06.01.31 Whole Body Dual X-Ray Absorptiometry (DXA) and Bioelectrical Impedance Analysis (BIA) to Determine Body Composition

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Summary

Related Policies

- 06.01.30 Screening for Vertebral Fracture with Densitometry or Biomechanical Computed Tomography

Description

Body composition measurements can be used to quantify and assess the relative proportions of specific body compartments such as fat and lean mass (e.g., bones, tissues, organs, muscles). These measurements may be more useful in informing diagnosis, prognosis, or therapy than standard assessments (e.g., body weight, body mass index) that do not identify the contributions of individual body compartments or their particular relationships with health and disease. While these body composition

measurements have been most frequently utilized for research purposes, they may be useful in clinical settings. A variety of techniques have been researched, including bioelectrical impedance analysis (BIA), and whole-body dual-energy x-ray absorptiometry (DXA). This evidence review addresses potential applications in clinical care setting rather than research use of the technology.

Summary of Evidence

For individuals who have a clinical condition associated with abnormal body composition who receive dual-energy x-ray absorptiometry (DXA) body composition studies, the evidence includes systematic reviews and several cross-sectional studies comparing DXA with other techniques. Relevant outcomes are symptoms and change in disease status. The available studies were primarily conducted in research settings and often used DXA body composition studies as a reference standard. Systematic reviews with meta-analyses exploring the clinical validity of DXA measurements against reference methods for the quantification of fat mass indicate strong overall agreement between these modalities but raise concerns regarding precision and reliability in some populations, particularly those without existing clinical conditions for which risk of adverse outcomes is influenced by abnormal visceral adiposity. More importantly, no studies were identified in which DXA body composition measurements were actively used in patient management. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have a clinical condition managed by monitoring changes in body composition over time who receive serial DXA body composition studies, the evidence includes several prospective studies monitoring patients over time. Relevant outcomes are symptoms and change in disease status. The studies used DXA as a tool to measure body composition and were not designed to assess the accuracy of DXA. None of the studies used DXA findings to make patient management decisions or addressed how serial body composition assessment might improve health outcomes. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have a clinical condition associated with abnormal body composition or who have a clinical condition managed by monitoring changes in body composition over time who receive bioelectrical impedance analysis (BIA) the evidence includes a few studies comparing BIA with other techniques. Relevant outcomes are symptoms and change in disease status. Studies exploring the clinical validity of BIA measurements against reference methods have demonstrated moderate to high correlation between BIA and MRI, bioelectrical impedance spectroscopy (BIS), or DXA in individuals with metabolic syndrome or those who underwent Roux-en-Y gastric bypass (RYGB). Currently, no studies have been identified in the literature in which BIA measurements were actively used in an individual's management, and studies have not reported data demonstrating the impact of body composition assessment on net health outcomes. Further studies are needed to assess the clinical utility of this testing. The evidence is insufficient to determine the technology results in an improvement in the net health outcomes.

Additional Information

None

OBJECTIVE

The objective of this evidence review is to determine whether the use of a whole-body dual-energy x-ray absorptiometry (DXA) or bioelectrical impedance analysis (BIA) improves the net health outcome in individuals with a condition associated with abnormal body composition.

PRIOR APPROVAL

Not applicable.

POLICY

Whole-body dual x-ray absorptiometry (DXA) and bioelectrical impedance analysis (BIA) body composition studies are considered **investigational** for all indications because the evidence is insufficient to determine the technology results in an improvement in the net health outcomes.

POLICY GUIDELINES

Coding

See the Codes table for details.

BACKGROUND

Body Composition Measurement

Body composition measurements can be used to quantify and assess the relative proportions of specific body compartments such as fat and lean mass (e.g., bones, tissues, organs, muscles). These measurements may be more useful in informing diagnosis, prognosis, or therapy than standard assessments (e.g., body weight, body mass index) that do not identify the contributions of individual body compartments or their particular relationships with health and disease. While these body composition measurements have been most frequently utilized for research purposes, they may be useful in clinical settings to:

- Evaluate the health status of undernourished patients, those impacted by certain disease states (e.g., anorexia nervosa, cachexia), or those undergoing certain treatments (e.g., antiretroviral therapy, bariatric surgery).
- Evaluate the risk of heart disease or diabetes by measuring visceral fat versus total body fat.
- Assess body composition changes related to growth and development (e.g., infancy, childhood), aging (e.g., sarcopenia), and certain disease states (e.g., HIV, diabetes).
- Evaluate individuals in situations where body mass index is suspected to be discordant with total fat mass (e.g., bodybuilding, edema).

A variety of techniques have been researched, including most commonly, anthropomorphic measures, bioelectrical impedance, and dual-energy x-ray absorptiometry (DXA). All of these techniques are based in part on assumptions about the distribution of different body compartments and their density, and all rely on formulas to convert the measured parameter into an estimate of body composition. Therefore, all techniques will introduce variation based on how the underlying assumptions and formulas apply to different populations of subjects (i.e., different age groups, ethnicities, or underlying conditions). Techniques using anthropomorphics, bioelectrical impedance, underwater weighing, and DXA are briefly reviewed below.

Anthropomorphic Techniques

Anthropomorphic techniques for the estimation of body composition include measurements of skinfold thickness at various sites, bone dimensions, and limb circumference. These measurements are used in various equations to predict body density and body fat. Due to its ease of use, measurement of skinfold thickness is 1 of the most common techniques. Skinfold thickness measurement precision and utility can

also be affected by operator experience and a lack of applicable reference data for specific patient populations or percentile extremes.

Bioelectrical Impedance

Bioelectrical impedance analysis (BIA) is based on the relation between the volume of the conductor (i.e., human body), the conductor's length (i.e., height), the components of the conductor (i.e., fat and fat-free mass), and its impedance. The technique involves attaching surface electrodes to various locations on the arm and foot. Alternatively, the individual can stand on pad electrodes. Estimates of body composition are based on the assumption that the overall conductivity of the human body is closely related to lean tissue. The impedance value is then combined with anthropomorphic data and certain other patient-specific parameters (e.g., age, gender, ethnicity) to give body compartment measures. These measures are calculated based on device manufacturer-specific regression models, which are generally proprietary. Bioelectrical impedance measures can be affected by fat distribution patterns, hydration status, ovulation, and temperature. BIA has been proposed as a method for whole body composition or body fat composition assessment in conjunction with annual wellness examinations or weight management evaluations with an individual’s health care provider.

Underwater Weighing

Underwater weighing requires the use of a specially constructed tank in which the subject is seated on a suspended chair. The subject is then submerged in the water while exhaling; the difference between weight in air and weight in water is used to estimate total body fat percentage. While valued as a research tool, weighing people underwater is obviously not suitable for routine clinical use. This technique is based on the assumption that the body can be divided into 2 compartments with constant densities: adipose tissue, with a density of 0.9 g/cm3, and lean body mass (i.e., muscle and bone), with a density of 1.1 g/cm3. One limitation of the underlying assumption is the variability in density between muscle and bone; for example, bone has a higher density than muscle, and bone mineral density varies with age and other conditions. In addition, the density of body fat may vary, depending on the relative components of its constituents (e.g., glycerides, sterols, glycolipids).

Dual-energy X-Ray Absorptiometry (DXA)

While the cited techniques assume 2 body compartments, DXA can estimate 3 body compartments consisting of fat mass, lean body mass, and bone mass. DXA systems use a source that generates x-rays at 2 energies. The differential attenuation of the 2 energies is used to estimate the bone mineral content and soft tissue composition. When 2 x-ray energies are used, only 2 tissue compartments can be measured; therefore, soft tissue measurements (i.e., fat and lean body mass) can only be measured in areas in which no bone is present. DXA can also determine body composition in defined regions (i.e., the arms, legs, and trunk). DXA measurements are based in part on the assumption that the hydration of fat-free mass remains constant at 73%. Hydration, however, can vary from 67% to 85% and can vary by disease state. Other assumptions used to derive body composition estimates are considered proprietary by DXA manufacturers.

Regulatory Status

Body composition software for several bone densitometer and bioelectrical impedance analysis (BIA) systems have been approved by the U.S. Food and Drug Administration through the premarket approval process. They include but are not limited to the following:

- Hologic DXA systems (Hologic)
- Lunar iDXA systems (GE Healthcare)
- Mindways Software, Inc. systems (Mindways Software, Inc.)
- Norland DXA systems (Swissray)

RATIONALE

This evidence review was created in September 2013 and has been updated regularly with searches of the PubMed database. The most recent literature update was performed through November 2024.

Evidence reviews assess whether a medical test is clinically useful. A useful test provides information to make a clinical management decision that improves the net health outcome. That is, the balance of benefits and harms is better when the test is used to manage the condition than when another test or no test is used to manage the condition.

The first step in assessing a medical test is to formulate the clinical context and purpose of the test. The test must be technically reliable, clinically valid, and clinically useful for that purpose. Evidence reviews assess the evidence on whether a test is clinically valid and clinically useful. Technical reliability is outside the scope of these reviews, and credible information on technical reliability is available from other sources.

Dual-Energy X-ray Absorptiometry as a Test to Detect Abnormal Body Composition

Clinical Context and Test Purpose

The purpose of whole-body dual x-ray absorptiometry (DXA) body composition studies is to improve the diagnosis and management of individuals who have clinical condition associated with abnormal body composition.

The following PICO was used to select literature to inform this review.

Populations

The relevant population of interest are individuals with clinical conditions associated with abnormal body composition.

Interventions

The test being considered is DXA body composition studies administered in an outpatient setting.

Comparators

The following practices are currently being used to make decisions in this group: standard of care without DXA or an alternative method of body composition analysis.

Outcomes

The general outcomes of interest include symptom management and change in disease status. For individuals with human immunodeficiency virus HIV who are treated with antiretroviral therapy, outcomes of interest would include lipodystrophy.

Study Selection Criteria

For the evaluation of clinical validity of DXA body composition testing, studies that meet the following eligibility criteria were considered:

- Reported on the accuracy of the marketed version of the technology (including any algorithms used to calculate scores)
- Included a suitable reference standard
- Patient/sample clinical characteristics were described

- Patient/sample selection criteria were described.

Clinically Valid
A test must detect the presence or absence of a condition, the risk of developing a condition in the future, or treatment response (beneficial or adverse).

Review of Evidence

Systematic Reviews
A systematic review and meta-analysis comparing the accuracy of alternative comparators versus reference standard computed tomography (CT) and magnetic resonance imaging (MRI) methods for the quantification of intra-abdominal adipose tissue (IAAT) was published by Murphy et al (2019). This systematic review assessed the performance of DXA for IAAT volume quantification and compared the performance of both DXA and bioelectric impedance analysis (BIA) approaches for IAAT area quantification. The American Society for Parenteral and Enteral Nutrition (ASPEN) also conducted a systematic review to evaluate the validity of relevant body composition methods in various clinical populations. The use of DXA, ultrasound, and BIA for body composition analysis was investigated. Fifteen studies featuring comparisons of DXA to reference standard methods (e.g., MRI and CT) were identified. Nine studies using CT or MRI to validate DXA measures of abdominal fat mass (FM) or total body FM were used for pooled analyses. Characteristics and results of studies included for meta-analysis are summarized in the tables below.

Table 1: Systematic Review & Meta-Analysis Characteristics

Study; Subgroup	Dates	Trials	Participants[1]	N (Range)	Design	Duration
Murphy et al (2019)	1995-2018	23	Studies: With IAAT quantified in humans by CT or MRI reference methods and one of DXA, ultrasound, BIA, or air displacement plethysmography With reference and comparator methods that quantify IAAT at the same anatomical location in the same unit of measurement	6116 (29 to 2689)	Cross-sectional, diagnostic test accuracy studies Retrospective studies	NR

			With reported or quantifiable mean differences and SDs of IAAT quantity			
IAAT Area						
DXA	2012-2014	3	Included population groups: Elderly adult men and women evaluated by DXA and CT at L4 to L5 Premenopausal women evaluated by DXA and CT at L4 to L5 Premenopausal women evaluated by DXA and CT at L4	381 (115 to 135)	Cross-sectional, diagnostic test accuracy studies Retrospective studies	NR
BIA	2008-2018	9*	Included population groups: Elderly Caucasian men and women evaluated by BIA and CT at L3 to L4 Elderly Korean adult men and women evaluated by BIA and CT at umbilicus Elderly Korean adult men and women	2139 (100 to 1006)	Cross-sectional, diagnostic test accuracy studies Retrospective studies	NR

			evaluated by BIA and CT at L4 to L5 Japanese outpatients with obesity evaluated by BIA and CT at umbilicus Elderly, middle-aged, and adult Chinese men and women evaluated by BIA and CT at L4 to L5 Elderly adult men and women evaluated by BIA and MRI at L4 to L5 Elderly, middle-aged, adult, and young men and women evaluated by BIA and CT at L4 to L5			
IAAT Volume						
DXA	2012-2018	7	Included population groups: Adult men and women evaluated by DXA and CT from S1 to head region Elderly adult men and women evaluated by DXA and CT from S1 to head region	3410 (40 to 2689)	Cross-sectional, diagnostic test accuracy studies Retrospective studies	NR

			Women with PCOS evaluated by DXA and MRI at L3 Middle-Eastern adult men and women evaluated by DXA and MRI at android region Adult men and women evaluated by DXA and MRI at L2 to L3 with conversion to L1 through L5			
IAAT Thickness						
US	2010-2014	4	Included population groups: Obese women with infertility evaluated by US and CT at L4 to L5 Middle-aged men and women evaluated by US and CT at L2 to L3 Elderly and adult men and women evaluated by US and MRI at L2 to L3 Elderly men and women evaluated by US and MRI at L4	186 (29 to 74)	Cross-sectional, diagnostic test accuracy studies Retrospective studies	NR
Sheean et al (2019) (ASPEN)	2001-2013	9	Studies: With body compositions	1660 (39 to 625)	Cross-sectional, diagnostic	NR

			assessed in clinical populations via DXA and a reference standard method (eg, MRI or CT) With correlation analyses		accuracy studies Retrospective studies	
Abdominal FM in any disease via DXA	2004-2013	4	Included population groups: Urban Asian Indians with type 2 diabetes Premenopausal women with anorexia nervosa Middle-aged Indian men with CVD Multiethnic cohort of men and women with HIV	874 (39 to 625)	Cross-sectional, diagnostic accuracy studies Retrospective studies	NR
Total FM in any disease via DXA	2001-2013	7	Included population groups: Women with CVD Postmenopausal women with CVD Men and women with CVD Middle-aged Indian men with CVD Individuals with myosteatosis	1473 (66 to 625)	Cross-sectional, diagnostic accuracy studies Retrospective studies	NR

			Multiethnic cohort of men and women with HIV			
Total FM in CVD via DXA	2001-2013	5	Included population groups: Men and women with CVD Postmenopausal women with CVD Middle-aged Indian men with CVD	521 (66 to 132)	Cross-sectional, diagnostic accuracy studies Retrospective studies	NR

ASPEN: American Society for Parenteral and Enteral Nutrition; BIA: bioelectrical impedance analysis; CT: computed tomography; CVD: cardiovascular disease; DXA: dual-energy x-ray absorptiometry; FM: fat mass; HIV: human immunodeficiency virus; IAAT: intra-abdominal adipose tissue; MRI: magnetic resonance imaging; NR: not reported; PCOS: polycystic ovarian syndrome; SD: standard deviation; US: ultrasound.
[1] Key study eligibility criteria and demographics of included subgroup participants.
* 3 of 9 trials were sampled twice for a total of 12 result sets due to use of multiple techniques for IAAT quantification via BIA.
** 1 of 8 trials was categorized as an outlier and excluded from pooled analysis.

Table 2: Systematic Review & Meta-Analysis Results

Study	**Mean Difference in IAAT Volume**	**Mean Difference in IAAT Area**		**Mean Difference in IAAT Thickness**
Murphy et al (2019)	DXA*	DXA	BIA	US
Total N	3410	381	2139	186
Pooled mean difference (95% LoA)	-10 (-280 to 300) (cm^3)	8.09 (-98.88 to 115.07) (cm^2)	-11.63 (-43.12 to 19.85) (cm^2)	-0.32 (-3.82 to 3.17) (cm)
Significance of mean difference (p)	.808	.061	.004	.400
I^2 (p)	99% (<.001)	98% (<.001)	94% (<.001)	93% (<.001)

Q	$Q_{(6)} = 458$	$Q_{(2)} = 31$	$Q_{(11)} = 544$	$Q_{(3)} = 41$
Range of N	40 to 2689	115 to 135	100 to 1006	29 to 74
Range of pooled mean differences	(-451 to 262) (cm^3)	(3.78 to 16.70) (cm^2)	(-57.20 to 10.96) (cm^2)	(-1.10 to 0.40) (cm)
DXA Subgroup Analysis	**Mean Difference in IAAT Volume by DXA and Gender**		**Mean Difference in IAAT Volume by DXA and Reference Method**	
Subgroup	Men	Women	CT	MRI
Subgroup N (Total N)	1483 (3287)	1804 (3287)	377 (3410)	3033 (3410)
Pooled mean difference (95% LoA) (cm^3)	144.04 (-512.29 to 800.38)	59.96 (-381.08 to 492.99)	-41.15 (-881.96 to 930.25)	49.52 (-498.42 to 586.23)
Significance for subgroup comparison (p)	.042		.311	
I^2	95%	90%	100%	90%
Range of Subgroup N	20 to 1212	20 to 1477	109 to 145	40 to 2689
Range of pooled mean differences (cm^3)	-43 to 379	4 to 143	451 to 262	4 to 104
Sheean et al (2019) (ASPEN)	DXA-derived Abdominal FM	DXA-derived Total FM		
	DXA vs. CT-derived VAT in any disease	DXA vs. CT/MRI-derived VAT in any disease	DXA vs. CT/MRI-derived VAT in CVD	
Total N	874	1473	521	

Pooled random effects correlation (95% CI)	0.74 (0.52 to 0.86)	0.71 (0.45 to 0.86)	0.71 (0.45 to 0.84)
I^2 (p)	87% (<.01)	98% (<.01)	95% (<.01)
Range of N	39 to 625	66 to 625	66 to 132
Range of individual correlations	0.52 to 0.86	0.49 to 0.80	0.49 to 0.87

ASPEN: American Society for Parenteral and Enteral Nutrition; BIA: bioelectrical impedance analysis; CI: confidence interval; CT: computed tomography; CVD: cardiovascular disease; DXA: dual-energy x-ray absorptiometry; FM: fat mass; IAAT: intra-abdominal adipose tissue; LoA: limits of agreement; MRI: magnetic resonance imaging; US: ultrasound; VAT: visceral adipose tissue.
* Results following the removal of a study due to identification as an outlier.

Because the analysis by Murphy et al (2019) aimed to evaluate agreement between DXA and CT or MRI, direct effects on key health outcomes were not explored and patient populations included for analysis displayed extensive heterogeneity and largely featured healthy populations. Measurements of IAAT volume via DXA were deemed comparable to the reference methods, however, 95% limits of agreement (LoA) were wide, and these results were not seen until the removal of a small outlying study. Performance of DXA for the measurement of IAAT volume also varied significantly between male and female subgroups. Furthermore, included studies did not pre-determine clinically meaningful LoA. The authors further caution that DXA measurement of IAAT volume has the capacity to differ from reference methods by more than 100%, however, the clinical significance of these margins of error are uncertain in individuals with obesity. While IAAT area cutoff points have been described for the determination of metabolic risk and visceral obesity based on single-slice CT, the authors do not recommend utilization of DXA IAAT area measurements for this purpose due to wide LoA. The clinical utility of existing IAAT area cut points is also uncertain as these parameters were found to have applicability for women and cannot necessarily be extrapolated to mixed populations.

Calella et al (2019) performed a systematic review exploring various methods for body composition analysis in patients with cystic fibrosis (CF). A previous systematic review by Calella et al (2018) presented on differences in body composition between patients with CF and healthy controls evaluated by DXA and other methods. DXA was most frequently used to measure lean body or fat-free mass which was significantly reduced in CF patients. While several included studies showed a correlation between lower fat-free mass and impaired pulmonary function, application, and use of this measure in patient management and its impact on health outcomes was not explored and requires further clarification. Since these reviews featured qualitative analyses, data on clinical validity could not be extracted.

A systematic review by Bundred et al (2019) evaluated body composition assessment and sarcopenia in patients with pancreatic ductal adenocarcinoma. Meta-analyses revealed that sarcopenia was associated with lower overall survival in both operable (harms ratio, 1.95; 95% confidence interval [CI], 1.35 to 2.81; p<.001) and unresectable patients (harms ratio, 2.49; 95% CI, 1.38 to 4.48; p=.002). However, of the 42 included studies, only 1 utilized measurement obtained by DXA, limiting the relevance of the overall findings to this technology, and preventing extraction of pertinent clinical validity data. Furthermore, the authors caution that many studies failed to account for variation introduced by gender, race, tumor stage, and other factors. Additionally, clear criteria for the diagnosis of sarcopenia or cachexia via body composition assessments with DXA are lacking.

Cross-Sectional Studies

Most of the literature on DXA as a diagnostic test to detect abnormal body composition involves the use of the technology in the research setting, often as a reference test; studies have been conducted in different populations of patients and underlying disorders. In some cases, studies have compared other techniques with DXA to identify simpler methods of determining body composition. In general, these studies have shown that DXA is highly correlated to various methods of body composition assessment. For example, a study by Alves et al (2014) compared 2 bioelectrical impedance devices with DXA for the evaluation of body composition in heart failure. Ziai et al (2014) compared bioelectric impedance analysis with DXA for evaluating body composition in adults with CF. The literature on DXA in population-based cohorts (e.g., National Health and Nutrition Examination Survey [NHANES], Prospective Epidemiological Risk Factor Study), involves the use of the technology to predict risk of overall mortality or cancer incidence. These studies often use DXA as a reference test to assess whether agreement with anthropometric measures (e.g., body mass index [BMI], relative fat mass [RFM]) is present or absent. Whether or not a DXA scan is considered the reference standard, the key consideration regarding its routine clinical use is whether the results of the scan can be used to manage patients and improve health outcomes.

Case-Control Studies

As a single diagnostic measure, it is important to establish diagnostic cutoff points for normal and abnormal values. This is problematic because normal values will require the development of normative databases for the different components of body composition (i.e., bone, fat, lean mass) for different populations of patients at different ages. Regarding measuring bone mineral density (BMD), normative databases have largely focused on postmenopausal white women, and these values cannot necessarily be extrapolated to men or to different races. DXA determinations of BMD are primarily used for fracture risk assessment in postmenopausal women and to select candidates for various pharmacologic therapies to reduce fracture risk. In an example regarding lean mass, Reina et al. (2019) conducted a case-control study to assess the correlation of BMI or serum albumin levels to DXA-derived parameters of nutritional status and sarcopenia in women (N=89) with rheumatoid arthritis. While 44% of cases met diagnostic criteria for sarcopenia based on quantification of the skeletal muscle index, a reference technique was not clearly identified in this study. Skeletal muscle index is calculated by dividing appendicular skeletal muscle mass by the square of the patient's height. A previously identified threshold of ≤5.75 kg/m^2 in women was applied, however, this metric was established through the use of BIA in a slightly older patient population. Given that DXA provides measures of lean mass which may be influenced by body compartments other than skeletal muscle, the relevance of this diagnostic cutoff point is uncertain. Furthermore, the study utilized a control group composed of patients affected by non-inflammatory rheumatic disorders as opposed to healthy controls, further limiting the relevance of applied cutoff points. In addition to the aforementioned uncertainties of establishing and applying normal values for components of body composition, it also is unclear how a single measure of body composition would be used in patient management. Studies discussing appropriate use and determination of DXA-derived lean mass cutoffs for sarcopenia in various populations of patients and underlying disorders continue to be featured in the literature.

Clinically Useful

A test is clinically useful if the use of the results informs management decisions that improve the net health outcome of care. The net health outcome can be improved if individuals receive correct therapy, or more effective therapy, or avoid unnecessary therapy, or avoid unnecessary testing.

Direct Evidence

Direct evidence of clinical utility is provided by studies that have compared health outcomes for patients managed with and without the test. Because these are intervention studies, the preferred evidence would be from randomized controlled trials (RCTs).

No RCTs were identified to support the utility of DXA for this indication.

Chain of Evidence

Indirect evidence on clinical utility rests on clinical validity. If the evidence is insufficient to demonstrate test performance, no inferences can be made about clinical utility.

Pooled analyses indicate that there is generally strong correlation between estimates of FM as assessed by DXA versus CT or MRI, particularly in populations with clinical conditions for which risk of adverse outcomes associated with visceral adiposity may be of particular importance.4, In a broader population, including healthy individuals, while there remains a strong overall correlation between these methods of FM estimation, significant variability suggests that there are some subpopulations in whom DXA may perform poorly as an estimate of adiposity compared to CT or MRI.3, A chain of evidence can be constructed supporting DXA as a clinically valid method of evaluating FM in individuals with certain clinical conditions, such as cardiovascular disease or chronic kidney disease. However, limited and heterogenous evidence does not allow for extension of this chain of evidence to the population at large. Additionally, there is a lack of evidence to indicate that evaluation of body composition via DXA changes clinical management.

Section Summary: Dual-energy X-ray Absorptiometry as a Test to Detect Abnormal Body Composition

The available evidence was generated primarily in research settings and often used DXA body composition studies as a reference standard; these studies do not permit conclusions about the accuracy of DXA for measuring body composition. Systematic reviews with meta-analyses exploring the clinical validity of DXA measurements against reference methods for the quantification of FM indicate strong overall agreement between these modalities but raise concerns regarding precision and reliability in some populations, particularly those without existing clinical conditions for which risk of adverse outcomes is influenced by abnormal visceral adiposity. Additionally, no studies were identified in which DXA body composition measurements were actively used in patient management.

Dual X-RAY Absorptiometry as a Test to Monitor Changes in Body Composition

Clinical Context and Test Purpose

The purpose of the serial whole body dual x-ray absorptiometry (DXA) body composition studies in individuals who have a clinical condition managed by monitoring body composition changes over time is to improve disease management.

The following PICO was used to select literature to inform this review.

Populations

The relevant individual population of interest are individuals with clinical conditions managed by monitoring body composition changes over time.

Interventions

The test being considered is serial DXA body composition studies.

Comparators

The following practices are currently being used to make decisions in this group: standard of care without DXA or an alternative method of body composition analysis.

Outcomes

The general outcomes of interest include symptom management and change in disease status. For individuals with anorexia nervosa, outcomes of interest would include disease -related mortality and rate of remission.

Study Selection Criteria

For the evaluation of clinical validity of DXA body composition testing, studies that meet the following eligibility criteria were considered:

- Reported on the accuracy of the marketed version of the technology (including any algorithms used to calculate scores)
- Included a suitable reference standard
- Patient/sample clinical characteristics were described
- Patient/sample selection criteria were described.

Clinically Valid

A test must detect the presence or absence of a condition, the risk of developing a condition in the future, or treatment response (beneficial or adverse).

The ability to detect a change in body composition over time is related in part to the precision of the technique, defined as the degree to which repeated measurements of the same variable give the same value. For example, DXA measurements of bone mass are thought to have a precision error of 1% to 3% and, given the slow rate of change in BMD in postmenopausal women treated for osteoporosis, it is likely that DXA scans would only be able to detect a significant change in BMD in the typical patient after 2 years of therapy. Of course, changes in body composition are anticipated to be larger and more rapid than changes in BMD in postmenopausal women; therefore, precision errors in DXA scans become less critical in interpreting results. However, precision errors for other body compartments such as lean and fat mass may differ and impact clinical validity. Coefficients of variation as high as 42.2% have been reported for FM.

Review of Evidence

Prospective Studies

Several studies have reported on DXA measurement of body composition changes over time in clinical populations; none of these studies used DXA findings to make patient management decisions and few addressed how serial body composition assessment might improve health outcomes. A long-term prospective study assessing the association between body fat and breast cancer risk in postmenopausal women with a normal BMI was published by Iyengar et al (2019), featuring the ad hoc secondary analysis of results from the Women's Health Initiative RCT and observational study cohorts. Women (N=3460) were assessed at baseline and during years 1, 3, 6, and 9 for BMI and via DXA. Multivariable-adjusted hazard ratios (HR) for the association of various body fat measures with the risk of developing invasive or estrogen receptor positive (ER+) breast cancer were reported. Median follow-up duration was 16.9 years. Characteristics and results of clinical validity for breast cancer risk assessment are summarized in the tables below.

Table 3: Study Characteristics of Clinical Validity of Risk Assessment

Study	Study Population	Design[a]	Reference Standard	Timing of Reference	Blinding of Assessors	Comment[b]

				and Index Tests		
Iyengar et al (2019)	Postmenopausal women aged 50 to 79 years enrolled in the Women's Health Initiative (WHI) RCT or observational study were considered for study. Women from 3 WHI trial centers were assessed longitudinally for body fat composition. Data from women with normal BMIs were assessed for correlations with breast cancer outcomes.	Prospective, sample selection NR	Clinical outcomes were confirmed via questionnaires. Breast cancer cases were confirmed via review of medical records and pathology reports.	NR	NR	Risk outcomes for women in the RCT and observational cohorts were not analyzed separately. Given that treatments utilized in the RCT group may have had an impact on breast cancer risk and outcomes, the relevance and utility of this study is uncertain.

BMI: body mass index; NR: not reported; RCT: randomized controlled trial.
[a] Note 2 aspects of design: prospective, retrospective or nonconcurrent prospective and sample selection random or consecutive
[b] Note other characteristics that could cause bias or limit relevance such as timeframe or practice setting.

Table 4: Clinical Validity of Breast Cancer Risk Assessment with Dual-Energy X-ray Absorptiometry

Study; Subgroup; Body Fat DXA Measurement (Cutoff)	Initial N	Final N Cases/Person-Years	Excluded Samples	Prevalence of Condition	Clinical Validity Outcome: Multivariable Adjusted HR (95% CI)				
					Baseline Body Fat Measures			Serial Body Fat Measures	
Iyengar et al (2019), Invasive Breast Cancer	3464*	3460	4*	182	Highest Quartile	p-value for trend	Per 5-unit increase	Cutoff	Time-Dependent

Whole-body fat mass, kg (>25.1)	NR	NR	NR	57	1.89 (1.21 to 2.95)	.004	1.28 (1.10 to 1.49)	≥22.1	1.43 (1.06 to 1.93)
Whole-body fat, % (>41.3)	NR	NR	NR	52	1.79 (1.14 to 2.83)	.03	1.19 (1.03 to 1.37)	≥38.0	1.45 (1.07 to 1.95)
Fat mass of trunk, kg (>11.4)	NR	NR	NR	50	1.88 (1.18 to 2.98)	.002	1.46 (1.14 to 1.87)	≥9.4	1.50 (1.12 to 2.03)
Ratio of trunk fat mass to mean of legs (>2.6)	NR	NR	NR	43	1.30 (0.83 to 2.02)	.10	NR	NR	NR
Iyengar et al (2019) ER+ Breast Cancer	3464	3460	4*	146	Highest Quartile	p-value for trend	Per 5-unit increase	Cutoff	Time-Dependent
Whole-body fat mass, kg (>25.1)	NR	NR	NR	48	2.21 (1.23 to 3.67)	.002	1.35 (1.14 to 1.60)	≥22.1	1.41 (1.01 to 1.97)
Whole-body fat, % (>41.3)	NR	NR	NR	44	2.17 (1.29 to 3.66)	.01	1.27 (1.08 to 1.48)	≥38.0	1.50 (1.07 to 2.10)
Fat mass of trunk, kg (>11.4)	NR	NR	NR	41	1.98 (1.18 to 3.31)	.003	1.56 (1.18 to 2.06)	≥9.4	1.46 (1.05 to 2.04)
Ratio of trunk fat mass to mean of legs (>2.6)	NR	NR	NR	34	1.28 (0.78 to 2.10)	.13	NR	NR	NR

CI: confidence interval; DXA: dual-energy x-ray absorptiometry; ER+: estrogen receptor-positive; HR: hazard ratio; NR: not reported.
* Excluded cases were lost to follow-up with ER+ status not reported.

These results suggest that standard BMI categorization may be inadequate for the risk assessment of invasive breast cancers in postmenopausal women. However, the clinical utility of DXA findings on patient management protocols and health outcomes requires further study.

Arthur et al (2020) published additional results from the Women's Health Initiative cohort of postmenopausal women (N=10,931), reporting additional associations between DXA-derived measures of body fat and breast cancer risk. The multivariable-adjusted HR for risk of invasive breast cancer per standard deviation (SD) increase in trunk fat mass was 1.21 (95% CI, 1.12 to 1.31) and whole-body fat mass was 1.21 (95% CI, 1.12 to 1.30). The multivariable-adjusted HR for risk of ER+ breast cancer per SD increase in trunk fat mass was 1.21 (95% CI, 1.11 to 1.31) and whole-body fat mass was 1.22 (95% CI, 1.11 to 1.33). Multivariable-adjusted HR for invasive breast cancer per SD increase in BMI was also significant, with an HR of 1.19 (95% CI, 1.10 to 1.28). Trends of time-dependent analyses of anthropometric measures and overall ER + incident breast cancer cases were significant for BMI (p <.001) and waist circumference (p<.001). Therefore, the added clinical utility of DXA-derived fat measures is unclear for this population. Relevance and study design and conduct limitations are summarized in the tables below.

Table 5: Study Relevance Limitations

Study	Population[a]	Intervention[b]	Comparator[c]	Outcomes[d]	Duration of Follow-Up[e]
Arthur et al (2020)	1. Study population is unclear.	2. Version used unclear regarding both DXA and patient participation in RCT treatment or observational groups.	3. Not compared to other tests used for same purpose.	5. Key clinical validity outcomes not reported; adverse events of the test not described.	
Iyengar et al (2019)	4. Study population is unclear; study population not representative of intended use.	2. Version used unclear regarding both DXA and patient participation in RCT treatment or observational groups.	3. Not compared to other tests used for same purpose.	5. Key clinical validity outcomes not reported; adverse events of the test not described.	

DXA: dual-energy x-ray absorptiometry; RCT: randomized controlled trial.
The study limitations stated in this table are those notable in the current review; this is not a comprehensive gaps assessment.
[a] Population key: 1. Intended use population unclear; 2. Clinical context is unclear; 3. Study population is unclear; 4. Study population not representative of intended use.
[b] Intervention key: 1. Classification thresholds not defined; 2. Version used unclear; 3. Not intervention of interest.
[c] Comparator key: 1. Classification thresholds not defined; 2. Not compared to credible reference standard; 3. Not compared to other tests in use for same purpose.
[d] Outcomes key: 1. Study does not directly assess a key health outcome; 2. Evidence chain or decision model not explicated; 3. Key clinical validity outcomes not reported (sensitivity, specificity, and predictive values); 4. Reclassification of diagnostic or risk categories not reported; 5. Adverse events of the test not described (excluding minor discomforts and inconvenience of venipuncture or noninvasive tests).
[e] Follow-Up key: 1. Follow-up duration not sufficient with respect to natural history of disease (true-positives, true-negatives, false-positives, false-negatives cannot be determined).

Table 6: Study Design and Conduct Limitations

Study	Selection[a]	Blinding[b]	Delivery of Test[c]	Selective Reporting[d]	Data Completeness[e]	Statistical[f]

Arthur et al (2020)	1. Selection not described.	1. Blinding not described.	1, 4. Timing of delivery of index or reference tests not clear; expertise of evaluators not described.	2. Evidence of selective reporting (covariates did not have to be pre-specified).		
Iyengar et al (2019)	1. Selection not described.	1. Blinding not described.	1, 4. Timing of delivery of index or reference tests not clear; expertise of evaluators not described.	2. Evidence of selective reporting (covariates did not have to be pre-specified).	1. Inadequate description of indeterminate and missing samples.	2. Comparison with other tests not reported.

The study limitations stated in this table are those notable in the current review; this is not a comprehensive gaps assessment.
[a] Selection key: 1. Selection not described; 2. Selection not random or consecutive (i.e., convenience).
[b] Blinding key: 1. Not blinded to results of reference or other comparator tests.
[c] Test Delivery key: 1. Timing of delivery of index or reference test not described; 2. Timing of index and comparator tests not same; 3. Procedure for interpreting tests not described; 4. Expertise of evaluators not described.
[d] Selective Reporting key: 1. Not registered; 2. Evidence of selective reporting; 3. Evidence of selective publication.
[e] Data Completeness key: 1. Inadequate description of indeterminate and missing samples; 2. High number of samples excluded; 3. High loss to follow-up or missing data.
[f] Statistical key: 1. Confidence intervals and/or p values not reported; 2. Comparison with other tests not reported.

Clinically Useful

A test is clinically useful if the use of the results informs management decisions that improve the net health outcome of care. The net health outcome can be improved if patients receive correct therapy, or more effective therapy, or avoid unnecessary therapy, or avoid unnecessary testing.

Direct Evidence

Direct evidence of clinical utility is provided by studies that have compared health outcomes for patients managed with and without the test. Because these are intervention studies, the preferred evidence would be from RCTs.

No RCTs were identified to support the utility of DXA for this indication.

Chain of Evidence

Indirect evidence on clinical utility rests on clinical validity. If the evidence is insufficient to demonstrate test performance, no inferences can be made about clinical utility.

Because the clinical validity of DXA for this population cannot be established, a chain of evidence cannot be constructed.

Section Summary: Dual-Energy X-ray Absorptiometry as a Test to Monitor Changes in Body Composition

Studies assessing serial DXA used it as a tool to measure body composition and were not designed to assess the accuracy of DXA. None of the studies used DXA findings to make patient management decisions or addressed how serial body composition assessment might improve health outcomes.

Bioelectrical Impedance Analysis (BIA) to Detect and/or Monitor Whole Body Composition

Clinical Context and Test Purpose
The purpose of bioelectrical impedance analysis (BIA) is to improve the diagnosis and management of individuals who have clinical conditions associated with abnormal body composition.

Populations
The relevant individual population of interest are individuals with clinical conditions associated with abnormal body composition.

Interventions
The test being considered is serial bioelectrical impedance analysis (BIA) studies.

Comparators
The following practices are currently being used to make decisions in this group: standard of care without bioelectrical impedance analysis (BIA) or an alternative method of body composition analysis.

Outcomes
The general outcomes of interest include symptom management and change in disease status.

Bioelectrical Impedance Analysis (BIA) to Detect Whole Body Composition

Review of Evidence

Clinical Utility
No studies were identified that provided direct evidence of the clinical utility of BIA body composition studies by comparing health outcomes for individuals managed with and without the test.

Clinical Validity
A test must detect the presence or absence of a condition, the risk of developing a condition in the future, or treatment response (beneficial or adverse).

Randomized Controlled Trials
Cloetens et al (2015) The aim of this study was to investigate the agreement between body composition measurements made with two methods-single-frequency bioelectrical impedance analysis (SF-BIA) and bioelectrical impedance spectroscopy (BIS). The body composition measurements using SF-BIA and BIS were performed seven times during 6 months on 41 patients (13 men and 28 women) with metabolic syndrome who were taking part in a dietary intervention study. The mean [standard deviation (SD)] fat mass (FM) and median [interquartile range (IQR)] FM% measured with SF-BIA were 32.7 (6.7) kg and 36.3 (30.3-39.3) %, respectively, compared with 38.2 (8.7) kg and 40.9 (35.5-45.6)%, respectively, using BIS. The median (IQR) fat-free mass (FFM) was 60.0 (53.3-73.5) kg according to SF-BIA and 55.4 (48.8-66.5) kg according to BIS. These results obtained with the two methods were significantly different ($P<0.001$). Still highly significant correlations were found between the results obtained with SF-BIA and BIS for FM and FFM (all $r \geq 0.89$, $P<0.001$). Using Bland-Altman analysis, the bias was found to be -5.4 (4.1) kg for FM, -5.5 (3.7) % for FM%, and 5.4 (4.1) kg for FFM. Rather wide limits of agreement were found for FM, FM%, and FFM." The authors concluded, "body composition data obtained using SF-BIA

and BIS in subjects with metabolic syndrome were highly correlated but not interchangeable. FM was systematically lower when using SF-BIA than when using BIS."

Cohort Study & Case-Control Studies

Vieira et al (2022) aimed "to apply the European Society for Clinical Nutrition and Metabolism/European Association for the Study of Obesity (ESPEN/EASO) consensus to identify sarcopenic obesity (SO) in adults mid to long-term post-Roux-en-Y gastric bypass (RYGB) using both dual-energy x-ray absorptiometry (DXA) and bioelectrical impedance analysis (BIA). Further, this approach was compared to accepted sarcopenia diagnostic criteria (Revised European Working Group on Sarcopenia in Older People [EWGSOP2] and Sarcopenia Definition and Outcomes Consortium [SDOC]). This cross-sectional study included adults $\geq$ 2 years post-RYGB surgery. Obesity was diagnosed by excess fat mass (FM) for all diagnostic criteria. Agreement was evaluated using Cohen's Kappa. We evaluated 186 participants (90.9% female, median age 43.9 years, 6.8 years post-surgery), of which 60.2% (BIA), and 83.3% (DXA) had excess FM. Low muscle strength was not identified using absolute handgrip strength. The prevalence of SO by BIA or DXA, respectively, was 7.9% (95%CI 3.9-12.5), and 23.0% (95%CI 17.1-30.3) [ESPEN/EASO SO consensus]; 0.7% (95%CI 0-2.0), and 3.3% (95%CI 0.7-5.9) [EWGSOP2]; and 27.0% (95%CI 19.7-34.2), and 30.3% (95%CI 23.0-37.5) [SDOC]. Agreement between the ESPEN/EASO SO consensus and other diagnostic criteria was none to slight using DXA: EWGSOP2 k = 0.19; 95% CI 0.04-0.34, or SDOC k = 0.16; 95% CI -0.01-0.32. Moderate agreement was observed within the ESPEN/EASO SO consensus for BIA and DXA (k = 0.43; 95% CI 0.26-0.60). The authors concluded, "this is the first study to explore the prevalence of SO using the ESPEN/EASO criteria. We identified a high but variable prevalence of SO in post-bariatric surgery patients (7.9-23.0%), depending on the body composition technique used; prevalence was higher using DXA. Little agreement was observed for the diagnosis of SO using the three diagnostic criteria. Future studies are needed to explore the relationship between SO identified by the ESPEN/EASO consensus and health status/outcomes."

Beato et al (2019) reported their "study was to determine accuracy and agreement between BC assessed by direct segmental multifrequency bioelectrical impedance analysis (DSM-BIA) and doubly labeled water (DLW) as reference method." "Twenty class III obese women (age 29.3 ± 5.1 years; body mass index 44.8 ± 2.4 kg/m (2)) underwent Roux-en-Y gastric bypass surgery. BC (fat mass [FM], fat-free mass [FFM], and total body water [TBW]) was assessed by InBody 230 and DLW in the following periods: before and 6 and 12 months after surgery. Accuracy between the methods was evaluated by the bias and root mean square error. Pearson's correlation, concordance correlation coefficient (CCC), and Bland-Altman method were used to evaluate agreement between the methods. Correlations were significant ($p < 0.001$) and CCC was good/excellent between both methods for the evaluation of FM (r = 0.84-0.92, CCC = 0.84-0.95), FFM (r = 0.73-0.90, CCC = 0.68-0.80), and TBW (r = 0.76-0.91, CCC = 0.72-0.81) before and after bariatric surgery. In addition, no significant bias was observed between DSM-BIA and DLW for FM (mean error [ME] = - 1.40 to 0.06 kg), FFM (ME = 0.91-1.86 kg), and TBW (ME = 0.71-1.24 kg) measurements." The authors concluded "the DSM-BIA was able to estimate the BC of class III obese women submitted to bariatric surgery with values consistent with those of the DLW method."

Section Summary: Bioelectrical Impedance Analysis (BIA) to Detect Whole Body Composition

Three studies have shown promising results demonstrating moderate to high correlation between BIA and MRI, bioelectrical impedance spectroscopy (BIS), or DXA in individuals with metabolix syndrome or those who underwent Roux-en-Y gastric bypass (RYGB). However, no studies were identified that evaluated the clinical utility of BIA for the evaluation of body composition.

SUPPLEMENTAL INFORMATION

The purpose of the following information is to provide reference material. Inclusion does not imply endorsement or alignment with the evidence review conclusions.

Practice Guidelines and Position Statements

Guidelines or position statements will be considered for inclusion in 'Supplemental Information' if they were issued by, or jointly by, a US professional society, an international society with US representation, or National Institute for Health and Care Excellence (NICE). Priority will be given to guidelines that are informed by a systematic review, include strength of evidence ratings, and include a description of management of conflict of interest.

American Association of Clinical Endocrinology et al

The American Association of Clinical Endocrinology (AACE) and American College of Endocrinology (ACE) clinical practice guideline on obesity was updated in 2016. The table below describes relevant recommendations for the diagnosis of overweight and obesity from the AACE/ACE guideline. The authors also state that "The DEXA [dual x-ray absorptiometry] scan also allows for calculation of the fat mass index (total body fat mass [kg] divided by height [m2]), which is a physiologic relevant measure of adiposity. The clinical utility of these measures is limited by availability, cost, and lack of outcomes data, but they have been applied extensively in research settings. Body fat percentage cut points for obesity have been proposed by the World Health Organization (WHO) to be 25% for men and 35% for women."

American Association of Clinical Endocrinology/American College of Endocrinology Recommendations for Diagnosis of Overweight and Obesity

Recommendation	Quality of Evidence[a]	Grade of Recommendation[b]
All adults should be screened annually using a BMI measurement; in most populations a cutoff point of ≥25 kg/m^2 should be used to initiate further evaluation of overweight or obesity.	2 (upgraded due to high relevance)	A
BMI should be used to confirm an excessive degree of adiposity and to classify individuals as having overweight (BMI 25 to 29.9 kg/m^2) or obesity (BMI ≥30 kg/m^2), after taking into account age, gender, ethnicity, fluid status, and muscularity; therefore, clinical evaluation and judgment must be used when BMI is employed as the anthropometric indicator of excess adiposity, particularly in athleses and those with sarcopenia.	2 (upgraded due to high relevance)	A
When evaluating patients for adiposity-related disease risk, WC should be measure in all patients with BMI <35 kg/m^2.	2 (upgraded due to high relevance)	A
In many populations, a WC cutoff point of ≥94 cm in mean and ≥80 cm in women should be considered at risk and consistent with abdominal obesity; in the U.S. and Canada, cutoff points that can be used to indicate	2 (upgraded due to high relevance)	A

increased risk are ≥102 cm for men and ≥88 cm for women.		
Other measurements of adiposity (e.g., bioelectric impedance, air/water displacement plethysmography, or dual-energy X-ray absorptiometry [DEXA]) may be considered at the clinician's discretion if BMI and physical examination results are equivocal or require further evaluation.	2 (downgraded due to evidence gaps)	C
However, the clinical utility of these measures [listed in the above recommendation] is limited by availability, cost, and lack of outcomes data for validated cutoff points.	2	B

BMI: body mass index; WC: waist circumference.
[a]Evidence quality 2 indicates intermediate-level evidence, including meta-analyses of nonrandomized prospective or case-controlled trials, nonrandomized controlled trials, prospective cohort studies, and/or retrospective case-control studies.
[b]Grade A, B, and C indicate strong, intermediate, and weak recommendations, respectively.

American College of Cardiology (ACC) et al

In 2013 the American College of Cardiology (ACC)/American Heart Association (AHA)/The Obesity Society (TOS) issued a guideline for the management of overweight and obesity in adults. The summary of recommendations for obesity state, “identifying patients who need to lose weight (BMI and waist circumference), measure height and weight and calculate BMI at annual visits or more frequently. Measure weight circumference at annual visits or more frequently in overweight and obese adults.” (E-Expert Opinion)

This guideline does not mention the use of whole-body dual x-ray absorptiometry (DXA) or bioelectrical impedance analysis (BIA) in the assessment and management of overweight and obese adults.

American College of Radiology et al

The American College of Radiology (ACR), the Society for Pediatric Radiology (SPR), and the Society of Skeletal Radiology (SRR) (2018) issued a collaborative practice parameter to assist practitioners in providing appropriate radiologic care for their patients. Dual-energy x-ray absorptiometry (DXA) was described as a "clinically proven, accurate and reproducible method of measuring bone mineral density (BMD) in the lumbar spine, proximal femur, forearm, and whole body," that "may also be used to measure whole-body composition, including nonbone lean mass (LM) and fat mass (FM)." DXA measurement of BMD, LM, or FM is indicated whenever a clinical decision is likely to be directly influenced by the test result. In particular, LM and FM may be useful in assessing conditions such as sarcopenia and cachexia. Specifically, DXA may be indicated as a tool for the measurement of regional and whole-body FM and LM in patients afflicted with conditions such as malabsorption, cancer, or eating disorders.

American Society for Parenteral and Enteral Nutrition

The American Society for Parenteral and Enteral Nutrition (ASPEN) published clinical guidelines on the validity of body composition assessment in clinical populations in 2019, as a complement to the Global Leadership Initiative on Malnutrition (GLIM) criteria for malnutrition (described below). The systematic review with meta-analysis used to develop these guidelines is described above. The target population of the guideline was adults "with a potentially inflammatory condition or pathological end point associated with a specific disease or clinical condition such as cancer, cardiovascular disease (CVD), cardiac failure,

diabetes, hepatic or renal disease, human immunodeficiency virus, or possessing a condition that requires surgical intervention." The target population did not include healthy individuals or those with obesity, except when "linked to a clinical condition such as metabolic syndrome, hypertension, etc." Studies evaluated for guideline development involved specific body composition assessment methodologies (DXA, bioelectrical impedance analysis, or ultrasound) and were required to use a more precise comparator; for studies evaluating DXA, these included computed tomography, magnetic resonance imaging, or multicompartment models. Anthropometric measurements "were not included since these are considered surrogate measures of body composition." Table 8 describes relevant recommendations from the ASPEN guideline.

American Society for Parenteral and Enteral Nutrition Clinical Guideline Recommendations for Body Composition Assessment in Adult Clinical Populations

Recommendation	Quality of evidence	Strength of recommendation
We recommend the use of DXA for assessing fat mass in patients with clinical conditions.	Low	Strong
No recommendation can be made at this time to support the use of ultrasound in a clinical setting for assessing body composition.	Very low	Weak
No recommendations can be made regarding the validity of using bioelectrical impedance analysis in clinical populations.	Low	Weak

International Society for Clinical Densitometry (ISCD)

The International Society for Clinical Densitometry (ISCD) (2019) updated their adult position statement which included a statement on the use of DXA body composition. The statement included the following ISCD position regarding the use of DXA total body composition with regional analysis in the following conditions:

- To assess fat distribution in patients with human immunodeficiency virus (HIV) who are using antiretroviral agents known to increase the risk of lipoatrophy.
- To assess fat and lean mass changes in obese patients undergoing bariatric surgery (or medical, diet, or weight loss regimens with anticipated large weight loss) when weight loss exceeds approximately 10%. The statement noted that the impact of DXA studies on clinical outcomes in these patients is uncertain.
- To assess fat and lean mass in patients with muscle weakness and poor physical functioning. The impact on clinical outcomes is uncertain.

Of note, pregnancy is a contraindication to use of DXA to measure body composition. The statement also adds that the clinical utility of DXA measurements of adiposity and lean mass (e.g., visceral adipose tissue, lean mass index, fat mass index) is uncertain. Furthermore, while the use of DXA adiposity measures such as fat mass index may be useful in risk-stratifying patients for cardio-metabolic outcomes, specific thresholds to define obesity have not been established.

National Institute for Health and Clinical Excellence (NICE)

In 2014, the National Institute for Health and Clinical Excellence (NICE) issued a guideline on obesity: identification, assessment and management that was last updated in July 2023. This guideline covers identifying, assessing and managing obesity in children (aged 2 years and over), young people and adults. It aims to improve the use of bariatric surgery and very-low-calorie diets to help people who are obese to reduce their weight and notes the following:

- **Measures of overweight, obesity and central adiposity in adults**
    - Do not use bioimpedance as a substitute for BMI as a measure of general adiposity in adults and children.

U.S. Preventive Services Task Force Recommendations (USPSTF)

The USPSTF recommendation statement on Obesity in Children and Adolescents: Screening (2017) does not provide recommendations for whole body dual x-ray absorptiometry (DXA) or bioelectrical impedance analysis (BIA) to determine body composition.

The USPSTF recommendation statement on Weight Loss to Prevent Obesity-Related Morbidity and Mortality in Adults: Behavioral does not provide recommendations for whole body dual x-ray absorptiometry (DXA) or bioelectrical impedance analysis (BIA) to determine body composition.

Ongoing and Unpublished Clinical Trials

Some currently ongoing and unpublished trials that might influence this review can be located at clinicaltrials.gov.

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CODES

To report provider services, use appropriate CPT codes, HCPCS codes, Revenue codes, and/or ICD diagnosis codes.

Codes	Number	Description
CPT		
	0358T	Bioelectrical impedance analysis whole body composition assessment, with interpretation and report
	76499	Unlisted diagnostic radiographic procedure
HCPCS		
	No code(s)	
Type of Service	Radiology	
Place of Service	Outpatient/Inpatient	

POLICY HISTORY

Date	Reason	Action
November 2024	Annual Review	Policy Revised
November 2023	Annual Review	Policy Renewed
April 2023	Annual Review	Policy Revised

Date	Reason	Action
April 2022	Annual Review	Policy Renewed
April 2021	Annual Review	Policy Renewed
April 2020	Annual Review	Policy Revised
April 2019	Annual Review	Policy Renewed
April 2018	Annual Review	Policy Renewed
April 2017	Annual Review	Policy Renewed
April 2016	Annual Review	Policy Revised
July 2015	Annual Review	Policy Revised
August 2014	Annual Review	Policy Renewed
September 2013		New Policy

New information or technology that would be relevant for Wellmark to consider when this policy is next reviewed may be submitted to:

Wellmark Blue Cross and Blue Shield
Medical Policy Analyst
PO Box 9232
Des Moines, IA 50306-9232

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