DXA)

Whole body bone mineral weight
Whole body bone mineral density
Head bone mineral weight
Head bone mineral density
Left arm bone mineral weight
Left arm bone mineral density
Right arm bone mineral weight
Right arm bone mineral density
Left rib cage bone mineral weight
Left rib cage bone mineral density
Right rib cage bone mineral weight
Right rib cage bone mineral density
Thoracic spine bone mineral weight
Thoracic spine bone mineral density
Lumbar spine bone mineral weight
Lumbar bone mineral density
Pelvic bone mineral weight
Pelvic bone mineral density
Left leg bone mineral weight
Left leg bone mineral density
Right leg bone mineral weight
Right leg bone mineral density
Lumbar spine 2-4 bone mineral density
Right and left femoral neck bone mineral density
Right and left trochanter region bone mineral density
Right and left Ward's triangle bone mineral density

2. Peripheral quantitative computed tomography (pQCT) (Fig.1)

D100: Cortical and trabecular bone density of ultradistal radius.
D50: Trabecular bone density over the core volume of ultradistal radius.
P100: Cortical bone density of proxima

Male	515.0	83.6	258	501.4	85.8	323	498.0	88.0	289	462.9	92.1	258	449.3	82.1	40	493.3	89.3	1168
Female	547.7	90.4	287	491.2	103.8	283	418.9	80.4	279	383.1	78.1	261	364.5	81.2	32	459.5	109.8	1142
Total	532.2	88.7	545	496.7	94.7	606	459.1	93.1	568	422.8	94.2	519	411.7	91.5	72	476.6	101.4	2310

Head bone mineral density (g/cm²)

	40 – 49yr			50 – 59yr			60 – 69yr			70 – 79yr			80yr –			Total		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Male	2.062	0.294	258	2.043	0.291	323	2.049	0.314	289	1.951	0.340	258	1.944	0.329	40	2.025	0.312	1168
Female	2.348	0.327	287	2.123	0.385	283	1.848	0.301	279	1.753	0.304	261	1.680	0.311	32	2.016	0.407	1142
Total	2.213	0.343	545	2.080	0.340	606	1.950	0.323	568	1.852	0.337	519	1.827	0.345	72	2.020	0.362	2310

Left arm bone mineral weight (g)

	40 – 49yr			50 – 59yr			60 – 69yr			70 – 79yr			80yr –			Total		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Male	175.0	24.5	258	172.2	25.8	323	166.9	25.7	289	155.6	24.3	258	143.6	29.8	40	166.9	26.6	1168
Female	122.7	16.8	287	110.9	17.1	283	96.8	15.5	279	85.5	16.0	261	78.0	18.8	32	103.7	21.9	1142
Total	147.5	33.4	545	143.6	37.8	606	132.5	41.0	568	120.3	40.7	519	114.4	41.5	72	135.6	39.9	2310

Left arm bone mineral density (g/cm²)

	40 – 49yr			50 – 59yr			60 – 69yr			70 – 79yr			80yr –			Total		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Male	0.786	0.052	258	0.779	0.059	323	0.768	0.060	289	0.744	0.059	258	0.718	0.073	40	0.768	0.061	1168
Female	0.679	0.041	287	0.640	0.048	283	0.594	0.047	279	0.561	0.048	261	0.544	0.049	32	0.618	0.065	1142
Total	0.730	0.071	545	0.714	0.088	606	0.682	0.102	568	0.652	0.106	519	0.640	0.108	72	0.694	0.098	2310

Right arm bone mineral weight (g)

	40 – 49yr			50 – 59yr			60 – 69yr			70 – 79yr			80yr –			Total		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Male	184.7	25.9	258	181.1	27.1	323	174.3	24.9	289	161.5	24.9	258	147.2	30.2	40	174.7	27.7	1168
Female	130.5	17.7	287	117.4	17.6	283	102.7	16.3	279	90.8	16.0	261	81.2	18.4	32	110.0	23.0	1142
Total	156.1	34.9	545	151.4	39.3	606	139.1	41.6	568	125.9	41.1	519	117.9	41.7	72	142.7	41.2	2310

Right arm bone mineral density (g/cm²)

	40 – 49yr			50 – 59yr			60 – 69yr			70 – 79yr			80yr –			Total		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Male	0.811	0.060	258	0.801	0.062	323	0.788	0.061	289	0.759	0.063	258	0.730	0.073	40	0.788	0.065	1168
Female	0.699	0.044	287	0.659	0.051	283	0.607	0.050	279	0.574	0.047	261	0.551	0.052	32	0.634	0.069	1142
Total	0.752	0.076	545	0.734	0.091	606	0.699	0.106	568	0.666	0.108	519	0.651	0.110	72	0.712	0.102	2310

Left rib cage bone mineral weight (g)

	40 – 49yr			50 – 59yr			60 – 69yr			70 – 79yr			80yr –			Total		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Male	88.0	18.2	258	85.4	15.0	323	82.7	14.9	289	76.2	15.2	258	68.6	17.1	40	82.7	16.6	1168
Female	72.2	12.7	287	65.4	13.0	283	58.7	10.7	279	54.9	10.6	261	49.3	9.5	32	62.6	13.6	1142
Total	79.7	17.4	545	76.1	17.3	606	70.9	17.7	568	65.5	16.9	519	60.0	17.1	72	72.8	18.2	2310

Left rib cage bone mineral density (g/cm²)

	40 – 49yr			50 – 59yr			60 – 69yr			70 – 79yr			80yr –			Total		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Male	0.648	0.089	258	0.632	0.066	323	0.631	0.067	289	0.607	0.070	258	0.585	0.088	40	0.628	0.075	1168
Female	0.603	0.056	287	0.554	0.059	283	0.512	0.050	279	0.493	0.046	261	0.467	0.048	32	0.539	0.069	1142
Total	0.624	0.077	545	0.595	0.074	606	0.572	0.084	568	0.550	0.082	519	0.533	0.094	72	0.584	0.085	2310

Right rib cage bone mineral weight (g)

	40 – 49yr			50 – 59yr			60 – 69yr			70 – 79yr			80yr –			Total		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Male	89.1	17.4	258	87.4	16.5	323	84.2	16.3	289	77.7	16.8	258	73.4	19.0	40	84.3	17.4	1168
Female	73.4	13.2	287	69.1	13.5	283	64.3	13.5	279	60.5	15.8	261	50.9	9.2	32	66.5	14.9	1142
Total	80.9	17.2	545	78.8	17.7	606	74.4	18.0	568	69.0	18.4	519	63.4	19.0	72	75.5	18.5	2310

Right rib cage bone mineral density (g/cm²)

	40 – 49yr			50 – 59yr			60 – 69yr			70 – 79yr			80yr –			Total		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Male	0.644	0.070	258	0.636	0.066	323	0.633	0.071	289	0.612	0.071	258	0.592	0.083	40	0.630	0.071	1168
Female	0.600	0.056	287	0.558	0.062	283	0.519	0.052	279	0.505	0.066	261	0.483	0.044	32	0.545	0.070	1142
Total	0.621	0.067	545	0.600	0.075	606	0.577	0.084	568	0.558	0.087	519	0.543	0.087	72	0.588	0.082	2310

Thoracic spine bone mineral weight (g)

	40 – 49yr			50 – 59yr			60 – 69yr			70 – 79yr			80yr –			Total		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Male	113.0	24.3	258	118.9	26.8	323	118.5	30.1	289	109.5	29.6	258	97.9	33.2	40	114.7	28.4	1168
Female	100.2	19.9	287	88.3	19.5	283	78.5	17.9	279	72.4	16.8	261	63.7	16.1	32	84.6	21.5	1142
Total	106.3	23.0	545	104.6	28.1	606	98.8	31.9	568	90.9	30.3	519	82.7	31.8	72	99.8	29.4	2310

Thoracic spine bone mineral density (g/cm²)

	40 – 49yr			50 – 59yr			60 – 69yr			70 – 79yr			80yr –			Total		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Male	0.833	0.108	258	0.850	0.121	323	0.877	0.134	289	0.858	0.148	258	0.843	0.184	40	0.855	0.131	1168
Female	0.849	0.099	287	0.771	0.112	283	0.695	0.094	279	0.654	0.089	261	0.610	0.058	32	0.741	0.125	1142
Total	0.842	0.104	545	0.813	0.123	606	0.788	0.148	568	0.756	0.159	519	0.739	0.183	72	0.798	0.140	2310

Lumbar spine bone mineral weight (g)

	40 – 49yr			50 – 59yr			60 – 69yr			70 – 79yr			80yr –			Total		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Male	60.5	14.1	258	59.5	14.2	323	60.2	15.2	289	56.7	16.6	258	54.6	21.2	40	59.1	15.3	1168
Female	55.7	10.9	287	46.3	12.0	283	38.7	10.2	279	33.2	9.9	261	29.2	9.8	32	43.3	13.8	1142
Total	58.0	12.7	545	53.4	14.7	606	49.6	16.9	568	44.9	18.0	519	43.3	21.2	72	51.3	16.6	2310

Lumbar bone mineral density (g/cm²)

	40 – 49yr			50 – 59yr			60 – 69yr			70 – 79yr			80yr –			Total		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Male	0.975	0.145	258	0.987	0.169	323	1.009	0.169	289	0.999	0.216	258	0.974	0.253	40	0.992	0.179	1168
Female	1.053	0.142	287	0.924	0.153	283	0.827	0.129	279	0.788	0.133	261	0.749	0.143	32	0.897	0.174	1142
Total	1.016	0.148	545	0.957	0.164	606	0.919	0.176	568	0.893	0.208	519	0.874	0.238	72	0.945	0.183	2310

Pelvic bone mineral weight (g)

	40 – 49yr			50 – 59yr			60 – 69yr			70 – 79yr			80yr –			Total		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Male	238.4	54.9	258	230.9	53.7	323	217.7	48.0	289	194.7	47.5	258	172.2	54.7	40	219.3	54.4	1168
Female	204.1	42.0	287	171.7	39.7	283	144.7	31.7	279	118.6	31.2	261	104.7	24.1	32	159.2	48.7	1142
Total	220.4	51.5	545	203.3	56.1	606	181.8	54.7	568	156.4	55.3	519	142.2	55.1	72	189.6	59.7	2310

Pelvic bone mineral density (g/cm²)

	40 – 49yr			50 – 59yr			60 – 69yr			70 – 79yr			80yr –			Total		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Male	1.138	0.143	258	1.127	0.143	323	1.110	0.139	289	1.057	0.145	258	0.978	0.150	40	1.105	0.148	1168
Female	1.156	0.130	287	1.077	0.150	283	0.996	0.125	279	0.904	0.136	261	0.849	0.105	32	1.031	0.166	1142
Total	1.148	0.137	545	1.104	0.149	606	1.054	0.144	568	0.980	0.160	519	0.920	0.146	72	1.068	0.161	2310

Left leg bone mineral weight (g)

	40 – 49yr			50 – 59yr			60 – 69yr			70 – 79yr			80yr –			Total		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Male	466.2	71.0	258	448.2	66.9	323	429.8	62.1	289	398.8	62.8	258	355.6	76.8	40	433.5	71.7	1168
Female	345.4	50.2	287	311.3	46.7	283	279.1	42.3	279	243.4	52.6	261	216.2	51.2	32	293.8	62.1	1142
Total	402.6	85.7	545	384.3	89.8	606	355.7	92.3	568	320.6	96.9	519	293.7	96.2	72	364.5	96.9	2310

Left leg bone mineral density (g/cm²)

	40 – 49yr			50 – 59yr			60 – 69yr			70 – 79yr			80yr –			Total		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Male	1.263	0.129	258	1.240	0.119	323	1.219	0.122	289	1.162	0.124	258	1.094	0.134	40	1.218	0.130	1168
Female	1.098	0.086	287	1.036	0.093	283	0.960	0.080	279	0.907	0.134	261	0.851	0.082	32	0.998	0.125	1142
Total	1.176	0.136	545	1.145	0.148	606	1.092	0.166	568	1.034	0.182	519	0.986	0.166	72	1.109	0.168	2310

Right leg bone mineral weight (g)

	40 – 49yr			50 – 59yr			60 – 69yr			70 – 79yr			80yr –			Total		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Male	458.8	69.0	258	441.6	63.7	323	423.1	60.3	289	393.8	61.5	258	353.6	75.0	40	427.2	69.3	1168
Female	342.7	47.8	287	308.0	45.1	283	274.7	42.3	279	240.8	51.8	261	207.2	50.8	32	290.4	61.5	1142
Total	397.7	82.6	545	379.2	86.9	606	350.2	90.7	568	316.9	95.4	519	288.5	97.9	72	359.6	94.7	2310

Right leg bone mineral density (g/cm²)

	40 – 49yr			50 – 59yr			60 – 69yr			70 – 79yr			80yr –			Total		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Male	1.240	0.121	258	1.222	0.109	323	1.198	0.119	289	1.149	0.116	258	1.082	0.124	40	1.199	0.123	1168

Female	1.095	0.081	287	1.033	0.092	283	0.959	0.092	279	0.902	0.149	261	0.838	0.082	32	0.995	0.130	1142
Total	1.163	0.125	545	1.133	0.139	606	1.081	0.160	568	1.025	0.182	519	0.974	0.163	72	1.098	0.162	2310

Lumbar spine 2-4 bone mineral density (g/cm²)

	40 - 49yr			50 - 59yr			60 - 69yr			70 - 79yr			80yr -			Total		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Male	0.979	0.138	260	0.988	0.153	323	1.010	0.163	290	0.996	0.206	258	0.949	0.245	41	0.992	0.169	1172
Female	1.030	0.130	289	0.906	0.148	284	0.812	0.128	280	0.775	0.140	263	0.717	0.148	32	0.879	0.170	1148
Total	1.006	0.136	549	0.950	0.156	607	0.913	0.177	570	0.884	0.207	521	0.847	0.237	73	0.936	0.179	2320

Lumbar spine 2-4 bone mineral density (percentage of Young Adult Mean (YAM))

	40 - 49yr			50 - 59yr			60 - 69yr			70 - 79yr			80yr -			Total		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Male	93.5	13.2	260	94.3	14.6	323	96.5	15.5	290	95.0	19.6	259	90.6	23.2	41	94.7	16.2	1173
Female	101.9	12.8	289	89.6	14.7	284	80.3	12.7	280	76.7	13.8	263	70.9	14.5	32	86.9	16.8	1148
Total	97.9	13.7	549	92.1	14.8	607	88.5	16.3	570	85.8	19.3	522	82.0	22.0	73	90.9	16.9	2321

Right femoral neck bone mineral density (g/cm²)

	40 - 49yr			50 - 59yr			60 - 69yr			70 - 79yr			80yr -			Total		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Male	0.784	0.117	260	0.785	0.102	323	0.763	0.109	290	0.709	0.107	260	0.649	0.116	41	0.758	0.114	1174
Female	0.759	0.098	290	0.707	0.097	283	0.648	0.091	279	0.584	0.084	260	0.544	0.060	32	0.673	0.114	1144
Total	0.770	0.108	550	0.749	0.107	606	0.707	0.116	569	0.647	0.115	520	0.603	0.108	73	0.716	0.122	2318

Right trochanter region bone mineral density (g/cm²)

	40 - 49yr			50 - 59yr			60 - 69yr			70 - 79yr			80yr -			Total		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Male	0.678	0.111	260	0.695	0.103	323	0.694	0.111	290	0.649	0.108	260	0.591	0.127	41	0.677	0.111	1174
Female	0.650	0.090	290	0.608	0.097	283	0.551	0.089	279	0.492	0.092	260	0.454	0.086	32	0.574	0.111	1144
Total	0.663	0.101	550	0.654	0.109	606	0.624	0.124	569	0.571	0.128	520	0.531	0.130	73	0.626	0.122	2318

Right Ward's triangle bone mineral density (g/cm²)

	40 - 49yr			50 - 59yr			60 - 69yr			70 - 79yr			80yr -			Total		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Male	0.622	0.137	260	0.591	0.124	323	0.551	0.130	290	0.474	0.120	260	0.416	0.113	41	0.556	0.140	1174
Female	0.645	0.123	290	0.565	0.128	283	0.458	0.125	279	0.376	0.109	260	0.331	0.086	32	0.510	0.160	1144
Total	0.634	0.130	550	0.579	0.126	606	0.505	0.136	569	0.425	0.125	520	0.379	0.110	73	0.533	0.152	2318

Left femoral neck bone mineral density (g/cm²)

	40 - 49yr			50 - 59yr			60 - 69yr			70 - 79yr			80yr -			Total		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Male	0.794	0.119	260	0.797	0.107	323	0.771	0.111	290	0.720	0.110	260	0.652	0.117	41	0.768	0.118	1174
Female	0.761	0.096	291	0.711	0.090	283	0.652	0.084	280	0.589	0.080	259	0.551	0.062	31	0.677	0.110	1144
Total	0.777	0.109	551	0.757	0.109	606	0.712	0.115	570	0.655	0.116	519	0.608	0.109	72	0.723	0.122	2318

Left trochanter region bone mineral density (g/cm²)

	40 – 49yr			50 – 59yr			60 – 69yr			70 – 79yr			80yr –			Total		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Male	0.688	0.112	260	0.703	0.105	323	0.704	0.116	290	0.654	0.112	260	0.595	0.129	41	0.685	0.115	1174
Female	0.650	0.090	291	0.612	0.100	283	0.557	0.085	280	0.498	0.088	259	0.465	0.068	31	0.579	0.108	1144
Total	0.668	0.103	551	0.661	0.112	606	0.632	0.126	570	0.576	0.127	519	0.539	0.125	72	0.633	0.123	2318

Left Ward's triangle bone mineral density (g/cm²)

	40 – 49yr			50 – 59yr			60 – 69yr			70 – 79yr			80yr –			Total		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Male	0.621	0.146	260	0.585	0.126	323	0.538	0.126	290	0.472	0.119	260	0.398	0.131	41	0.550	0.143	1174
Female	0.641	0.122	291	0.556	0.123	283	0.443	0.114	280	0.364	0.103	259	0.341	0.080	31	0.501	0.157	1144
Total	0.632	0.134	551	0.571	0.125	606	0.492	0.129	570	0.418	0.124	519	0.373	0.115	72	0.525	0.152	2318

2. Peripheral quantitative computed tomography (pQCT) (Densiscan 1000)

D50 (trabecular bone density over the core volume of ultradistal radius) (mg/cm³)

	40 – 49yr			50 – 59yr			60 – 69yr			70 – 79yr			80yr –			Total		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Male	292.6	67.9	246	282.8	63.1	301	266.1	62.9	275	237.2	68.2	246	215.0	58.9	39	268.3	68.8	1107
Female	240.0	56.6	266	203.6	64.5	268	158.0	60.3	268	134.2	59.7	243	129.4	49.4	30	183.5	72.7	1075
Total	265.2	67.5	512	245.5	75.0	569	212.7	82.0	543	186.0	82.2	489	177.8	69.3	69	226.5	82.5	2182

D100 (cortical and trabecular bone density of ultradistal radius) (mg/cm³)

	40 – 49yr			50 – 59yr			60 – 69yr			70 – 79yr			80yr –			Total		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Male	593.5	92.0	246	573.4	90.4	301	537.9	93.2	275	488.9	96.1	246	445.3	91.0	39	545.8	101.9	1107
Female	608.2	85.4	266	537.1	99.4	268	439.7	91.5	268	383.3	80.5	244	347.2	74.9	30	490.2	125.5	1076
Total	601.2	88.8	512	556.3	96.4	569	489.4	104.5	543	436.3	103.2	490	402.7	97.1	69	518.4	117.4	2183

P100 (cortical bone density of proximal radius) (mg/cm³)

	40 – 49yr			50 – 59yr			60 – 69yr			70 – 79yr			80yr –			Total		
	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Male	1286.0	126.4	245	1229.4	128.2	299	1176.7	140.9	273	1115.1	163.4	240	1048.9	186.7	39	1197.5	156.3	1096
Female	1381.9	112.6	264	1251.6	159.2	267	1076.5	147.7	267	959.6	165.1	240	911.1	158.8	30	1164.8	220.1	1068
Total	1335.7	128.6	509	1239.8	144.0	566	1127.2	152.6	540	1037.3	181.6	480	989.0	187.0	69	1181.4	191.1	2164