Body Composition Analysis using DXA Technology from GE Healthcare
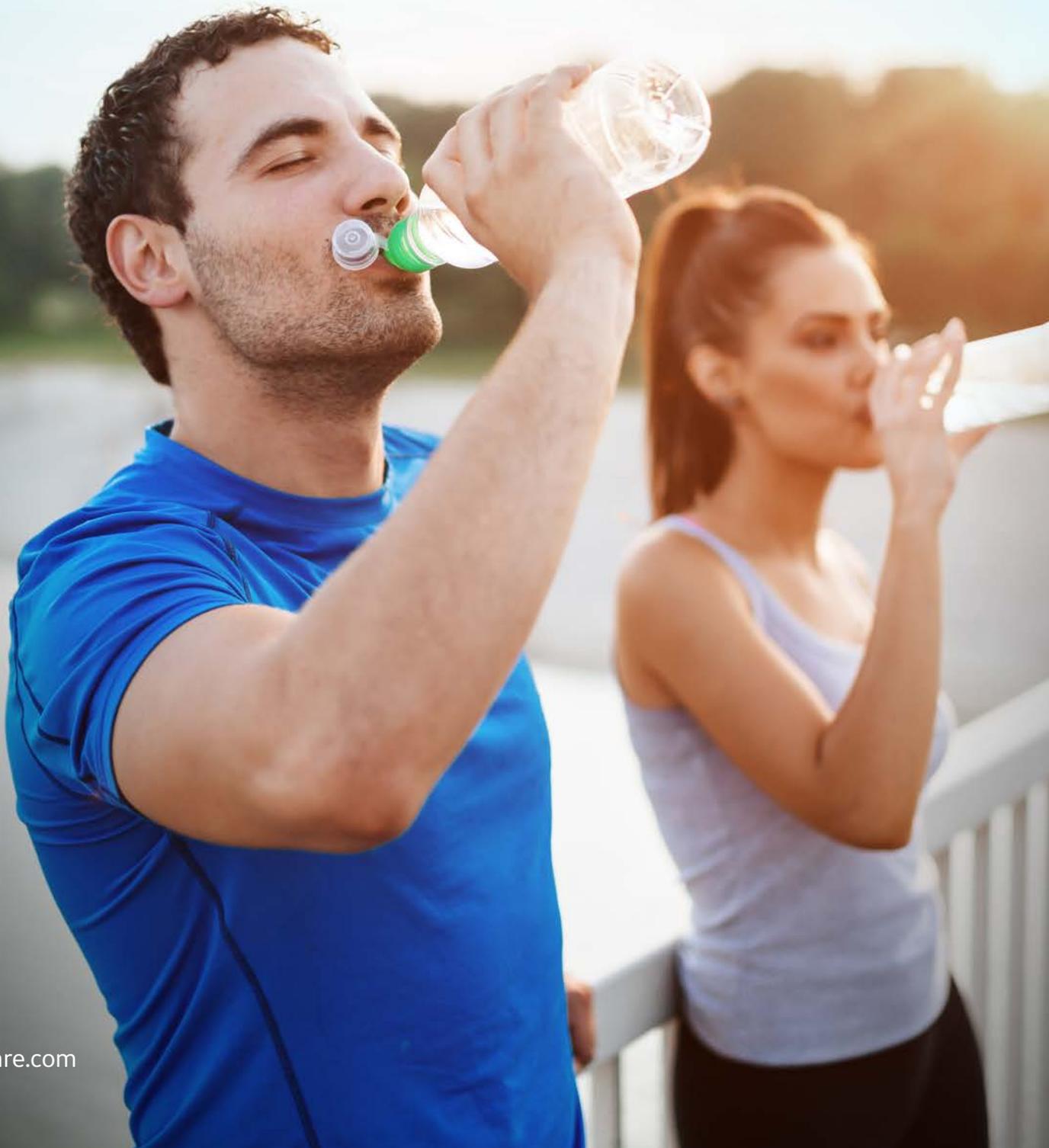
Fat matters...
where matters more.

Looking beyond the bathroom scale

Accurate measurement of body composition provides valuable information for assessing, monitoring and treating a variety of diseases and disorders.

Most people are used to stepping on a scale before every visit to a doctor's examining room. But monitoring patients' weight – while helpful – is at best a crude and imprecise way to assess their health. Today's body composition measurement tools provide far more complete and precise information that can help support diagnoses and guide treatment. They can even help athletes make decisions on the training regimens they use to achieve the best performance.

Body composition measurement with dual-energy X-ray absorptiometry (DXA) can look beyond weight and the traditional body mass index (BMI) to determine body fat distribution – an important risk factor in a variety of serious diseases. More broadly speaking, information from DXA exams can prove valuable in conditions, such as:

- Obesity
- Anorexia nervosa
- Cystic fibrosis
- Wasting syndrome (caused by HIV/Aids)
- Chronic renal failure

In all these cases, body composition measurement contributes to a thorough patient evaluation and helps physicians monitor the effects of therapy, diet or exercise.

Body composition scans with DXA provide precise and accurate data on bone and tissue composition, including bone mineral density (BMD), lean tissue mass, and fat tissue mass. They provide both total body data and regional results (trunk, arms, legs, pelvis and android/gynoid regions). The measurements are fast and non invasive.
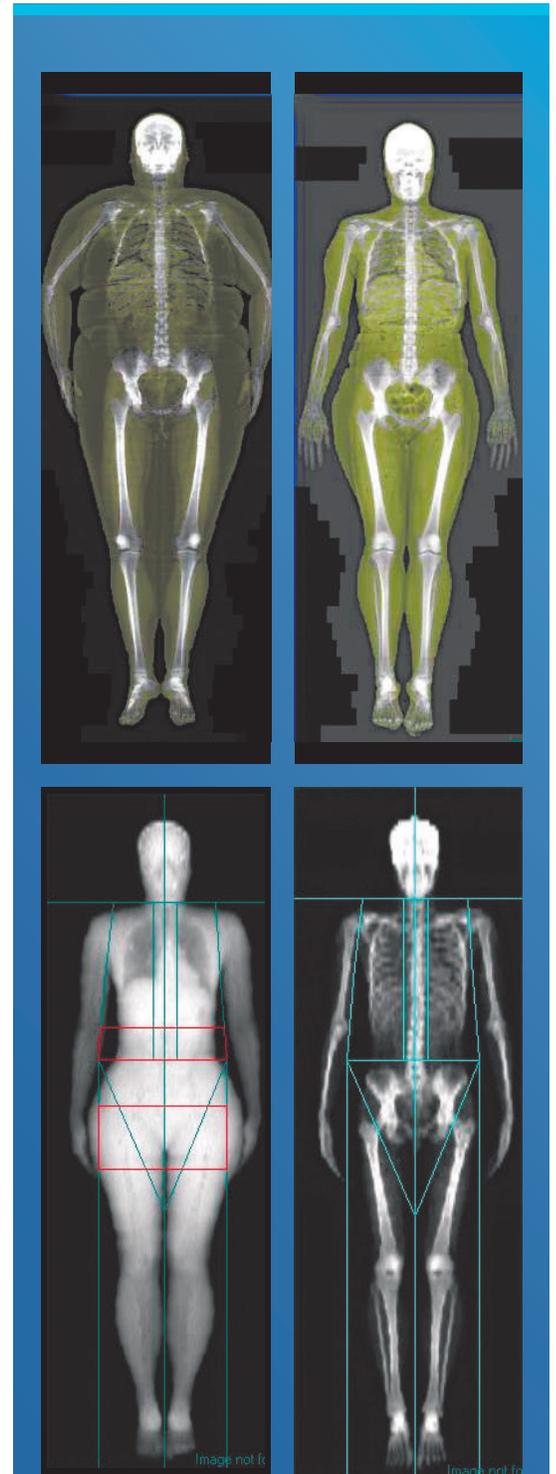
Clinical obesity

Obesity is linked to many debilitating and life-threatening disorders. Body mass index gives a simple anthropometric measurement of obesity, but data shows that the regional distribution of excess body fat is an important independent risk factor.[1]

Those at greatest risk are now thought to be those with central obesity – high levels of upper body (abdominal) fat.[2]

- Worldwide obesity has more than doubled since 1980

- More than 1.9 billion adults, 18 years and older, are overweight. Of these, over 600 million are obese[13]

Important clues for managing eating disorders

Assessment of body composition is important in evaluating and managing severe eating disorders such as anorexia. It is well known that women with anorexia nervosa more easily develop osteoporosis.[5]

Patients with anorexia lose a substantial amount of lean tissue, accounting for from 15% to 45% of the loss of total body mass. Much of this loss in lean tissue is muscle. Physicians treating anorexia use body composition with DXA to:

a) evaluate disease severity by setting target values of lean and fat

b) monitor changes in both lean and fat compartments

c) measure the effectiveness of nutritional interventions.[7]

As one study found, "A key advantage of DXA is that changes in bone mineral density, fat and lean mass can be monitored. Weight scale measures general weight change, but without specific differentiation of changes in fat and lean mass for the total body or in various regions of interest."[8]

Nutritional therapies must not only increase fat tissue, but must also re-establish the normal relationship of fat to lean tissue. Young women with eating disorders have an increased risk for osteopenia, and osteoporotic fractures later in life.[8]

Studies show that change in whole body lean-tissue mass correlates strongly with change in body weight after hemodialysis. Renal failure also affects the skeletal constitution: Patients with renal dysfunctions are at significantly higher risk of primary and secondary osteoporosis.[9]

AIDS/HIV

Wasting syndrome, defined as weight less than 90% of ideal body weight, is a devastating disease and a consequence of HIV infections.[10] Accurate determination of body composition with DXA has value in assessing the extent of gender-specific muscle wasting and fat loss. The information can be used to monitor the effects of pharmacological and nutritional programs aimed at preventing or treating wasting syndrome of AIDS/HIV.[10]
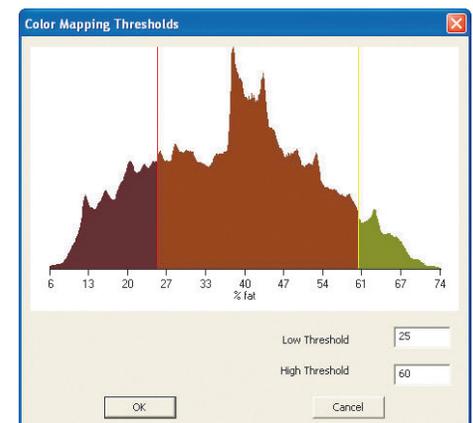
User-adjustable %fat threshold: To visualize high % fat regions.

# Helping athletes make decisions on training regimens

The value of body composition measurement is not limited to treating illnesses – it can help some of the healthiest . Most athletes benefit from a lean body composition (low body fat percentage). In general, body fat beyond the amount needed for good health reduces efficiency. Athletes can achieve the body composition they desire through training and a proper diet.

Experts say the key is to track how much body fat athletes lose instead of relying on the bathroom scale. Height/weight tables based on BMI do not distinguish muscle from fat and so are not useful for highperforming athletics. A recent study in the United States by Oates et al.

suggest that "DXA values may be more fundamental and less affected by anthropometric variables, or at least more precisely determined than the values for the other techniques".[11]

For highly trained athletes, even a small change in body composition can significantly affect performance. Body composition monitoring provides valuable information that athletes and their trainers can use to adjust diet and training regimens. Body composition measurement helps establish a starting point and a target, helping any athlete to pursue a specific goal.
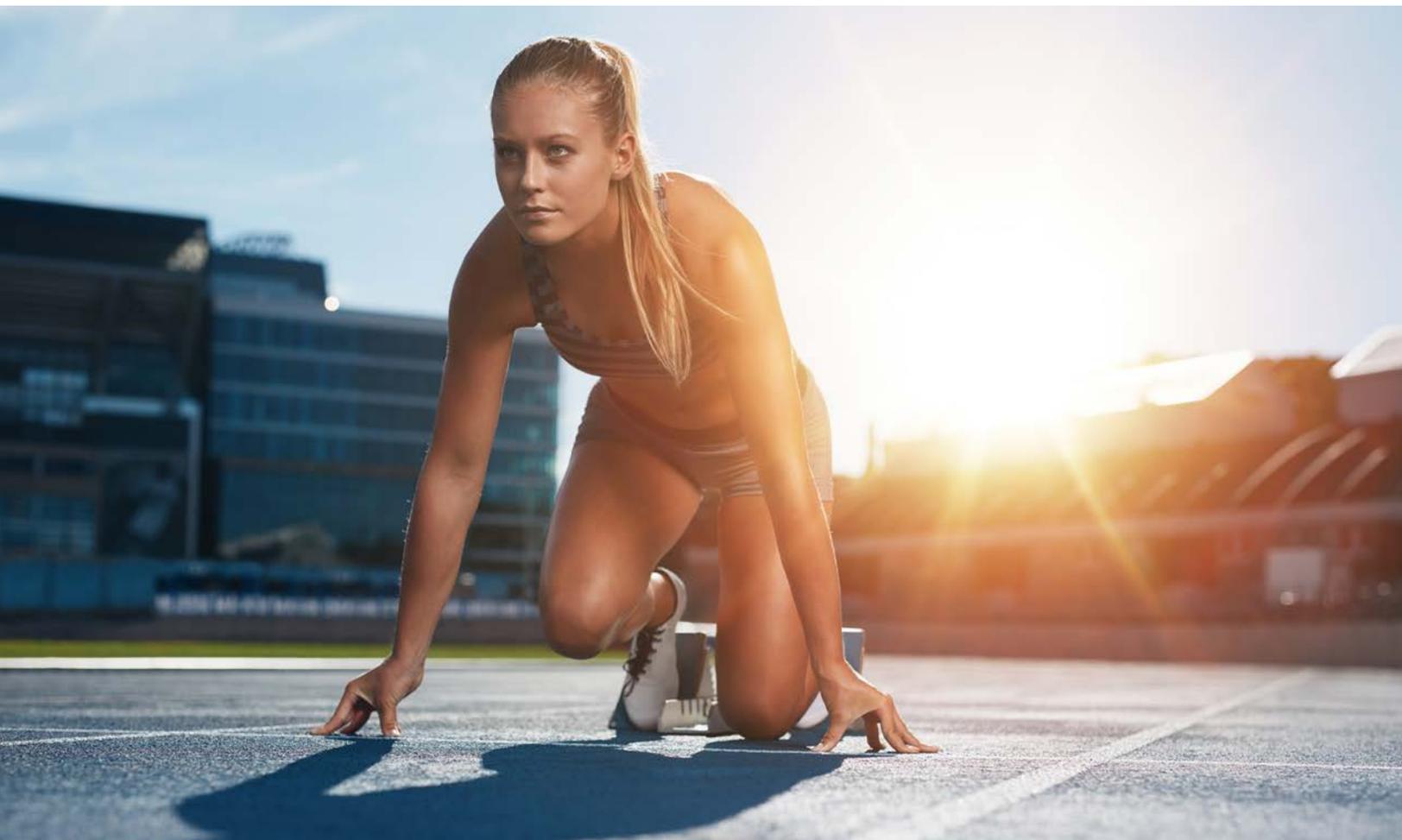
DXA body composition measurement

More powerful than ever

Physicians today use DXA for body composition because it accurately shows exactly where fat is distributed throughout the body. Lunar DXA systems directly measure and calculate total fat, lean and bone tissue, instead of estimating body composition.

DXA systems must perform at the highest precision possible. In fact, experts agree that in monitoring patients over time, it is crucial to get consistent results. Lunar DXA systems are backed by numerous studies that demonstrate high accuracy and precision in total body measurement.[12]

The precision of Lunar DXA systems is enabled by TruView image reconstruction technology, which eliminates the magnification and distortion inherent in traditional wide-angle fan-beam technology. TruView assesses the size of the anatomy accurately without making assumptions, providing true area and body composition measurements.

When measuring total body composition it is critical to take the entire body into account: bone, fat, and lean tissue. Lunar DXA systems calibrate across a full range of values, rather than calibrating to an average patient.
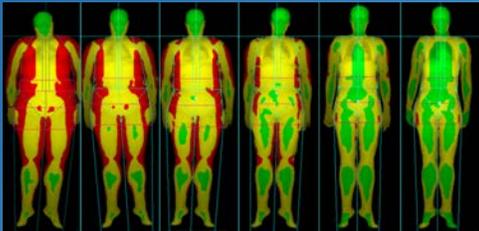
Body Composition Applications

GE Healthcare's Windows®-based enCORE software platform offers a range of body composition applications:

Body Composition – Total/Regional

Allows measurement of the regional and whole body lean and fat tissue mass, and calculates other derivative values which can be displayed in user-defined statistical formats and trends, and be compared to reference populations at the sole discretion of the healthcare professional.
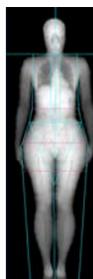
Android and Gynoid Ratio (A/G Ratio)

Android and Gynoid Composition ROIs are available in software that allows the calculation of the Android/Gynoid (A/G) ratio which is the ratio between the %Fat of the Android (central) and %Fat of the Gynoid (hip and thigh) regions.

Metabolic Information

Provides insight on metabolic information such as Resting Metabolic Rate (RMR) and Relative Skeletal Muscle Index (RSMI) with ability to capture Total Body Water (TBW), Intracellular Water (ICW), & Extracellular Water (ECW).

Composer

Composer feature provides many pre-generated report formats as well as ability to create custom reports.

CoreScan™ (Estimated VAT)

CoreScan software feature estimates the VAT (Visceral Adipose Tissue) mass and volume within the android region. The values can be displayed in user-defined statistical formats and trends.

Composition Trending

Ability to trend total body as well as region lean, & fat tissue and BMC over time for the same patient.
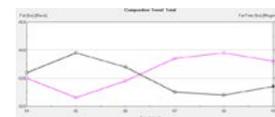
Custom Regions of Interest (ROI)

Allows the operator to define custom regions of interest (ROI) in a total body scan and measure lean and fat tissue along with BMC for the region.
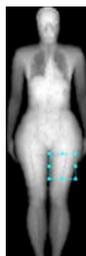
Custom Reference Population

Healthcare providers can create a custom reference population and use that population for comparison to their patients' results.

Multi-user Database Access

Allows multiple users to access and analyze data from the same patient database.

Color Coding

Color coding can be used to code bone, lean tissue and fat tissue. Color Coding feature is available with Lunar iDXA, and Prodigy enhanced or basic.
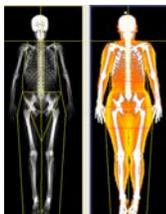
Color Mapping

Color Mapping can be used to set threshold adjustments on fat %.

Sarcopenia

Sarcopenia software calculates values based on published definitions and thresholds using measured appendicular lean mass in combination with patient demographics and entered values of muscle strength and physical performance.
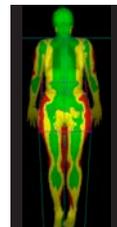
MirrorImage Scan

The MirrorImage function can be used to estimate the total body composition and bone mineral density (BMD) when regions of the body are outside of the scan window by using scanned data from the corresponding region(s) on the opposite half of the body.

Composition BMI (Body Mass Index)

Displays BMI measure in Kg/m2 based on WHO BMI classification:
• Underweight (<18.5 BMI)
• Normal (18.5-24.9 BMI)
• Overweight (25.0-29.9 BMI)
• Obese (30.0 and above)

Sample Body Composition Report

Business Name
Street Address
City, State Zip
Phone: ### ###-####   Fax: ### ###-####
Web: http://##########.com

Body Composition/BMD Report: (Day, Month, Year)

CLIENT

(Patient Name)
Age: ##.#

ID: #######   **Birth Date:** ##/##/####   **Height:** 65.0 in.   **Exam Date:** ##/##/####
Gender: Female   **Ethnicity:** White   **Weight:** 214.5 lbs.

LEAN

Lean mass includes all parts of the body [organs, muscle, and fluids] but excludes body fat.

The higher the Tissue %Lean, the more muscular the body.

Total Weight:	123.4 lbs
Lean Weight:	83.85 lbs
Tissue %Lean:	67.9%

FAT

**Total Body: Total**
Tissue (%Fat)   Centile
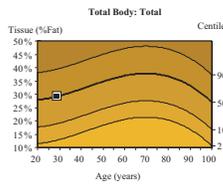
Fat Weight:	34.62 lbs
Tissue %Fat:	29.2%

Composition Reference Centile Graph shows your Total Body Tissue %Fat result compared to a reference population. This comparison is very similar to how babies are measured and compared to reference data for height and weight. The **bold** black line on the graph represents the 50th percentile (average) result for the reference population. The square on the graph represents your result. There are currently no standard definitions of normal or obesity based on Tissue %Fat results, but you can see how you compare to this reference population.

BONE

Total Body: Total
BMD (g/cm²)   YA T-Score
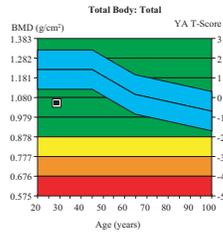
Date	Age	BMD	T-Score
##/##/####	28.8	1.052 g/cm²	-0.3

A bone densitometry test helps your physician to diagnose osteoporosis. The test compares your Bone Mineral Density (BMD) to that of a "young adult" at peak bone strength, displayed as your T-score. It also compares your results to people of your same age, called "age-matched" displayed as your Z-score. This information, along with other factors, helps physicians assess your risk of osteoporotic fracture. The difference between your result and that of a "young adult" is given as a T-score. A panel of experts at the World Health Organization (WHO) has developed categories that define the amount of bone loss:

Normal: T-score that is above –1
Osteopenic: T-score between –1 and –2.5 *(Low bone density)*
Osteoporosis: T-score below –2.5

Sample Body Composition Report

Client	Sex	Ethnicity	Birth Date	Height	Weight	Measured
####, ####	####	####	####	####	####	####

Segmental Analysis

Color Coding
Bone   Lean   Fat

Region	%Fat (%)	Total Mass (lbs)	Fat Mass (lbs)	Lean Mass (lbs)	BMC (lbs)
Arms Total	33.8	14.4	4.6	9.1	0.7
Right	31.2	7.4	2.2	4.8	0.4
Left	36.5	7.0	2.4	4.2	0.4
Difference	-5.3	0.4	-0.2	0.6	0.0
Legs Total	37.9	44.6	16.2	26.5	1.9
Right	37.6	22.5	8.1	13.5	0.9
Left	38.3	22.0	8.1	13.0	1.0
Difference	-0.8	0.5	0.0	0.5	0.0
Trunk	22.9	55.9	12.5	42.0	1.4
Android	18.2	7.3	1.3	5.9	0.1
Gynoid	38.2	21.8	8.1	13.1	0.5
Total	29.4	124.0	35.0	83.9	5.1

BMC = Bone Mineral Content

World Health Organization BMI Classification
BMI = 22.5 (kg/m²)

13	18.5	25	30	35
Underweight	Normal	Overweight	Obese	
78	111	150	180	210

Weight (lbs.) for height = 65.0 in.

Image not for diagnosis   Image for demonstration only
####

Body Composition History (Region: Total)

Measured Date	Total Mass (lbs)	Change vs. Baseline (lbs)	Change vs. Previous (lbs)	Fat Mass (lbs)	Change vs. Baseline (lbs)	Change vs. Previous (lbs)	Lean Mass (lbs)	Change vs. Baseline (lbs)	Change vs. Previous (lbs)
####	124.0	baseline	-	34.9	baseline	-	84.0	baseline	-
####	124.0	0.0	0.0	35.0	0.1	0.1	83.9	-0.1	-0.1

Total Body: Total
Total Mass (lbs)

Total Body: Total
Fat (lbs)

Total Body: Total
Lean (lbs)
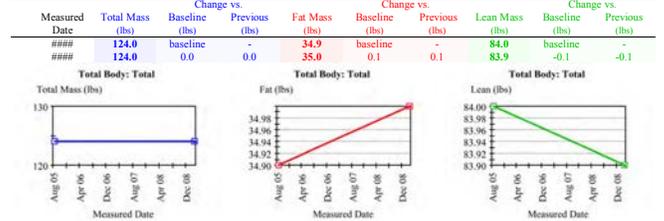
Recommendation / Follow-up

Add text here...

Breakthroughs in DXA technology

Consider these advances in DXA, available from GE Healthcare:

Lunar iDXA™

GE Healthcare's premier, research-grade bone densitometer that provides highest quality, research-grade whole body assessment across a broad range of patient sizes and conditions. State-of-the-art design.

Prodigy™

GE Healthcare's performance grade bone densitometer that provides basic body composition analysis, including bone mineral density (BMD), and lean and fat tissue mass. Available in Full and Compact sizes.

Indications for use:

The Lunar Body Composition Software option (body composition) used on Lunar DEXA bone densitometer measures the regional and whole body bone mineral density (BMD), lean and fat tissue mass and calculates derivative values of bone mineral content (BMC), area, soft tissue mass, regional soft tissue mass, total soft tissue mass, fat free mass, regional/total soft tissue mass ratio, % fat, region % fat, total body % fat, Android % fat, Gynoid % fat, Android/Gynoid ratio (A/G ratio) and Body Mass Index (BMI). The values can be displayed in user-defined statistical formats and trends with color image mapping, and compared to reference populations at the sole discretion of the health care professional.

These body composition values are useful to health care professionals in their management of diseases/conditions where the disease/condition itself, or its treatment, can affect the relative amounts of patient fat and lean tissue. The Lunar Body Composition Software option does not diagnose disease, or recommend treatment regimens, or quantify treatment effectiveness. Only the health care professional can make these judgments. Some of the diseases/conditions for which body composition values are useful include chronic renal failure, anorexia nervosa, obesity, AIDS/HIV and cystic fibrosis. DEXA body composition is a useful alternative to hydrostatic weighing and skin fold measurements.

References:

1. The International Association for the Study of Obesity

2. Snijder MB, van Dam RM, Visser M, Seidell JC (2006) What aspects of body fat are particularly hazardous and how do we measure them? Int J Epiemiol35:83-92.

3. Smith SR, Lovejoy JC, Greenway F, Ryan D, deJonge L, de la Bretonne J, Volafova J, Bray GA (2001). Contributions of total body fat, abdominal subcutaneous adipose tissue compartments, and visceral adipose tissue to the metabolic complications of obesity. Metabolism 50:425-435.

4. Kamel EG, McNeill G, Han TS, Smith FW, Avenell A, Davidson L, Tothill P (1999) Measurement of abdominal fat by magnetic resonance imaging, dual-energy x-ray absorptiometry and anthropometry in non-obese and obese women.

5. Kooh SW, Noriega E, Leslie K, Muller C, Harrison JE (1996) Bone mass and soft tissue composition in adolescents with anorexia nervosa. Bone 19:181-188.

6. Polito A, Cuzzolaro M, Raguzzini A, Censi L, Ferro-Luzzi A (1998) Body composition changes in anorexia nervosa. Eur J Clin Nutr 52:655-662.

7. Joyce JM, Warren DL, Humphries LL, Smith AJ, Coon JS (1990) Osteoporosis in women with eating disorders: comparison of physical parameters, exercise, and menstrual status with SPA and DPA evaluation. J Nucl Med 31:325-331.

8. Soyka LA, Grinspoon S, Levitsky LL, Hergog DB, Klibanski A (1999) The effects of anorexia nervosa on bone metabolism in female adolescents. J Clin Endocrinol Metab 84: 4489-4496.

9. Fiori CE, Dieli M, Vintaloro G, Gibilaro M, Giacone G, Cottini E (1996) Body composition and bone mineral density in competitive athletes in different sports. Int J Tiss Reac 18:121-124.

10. Grinspoon S, Corcoran C, Askair H, Schoenfeld D, Wolf L, Burrows B, Walsh M, Hayden D, Parlman K, Anderson E, Bagoz N, Klibanski A (1998) Effects of androgen administration in men with the AIDS wasting syndrome. Ann Intern Med 129:18-26.

11. MK. Oates, S Puhl, WK Wacker Total Body %Fat - Comparison of DXA With Other Body Composition Methods Abstract Published J Bone Miner Res 2006; 21(Suppl 1):S117 ASBMR Annual Meeting, Philadelphia, PA, September 2006

12. Lunar publication BMD-0172-05.06.-EN-US 21. KG Faulkner, Accuracy and Precision of the Lunar iDXA, a New Fan-Beam Densitometer, presented at ECTS 2006. fan beam densitometers available.

13. World Health Organization, 2016. http://www.who.int/mediacentre/factsheets/fs311/en/

April 2017
JB48048XX