

Headquarters U.S. Air Force

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Air Force Research to Inform Gender Integration Decisions



**Neal Baumgartner, Ph.D.
Chief, AF Exercise Science Unit
AF/A1P / AFPC/DSY, JBSA Randolph, TX**

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AF Development of OSOR PF Tests and Standards

- **BLUF: AF research work: 1) employed a scientifically and legally defensible process, that 2) produced an occupationally-specific, operationally-relevant (OSOR) and gender-neutral prototype physical product that can be used to successfully integrate females into previously closed career fields; for tests and training**

- **Five major steps to develop and validate OSOR, science-based, criterion physical performance tests and standards**
 1. **Conduct an AFSC-specific physical demand job analysis to identify, describe and quantify physically demanding tasks/job requirements**
 2. **Develop tests to evaluate ability to perform physically demanding work; Test Battery (TB), Physical Task Simulations (PTs)**
 3. **Define physical capacity to perform work; establish minimum test scores; validate and set physical tests and standards**
 4. **Implement test prototype, standardize test administration, verify tests and standards against ops performance, provide science-based exercise training principles and methods**
 5. **Public law adaptation period and study publications**

Constable S.H. and Palmer B., editors. The Process of Physical Fitness Standards Development. Human Systems Information Analysis Center State of the Art Report. Wright-Patterson Air Force Base, OH., 2000



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Step 1 - Physical Demand Analysis per BFOR

- **Step 1 - Conducted physical demand job analysis per “Bona Fide Occupational Requirements” process; developed AFSC-specific Critical Physical Tasks (CPTs) = Occupational Standards**
 - Specifically, defined and delineated duty tasks that are both physically demanding *and* critical to mission success
 - Developed preliminary task lists (PPTs) from AFSC source documentation
 - 1A Focus Groups ($n = 60$; 3 FGs per AFSC) and 1B AF-wide Scoring Assessments ($n = 798$) objectively scored physical tasks for frequency, duration, intensity and importance
 - 1C Observations/Needs Analyses (observed 6 Full Mission Profiles)
 - 1D Leadership Interviews - reviewed final CPTs (31 x one hour/each)
 - **Products:** Analysis identified operationally-required CPTs, plus six PF components and 14 physical movement patterns necessary to perform CPTs

TABLE 1: CPTs identified out of total number of duty tasks.

PJ/CRO	CCT/STO	TACP/ALO	SOWT
50 of 981	40 of 556	44 of 415	50 of 586

- **Example:** “Extract a 185 pound casualty and 65 pounds of equipment from a combat disabled vehicle to an operational vehicle while wearing combat load”



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Step 2 - Physical Task Simulations and Physical Fitness Tests

- **Step 2 - used CPTs to develop Physical Task Simulations (PTSs); developed fitness tests (PFTs) to evaluate ability to perform PTSs**
 - **2A Developed 15 PTSs via AFSC SME workshops and interviews**
 - **2B Identified 85 PF test candidates per objective criteria**
 - **Objectively scored: content validity, physical descriptor (14) breadth, ease of administration, resources, subject skill requirements**
 - **Discriminators: PF component (11) breadth, SME input, injury risk, literature, reliability, standards, protocol, field vs lab, cost, face validity, adverse impact**
 - **Narrowed PF test candidates from 85 → 65 → 39 (scoring matrix / pilot work)**
 - **2C Conducted testing, subjects ($n = 171$, 62 female; age, 28.5 ± 5.6 yrs) completed 15 PTSs and 39 PF tests to determine the optimal PF test battery for predicting operational task success**
 - **2D Established Test-Performance Link and Min Effective Times (METs)**
 - **Products: valid PTSs and initial Prototype PF test battery 39 → 10; ten component Prototype PFT addresses all operationally-required PFCs (6) and all physical movement patterns (14)**

PTS x PFT Link

PTS: Cross Load Personnel and Equipment

- Cross load injured personnel, two ruck sacks, two weapons from damaged vehicle to operational vehicle / Casualties 215 lb each (185 lb + 30 lb vest) / Subject vest 30 lb



Predictive PF Test

Farmer's Carry

- PFCs: anaerobic metabolism, muscular strength
- Physical Descriptors: Velocity, Lift, Power, Isometric Contraction
- Run 100 yards while carrying two 50 lb sandbags





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Step 3 - Validate and Set Physical Tests and Standards

- **Step 3 - Validated and set physical tests and standards**
 - **3A Scored separate set of subjects ($n = 34$, 9 female; age, 26.8 ± 5.2 yrs) on PTSs and Prototype PFT**
 - **3B Scored separate set of operators ($n = 29$; age, 26.9 ± 4.8 yrs) on the PFT before and after a physically arduous FMP, one group ($n = 16$) in jungle operations, a second ($n = 13$) in high altitude operations; effects of mission and environment**
 - **3C Set physical performance standards at operational level via test data, METs, and mission/environmental effector data**
 - **Products: Prototype Tests and Standards at RATO levels with:**
 - **Strong predictive validity - average number of PTSs per PF test component was higher in PFT than incumbent test (4.3 PTS per test component vs 1.6) at strong ($r = 0.75$ to 1) or moderate ($r = 0.50$ to 0.74) correlations, and lower in PFT than incumbent (3.7 PTS per test component vs 6.4) at low ($r = 0.25$ to 0.49) or very low ($r = 0$ to 0.24) correlations**
 - **Additionally, PFT explained variance in subjects' PTS performance significantly better than incumbent test**

Adjusted R² for Incumbent and Prototype Tests for Predicting PTS Performance

	PJ/CRO	CCT/STO	TACP/ALO	SOWT
Incumbent	59%	63%	58%	62%
Prototype	78%	82%	80%	80%

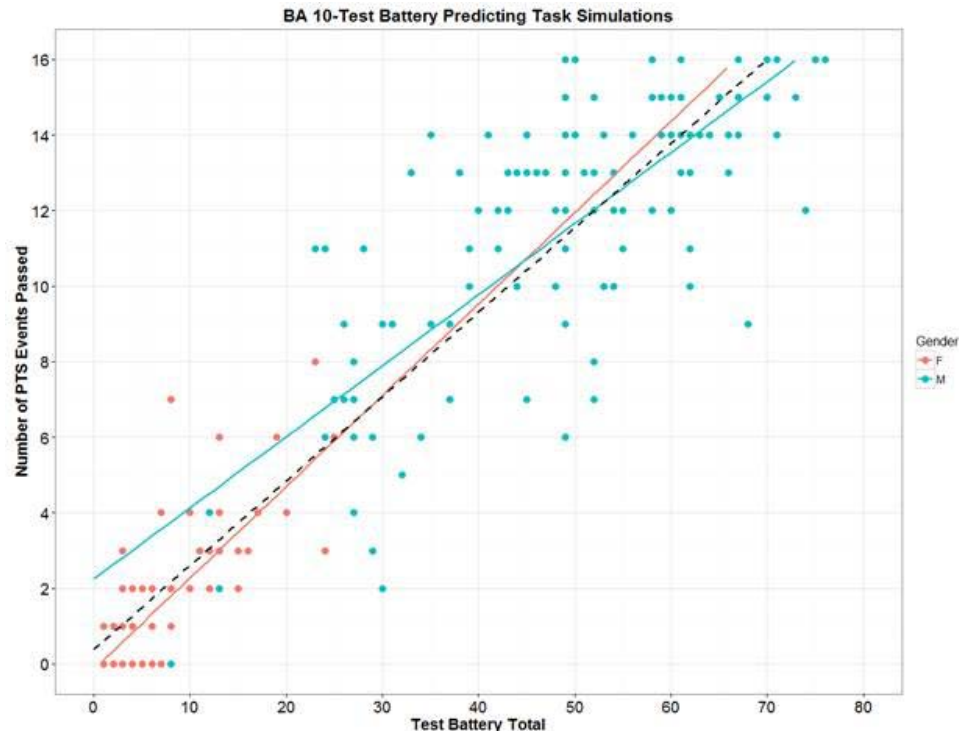
Step 3 - continued

- **Consequential Validity/Classification Accuracy - Prototype PFT classification accuracy was significantly better at 85% correct versus incumbent test at 66% (p < .05)**

Classification Accuracy for
Incumbent and Prototype Tests (CCT)

Incumbent Test		Prototype Test	
Correct	Incorrect	Correct	Incorrect
66%	34%	85%	15%

- **Gender Neutrality - Prototype PFT differences in prediction at the passing score were only 0.0 to 2.0 PTSs which are not at a level of practical importance, confirming gender neutrality**





Step 4, 5, and Training

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- **4A - implemented Prototype PFT at 13 ALO-TACP units; units conducted tests ($n = 809$) over six month period**
- **4B - conducted verification tests ($n = 47$, 4 females) Prototype PFT vs ALO-TAP specific PTSs**
- **4C - refining final recommended product for ALO-TACP**
- **Step 5 - public law adaptation period and study publications**
- **Study proved efficacious for:**
 - **Developing viable Prototype PF tests and standards that strengthen the validity and mitigate deficiencies in traditional PF tests**
 - **Prototype PFT meets public law requirements that qualifying PF tests and standards for military specialties be OSOR and gender neutral**
- **Training**
 - **Sex differences - see ACSM Position Stand**
 - ***AF Exercise Principles and Methods Course* - provides science-based exercise training principles and methods for myriad units, programs, AFSCs, males and females; includes sex-specific training methods/techniques**

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PF Test Battery *Prototype*

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PFC	Selection 1	Selection 2	Training	Operations
Power	Standing Long Jump	Med Ball Toss, back/side	Med Ball Toss, back/side	Med Ball Toss, back/side
Agility	Three Cone Drill	Three Cone Drill	Three Cone Drill	Three Cone Drill
Strength	Grip Strength	Grip Strength	Grip Strength	Grip Strength
Endurance	Lunges-wtd, 50 lbs	Lunges-wtd, 50 lbs	Lunges-wtd, 50 lbs	Lunges-wtd, 50 lbs
	Pull-Up	Pull-Up	Pull-Up	Pull-Up
Anaerobic	Ext Cross Knee Crunch	Ext Cross Knee Crunch	Ext Cross Knee Crunch	Ext Cross Knee Crunch
	Shuttle Run, 300 yd	Farmer's Carry, 100 yd	Farmer's Carry, 100 yd	Farmer's Carry, 100 yd
Aerobic	Run, 1.5 mile	Run, 1.5 mile	Row Ergometer, 1000 m	Row Ergometer, 1000 m
	Surface Swim, 500 m	Fin Swim, 500 m	Run, 1.5 mile (Tier 1)	Run, 1.5 Mile (Tier 1)
Additional Required Tests:	UW 25m	Basic Water Skills Test (Underwater, Treading Water, Snorkel)	Ruck, 10 mi - 50 lbs*	Ruck, 10 mi - 50 lbs*
	SAT at MEPS		Fin Swim, 1500 m*/500 m	Fin Swim, 1500 m*/500 m
			*Career field requests; requires further study	
Optional tests with operationally-relevant standards			Chest Pass, Long Jump, Pull-Up-wtd 25 lbs, Inverted Row, Push-up (metronome), Shuttle Run, Sled Drag, Sled Haul, Row Ergometer 500 m, Run 800 m, Versa Climber, Ruck, 3 mi - 50 lbs	
Selection 1 [PAST-R] - Recruit 1 (initial) and Recruit 2 (pre-ship); Selection 2 [PAST-A] - BMT 0 WOT and Transition Week pre-TT				

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PF Test Battery *Prototype*

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TACP/ALO	Grip Strength Max	Med Ball Toss Sum	Three Cone Drill	Trap Bar DL	Pull up	Lunges Wtd	Ext Cross Knee Crunch	Farmer's Carry	Row Erg 1000m	Run 2414m
Points	kPa	m	secs	kg	reps	reps	reps	secs	mins:secs	mins:secs
10	1365	15.4	7.4	212	30	199	168	13.2	3:19	7:40
9	1145	14.5	7.8	186	26	161	149	15.1	3:25	8:15
8	1055	13.6	8.2	171	23	125	130	17.2	3:34	9:03
7	993	12.8	8.5	161	20	104	111	18.5	3:39	9:35
6	945	12.3	8.7	152	18	88	92	19.6	3:43	10:01
5	896	11.9	8.9	145	16	74	73	20.7	3:48	10:26
4	855	11.4	9.2	137	14	62	55	21.7	3:52	10:49
3	807	10.8	9.4	129	12	50	40	22.8	3:56	11:16
2	745	10.2	9.7	118	9	36	28	24.2	4:01	11:48
1	655	9.1	10.1	103	6	21	16	26.2	4:10	12:35

TACP- Component Minimums indicated in blue

Composite score requirement ≥ 52 of 100

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Sex/Gender Physiological Differences



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Iron Status

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- **Most service members experience decreases in iron stores during intense physical training, but women have a precipitous decline compared to men**
- **Effects of low iron levels (with or without anemia):**
 - **Decreased aerobic capacity impacts physical fitness ability**
 - **Increased musculoskeletal injuries, particularly stress fractures**
 - **Increased emotional lability**
 - **Neurocognitive impairment**
 - **Diminished immune function**
- **Women have a higher attrition rate from basic military training as compared to men**
- **Two projects underway to improve the iron status of military women**
 - **Process Improvement Project**
 - **Small Business Innovation Research**



Iron Status Project #1

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- **Project #1: Process Improvement project, “Evaluation of a Standard Clinical Practice Guideline for Sustaining Iron Status in Female Warriors”**
- **Three-year JPC-5 funded study to hire personnel to implement clinical practice guideline (CPG)**
- **Begin study implementation at JB-San Antonio, Lackland AFB, TX**



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Iron Status Project #2

- **Project #2:Technology,“Iron Status Determination Point-of-Care Device”**
- **Three-year Small Business Innovation Research (SBIR) funded by US Army Medical Research Acquisition Activity at Ft. Detrick**
- **Three companies developing a small (portable) iron deficiency determination device to be used in high volume settings, like basic military training**
- **Use less than 3 cc of blood and determine results in less than 5 minutes**
- **Device displays a probable diagnosis based on laboratory results that will aid in determining need to see provider**
- **Phase 1 of 3, concept development, is complete**



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Back Up Slides



- **Most service members experience decreases in iron stores during intense physical training, but women have a precipitous decline compared to men**
- **Risk factors for low iron for trainees in military training settings:**
 - **Inadequate iron-rich food intake**
 - **Foot-strike hemolysis**
 - **Losses through sweat**
 - **Gastrointestinal blood loss**
 - **Urinary blood loss**
 - **Increased body temperature**
 - **Blood donation**
- **Women have additional losses through menstruation**



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Iron Status

- **The symptoms of low iron/anemia may be insidious and mimic vigorous physical training requirements**
- **Screening will reduce the provider reliance on vague symptoms**
- **Screening frequency based on research evidence**
 - **Ideally, before entrance into military**
 - **If not before entrance, screen day 0 with other blood analyses**
 - **Rescreen 4-5 weeks after initial testing**
 - **Rescreen every 90 days while adjusting to physically demanding environments**
 - **Before deployment for women with a history of anemia**



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Scoping Review

- **Medical literature published from 2000-2015 were reviewed on the topic of women's health**
- **Two-year project funded by TriService Nursing Research Program (TSNRP)**
- **979 articles were included in six topic areas**
- **Gender differences were included in this review**
- **Due to be publically released by Naval Health Research Center Fall 2017**



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Questions

candy.s.wilson.mil@mail.mil

202-498-1369

DSN 857-4979