Defense Advisory Committee on Women in the Services Requests for Information
Office of the Assistant Secretary for Health Affairs and Defense Health Agency Response
August 2022

PHYSICAL FITNESS STANDARDS

RFI 10. *In accordance with DACOWITS' Terms of Reference, the E&I Subcommittee will examine the components of the Military Services' physical fitness tests, to include body fat specifications, height/weight measurements and scales, and physical ability requirements deemed necessary for adequate occupational performance. In addition, the E&I Subcommittee will assess whether the Military Services' physical fitness standards disproportionately affect women's career progression and identify solutions, as required.*

In 2016, the Committee recommended that the "Secretary of Defense should require a complete review and update of the 2002 DoD Physical Fitness and Body Fat Programs Procedures (DoDI 1308.3) with the recent opening of more than 200,000 positions to servicewomen." Following up in 2019, the Committee recommended that the "Secretary of Defense should conduct a comprehensive, scientific review of height and weight standards as well as body fat measurement techniques and use the findings as a baseline for setting a Department-wide standard for measurement and acceptable levels." In 2020, the Defense Department published a revised DoDI 1308.3.

The Committee requests a written response from the Health Affairs on the physiological science and studies utilized to revise the instruction's requirements and scoring of each of the Service's physical readiness test(s) and body composition requirements.

RESPONSE:

The DoD recently updated physical fitness (PF) and body composition (BC) requirements in DoD Instruction (DoDI) 1308.03, "DoD Physical Fitness/Body Fat Programs Program" (March 10, 2022). Current PF and BC standards and training reflect scientific evidence, at minimum, address the primary physical fitness components of cardiorespiratory endurance, muscular strength, muscular endurance, and body composition, and emphasize warfighter lethality and performance.

PF Testing

Mission requirements have re-emphasized warfighter lethality and performance (Department of Defense, 2018). Compared to previous physical readiness standards, which conflated physical performance with health behaviors standards as a condition of employment, updates to physical readiness standards, including BC, focus on operationally-relevant physical performance requirements. Physical readiness standards are based on scientific research, and establish both health-based criteria and operational physical performance-based criteria for physical fitness (Friedl & Vogel, 1999; Caspersen, Powell, & Christenson, 1985). These standards meet occupationally-specific, operationally-relevant physical requirements for physically demanding career fields, and includes identifying specific physical capabilities required by the physically demanding occupational specialties (e.g., the occupation's mission critical operational physical tasks).

The Military Services design PF and BC testing programs that: (1) promote combat readiness; (2) minimize injuries; and (3) meet Service-specific operational mission requirements. Research conducted by the Services (Friedl & Vogel, 1999) determined that PF should emphasize two separate objectives of physical training and physical readiness standards: health-based criteria for minimal generalized physical readiness (e.g., overall health-based fitness); and job-specific physical capabilities for occupationally-specific, occupationally-relevant physical readiness (Nindle, et al., 2015; Caspersen, Powell, & Christenson, 1985).

Health-based criteria leverage science-based physical testing and training programs, which promote physical fitness required to maintain health and fitness for general duty, and help prevent negative consequences of suboptimal fitness, such as musculoskeletal injury. Comparatively, to account for occupationally-specific, operationally-relevant physical requirements for physically demanding career fields, specific physical capabilities required by these occupational specialties are identified (e.g., the occupation's mission critical operational physical tasks), and result in the development of specific physical fitness tests and standards associated with each identified occupational physical task or group of tasks (Foulis, 2017; Sharp, et al., 2017).

For career fields, where it is deemed necessary to ensure adequate skill, performance, and safety, the Military Services may promote physical fitness programs that incorporate occupationally-specific physical fitness requirements. Detailed analyses of common tasks and military job specialties are leveraged to develop practical test batteries, which are predictive of a Service members ability to safely and effectively assess occupational physical performance associated with high physical demand job specialties tasks (Foulis, 2019; Foulis, 2017; Baumgartner, Logan, Gruse, Hale, & Batterton, 2016; NATO, 2019).

Further highlighting the need for occupationally-specific standards, supporting data associated with occupational physical demands links predictive test standards to rates of job attrition and musculoskeletal injury. The U.S. Army Physical Demands Study identified a common set of exercise constructs associated with common Soldier and military occupational specialty (MOS) specific tasks (Foulis, 2017). Similarly, operationally relevant physical fitness tests for U.S. Air Force Battlefield Airmen were more effective than general physical fitness tests with normative standards for reflecting task achievement in military occupations (Baumgartner, Logan, Gruse, Hale, & Batterton, 2016). These studies illustrate the benefit of developing occupation and operationally-specific standards that are highly predictive of performance, require no complex equipment, cover a range of physical fitness domains, and focus on DoD mission requirements, promoting a ready force.

The Military Services consider emerging science and training methodologies when designing appropriate physical fitness training. Established physical training resources and courses certified by leading professional exercise science organizations (e.g., American College of Sports Medicine (ACSM), National Strength and Conditioning Association (NSCA), etc.) are leveraged to create and conduct physical training programs and fitness assessments. For example, individuals with high fitness levels and high non-fat mass may be misclassified as "overweight" when assessed by weight-for-height or Body Mass Index (BMI) standards alone;

thus, additional considerations must be taken into account when assessing these individuals for fitness standards. Consequently, if high scores on physical fitness tests are attained which may enhance duty-related physical requirements (e.g., high muscular power or strength), individuals could be considered for exemption from negative consequences of exceeding body fat (BF) standards (Pierce, et al., 2017). These type of exemptions promote physical training and exercise in a manner that minimizes scientifically-recognized risks of injury or other adverse health outcomes, such as poor nutrition fitness or fatigue. Furthermore, these exemptions aim to minimize exclusion of military members who are overweight or overfat by traditional standards, but otherwise excel on certain fitness attributes required of selected occupations.

Physical training is more important than physical fitness testing. High rates of musculoskeletal injury during military training and high rates of attrition during the first term of enlistment highlight the need to move away from previous/outdated training models, which focused on high-volume running and resulted in overuse injuries (Knapik, et al., 2005). In addition, integration of other readiness components (e.g., sleep, nutrition, mental outlook) are emerging as important aspects of more effective physical training including musculoskeletal remodeling and repair. Thus, it is imperative that physical training follow key exercise principles of consistency, progression, and proper overload, and also attempt to reduce overuse and overtraining related musculoskeletal injuries.

Current policies and programs assist in motivating Service members toward the achievement of high fitness standards. For example, Services leverage the use of ability groups, which is especially important for unfit Service members, bringing individuals of similar fitness levels together to provide cohesion, support, and motivation whilst exercising at a level that is more likely to be appropriate to their needs (Hewett, Meyer, Ford, Paterno, & Quatman, 2016; Hong & Kim, 2018). Additionally, policies and procedures are in place, which prescribe PF/BC programs that are scientifically shown to enhance physical capabilities needed for job performance while minimizing risk of adverse health outcome. These PF/BC programs focus on frequency, volume, and intensity of physical training and exercises in order to optimize performance in a context that minimizes musculoskeletal injury, particularly those due to overuse.

BC Testing

With regard to BC testing, BC is not mutually exclusive to PF, but rather inherent to fitness, and is a core PF component as recognized by exercise physiology texts and numerous exercise/fitness professional organizations (e.g., ACSM, NSCA, National Heart, Lung, and Blood Institute (NHLBI), American Heart Association (AHA), National Institutes of Health (NIH), President's Council on Fitness, Sports, & Nutrition (PCSFN), National Association for Health and Fitness (NAHF), National Coalition for Promoting Physical Activity (NCPPA), American Council on Exercise (ACE), Medical Fitness Association (MFA), IDEA Health & Fitness Association, International Health, Racquet & Sportsclub Association (IHRSA), Shape Up America). Similar to PF, the latest updates to BC policies and procedures (as indicated in this response) are based on scientific research, and utilize a hybrid of health-based criteria and operationally-relevant physical performance requirements.

Evaluating BC via weight-screening thresholds is a vestigial remnant of standards that were used forty years ago. Further, Service observations indicate that shifts in weight screening thresholds are associated with changes in fitness and demographic diversity. Weight-screening may, in fact, overlook metabolically obese individuals that screen as normal weight (e.g., "skinny fat"). Given the limited data associated with sex-specific relationships between weight, body composition, and performance, weight-screening may not be the most accurate measurement for the increasing representation of female Service members in all MOS roles.

Weight screening, such as Body Mass Index (BMI), which is an anthropometric index of weight divided by height squared (weight (kg) / height $(m)^2$), is not based on fat content or distribution, is not a true measure of overfat/obesity, and does not appropriately assess the metabolic effects of excess fat on cardiovascular health (Lee, Blair, & Jackson, 1999; Zhu, et al., 2002). Further, BMI does not adequately evaluate on the individual level: type of mass (e.g., bone, muscle, or fat); type of mass gained or lost; or the relationship between BC and health outcomes. The use of BMI alone may result in the misclassification of healthy, overweight, or obese adults (Tomiyama, Hunger, Nguyen-Cuu, & Wells, 2016).

"Overweight" does not necessarily equal "overfat," particularly on the individual level. For example, two individuals that have the same weight and height will exhibit the same BMI; however, these individual may have different types of mass (e.g., muscle vs. fat), which contribute to the BMI result. These individuals may also exhibit vastly different levels of physical performance (Pierce, et al., 2017) and different levels of fat-related health risks (Hruby, et al., 2017) (e.g., cardiovascular diseases (CVD)). Briefly, BMI potentially misclassifies Service members with high levels of fat-free mass (e.g., muscle) as overweight or obese. Conversely, BMI can misclassify Service members with low fat-free mass, but high fat mass (e.g., "skinny fat"), as healthy. These misclassifications have negative performance and health implications, and potentially result in misapplication of intervention resources (e.g., missing an intervention opportunity for Service members that are "skinny fat" and/or unfit, yet classified as BMI "healthy").

Height-weight screening tables are poor predictors of obesity in high performers (Wellham & Behnke, 1942; Wilmore & Behnke, 1969; Wilmore & Behnke, 1970), and data shows that BMI misclassifies various military members; Service members with a BMI greater than 25 kg/m^2 labeled as "overweight" and deemed a higher health risk, can also exhibit a relatively high fitness levels and a BC comprised of high fat-free mass. Further illustrating potential misclassification, studies show that some Service members that fail body composition standards can achieve exceptional physical fitness scores (Jones, et al., 2017)(Friedl K. , 2002), and preliminary unpublished observations demonstrate that female soldiers engaged in strength training with exceptional performance, may not be correctly assessed for BF with BMI methods.

Individuals with proven high physical fitness achievement should be protected from BC standards, especially if they demonstrate exceptional performance. As described above, the evolving science has been leveraged to enable the Services to implement policies that exempt personnel from negative consequences of exceeding body fat (BF) standards if high scores on physical fitness tests are attained.

Impaired performance and disease susceptibility are not mediated solely by overall body fat mass, and depend largely on differences in regional body fat distribution. Locations of fat deposits (android (apple-shaped) vs. gynoid (pear-shaped) fat distribution patterns) are more important than actual amount of fat, with particular regard to metabolic health. Better evaluators of BC include measures of central adiposity, such as abdominal circumference (AC), waist-to-height ratio (WHtR), fitness-fatness index (FFI), or any combination thereof. These measures are superior to BMI for assessing health risk and injury risk, and may be coupled with total adiposity measures for assessing performance.

AC can be utilized as an anthropometric predictor of visceral adipose tissue (VAT), which is involved in the etiology of metabolic disturbances. Medically labile VAT significantly predicts disease risk factors and morbidity, independent of BMI; therefore, AC can also be used to predict health risks (e.g., cardiovascular disease (CVD)) (Nye, et al., 2014; Janssen, Katzmarzyk, & Ross , 2002; Kannel, et al., 1991). Measuring AC is a simple and convenient measure, highly reproducible, and positively correlates with body fat percentage and intra-abdominal fat content, regardless of BMI level. However, there are short-comings with using AC alone without correction for height, as it may be biased against taller Service members.

Waist-to-height ratio evaluates BC, accounting for stature (Han, et al., 1997), and evaluating BC with FFI adjusts for WHtR to produce a single value that incorporates central adiposity and stature with respect to a Service member's fitness level (FFI = CRE / WHtR). Because FFI accounts for changes in fitness or fatness, it is an advantageous measure that addresses PF components for health and fitness (Firth & Loprinzi, 2017). Importantly, FFI increases service member autonomy – the individual has control, and can mitigate some of the negative consequences of higher AC by improving CRE (e.g., aerobic test score). Thus, the greater the CRE, the larger the allowable AC.

Individual readiness standards are different than NHLBI obesity guidelines that established single male and female waist circumferences (e.g., AC) as public health goals in the 1980s. Abdominal circumference methodology employs science-based health criterion standards which are independent of BMI, unlike the 1988 NHLBI guidelines. Fitness levels (e.g., CRE) are inversely proportional to abdominal fat independent of BMI, and higher CRE reduces health risk across all categories of BC (Nevill, Duncan, & Sandercock, 2017; Firth & Loprinzi, 2017). Further, higher levels of CRE and muscle fitness mitigate some of the negative effects of fat (lower BC fitness scores) (Lee, Blair, & Jackson, 1999), illustrating an inextricable inverse relationship between CRE and central adiposity.

It is important that DoD BC standards are linked to substantiated health standards, common tasks, or MOS-specific task criteria. Body composition standards exist to ensure physical readiness and motivate healthy fitness behaviors. For instance, studies indicate a correlation between females with a higher BMI and low injury rates during physically demanding training (Jones, et al., 2017) therefore, it is important to accommodate for more muscularly dense women that perform at high levels of physical fitness vice succumbing to poor nutrition and unhealthy habits to meet weight-for-height standards.

When assessing BC, the interrelationships of sex, age and fitness should also be kept in mind (APHC HoF 2020 in press). For instance, Army surveillance data demonstrate that, on average, women have a higher BF percentage and run slower than men on timed running events (e.g., 2-mile run). Taking age into account, as women and men age, successively higher age groups exhibit higher BF percentages and slower runtimes for two miles compared to their younger counterparts. Although there are some exceptions, sex and age have predictable effects on BC and aerobic fitness (e.g., increased body fat percentage and slower run times, respectively), and sex appears to further modify age-associated declines changes in BC and physical performance.

PF/BC and Pregnancy

Updates to PF and BC standards account for new data associated with pregnancy and postpartum BC. Pregnant service members are exempt from said PF and BC assessments for 12 months from date of delivery, where additional time may be granted, as necessary, due to unique medical circumstances, including difficult pregnancies, cesarean sections, or still births. Affording a postpartum Service member more time before mandating fitness testing and BC compliance enables a fuller recovery and lower injury risk, as well as preventing potential long-term persistent factors and eliminating potential impact on reduced breast milk production due to rapid weight loss.

The American Academy of Pediatrics (AAP) recommends that infants be exclusively breastfed for the first six-months, with continued breastfeeding along with introducing complementary foods for a year or longer. Joint laxity persists for approximately three months following termination of lactation for women that breastfeed. While joint laxity persists, Service members who are postpartum are recommended to take a gradual approach for introducing high impact, high intensity activities, with maximal exertion avoided during this period in order to avoid injury (Butte, Wong, Treuth, Ellis, & Smith, 2004).

Updates to PF and BC policies associated with pregnancy account for: (1) children of women with inadequate weight gain during pregnancy are at risk for obesity and insulin resistance, depending on the affected stage of pregnancy; and (2) guidelines for appropriate weight gain during pregnancy differ on the basis of pre-pregnancy weight status (Ravelli, 1998; Ravelli, Stein, & Susser, 1976; Normile, 2018) (Butte, Wong, Treuth, Ellis, & Smith, 2004). CRE and BC are very important fitness components during pre-conception, pregnancy, and postpartum. Additionally, data indicate that service women can generally return to pre-partum BC and fitness programs within 12 months postpartum if they engage in safe and appropriate physical training and nutritional regimens (Mottola, 2009; Mottola M. , 2010; O'Toole, 2003).

Pregnant Service members should engage in appropriate physical activity to maintain healthy gestational weight gain and aerobic and anaerobic fitness throughout the pregnancy and postpartum period, in accordance with medical guidance. Moderate-to-high participation in the Army's Pregnancy Postpartum Physical Training (P3T) resulted in better postpartum recovery in 2-mile run time performance, postpartum recovery in sit-up performance, and a lower Army Body Composition Program (ABCP) failure rate compared to non-to-low participation. Proportions of Soldiers sustaining a musculoskeletal injury during pregnancy and postpartum did not appear to differ between groups (Dada, et al., 2020). Additionally, exercise regimens should consist of routines that include physical training and nutritional counseling. The Army P3T Program and the nascent Air Force/Space Force P4 Program for female Service members are examples of best practices employed in the DoD.

Conclusion

Updating physical readiness standards, including BC standards, has re-focused on operationally-relevant requirements. Physical readiness standards are based on scientific research, and establish both health-based criteria and operational physical performance-based criteria for physical fitness. Current PF and BC testing programs promote readiness by emphasizing necessary physical capabilities, minimizing injuries, and meeting Service-specific operational mission requirements.

References

Baumgartner, N., Logan, R., Gruse, E., Hale, K., & Batterton, K. (2016). USAF Battlefield Airmen Occupationally Specific, Operationally Relevant Physical Fitness Tests and Standards: Prototype vs Incumbent. *Medicine & Science in Sports & Exercise*.

Butte, N., Wong, W., Treuth, M., Ellis, K., & Smith, E. (2004). Energy requirements during pregnancy based on total energy expenditure and energy deposition. *Am J Clin Nutr, 79*(6), 1078-1087.

Caspersen, C., Powell, K., & Christenson, G. (1985). Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public Health Rep, 100*(2), 126-31.

Dada, E., Toussaint, M., Goncalves, L., Forrest, L., Taylor, B., Eng, M., . . . Jones, B. (2020). "Effects of Army Pregnancy Postpartum Physical Training on Physical Fitness, Body Composition, and Injury. *Fifth International Congress on Soldiers' Physical Performance (ICSPP).* Quebec City.

Department of Defense. (2018). Summary of the 2018 National Defense Trategy of the United States of America: Sharpening the American Military's Competitive Edge.

Firth, E., & Loprinzi, P. (2017). *Clin Cardiology*, 469-473.

Foulis, S. (2017). U.S. Army Physical Demands Study: Development of the Occupational Physical Assessment Test for Combat Arms soldiers. *J Scie Med Sport, 20*, S74-S78.

Foulis, S. (2019). U.S. Army Physical Demands Study: Accuracy of Occupational Physical Assessment Test Classifications for Combat Arms Soldiers. *Work*, 571-579.

Friedl, K. (2002). Body Fat Standards and Individual Physical Readiness in a Randomized Army Sample Screening Weights, Methods of Fat 2Assessment, and Linkage to Physical Fitness. *Mil Med, 167*(12), 994-1000.

Friedl, K., & Vogel, J. (1999). Summary Report: Research Workshop on Physicla Fitness Standards and Measurements Within The Military Services.

Han, T., Seidell, J., Currall, J., Morrison, C., Deurenberg, P., & Lean, M. (1997). The in¯uences of height and age on waist circumference as an index of adiposity in adults. *International Journal of Obesity, 21*, 83-89.

Hewett, T., Meyer, G., Ford, K., Paterno, M., & Quatman, C. (2016). Mechanisms, prediction, and prevention of ACL injuries: Cut risk with three sharpened and validated tools. *J Orthop Rex, 34*(11), 1843-1855.

Hong, A., & Kim, A. (2018). Effects of Resistance Exercise on Bone Health. *Endocrinol Metab, 33*, 435-444.

Hruby, A., Bulathsinhala, L., McKinnon, C., Hill, O., Montain, S., Young, A., & Smith, T. (2017). Body Mass Index at Accession and Incident Cardiometabolic Risk Factors in US Army Soldiers, 2001-2011. *PLoS One, 12*(1).

Janssen, I., Katzmarzyk, P., & Ross , R. (2002). Body mass index, waist circumference, and health risk: evidence in support of current National Institutes of Health guidelines. *Arch Intern Med, 162*(18), 2074-2079.

Jones, B., Hauret, K., Dye, S., Hauschild, V., Rossi, S., Richardson, M., & Friedl, K. (2017). Impact of physical fitness and body composition on injury risk among active young adults: a study of army trainees. *Journal of Science and Medicine in Sport*, S17-S32.

Kannel, W., Cupples, L., Ramaswami , R., Stokes III, J., Kreger, B., & Higgins , M. (1991). Regional obesity and risk of cardiovascular disease; theFramingham study. *J Clinical Epidemiology, 44*(2), 183-190.

Knapik, J., Darakjy, S., Scott, S., Hauret, K., Canada, S., Marin, R., . . . Jones, B. (2005). Evaluation of a standardized physical training program for basic combat training. *Journal of Strength and Conditioning Research*, 246.

Lee, C., Blair, S., & Jackson, A. (1999). Cardiorespiratory fitness, body composition, and all-cause and cardiovascular disease mortality in men1–. *Am J Clin Nutr, 69*, 373-380.

Mottola. (2009). Exercise Prescription for Overweight and Obsese Women: Pregnancy and Postpartum. *Obstetrics and Gynecol Clin, 36*(2), 301-316.

Mottola, M. (2010). Nutrition and Exercise Prevent Excess Weight Gain in Overweight Pregnant Women. *Med Sci Sports Exerc, 42*(2), 265-272.

NATO. (2019). *STO Techncial Report. Combat Integration: Implications for Physical Employment Standards.*

Nevill, A., Duncan, M., & Sandercock, G. (2017). Scaling waist girth for differences in body size reveals a new improved index associated with cardiometabolic risk. *Scand J Med Sci Sports, 27*(11), 1470-1476.

Nindle, B., Jaffin, D., Dretsch, M., Cheuvront, S., Wesensten, N., Kent, M., . . . Deuster, P. (2015). Human performance optimization metrics: consensu findings, gaps, and recommendations for future research. *The Journal of Strenght & Conditioning Research*, S221-S245.

Normile, D. (2018). Staying slim during pregnancy carries a price. *Science, 361*(6401), 440.

Nye, N., Carnhan DH, Jackson, J., Covey, C., Zarzabal, L., Chao , S., . . . Crawford, P. (2014). Abdominal Circumference Is Superior to Body Mass Index in Estimating Musculoskeletal Injury Risk. *Medicine and Science in Sports Exercise, 46*(10), 1951-1959.

O'Toole, A. (2003). Guidelines of the American College of Obstetricians and Gynecologists for exercise during pregnancy and the postpartum period. *Br J Sports Med, 37*(1), 6-12.

Pierce, J., DeGroot, D., Grier, T., Hauret, K., Nindl, B., East, W., . . . Jones, B. (2017). Body mass index predicts selected physical fitness attributes but is not associated with performance on military relevant tasks in U.S. Army Soldiers. *J Sci Med Sport, 20*(Suppl 4), S79-S84.

Ravelli. (1998). Glucose tolerance in adults after prenatal exposure to famine. *The Lancet, 351*(9097), 173-177.

Ravelli, G., Stein, Z., & Susser, M. (1976). Obesity in young men after famine exposure in utero and early infancy. *N Engl J Med, 295*(7), 349-353.

Sharp, M., Cohen, B., Boye, M., Foulis, S., Redmond, J., Larcom, K., . . . Zambraski, E. (2017). U.S. Army physical demands study: Identification and validation of the physically demanding tasks of combat arms occupations. *J. Sci Med Sport, 20*(Suppl 4), S62-S67.

Tomiyama, A., Hunger, J., Nguyen-Cuu, J., & Wells, C. (2016). Misclassification of cardiometabolic health when using body mass index categories in NHANES 2005-2012. *International Journal of Obesity, 40*, 883-886.

Wellham, W., & Behnke, A. (1942). The Specific Gravity of Healthy Men. *JAMA, 118*(7), 498-501.

Wilmore, J., & Behnke, A. (1969). An anthropometric estimation of body density and lean body weight in young men. *J Appl Physiol, 27*(1), 25-31.

Wilmore, J., & Behnke, A. (1970). An Anthropometric Estimation of Body Density and Lean Body Weight in Young Women. *Am J Clin Nutr, 23*(3), 267-274.

Zhu, S., Wang, Z., Heska, S., Heo, M., Faith, M., & Heymsfield, S. (2002). Waist circumference and obesity-associated risk factors among whites in the third National Health and Nutrition Examination Survey: clinical action thresholds. *Am J Clin Nutr, 76*, 743-749.