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The Relationship between Physical Fitness and Combat Fitness Among Female United States Marines: A Brief Report

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Abstract- The United States Marines Corps (USMC) have implemented a Physical Fitness Test (PFT) to assess physical fitness levels and a Combat Fitness Test (CFT) to assess a Marine's functional fitness as it relates to the demands of combat operations. The PFT involves three events; pull-ups/push-ups (PU), two-minute abdominal crunches/sit-ups (AC), and a timed three-mile run (RUN). The CFT also involves three events; Movement to Contact (MTC), two-minute Ammunition Lift (AL), and Maneuver-Under-Fire (MANUF). Prior research suggests that the PFT and CFT are both necessary among male Marines. As such, the purpose of this study was to determine the degree of relationships between PFT (PU, AC, RUN, and total) and CFT (MTC, AL, MANUF, and total) scores among female Marines. The PFT and CFT scores from 554 active duty enlisted USMC females (age 22.7±1.4 years, height 163±7 cm, body mass 62.8±7.3 kg) were analyzed. Pearson correlation coefficients (r) were calculated between the PFT and CFT total scores as well as individual events. The PFT mean±sd scores were as follows: PU=7.1±4.3 (pull-ups), AC=104.9±10.2 (repetitions), RUN=1550.7±145.8 sec, PFT total=254.3±26.3. The CFT mean±sd scores were as follows: MTC=211.7±22.2 sec, AL=74.9±13.4 repetitions, MANUF=184.3±23.5 sec, CFT total=272.1±25.4. Moderate significant ($p<0.01$) correlations were found between: the PFT total and MTC (r=-0.47), PFT total and CFT total (r=0.48), RUN and MTC (r=0.56), RUN and MANUF (r=0.42), & RUN and CFT total (r=-0.50). Other correlations between variables yielded "no to low" association but were also significant due to the large sample size. Within the parameters of this study, PFT and CFT event scores demonstrated no to moderate correlations suggesting that different fitness characteristics are being assessed and supports the need for both the PFT and CFT assessments.

Keywords- *USMC, Military, Readiness*

I. INTRODUCTION

The United States Marine Corp's (USMC) Physical Fitness Test (PFT) assesses aerobic capacity (i.e., efficiency of the cardiovascular and respiratory systems) as well as the Marine's total body muscle strength and endurance [13-16]. The PFT involves three events (i.e., hybrid Pull-ups (PU)/Push-ups, two-minute timed abdominal crunches (AC), and timed three-mile run (RUN)/Row option) conducted in a two hour session [13-16]. The goal of the PFT is to help ensure that all Marines are battle-ready.

The USMC's Combat Fitness Test (CFT) is a complement to the general fitness measures included in the PFT, adding agility, coordination and anaerobic capacity measures [15]. The CFT involves performing three timed events during a two hour session in the following sequence: movement to contact (MTC), ammunition lift (AL), and the maneuver under fire (MANUF) [13-16]. The CFT's intent is to measure the Marine's physical abilities in the execution of a wide range of combat related tasks that involve muscular and cardiovascular fitness along with coordinative abilities [13,14].

Despite the USMC's implementation of both the PFT and CFT, little is known about the relationship between these two tests. This is an important question, as multiple tests that assess the same attributes simply take time away from other critical tactical training or strength and conditioning activities.

Figure 1. Extensive physical and mental preparation provides the core foundation of every US Marine (Public Domain: *www.dvidshub.net).*

Recently, Keefer and DeBeliso [7] wanted to determine if the PFT and the CFT were both necessary, or were they measuring similar attributes. Using PFT and CFT scores from 19,678 active duty, male Marines, they set out to determine the degree of relationships between PFT (PU, AC, RUN, and total) and CFT (MTC, AL, MANUF, and total) scores. Pearson correlation coefficients (r) were calculated between the PFT and CFT total scores as well as individual events. PFT and CFT event scores demonstrated no to moderate correlations suggesting that different fitness characteristics are being assessed and supports the need for both the PFT and CFT assessments. This finding helps inform efficient and necessary PFT and CFT testing, yet it only involved male, active duty Marines, limiting generalizability.

Therefore, the purpose of this study was to quantify the relationship between the USMC PFT and CFT event and total scores for the period of 01/01/2017 to 08/12/2018 in active duty, female Marines. To the best of our knowledge, this is the first systematic examination of the relationship between the USMC PFT and CFT event and total scores in female Marines and should provide insight regarding the necessity of administering both the PFT and CFT. Based on Keefer & DeBeliso [7], it was hypothesized that there would be no to moderate relationships between the USMC PFT and CFT event and total scores.

II. METHODS

A. Participants

This study was an examination of pre-existing data as collected by the USMC and archived in the USMC Operational Data Store Enterprise System and is a continuation of the Keefer and DeBeliso [7] investigation. The participant sample examined in the current study was comprised of 554 female Active Duty enlisted United States Marines between the ages of 21-25. The data examined was from USMC fitness records collected during the period of between 01/01/2017 to 08/12/2018. Permission to conduct this study of existing data was obtained from the Institutional Review Board at Southern Utah University and was approved as an exempt status (SUU IRB approval *#06-022019a*). "This research was carried out fully in accordance to the ethical standards of the International Journal of Exercise Science" as described previously [10].

G*POWER 3.1.9.2 (Universitat Kiel, Germany) software was utilized to conduct a power analysis [5]. In order to achieve a medium-high effect size of ES=0.40 [4] with a statistical power 1-β=0.80 (two- tailed, and α=0.05), 46 participants were required. The sample size examined in the current study consisted of n=554 Marines.

B. Protocol

The data for this study was obtained from the USMC Operational Data Store Enterprise System. The data consisted of age, height, weight and performance results on the PFT and CFT. Specifically, the assessed scores for: PFT total, PU, AC, RUN, CFT total, MTC, AL, and MANUF (Individuals with push-up, rowing or scores performed at altitude above 4500 feet mean sea level were not included).

Local USMC commands input PFT and CFT event performance data and calculate scores by referencing the appropriate event table for the Marine Corps physical fitness and combat fitness tests in the current Marine Corps Order [14,15,16].

The manner in which the PFT and CFT assessments were carried out are described in detail elsewhere [7]. All USMC PFT procedures and necessary equipment to conduct the assessments can be found by referencing MCO 6100.13A [14], MCBul 6100 [13], and MCO 6100.13 W/CH 2 [16]. Listed below are the USMC PFT events.

- Hybrid Pull-Up/Push-Up
    - Pull-up (PU): only PU's are reported.
- Abdominal Crunch (AC)
- Three-Mile Run (RUN)

All USMC CFT procedures can be found by referencing MCO 6100.13A [14], MCBul 6100 [13], and MCO 6100.13 W/CH 2 [16]. Listed below are the USMC CFT events.

- Movement to Contact (MTC)
- Ammunition Lift (AL)
- Maneuver Under Fire (MANUF)

The only authorized uniform for the CFT is the Marine Corps Combat Utility Uniform and boots. Watch cap, kneepads/elbow pads and gloves may be worn, as required. For the AL event, Marines will wear a green short sleeve t-shirt so that lock out of the elbows can be observed. The blouse will be worn for the MANUF event. COs/OICs may authorize Marines to remove blouses for the running of the MTC event [14].

C. Analysis

The mean and standard deviation (SD) was calculated for the Marine's demographic information. Likewise, the mean and SD was calculated for the: PFT total, PFT event, CFT total, and CFT event scores. Pearson correlation coefficients (r) were calculated between the PFT and CFT total scores as well as individual events. Significance was considered as alpha$\leqslant$0.05 when an |ES|$\geqslant$0.40 was detected. The threshold for effect size was established based on Cohen's [4] ES criteria where a moderate ES ranges from r=|0.30-0.50| and large=|0.50|. As such it was considered that a moderate to large ES was consistent with an r=|0.40|. Statistical analysis were conducted with MS Excel 2013. The Excel spreadsheet was peer reviewed for accuracy as suggested by AlTarawneh and Thorne [3].

III. RESULTS

Descriptive information of the Marines are presented in Table 1 (n=554). Table 2 provides the mean and standard deviation for the USMC PFT events and PFT total score. Table 3 presents the mean and standard deviation for the USMC CFT events and CFT total score. Table 4 displays the correlations between the PFT and CFT events and total scores.

TABLE I. USCM DESCRIPTIVE INFORMATION

USMC Active Duty	Age (years)	Height (cm)	Mass (kg)
Females (n=554)	22.7±1.4	163.0±7.0	62.8±7.3

*mean±standard deviation

TABLE II. USMC PHYSICAL FITNESS TEST (PFT) SCORES

USMC Active Duty	PU (Reps)	AC (Reps)	RUN (Seconds)	PFT Total Score
Females (n=554)	7.1±4.3	104.9±10.2	1550.7±145.8	254.3±26.3

*mean±standard deviation, PU-push-ups, AC-abdominal crunch, RUN-3-mile run

TABLE III. USMC COMBAT FITNESS TEST SCORES

USMC Active Duty	MTC (Seconds)	AL (Reps)	MANUF (Seconds)	CFT Total Score
Females (n=554)	211.7±22.2	74.9±13.4	184.3±23.5	272.1±25.4

*mean±standard deviation, MTC-movement to contact, AL-ammunition lift, MANUF-maneuver under fire

TABLE IV. CORRELATION MATRIX PFT AND CFT

	MTC (Seconds)	AL (Reps)	MANUF (Seconds)	CFT Total
PU (Reps)	-0.24	0.22	-0.19	0.23
AC (Reps)	-0.18	0.25	-0.18	0.25
RUN (Seconds)	0.56*	-0.19	0.42*	-0.50*
PFT Total	-0.47*	0.25	-0.39	0.48*

*P-value<0.05 and |ES|≥0.40, PU-push-ups, AC-abdominal crunch, RUN-3-mile run, MTC-movement to contact, AL-ammunition lift, MANUF-maneuver under fire

IV. DISCUSSION

Recent research has been conducted to determine the relationship between PFT and CFT event scores among male Marines [7]. This report is a continuation of that effort in that we have set out to determine the relationship between PFT and CFT event scores among female Marines. It was hypothesized that the relationships between the PFT and CFT event scores for female Marines would be similar to those reported for male Marines. The results of the current investigation support the aforementioned hypothesis.

Consistent with the results of the Keefer et al. investigation [7], the association between the PFT and CFT event scores ranged from low to moderate. In the current study the association between the PFT and CFT events ranged from r=-0.18 to 0.56, whereas Keefer et al. reported (r=-0.14 to 0.50). Further, each correlation reported in the correlation matrix was similar between the Keefer et al. [7] investigation and that reported in the current study. It should also be noted that the age range of the Marines in both studies was 21-25 years. The PFT and CFT scores reported in the Keefer et al. study [7] were as follows: PU=18.0±5.0 reps, AC=111.2±9.0 reps, RUN=1377.0±131.4 seconds, MTC=172.5±16.3 seconds, AL=113.2±10.4 reps, and MANUF=138.3±17.2 seconds. As such, the difference between the male and female Marine PFT and CFT event scores ranged from 5-61%.

Our primary goal in conducting this investigation was to examine the data and make the information available to the readers and practitioners to guide in their clinical and policy decisions regarding the physical preparation of Marines. In our earlier investigation with male Marines [7] we provided a detailed accounting of the ramifications of the relationships between the PFT and CFT event scores. Given the similarity of the results in the current investigation with female Marines, we suggest that the recommendations made in the prior research regarding male Marines [7] should apply to female Marines as well. Interested readers of this manuscript are directed to the Discussion of that earlier investigation [7].

The results of the current study adds to the growing literature regarding optimizing training strategies for military women that has included: body composition and CFT performance among female Marines, and physical performance characteristics as related to graduation from Combat Military Occupational School among female Marines [1,2,9,11,12].

As of 2020 the USMC adopted the plank as an alternative to AC PFT event. Effective January 2023 the plank will be mandatory, replacing the AC, for the PFT [6]. The current authors support that change to the PFT as the potential negative ramifications of the AC to the lumber region of the spine has been known for some time [8]. Future research may reveal if the plank has a more meaningful relationship to CFT events than the AC.

Finally, the relationships between the PFT and CFT event scores ranged from r=-0.18 to 0.56 with the associated coefficient of determinations (CD) ranging from 3% to 31%. The low range of CD's suggests that different physical qualities are being assessed and provides strong evidence for the need for conducting both the CFT and PFT among female Marines.

V. CONCLUSIONS

In summary, within the parameters of this study:

- The PFT and CFT event scores for the female Marines differed from their male counterparts by 5-61%,
- The association between PFT and CFT event scores for female Marines are similar to those reported for male Marines,
- PFT and CFT event scores showed "low" to "moderate" correlations suggesting that different physical qualities are being assessed and supports the necessity for both the PFT and CFT,
- Information garnered may serve Marine policy makers as they evolve assessment practices and standards for the PFT and CFT.

CONFLICTS

The authors have no conflicts of interest regarding this manuscript.

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