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THE METABOLIC "PINK TAXING" OF FITNESS STANDARDS FOR FEMALE SERVICE MEMBERS

Author Note: We have no conflicts of interest to disclose.

The opinions herein represent those of the author and do not reflect official viewpoints of the federal government, Department of Defense, and Department of the Army.

An independent review of the original implementation of the United States Army Combat Fitness Test (ACFT)—using data collected from 2019 through September 10, 2021—found that female soldiers failed the test at substantially greater rates than male soldiers, with failure rates of 48% for female enlisted soldiers compared to 8% for male enlisted soldiers and 28% for female officers compared to 4% for male officers (9). Again in 2023, a study showed results that females struggled to pass the ACFT at higher rates than males (21). This result has been central to a larger ongoing debate, primarily within the United States Congress, about gender-neutral and job-specific standards for military readiness. One reason for the sex difference in success rates and the associated debate about readiness standards is inherent sex differences in basic biology and physiological functioning, which effectively rendered the fitness requirements to pass the ACFT more difficult for female soldiers. The following evaluation of fitness standards in terms of sex-specific norms and biological constraints will present a discussion that, compared to their male counterparts, female soldiers must expend more metabolic energy and function substantially closer to peak possible performance to meet or exceed minimum fitness requirements. Potentially, this means that a female soldiers must reach greater relative levels of achievement to earn the same ACFT score as male counterparts. This article will explore this discussion and present the logic that leads to this conclusion, which is rooted in an appropriate understanding of core sex differences in biology.

THE BIOLOGY OF SEX

Across all sexually reproducing species, including humans, the individual members of the species that produce larger gametes (i.e., ova) are identified as female while the individual members of the species that produce smaller gametes (i.e., sperm) are identified as male (12). This difference in gamete size is associated with a difference in the average metabolic cost of gamete biomass production, which is three orders of magnitude—that is, 1,000 times—higher for females than for males (10). For men, the only added metabolic cost of reproduction beyond gamete production is the energy it takes to introduce those gametes into a woman's reproductive tract. Of course, there are individual differences in the effort men make toward this endeavor, but on average it costs men the metabolic equivalent of a brief bout of light housework (7). For women, on the other hand, the cost is immense. Presuming she manages to successfully maintain a viable pregnancy while avoiding severe illness and death (which is a meaningful presumption, given that even with modern medicine the prevalence of maternal morbidity and mortality is substantial), a pregnant woman operates at 2.2 times her basal metabolic rate (BMR) throughout the entirety of the gestational period (5,6). The maximum level a human body can sustain long-term before potentially lethal deterioration is 2.5 times BMR, which means pregnant women spend the roughly 270-day gestational period near maximum physiological expenditure (25). Therefore, it seems reasonable to consider the human female as having been designed by evolution to be the ultimate endurance athlete. Males, on the other hand, evolved physiological features that would function to increase their reproductive fitness through successful intrasexual competition, that is, features specifically suited to increase their formidability as combatants (22).

From an athletic and human performance perspective, evolution has imbued in females the physiological features needed to excel at the greater-than-ultra-endurance task of gestation and in males the features needed to excel at strength tasks related to physical combat (15). This results in significant sex differences in several fitness relevant variables. A comprehensive overview of these differences is beyond the scope of this article, but as particularly pertinent examples consider established sex differences in muscle fiber size, type, and fatigability. Compared to women, men develop and maintain significantly larger muscles and a greater amount of fast-twitch muscle fibers, both of which contribute to the ability to exert powerful force (3,8,18). Men also demonstrate increased muscle fatigability, and fatigability allows for neuromuscular adaptive responses of rebuilding muscle tissue post-training. Because women have comparatively reduced fatigability, there is a comparatively lesser ability to rebuild muscle tissue post-training, impacting the ability to build strength (11).

The preponderance of evidence suggests these sex differences in the size, structure, and function of skeletal muscle are consequent to sex differences in gene expression in skeletal muscles and sex differentiated hormones rather than experience and training (8,26). In fact, in terms of the ACFT, data suggest training may increase rather than reduce sex differences in soldier performance. The Office of the Army Surgeon General's executive summary of active-duty service members who completed a 180-day strength and conditioning program in preparation for the ACFT observed a training effect for men but not women (2). That is, men significantly increased their raw deadlift weight from baseline assessment but women did not, thus expanding the performance gap between female and male soldiers.

COMPARATIVE REQUIREMENTS FOR PHYSICAL FITNESS

The gender-normed standards of the US Army's physical fitness requirements are clearly an effort toward acknowledging performance-relevant physiological sex differences. A more considered review that compares male and female soldiers' fitness standards to sex-specific norms and performance markers, rather than to one another, demonstrates that the standards continue to be more stringent for female soldiers. This can be demonstrated with a comparative evaluation of requirements for female and male soldiers on anthropometrics and three sections of the original implementation of the ACFT.

ANTHROPOMETRICS

The average American male of military age (17 – 59) is 69 in. tall and weighs 198.0 lb and the average American female of military age is just under 64 in. tall and weighs 170.9 lb (4). According to AR 600-9, a male soldier of average height can weigh no more than 175 – 186 lb (depending on age) and a female soldier of average height can weigh no more than 145 – 151 lb (depending on age; Figure 1). This translates to a requirement for average-height male soldiers to weigh 6 – 12% less than the average male and a requirement for average-height female soldiers to weigh 12 – 15% less than the average female (Figure 2). Compared to male soldiers, female soldiers are held to a more rigorous bodyweight standard relative to sex specific anthropometric averages.

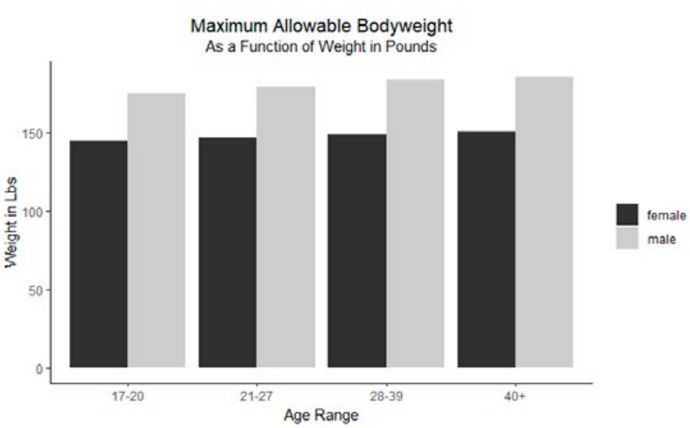

FIGURE 1. SEX DIFFERENCES IN REQUIREMENTS FOR MAXIMUM ALLOWABLE BODYWEIGHT IN POUNDS

Note: For both female and male soldiers, maximum allowable bodyweight is scaled by age range, with bodyweight limits increasing as age increases. This plot depicts the maximum allowable bodyweight for female and male soldiers of average height, which is 64 in. and 69 in., respectively.

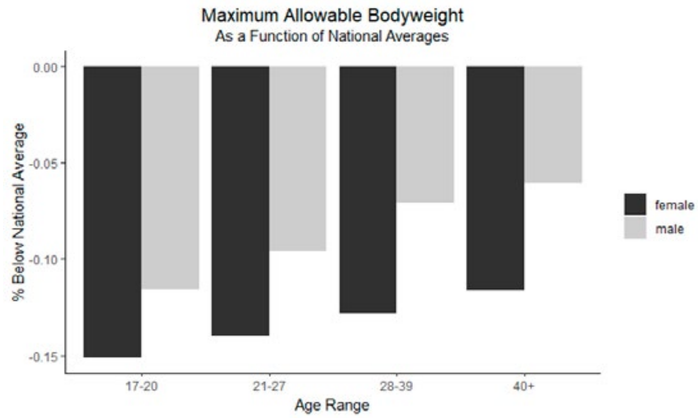

FIGURE 2. SEX DIFFERENCES IN REQUIREMENTS FOR MAXIMUM ALLOWABLE BODYWEIGHT RELATIVE TO NATIONAL AVERAGES

Note: When evaluating maximum allowable bodyweight as a function of sex-specific anthropometric averages, female soldiers at all age ranges are required to maintain bodyweights that are 12 – 15% lower than the average female while male soldiers are required to maintain bodyweights that are 6 – 12% lower than the average male.

The challenge in reaching this more rigorous bodyweight standard may be exacerbated for female soldiers given that females, more than males, evolved to conserve fat. This sex difference is consequent to the adaptive need to protect against the threat of food scarcity and the inextricable relationship between sufficient fat availability and female fertility, a relationship that does not exist in males (19). In short, female bodies evolved to store more fat and limit fat loss, a physiological reality that would make reaching and maintaining low body fat percentages and lower bodyweight particularly more difficult for female soldiers compared to male soldiers. However, it is also important to note that female typical fat deposits (i.e., adipose tissue stored subcutaneously and in regions of the lower body) are not associated with the same negative health outcomes that are seen with the abdominal and visceral fat deposits more typically seen in males (17,23). This means that, even though female soldiers are less likely to have unhealthy stores of fat, they are expected to maintain relatively lower bodyweights than their male counterparts. Although there are additional metrics that can be implemented if the soldier fails the screening, these additional metrics do not negate the discrepancy of the initial standard.

DEADLIFT

For the deadlift portion of the original implementation of the ACFT, each soldier earned points by performing three successful deadlifts. The number of points earned was determined by the amount of weight lifted, scaled by age. Across all age groups, in order to earn the minimum passing score of 60 on this portion of the ACFT, male soldiers must successfully completed three deadlifts of 140 lb and female soldiers must have completed 3 lifts of 120 pounds. From those minimums, additional points could be earned by reaching additional benchmarks, which differed by sex and age. For example, male soldiers aged 27 – 31 had an additional 20 benchmarks they could reach to earn additional points before reaching the maximum possible score of 100 (2). Females in that same age range had just over half the number of point-earning opportunities, with only 11 benchmarks available to them prior to reaching the maximum of 100 points (Figure 3). It is possible the discrepancy in number of point-earning opportunities was secondary to logistical constraints of having more 5 – 10-lb plates available in a unit's ACFT kit, but even if so, the logistical constraints would disproportionally affect female soldiers' scores.

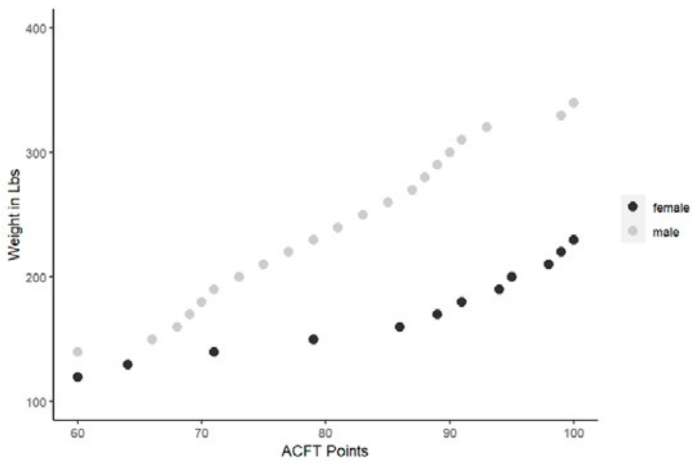

FIGURE 3. SEX DIFFERENCES IN ACFT POINTS AWARDED TO AN AVERAGE-AGED SOLDIER AS A FUNCTION OF DEADLIFT WEIGHT IN POUNDS

Note: In order to earn points on the deadlift portion of the ACFT, a soldier must have completed three successful deadlifts. The number of points earned by those lifts was determined by the amount of weight lifted scaled by sex and age. In order to earn the minimum passing score of 60 points, a male soldier of any age must have lifted 140 lb while a female soldier of any age must have lifted 120 lb. This figure demonstrates the additional points-earning opportunities for male and female soldiers aged 27 – 31. Male soldiers in this age range had 20 additional opportunities to earn ACFT points until reaching the maximum score of 100. Female soldiers in this age range had only 11 additional opportunities to earn ACFT points until reaching the maximum score of 100 (2).

Given these scoring guidelines, considering the anthropometric requirements discussed above and depending on age, this means an average-height male soldier at the maximum allowable bodyweight for his age must have lifted 75 – 80% of his bodyweight to earn a minimum passing score on the deadlift portion of the ACFT. Meanwhile, an average-height female soldier at the maximum allowable bodyweight for her age must have lifted 79 – 83% of her bodyweight to earn a minimum passing score (4).

Another way to consider the deadlift requirements is in reference to the recognized maximum weights a human male and female have ever been able to successfully deadlift. At the time of first implementation of the ACFT, the deadlift world records were 1,104.5 lb for men (450 lb; 2.45 x bodyweight) and 639.4 lb for women (308 lb; 2.08 x bodyweight). This means that to earn the minimum passing score of 60 points, male soldiers must have lifted 12.7% of the world record weight. Female soldiers must have lifted 18.8% of the world record weight (Figure 4). Therefore, female soldiers were required to lift closer to the world record weights than were their male counterparts to meet the minimum criterion for the deadlift portion of the ACFT.

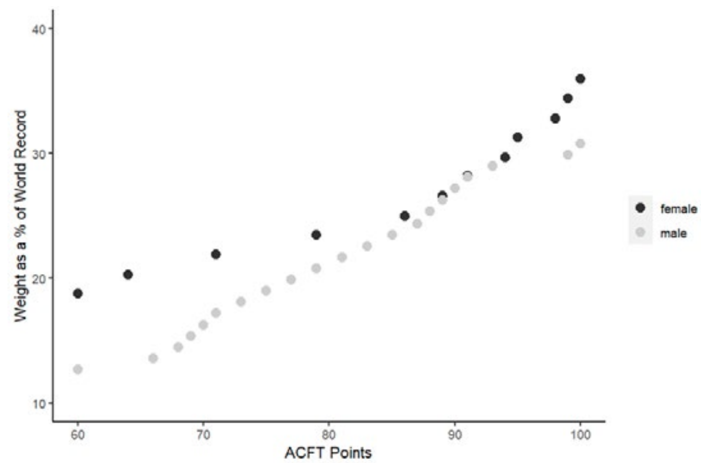

FIGURE 4. SEX DIFFERENCES IN ACFT POINTS AWARDED TO AN AVERAGE-AGED SOLDIER AS A FUNCTION OF DEADLIFT WEIGHT AS A PERCENT OF WORLD RECORD LIMITS

Note: In order to earn the same number of points as male soldiers on the deadlift portion of the ACFT, female soldiers must have lifted closer to the world record weights than male soldiers were required to lift.

SPRINT-DRAG-CARRY

The sprint-drag-carry portion of the ACFT required soldiers to sprint for a total distance of 250 m, which included dragging a 90-lb sled for 50 m and carrying two 40-lb kettlebells for 50 m. Points were awarded based on overall time of completion scaled by sex and age. Although the time-to-completion requirements and associated points were scaled by sex and age, all soldiers were required to drag 90-lb sleds and carry 40-lb kettlebells. This means that a male soldier of average height at maximum allowable bodyweight, depending on age, must have dragged 48 – 51% of his bodyweight and carried 22 – 23% of his bodyweight in each hand. A female soldier of average height at maximum allowable bodyweight, depending on age, must have dragged 60 – 62% of her bodyweight and carried 27 – 28% of her bodyweight in each hand.

The challenge that female soldiers faced in dragging and carrying a greater percent of their bodyweight in order to earn the same score on the sprint-drag-carry portion of the ACFT as their male counterparts was further complicated by women's substantially lesser grip strength. This resulted in the strength requirements approaching and, in some cases, exceeding the maximum possible grip strength for female soldiers in a way that is not applicable to male soldiers (13). This phenomenon has been demonstrated in evaluations of tasks similar to the sprint-drag-carry in which military personnel were required to carry combat-relevant loads to exhaustion. For example, the force required to carry a combat-relevant load reached 90% of male personnel's maximum voluntary grip strength and 130% of female personnel's maximum voluntary grip strength. This ultimately resulted in male personnel being able to carry the load twice as far as female personnel (14). Additional evaluations confirmed that the most influential limiting factor predicting military personnel's ability to carry a combat-relevant load was handgrip strength, explaining why such tasks were completed by 100% of male personnel but only 35% (prior to training) to 52% (post-training) of female personnel (20).

TWO-MILE RUN

To earn the minimum passing score of 60 on the two-mile run portion of the ACFT, male soldiers were required to complete a two-mile run in under 22:00 and female soldiers were required to completed the same run in under 23:13 (Figure 5). At the time of the first implementation of the ACFT, the men's world record for fastest two-mile run time was 7:59 and the women's world record for fastest two-mile run time was 8:59. This means in order to earn the minimum passing score of 60 points, male soldiers needed to complete a two-mile run within 2.8 times the world record limit while female soldiers needed to complete the same run within the shorter relative duration of 2.6 times the world record limit. Female soldiers were thus required to maintain a pace closer to the world record than were their male counterparts to earn the same number of points on the two-mile run portion of the ACFT (Figure 6).

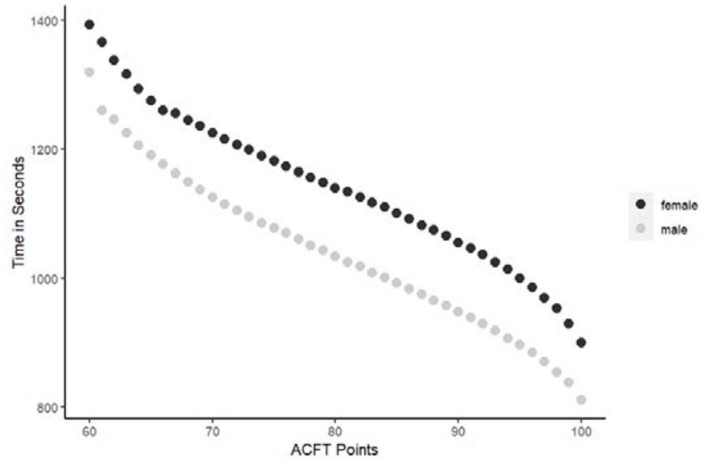

FIGURE 5. SEX DIFFERENCES IN ACFT POINTS AWARDED TO AN AVERAGE-AGED SOLDIER AS A FUNCTION OF TWO-MILE RUN TIME IN SECONDS

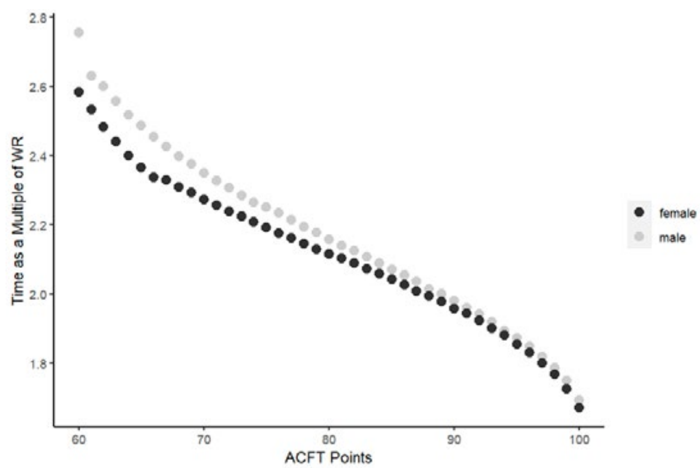

FIGURE 6. SEX DIFFERENCES IN ACFT POINTS AWARDED TO AN AVERAGE-AGED SOLDIER AS A FUNCTION OF TWO-MILE RUN TIME RELATIVE TO WORLD RECORD LIMITS

Note: In order to earn the same number of points as male soldiers on the two-mile run portion of the ACFT, female soldiers needed to run at a pace closer to the world record pace than was required of male soldiers.

WHAT IT MEANS AND WHY IT MATTERS

Arguments have been made against sex-normed physical fitness requirements, claiming various harms of holding female soldiers to a "lower standard" compared to male soldiers (24). The authors claim that the US Army's physical fitness test effectively held female soldiers to a higher relative standard, not a lower one. Our evaluation could partially explain the reported sex differences in ACFT passing rates and overall attrition rates, particularly for female soldiers in "heavy" physically-demanding units or jobs. When considering biologically constrained sex differences in human anatomy and demonstrated performance limits (e.g., world records), it becomes clear that female soldiers were required to run relatively faster, lift relatively heavier weights, and generally expend a larger portion of their energetic resources than were their male counterparts. In short, reaching the US Army's physical fitness standards was effectively more physiologically costly for female soldiers. It is akin to the "pink tax" phenomenon in economics, whereby women are charged higher rates for the same goods and services than men (16). Instead of money, though, this metabolic pink tax charged female soldiers a higher fee in terms of energetics. This inequity required female soldiers to reach levels of achievement that were substantially closer to the upper limits of what is physiologically possible compared to what was required of male soldiers.

The authors are not claiming that female soldiers as a group are categorically incapable of doing the same jobs as male soldiers. Rather, we are clarifying the truth that any individual female soldier who completes the same physical feat as a male soldier has done so at a considerably higher metabolic cost. Therefore, it is essential that every echelon of a tactical organization – from leaders, program managers, and coaching staffs, to those responsible for unit-level physical readiness training – recognizes the higher metabolic cost to female personnel compared to their male counterparts throughout the lifecycle of a training program or plan. At this stage of ACFT implementation, it will be difficult to correct success-rate inequities of approved standards. Units, instead, can scale physical readiness plans by sex (for large formations) or can introduce sex-specific strength and conditioning programs for mitigating injury risk as recently introduced in a military-relevant population (1). The return on investment for sex-tailored physical readiness plans to offset approved standards include improved individual performances on the ACFT and greater unit pass rates.

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