COMMENTARY

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Overweight BMI (25–29) in Active Duty Military: Excess Fat or More Lean Mass? A Look at the Evidence

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ABSTRACT Many active duty service members and their health care providers feel that the current body mass index (BMI) standard for diagnosing obesity, BMI $\geq$30 kg/m^2, may unfairly overclassify as obese those with higher muscle mass. Unfortunately, a closer look at the data available for service members repeatedly demonstrates the exact opposite: we are actually underestimating the rates of obesity in service members using current BMI cutoffs when compared with body fat mass as measured by either dual-energy X-ray absorptiometry or bioelectrical impedance analysis as the gold standard. Using a lower BMI threshold and refining positive results via history, exam, labs, and/or more specific measurements of body composition would more accurately estimate body fat percentage in active duty service members while remaining convenient and scalable. Given the current obesity epidemic in our nation, this suggests the critical need for new approaches to screening, as well as treatment, of overweight and obesity in our military to improve service readiness.

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There are more active duty service members with an overweight body mass index (BMI; 25–29.9 kg/m^2) than any other BMI category, roughly 51.6%.[1] Another 15.1% are classified as obese, with 33.3% classified as normal weight. There is a popular notion among both active duty service members and their health care providers that a BMI 25–29.9 kg/m^2 is not useful for discriminating between lean and fat mass within active duty service members.[2,3] Usually, the underlying concern is that BMI is useful at a population level but not at the level of an individual. It is thought that many individual active duty service members require and achieve more lean mass for their day-to-day operations compared to the general population. Many individuals extrapolate that BMI may have poor specificity to determine excess body fat percentage (BF%) in active duty service members as it sometimes does in collegiate athletes.[4]

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It is true that alternative body composition measurement techniques have more precision in determining BF% at an individual level. However, the most accurate means of evaluating body composition in our military personnel has not yet been evaluated with a sufficiently robust literature search and remains to be determined. Furthermore, each modality has drawbacks to consider and may not be cost-effective or practical to deploy across all military bases and locations for widespread use. Three body composition measurement techniques commonly utilized as gold standards for BF% assessment in research studies include bioelectrical impedance analysis (BIA), air displacement plethysmography, and dual-energy x-ray absorptiometry (DXA). BIA measures total body water and estimates fat-free mass assuming a constant hydration of fat-free mass of 73% but requires training and maintaining an operator and supply costs.[5] Air displacement plethysmography measures body volume through air displacement inside a sealed chamber but also assumes a hydration constant for fat-free mass and requires participant cooperation to follow instructions.[5] DXA obtains a whole-body scan to provide values for fat, bone, and bone-free mass for each limb and the trunk but requires a certified radiology technician and involves a low dose of radiation.[5] All three methods require significant upfront costs as well as space to house the unit. However, BMI remains the most commonly utilized rapid screening assessment for obesity as measurements of height and weight are routinely obtained at most in-person visits with a health care provider and do not require additional equipment, cost, or personnel to perform. For this reason, BMI is also the most reported measure in published research studies. So just how accurate is BMI compared to other body composition measurement techniques?

In the general population, systematic reviews demonstrate that, using a BMI cutoff of 30 kg/m^2, BMI has good specificity (90%–97%) but poor sensitivity (49%–51%) in determining those who have excess BF% using gold standard body composition techniques, such as DXA.[6,7] In other words, over 90% of individuals with a BMI of 30 kg/m^2 or higher indeed have excess BF%. Conversely, roughly 50% of individuals with excess BF% have a BMI under 30 kg/m^2. This means that our current BMI-based definition of obesity is inaccurate, and we are actually underdiagnosing and underestimating the number of individuals with excess adiposity and obesity in the general population if we are utilizing BMI alone to make the diagnosis.

But What About Active Duty Service Members?

A 2008 study of active duty U.S. Air Force personnel found that waist circumference and BMI significantly underestimated excess BF% as determined by BIA.[8] For example, 68%–78% of women with obesity and 35%–42% of men with obesity, as defined by BF% using BIA, were misclassified as nonobese according to traditional waist circumference and BMI definitions, respectively. The authors suggested that the optimal cut points for defining obesity in this population are a BMI of 29 kg/m^2 or waist circumference of 100 cm in men and a BMI of 26 kg/m^2 or waist circumference of 83 cm in women. Utilizing excess BF% standards by the National Institutes of Health yielded even more strict cutoffs for waist circumference (79 cm) and BMI (25.5 kg/m^2) in women. The National Institutes of Health and World Health Organization cutoffs for excess BF% in men do not differ. These suggested cut points maximized both sensitivity and specificity (which they defined as >65%) for diagnosing obesity and are lower than current thresholds for defining obesity in the general population. They suggest that combining waist circumference measures with BMI and adjusting cut points could improve accuracy even further. The authors acknowledge that their method of BIA tends to underestimate BF%, suggesting obesity rates are even higher still.

A 2015 study of active duty (73.6% of enrollees) and nonactive duty (26.4% of enrollees) U.S. Navy personnel found that standard BMI cutoffs for obesity significantly underestimated excess BF%, as determined by gold standard DXA.[9] For example, 38% of the BF%-defined subjects with obesity were misclassified as nonobese by BMI. However, 97% of BMI-defined subjects with obesity had excess BF% by DXA. Rates of excess BF% were similar to the general population. The study suggested an optimal BMI cutoff for obesity of 25–26 kg/m^2 to yield the highest agreement with obesity classified by excess BF%. The authors acknowledge that the BMI cutoffs for obesity would likely be lower if the population were more representative of the overall Navy population, i.e., more minorities and fewer non-Hispanic whites.

A 2015 study of active duty U.S. Army infantry, all men with lower BMI than the average soldier, found that those classified with overweight or obesity had a disproportionate increase in fat compared to lean mass.[10] This study utilized age and gender-specific BMI cutoffs in line with U.S. Army standards, which classified individuals more accurately compared to standard BMI cutoffs. For example, using male BMI cutoffs of 25.9–27.5 kg/m^2 to define excess BF%, BMI had 100% specificity and 77% sensitivity compared to BF% as determined by DXA. They suggested using a BMI cutoff of 28.3 kg/m^2 for men of all ages to optimize sensitivity and specificity for obesity.

A 2020 secondary analysis of U.S. Army volunteers recommends using a combination of BMI + circumference-based equations to assess adiposity in the U.S. military. However, this combination still results in poor sensitivity (50–54%) for excess BF% as determined by BIA.[11] This would result in 50% of obese patients with false negatives: there would still be active duty military classified as “normal weight” by BMI + circumference-based equations who would actually have obesity by BIA.

Taken together, evidence shows that many active duty service members with a BMI of 25–29.9 kg/m^2 have excess BF% as defined by gold standard testing and that obesity is not being overdiagnosed in service members at all. Current screening methods actually underestimate the number of active duty members with obesity who likely have or are at risk for obesity-related complications, such as diabetes, hypertension, hyperlipidemia, sleep apnea, osteoarthritis, and obesity-related cancers in the future. Since the purpose of a screening test is to have a high sensitivity (a negative result excludes the presence of a condition), active duty service members with an overweight BMI should be further evaluated for excess BF%. Service-specific cutoffs as suggested above would be reasonable BMI cutoffs. The U.S. Army utilizes an approach that is most closely aligned with the evidence. The U.S. Air Force does not currently incorporate BMI into either its fitness assessment or medical standards directory, even for those with BMI >30 kg/m^2. The absence of BMI data may incur a missed opportunity to recognize and treat overweight and obesity and potentially preventable obesity-related chronic disease. While in the U.S. Air Force Fitness Management database, waist-to-height ratio was a better correlate with fitness (assessed as 1.5 mile run time, number of push-ups, and sit-ups) than BMI, waist circumference, or height to weight ratio,[12] waist circumference above specified cutoffs remains extremely specific for excess BF%.[11] Waist circumference measures have a strong association with related medical conditions and thus provide useful information from a clinical perspective for preventative care.[13]

Clinical practice guidelines for both active duty service members and the general population recommend screening for adiposity based chronic diseases in those with overweight BMI (BMI $\geq$ 25 kg/m^2, in some ethinicities, BMI $\geq$ 23 kg/m^2).[13,14] The guidelines acknowledge ethnic differences in BMI and waist circumference that were not discussed above. In the absence of service-specific BMI cutoffs, these BMI cutoffs should be utilized to maximize sensitivity in the detection of obesity. For those individuals above the specified BMI cutoffs, methods to screen these individuals for medical conditions related to adiposity include history taking (e.g., screening for hypogonadism, obstructive sleep apnea, osteoarthritis, urinary stress incontinence, polycystic ovarian syndrome, and gastroesophageal reflux disease), biochemical assessment (e.g., screening for pre-diabetes, diabetes, fatty liver disease, and hyperlipidemia), physical exam to assess blood pressure, evaluate body fat distribution and evaluation for acanthosis nigricans as an early sign of insulin resistance, and consideration of additional body composition measurements based on available resources as well as cost.[13,14] History taking, physical exam and biochemical assessment may be more easily scalable methods for screening purposes compared to additional body composition measurements. These methods are readily available to most health care providers and it is vital to initiate this process to optimize health and to maintain service-readiness of service members worldwide. It is important to screen and treat overweight and obesity not only for the patient's health but also for the cost to the military health care system. For example, obesity increases the prevalence of obstructive sleep apnea and that currently leads to costly disability payments. If the obesity epidemic continues on its current trajectory, the military may not have sufficient personnel at a health level that can compete with traditional wartime practices.

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CONFLICT OF INTEREST STATEMENT

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