

RELATIONSHIP OF FAT MASS-TO-FAT-FREE MASS RATIO AND PUSH-UP PERFORMANCE IN HEALTHY YOUNG ADULTS

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Abstract

INTRODUCTION: Fat mass (FM) and fat-free mass (FFM) have been two body composition metrics shown to relate to muscular performance. However, the impact that these metrics have on performance is not independent. To account for this, the FM-to-FFM ratio (FM:FFM) is an emerging body composition marker that may relate to performance above and beyond their standalone values. **PURPOSE:** The purpose of this study was to determine if push-ups to failure was more strongly related to the FM:FFM compared to FM and FFM alone in a sample of healthy adult men and women. **METHODS:** One-hundred forty-five (49% women) individuals (24.1 ± 7.9 years, 172.4 ± 9.9 cm, 74.0 ± 15.8 kg) agreed to participate in the study. During a single visit to the Exercise Physiology Laboratory at the University of Alabama, self-reported age and gender were collected for each participant. Standing height was measured to the nearest 0.1 cm using a stadiometer (SECA 213, Seca Ltd., Hamburg, Germany). Body mass was measured to the nearest 0.1 kg using a calibrated digital scale (Tanita BWB-800, Tanita Corporation, Tokyo, Japan). Dual Energy X-Ray Absorptiometry (DXA) was used to determine FM and FFM. Then, FM was divided by FFM to give the FM:FFM ratio. Subjects then completed a maximal-rep push-up test. Based on self-reported gender, females were required to do push-ups on their knees and males were required to not use their knees to standardize form based on established strength differences between genders. Pearson correlational analysis was completed using SPSS to determine the relationships between body composition metrics and muscular performance. Statistical significance was considered as $p < 0.05$. **RESULTS:** The mean ± standard deviation for FM was 19.8 ± 8.6 kg, for FFM was 54.2 ± 12.9 kg, for FM:FFM was 0.385 ± 0.179, and for maximal push-ups was 32.9 ± 15.5 repetitions. The push-ups performance significantly correlated with FM ($r = -0.44$, $p < 0.001$), FFM ($r = 0.32$, $p < 0.001$) and FM:FFM ($r = -0.54$, $p < 0.001$). **CONCLUSION:** The results of the study show that push-up test performance is related to FM, FFM, and FM:FFM. However, FM:FFM provided the strongest correlation to the push-ups test. **PRACTICAL APPLICATION:** Based on these results, practitioners should consider accounting for both FM and FFM codependently when relating body composition to muscular performance. Additionally, more research should be completed to validate these findings, as well as compare these metrics to other demonstrations of muscular performance.

Introduction & Purpose

- It has been well established through research that body composition is related to the amount and type of physical activity as well as muscular fitness.
- Fat mass (FM) and fat-free mass (FFM) have both been shown to independently relate to muscular performance.
- FM is negatively correlated with impaired muscular strength and performance, (1,2,3), while higher muscular performance and strength is associated with higher levels of FFM, (2,3).
- Recently, a new metric related to body composition has been shown to be effectively related to health outcomes. This metric is known as the ratio between FM and FFM or FM:FFM, (4).
- The ratio of FM:FFM can be effective in allowing individuals to understand the distribution of tissue types within a body compared to simple percent body fat.
- While FM:FFM has been assessed in healthy adults, it's relationship with muscular fitness has not been thoroughly studied, especially when compared to FM and FFM alone.
- The purpose of this study was to determine the relationship between FM:FFM ratio and muscular fitness as assessed by a maximal-rep push-up test.

Methods

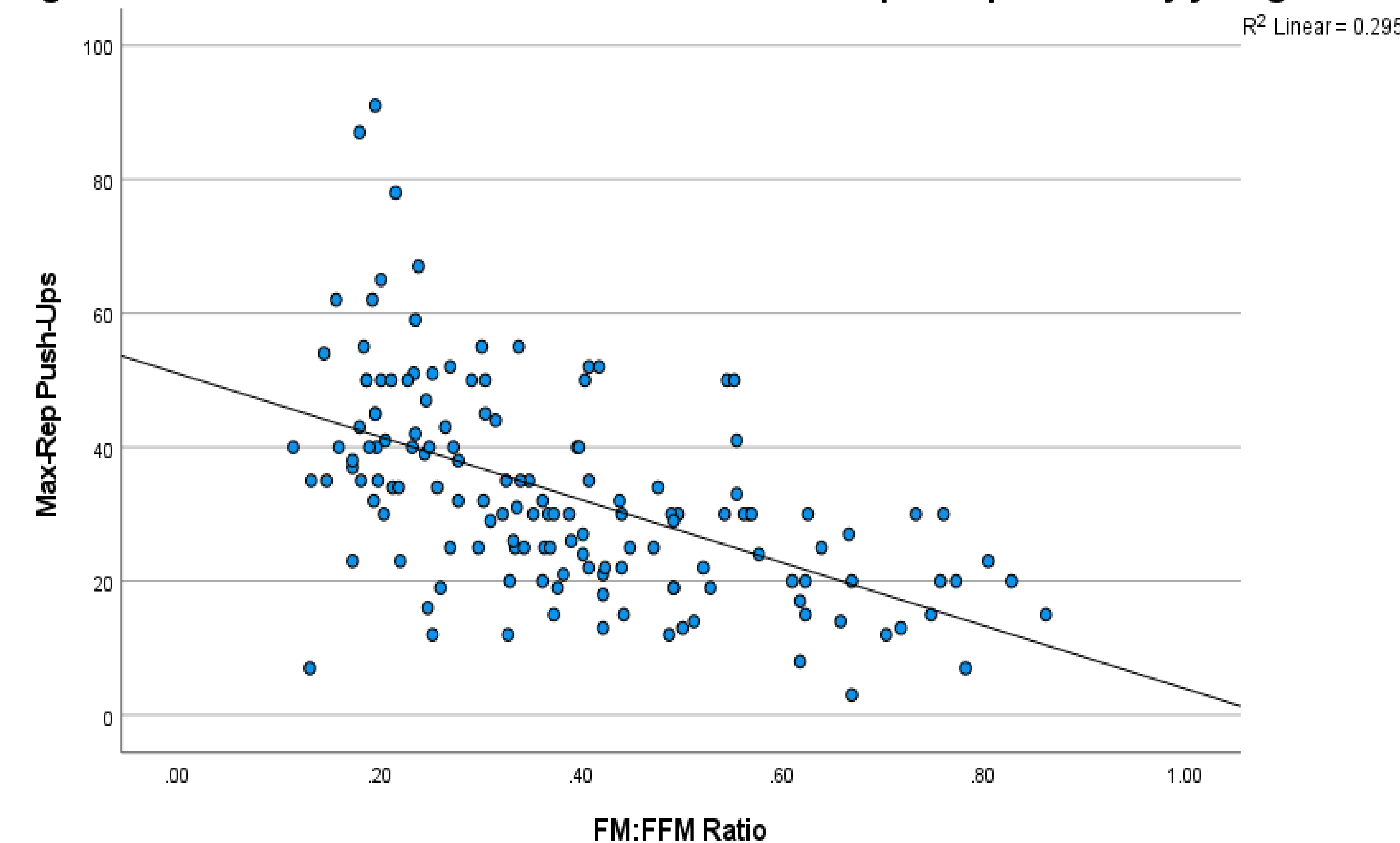
- A convenience sample of participants was recruited for the study, (n=145, Female = 49%, 24.1 ± 7.9 yrs).
- Standing height was measured to the nearest 0.1 cm using a stadiometer, and body mass was measured to the nearest 0.1 kg using a calibrated digital.
- Fat mass and fat-free mass in was measured using dual x-ray absorptiometry, (DXA).
 - FM:FFM ratio was calculated by dividing FM by FFM for each subject.
- Subjects then completed a max-rep push-up test to assess muscular performance.
- Based on self-reported gender, females were required to do push-ups on their knees and males were required to not use their knees to standardize form based on established strength differences between genders.
- Pearson correlational analysis was completed using SPSS to determine the relationships between body composition metrics and muscular performance. Statistical significance was considered as $p < 0.05$.

Results

Table 1. Pearson Correlational analysis related to push-up performance

	r	R ²	P
FM	-0.440	0.194	< 0.001
FFM	0.318	0.101	< 0.001
FM:FFM	-0.544	0.296	< 0.001

Figure 1. Correlation between FM:FFM Ratio and AMRAP push-ups in healthy young adults.



Conclusions

- Average FM:FFM ratio for the entire population was 0.385 ± 0.179, (means ± sd). This is toward the higher end of the previously established median values for young adults (≤39.9 years old) which was 0.24 for males and 0.40 for females, (4).
- The correlational analysis showed higher r and R² values between FM:FFM and push-up performance than FM or FFM individually, displaying 0.102 and 0.195 higher R² values.
- The higher variance accounted for by FM:FFM could indicate that this ratio is a better predictor of muscular fitness compared to FM or FFM alone.
- Limitations for this study include the fact that this study was correlational in nature. Future studies should assess the direct impact of FM, FFM, and FM:FFM comparatively on muscular fitness.
- Another limitation is that male and females have biological and physiological differences that cause variance in both FM:FFM ratio and muscular fitness results. Additional studies should assess these direct differences and determine normative values.
- Finally, this is, to the researchers' knowledge, one of the first studies assessing the correlations between FM:FFM ratio and muscular fitness assessments. Follow-up research should be conducted to verify these findings.
- Additionally, this was a healthy, average population. There may be different relationships between FM:FFM and muscular fitness in elite or diseased individuals. Research should be done to assess these relationships.

Practical Applications

- These findings suggest that FM:FFM may be a better indicator of muscular fitness in average healthy young adult populations than simply FM or FFM alone.
- Practitioners may find that utilizing this tool can be a useful and effective addition to their body composition assessments to look at muscular fitness

References

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