



Changes in Physical Training, Physical Performance, and Injury After Implementation of an Age and Gender-Neutral Military Fitness Test

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Previous Test of Record: Army Physical Fitness Test

- The previous Army physical fitness test (APFT) was used from 1980 to 2022
- Gender- and age-normed
- Three events
 - Maximum push-ups in two minutes
 - Maximum sit-ups in two minutes
 - Two-mile run for time
- The APFT provides moderately poor predictability in identifying Soldiers capable of executing warrior task and battle drills and common Soldier tasks ($R^2=0.432$, $p<0.01$)*

*East et al. Baseline Soldier Physical Readiness Requirements Study, 2019



Current Test of Record: Army Combat Fitness Test

- As of 1 Oct 2022, the Army Combat Fitness Test (ACFT) officially replaced the APFT.
- Gender- and age-normed
- Six events
 - Three repetition maximum deadlift
 - Standing power throw for distance
 - Maximum hand release push-ups in two minutes
 - Sprint-drag-carry event for time (5X50 meter shuttle)
 - Plank as long as possible
 - Two-mile run for time
- The ACFT provides acceptable predictability to identify Soldiers capable of executing warrior task and battle drills and common on Soldier tasks ($R^2=0.835$, $p<0.01$)*

*East et al. Baseline Soldier Physical Readiness Requirements Study, 2019



Purpose

- To assess potential changes in physical training, physical performance, and musculoskeletal injury before and after the implementation of the pilot ACFT



Surveys

- Sixty-one battalions were selected to pilot the new ACFT
- Baseline survey administered from Oct 2018 to Apr 2019 and inquired about the previous 12 months
- Follow-up survey administered from Jan to Apr 2020 and inquired about the previous 12 months



Pilot ACFT

- Soldiers completed multiple ACFTs during this pilot investigation
- ACFT:
 - Gender- and age-neutral
 - ACFT minimum passing standards were based on the physical demand levels of a Soldier's military occupational specialty:
 - ✓ Moderate – Lift up to 20 lbs. with frequent lifting of 10 lbs.
 - ✓ Significant – Lift up to 50 lbs. with frequent lifting of 25 lbs.
 - ✓ Heavy – Lift up over 100 lbs. with frequent lifting of 50 lbs.



Pilot ACFT Events

- Pilot ACFT events:
 - Three repetition maximum deadlift
 - Standing power throw for distance
 - Maximum hand release push-ups in two minutes
 - Sprint-drag-carry event for time (5X50 meter shuttle)
 - Maximum number of leg tucks in two minutes
 - Two-mile run for time



ACFT Minimum Passing Standards

Pilot ACFT minimum passing standards by the military occupational specialty standards of moderate, significant and heavy

Events	Moderate	Significant	Heavy
Deadlift (lbs.)	140	160	180
Power Throw (meters)	4.6	6.5	8.5
Hand Release Push-Ups (reps)	10	20	30
Sprint-Drag-Carry (min)	3:35	2:45	2:09
Leg Tuck (reps)	1	3	5
Two-Mile Run (min)	21:07	19:00	18:00



Respondents

	Completed a Baseline Survey	Completed a Follow-up Survey	Completed Both Surveys
Men	4,229	2,859	871
Women	969	661	263
Total	5,198	3,520	1,134



Demographics for Men

	Baseline Survey Before Pilot	Follow-up Survey After Pilot	Both Surveys Before Pilot	Both Surveys after Pilot
Age (yrs.)	28.8±7.9	29.8±8.3	31.3±8.6	32.4±8.6
Height (in)	70.0±3.2	69.8±2.8	70.2±3.3	70.0±2.8
Weight (lbs.)	184.1±27.6	185.5±28.1	185.5±27.4	188.3±27.2
Body Mass Index (kg/m ²)	26.5±3.4	26.8±3.3	26.4±3.3	27.0±3.2
Cigarette Smokers %	14.6	14.6	11.0	12.3
Sleep Duration (hours)	6.1±1.3	6.0±1.3	6.1±1.1	6.0±1.2



Demographics for Women

	Baseline Survey Before Pilot	Follow-up Survey After Pilot	Both Surveys Before Pilot	Both Surveys after Pilot
Age (yrs.)	28.3±7.4	28.6±7.5	30.0±7.8	30.9±7.7
Height (in)	65.0±3.3	64.9±3.0	65.4±3.5	65.1±2.8
Weight (lbs.)	146.9±21.4	147.8±20.8	146.7±20.9	148.3±21.1
Body Mass Index (kg/m ²)	24.5±3.1	24.7±2.8	24.1±3.1	24.6±2.9
Cigarette Smokers %	7.0	6.8	3.8	4.2
Sleep Duration (hours)	6.1±1.4	6.0±1.4	6.3±1.1	6.2±1.3



Unit Physical Fitness Training for Men

Minutes per Week of Unit Physical Training	n	Before ACFT Pilot	After ACFT Pilot	Percent Change	p-value*
Run	375	69.0±32.9	66.1±47.4	-4.4	0.29
Sprinting	386	41.4±33.5	42.8±34.9	+3.4	0.54
Calisthenics	385	52.7±51.5	44.9±45.9	-17.4	<0.01
Cross-training	382	43.2±41.9	50.2±46.4	+16.2	0.02
Agility Training	384	28.8±35.6	31.0±35.3	+7.6	0.37
Resistance Training	386	43.2±47.4	55.7±59.1	+28.9	<0.01
Total Exercise Time	389	278.9±130.5	295.4±126.0	+5.9	0.04

*Paired t-test

Population is Soldiers who completed both surveys



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Unit Physical Fitness Training for Women

Minutes per Week of Unit Physical Training	n	Both Surveys Before Pilot	Both Surveys after Pilot	Percent Change	p-value*
Run	83	69.1±34.1	61.8±34.1	-7.3	0.16
Sprinting	87	45.0±37.7	45.9±38.8	+2.0	0.87
Calisthenics	86	41.2±51.2	45.1±44.2	+9.5	0.54
Cross-training	86	49.7±53.0	54.3±52.2	+9.3	0.51
Agility Training	86	30.5±39.1	29.8±37.7	-2.3	0.90
Resistance Training	87	41.7±48.0	64.0±60.9	+53.5	<0.01
Total Exercise Time	88	273.5±139.3	299.9±129.7	+9.7	0.15

*Paired t-test

Population is Soldiers who completed both surveys



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Personal Physical Fitness Training for Men

Minutes per Week of Unit Physical Training	n	Both Surveys Before Pilot	Both Surveys after Pilot	Percent Change	p-value*
Run	511	57.6±64.2	65.1±63.4	+13.0	0.02
Sprinting	510	26.9±38.3	25.3±35.4	-6.3	0.41
Calisthenics	511	37.0±53.1	38.1±55.9	+3.0	0.72
Cross-training	512	45.9±70.6	50.8±70.8	+10.7	0.20
Agility Training	509	14.8±29.9	16.8±34.1	+13.5	0.25
Resistance Training	510	73.0±101.8	90.7±113.9	+24.2	<0.01
Total Exercise Time	513	326.4±201.7	290.7±200.6	-12.3	<0.01

*Paired t-test

Population is Soldiers who completed both surveys



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Personal Physical Fitness Training for Women

Minutes per Week of Unit Physical Training	n	Both Surveys Before Pilot	Both Surveys after Pilot	Percent Change	p-value*
Run	167	58.8±45.3	61.2±48.6	+4.1	0.18
Sprinting	169	29.6±39.5	28.3±43.3	-4.6	0.75
Calisthenics	169	31.5±45.1	26.3±43.0	-19.8	0.23
Cross-training	169	62.7±74.8	60.1±83.2	-4.3	0.74
Agility Training	167	13.3±28.2	12.9±28.7	-3.1	0.88
Resistance Training	169	62.3±81.2	86.3±95.3	+38.5	<0.01
Total Exercise Time	169	326.5±203.9	277.4±194.1	-17.7	<0.01

*Paired t-test

Population is Soldiers who completed both surveys



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ACFT Pass and Fail Percentages for Men

Event	n	Percent Passed	Average Pass Performance	Percent Failed	Average Fail Performance
Deadlift (lbs.)	2002	95.1	247.4±59.3	4.9	169.6±12.6
Standing Power Throw (m)	1951	94.6	9.6±1.7	5.4	7.0±0.8
HR Push-ups (reps)	1958	97.1	35.9±10.7	2.9	23.4±4.9
Sprint-Drag-Carry (min)	1955	94.8	1.87±0.25	5.2	2.34±0.23
Leg Tuck (reps)	2013	88.0	9.2±5.5	12.0	0.94±1.4
Two-Mile Run (min)	1850	89.8	16.43±1.72	10.2	20.8±2.31
Overall Pass and Fail Rates	2021	75.6	481±61	24.4	403±73

Maximum score of 100 points per ACFT event with a maximum total score of 600

ACFT data is from the Defense Training Management System for those who completed a follow-up survey



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ACFT Pass and Fail Percentages for Women

Event	n	Percent Passed	Average Pass Performance	Percent Failed	Average Fail Performance
Deadlift (lbs.)	364	73.6	175.6±35.8	26.4	151.0±17.1
Standing Power Throw (m)	385	57.7	6.2±1.6	42.3	5.2±1.1
HR Push-ups (reps)	377	88.3	25.3±9.8	11.7	15.5±7.6
Sprint-Drag-Carry (min)	379	67.3	2.32±0.32	32.7	2.70±0.40
Leg Tuck (reps)	393	34.9	5.6±4.3	65.1	0.23±0.71
Two-Mile Run (min)	352	79.5	17.64±1.58	20.5	21.03±2.07
Overall Pass and Fail Rates	397	27.2	419±62	72.8	315±66

Maximum score of 100 points per ACFT event with a maximum total score of 600

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Average ACFT Performance by Body Mass Index for Men

Event	BMI ≤24.99	BMI 25.00-27.49	BMI 27.5-29.99	BMI ≥30.00
Deadlift (lbs.)	221±52*	245±59*	258±61	264±63 (REF)
Standing Power Throw (m)	8.8±1.6*	9.5±1.7*	9.7±1.7*	10.2±1.7 (REF)
HR Push-ups (reps)	36±11*	37±11*	35±11	34±9.7 (REF)
Sprint-Drag-Carry (min)	1.91±0.27	1.87±0.28*	1.88±0.25*	1.93±0.28 (REF)
Leg Tuck (reps)	9.4±5.7*	8.7±6.0*	7.3±5.6*	5.9±5.0 (REF)
Two-Mile Run (min)	16.3±2.0*	16.6±2.1*	17.3±2.2*	18.1±2.3 (REF)

REF=Reference, *ANOVA with Least Squared Difference Post Hoc test $p < 0.05$

ACFT data is from the Defense Training Management System for those who completed a follow-up survey

BMI = Body Mass Index



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Average ACFT Performance by Body Mass Index for Women

Event	BMI ≤24.99	BMI 25.00-27.49	BMI ≥27.50
Deadlift (lbs.)	166±30*	169±33*	181±43 (REF)
Standing Power Throw (m)	5.6±1.5*	5.8±1.4*	6.4±1.6 (REF)
HR Push-ups (reps)	25±11	23±9	23±9 (REF)
Sprint-Drag-Carry (min)	2.44±0.42	2.43±0.36	2.45±0.35 (REF)
Leg Tuck (reps)	2.5±3.9*	1.8±3.3	1.1±3.0 (REF)
Two-Mile Run (min)	18.1±2.2*	18.2±1.9*	19.6±2.4 (REF)

REF=Reference, *ANOVA with Least Squared Difference Post Hoc test $p < 0.05$

ACFT data is from the Defense Training Management System for those who completed a follow-up survey



Injury Rates Before and After the ACFT

- Medical record data used to determine injury rates 12 months before and after the implementation of the ACFT
- Men
 - Before 40.8%, After 47.6%
 - Risk Ratio 1.17, 95%CI 1.05-1.30, $p < 0.01$
- Women
 - Before 46.0%, After 55.9%
 - Risk Ratio 1.22, 95%CI 1.03-1.44, $p = 0.02$



Adjusted Odds Ratios Associated with Musculoskeletal Injury Risk for ACFT Events Controlling for Age and BMI for each Event (Men)

- Deadlift
 - ≤ 190 lbs./ ≥ 296 lbs. (REF), OR 1.51, 95%CI (1.16-1.96), $p < 0.01$
- Hand Release Push-ups
 - ≤ 29 reps/ ≥ 43 reps (REF), OR 1.55, 95%CI (1.20-2.02), $p < 0.01$
- Sprint-Drag-Carry
 - ≤ 2.06 min/ ≥ 1.68 min (REF), OR 1.38, 95%CI (1.06-1.81), $p = 0.02$
- Leg Tuck
 - ≤ 3 reps/ ≥ 12 reps (REF), OR 1.51, 95%CI (1.15-1.97), $p < 0.01$
- Two-Mile Run
 - ≤ 18.04 min/ ≥ 15.42 min (REF), OR 1.31, 95%CI (1.00-1.72), $p = 0.05$
 - ≤ 18.04 min/ ≥ 16.73 -18.03 min (REF), OR 1.33, 95%CI (1.02-1.74), $p = 0.04$



Adjusted Odds Ratios Associated with Musculoskeletal Injury Risk for ACFT Events Controlling for Age and BMI for each Event (Women)

- Sprint-Drag-Carry
 - ≤ 2.54 min/ ≥ 2.23 min (REF), OR 2.16, 95%CI (1.29-3.62), $p < 0.01$
 - ≤ 2.54 min/2.24-2.53 min (REF), OR 1.91, 95%CI (1.12-3.25), $p = 0.02$
- Two-Mile Run
 - ≤ 18.04 min/ ≥ 15.42 min (REF), OR 1.31, 95%CI (1.00-1.72), $p = 0.05$



Conclusions

- With the implementation of a new physical fitness test, the ACFT, physical training behavior, physical performance, and musculoskeletal injury incidence will likely be affected.
- Soldiers are likely to adapt their physical training program to meet the demands of a new physical fitness test.
- Sex and body composition influenced military physical fitness test performance.
- Low performance on five of the six ACFT events were associated with a higher risk of a musculoskeletal injury for men and two of the six ACFT events for women.

