

The Effects of Ramadan Fasting on Physical Field-Expedient Measures in Army Cadets

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ARTICLE INFO

Article type:
Original article

Article History:
Received: 07 Sep 2016
Accepted: 09 Nov 2016
Published: 10 Nov 2016

Keywords:
Army personnel
Dietary modification
Fasting
Physical fitness
Ramadan
Work capacity evaluation

ABSTRACT

Background and Objectives: Given the limited number of studies on Ramadan fasting and military performance, we conducted this study to identify the effect of Ramadan fasting on physical fitness performances in army cadets.

Methods: Twenty healthy males were randomly selected from a larger sample group. The subjects were divided into fasting (n=10) and non-fasting (n=10) groups. They performed various military physical fitness tests (pull ups, sit ups, swimming obstacle course, push ups, obstacle course, and one mile run) in three separate periods (1st: baseline, 2nd: pre-Ramadan fasting, and 3rd: post-Ramadan fasting). All the cadets also completed three-day food records prior to each exercise testing.

Results: Repeated measures ANOVA showed non-significant differences between the groups for pull ups, sit ups, swimming obstacle course, and push ups ($P>0.05$). However, towards the end of the testing (when performing the obstacle course and the one-mile run) the fasting group showed significantly lower performance ($P<0.001$) compared to the non-fasting group. Performance percentage differences (pre- and post-Ramadan fasting) for the fasting group were 5.0%, 2.5%, 1.0%, 1.0%, -2.8%, and -4.0% for pull ups, sit ups, swimming obstacle course, push ups, obstacle course, and one-mile run, respectively. Following dietary analysis, no significant difference ($P>0.05$) was noted in various nutritional parameters across the three food recording periods.

Conclusion: Ramadan fasting does not affect overall military fitness performance; however, it seems that fasting cadets cannot handle repeated maximal exercise testing efficiently possibly due to inadequate recovery between tests.

► Please cite this paper as:

Havenetidis K. The Effects of Ramadan Fasting on Physical Field-Expedient Measures in Army Cadets. J Fasting Health. 2016; 4(3): 111-116. [10.22038/jfh.2016.7790](https://doi.org/10.22038/jfh.2016.7790)

Introduction

During military operations military personnel is exposed to various stressors such as exertional fatigue, sleep deprivation, and energy deficit (1). Especially, army infantry training exposes recruits to an extremely demanding physical environment, which frequently exceeds their prior level of physical activity (2). Walking with heavy loads, marching for long distances, and running with or/and without equipment in harsh environments are some of the military activities that exceed the limits of their musculoskeletal system.

Even though total running mileage has been altered in some armies to reduce the

incidence of lower-limb injury (3), many studies (4, 5) demonstrated that long-term underfeeding can also deteriorate military performance and indirectly lead to musculoskeletal injuries. However, few studies performed on military recruits have evaluated the effect of complete fast for several hours during a day (such as Ramadan fasting). In those studies (6, 7), it was proposed that fasting did not prevent military recruits to fulfil the strict military and athletic programmes in an Army Academy. Nonetheless, a less efficient recovery between training days was evident for fasting recruits as shown by subjective measures of total

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quality recovery and rating of perceived exertion measures. However, further data is needed to determine the effects of fasting on military exercise performance.

It has been reported (8) that a reliable model for gathering physical conditioning data, is the semestrial physical fitness examination, because all cadets perform various tests under identical conditions. This model also provides an ideal opportunity to compare those who fast and those who do not. Accordingly, the aim of the present study was to investigate the effect of Ramadan fasting on military exercise performance during standardized semester physical fitness examinations.

Material and methods

Subjects

Twenty non-Muslim and Muslim healthy male cadets were assigned to non-fasting and fasting groups, respectively. These cadets represented a sample group of the Army Academy population ($n=230$ male upper-classmen cadets). The non-fasting group (control; $n=10$) consisted of non-Muslim cadets with the mean age of 22.2 ± 0.4 years, body mass index (BMI) of 75.9 ± 6.6 kg/m², height of 178.0 ± 4.2 m, and body fat percentage of $12.1\pm 2.0\%$. The fasting group (experimental;

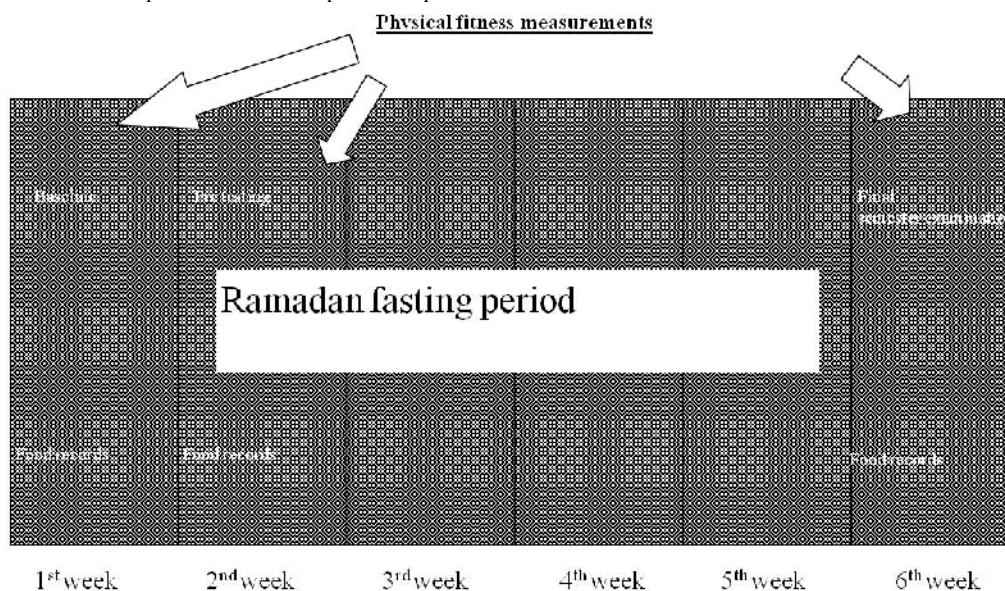
$n=10$) constituted Muslim cadets who were fasting during Ramadan with the mean age of 22.4 ± 0.7 years, BMI of 73.5 ± 6.4 kg/m², height of 179.2 ± 5.8 m, and body fat percentage of $10.7\pm 2.5\%$.

The inclusion criterion for the participants was to present amongst themselves similar physical fitness test performances during last semester's fitness examination. All the cadets were informed of the experimental procedures and provided written informed consent. Ethical approval was obtained from the Hellenic Army Academy Ethics Committee.

Experimental procedures

Since the details of the cadet's training programme and living conditions are given elsewhere (6), the methodology is described here only briefly. All the cadets undertook a series of physical fitness tests within two days of semester's examination. Pull ups, sit ups, and swimming obstacle course were performed on the first day, whilst push ups, obstacle course, and one-mile run were performed on the second day of semester's examination. These series of physical fitness tests were performed thrice (1st week: baseline measurements, 2nd week: pre-testing measurements [pre-Ramadan fasting for the fasting group], and 6th week: final semester's

Figure 1. Schematic representation of the experimental procedures and measurements



examination measurements [post-Ramadan fast for the fasting group]; Figure 1). All the cadets were allowed 30 minutes to recover between each test.

Despite the fact that these are field and not laboratory tests, they are quite common and convenient in military testing (9). For the above tests (except for the one-mile run), performance was recorded for each cadet separately. One-mile run took place in an outdoor 400 m long synthetic track (tartan), and it was performed by ten cadets each time. Push ups, sit ups, and pull ups were performed using standardised procedures (10).

Description of the obstacle course and the swimming obstacle course

The obstacle course had a length of 500 m and comprised of 20 obstacles placed at a minimum of 10 m intervals at least: These were:

1. "rope ladder", 2. "double beam", 3. "trip wire", 4. "network of wires", 5. "ford", 6. "espalier", 7. "balance beam", 8. "sloping wall with rope", 9. "horizontal beams (over-under)", 10. "irish table", 11. "tunnel and twin beams", 12. "four steps of beams", 13. "banquette and pit", 14. "assault wall", 15. "pit", 16. "vertical ladder", 17. "assault wall II", 18. "balance beam [zig-zag]", 19. "chicane", and 20. "assault walls in succession". The swimming obstacle course had a length of 50 m and included three floating (1st: "tubular beams", 2nd: "raft", and 4th: "tubular beam") and one projecting from water level obstacles (3rd: "fixed platform"), all placed at 6-12 m intervals (11).

Diet and fasting period

Ramadan fasting lasted 14.40-14.48 hours from sunrise to sunset. Fasting cadets refrained from eating, drinking, and sexual intercourse from sunrise until sunset. Non-fasting cadets did not alter their normal patterns of eating or training during the period of the study (7). All the cadets also completed three-day food records prior to each occasion of exercise testing (baseline, as well as pre- and post-Ramadan fasting for the fasting cadets) in order to determine total energy, carbohydrate, protein and fat values, using nutrient analysis software (Science Tech Diet 200A, Athens,

Greece).

Water and non-caloric drinks were consumed ad-libitum. Before exercise testing, each cadet was provided with specific verbal and written instructions for reporting detailed dietary intake (7). All the cadets performed the same tasks with no time to exercise outside the training schedule and followed an obligatory dietary program with the exception of those fasting, who abstained from eating in three out of the four meals provided per day. However, during dinner, fasting cadets were allowed to eat additional servings and to have access to a greater variety of foods in order to replenish their lost meals (7).

Measurements

BMI and body height were measured to the nearest 0.1 kg/m² and 0.5 cm, respectively, using a balance beam scale equipped with a stadiometer (SECA 710, Hamburg, Germany). Skinfold assessment was then performed using Harpenden Skinfold Calipers (John Bull Indicators, Ltd., UK) according to Durnin and Womersley's method (12) for the determination of body fat percentage. During skinfold assessment each was standing barefoot wearing minimal clothing. Skinfold measurements were taken from bicep, tricep, subscapular, and supriliac site. All the measurements were carried out by the same investigator twice and were recorded to the nearest millimetre; the mean value of these readings (as long as they characterized by a variation of less than 1 mm) on each site were used for the calculation of body fat percentage.

During physical fitness tests, repetitions or time in each trial was recorded with the use of handheld digital stopwatches (Accusplit 625, Linemore, USA). It has been reported (13) that during exercise intervals of 2-3 seconds, an error of 0.04 seconds exists for the handheld compared to electronic timing. Therefore, for the time span used in the present measurements (52-200 seconds) that difference was considered to be negligible.

Furthermore, in order to avoid potential errors, time was simultaneously recorded by three head examiners with 25 years experience in testing, who were also certified coaches by the respective athletic federation

(track and field for mile run, swimming federation for the 50 m swim-obstacle swim course). During time recording, inter-examiner differences were shown to be less than 1%. Data were collected once during training (2:30 pm-7:00 pm) with air temperature of 22.5-24.2°C in the first week, 21.6-23.8°C in the second week, and 19.4-23.2°C in the sixth week and humidity of 45-58% in the first week, 49-56% in the second week, and 48-63% in the fourth week (Acu-Rite 01500, Chaney Instrument Co., USA).

Statistical analysis

Student's *t*-test was employed to compare physical characteristics between the control and experimental groups. In order to detect differences in nutrition and performance parameters between the groups, we ran a two-way analysis of variance between factor (group) and within repeated factor (week). Where significant *F* ratios were observed, independent *t*-test was used to evaluate differences between the groups. Probability values from level 0.01 to level 0.05 were considered to indicate statistical significance. Statistical analysis was performed using SPSS, version 19.

Results

Statistical analysis showed that both groups

were similar ($P>0.05$) in terms of individual characteristics (i.e., age, $P=0.38$; BMI, $P=0.79$; height, $P=0.61$; and body fat percentage, $P=0.56$). In terms of dietary analysis, no significant difference ($P>0.05$) existed among various nutritional parameters (energy, $P=0.11$; protein, $P=0.21$; carbohydrates, $P=0.42$; and fat, $P=0.08$) across the three food recording periods.

The interaction between each food recording period and group also failed to reach statistical significance for energy, protein, carbohydrates, and fat ($P=0.85, 0.90, 0.60,$ and 0.33 , respectively).

In terms of performance during the 1st, 2nd, and 6th weeks of measurements, the statistical findings showed non-significant differences between the groups (week by group interaction; $P<0.05$) for pull ups ($P=0.72$), sit ups ($P=0.74$), swimming obstacle course ($P=0.20$), push ups ($P=0.37$), whilst towards the end of the testing procedure (when performing the obstacle course and the one-mile run), the fasting group showed significantly lower performance ($P<0.001$ in both cases) compared to the non-fasting group. Statistical results for energy/macronutrient and exercise performance are presented in Tables 1 and 2.

Table 1. Nutrient parameters during different periods for fasting and non-fasting cadets

	Energy (kcal)	Proteins (gr)	Carbohydrates (gr)	Fat (gr)
Baseline food records (week 1)				
F	3598±483	160±36	319±68	112±18
NF	3309±443	168±48	301±47	98±16
Pre-Ramadan food records (week 2)				
F	3715±522	153±33	301±48	116±16
NF	3476±3s8	166±26	352±49	106±14
Post-Ramadan food records (week 6)				
F	3726±475	168±41	295±51	118±11
NF	3470±280	177±22	340±46	100±10

F=Fasting, NF=Non-fasting

Table 2. Performance during different periods of testing for fasting and non-fasting cadets

Physical fitness tests	Baseline measurements		Pre-Ramadan fasting measurements		Post-Ramadan fasting measurements	
	F	NF	F	NF	F	NF
Pull ups (reps)	12.1±4.1	14.3±4.6	12.1±3.6	14.3±4.4	12.7±3.6	14.7±4.2
Sit ups (reps)	42.4±3.1	45.1±3.9	44.1±2.6	45.9±3.2	44.1±2.6	46.6±2.9
Swim obstacle course (s)	57.6±8.7	60.1±7.4	57.7±8.8	60.5±7.6	57.0±8.6	60.0±7.9
Push ups (reps)	51.4±4.1	46.1±5.2	51.7±3.4	46.5±5.0	52.3±3.0	47.4±4.7
Obstacle course (s)	252±28	251±20	248±29	252±21	254±27**	238±19
Mile run (s)	333±18	355±28	335±17	356±29	349±20**	332±30

F= Fasting, NF=Non-Fasting, reps=repetitions, s=seconds

**significantly different from baseline and pre-Ramadan fasting measurements at a level of $P<0.001$

Discussion

In a previous study (6), it was shown that fasting cadets were able to meet training conditions in a military academy. In the present study, it was found that fasting cadets could not achieve high fitness test performances as their counterparts during a two-day physical conditioning testing procedure. Data indicated that fasting cadets had an equally high performance in all fitness tests compared to non-fasting cadets.

These findings are in accordance with those reported by Kirkendall (14), where athletes were trained twice a day and the absence of any negative effect of fasting was attributed to training in residential environment. Our results did run contrary to previous findings “where poorer physical performance measures were shown by the end of the Ramadan month” in an athletic group (15).

The present study also illustrated that the fasting group was unable to maintain similar performance to the non-fasting group as the testing procedure progressed. This is confirmed by the higher performance of the non-fasting group in the last tests (obstacle course and one-mile run). This cannot be attributed to variation in performance values for the specific test, since an earlier study (7) showed that using a similar running test (two mile run) led to insignificant differences for the respective sample groups. A plausible explanation could be incomplete recovery or/and staleness, a phenomenon also shown in a former study (6), where a similar sample group was recruited. In that study (6), subjective measures such as total quality recovery (TQR) and rating of perceived exertion (RPE) were significantly lower and higher values, respectively, for the fasting compared to the non-fasting group. Despite the fact that RPE and TQR measures focus on the cognitive aspects and psychophysiological cues of athletes, respectively, they can be valuable tools for recognizing staleness as “the most sensitive instrument currently available for detecting the different degrees of staleness in athletes’ own body” (16). It is worth mentioning that in that study (6), the daily training programme consisted of two mandatory sessions per day, which exerted a strong work stimulus, but these sessions did not affect the achievement of fasting

cadets’ daily training goals. However, those sessions mainly comprised of submaximal exercise of long duration, whereas the present semestrial physical fitness examination involved repeated “all-out” testing to exhaustion. This type of testing would probably prevent fasting cadets from achieving full recovery since the metabolic (lactate removal, glycogen depletion, and amino acid imbalance) and neuromuscular (actin-myosin disruption) effects of maximal exercise are difficult to overcome in a few days (17). However, there are no additional measurements (blood, urine, or saliva) to verify the existence of the above mechanisms and this can be considered as a limitation for the present study.

Regarding nutrient analysis, the present study showed no significant differences and the obtained values were within the recommended amounts of nutrient intakes for military populations (18), indicating that Ramadan fasting did not lead to malnutrition and/or deficiencies. The present results do not support the prevalent point of view that during Ramadan fasting Muslims tend to counterbalance in terms of food intake. The present results are of paramount interest since participants conformed to the same dietary habits and daily schedule, as testing took place in one location only and differences that may exist in daily living habits were not taken into consideration; therefore, no alternative daily schedule was provided.

Future studies should focus on energy flux during Ramadan fasting in relation to nutrition intake and expenditure in military establishments. Additionally, the present data may prove useful in designing military testing procedures in which various aspects of exercise recovery are taken into consideration.

Conclusion

This study suggests that Ramadan fasting does not affect the achievement of high performance in a series of military physical conditioning tests. However, it seems that the repetitive and inelastic pattern of military testing procedure may hinder full recovery and eventually deteriorate performance in fasting cadets at a later stage.

Acknowledgments

Many thanks to the cadets who participated in the present study. This manuscript reflects

author's personal views which are not related to any official policy or position of the Greek Government

References

1. Castellani JW, Stulz DA, Degroot DW, Blanchard LA, Cadarette BS, Nindl BC, et al. Eighty-four hours of sustained operations alter thermoregulation during cold exposure. *Med Sci Sports Exerc.* 2003; 35(1):175-81.
2. Cowan DN, Jones BH, Frykman PN, Polly DW Jr, Harman EA, Rosenstein RM, et al. Lower limb morphology and risk of overuse injury among male infantry trainees. *Med Sci Sports Exerc.* 1996; 28(8):945-52.
3. Papis P, Hanley B, Havenetidis K, Bissas A. Cypriot and Greek Army Military boot cushioning: ground reaction forces and subjective responses. *Mil Med.* 2013; 178(4):e493-7.
4. Booth CK, Coad RA, Forbes-Ewan CH, Thomson GF, Niro PJ. The physiological and psychological effects of combat ration feeding during a 12-day training exercise in the tropics. *Mil Med.* 2003; 168(1):63-70.
5. Montain SJ, Young AJ. Diet and physical performance. *Appetite.* 2003; 40(3):255-67.
6. Havenetidis K. Exercise performance and recovery of Muslim endurance athletes during Ramadan fasting. *Int J Sport Sci Coach.* 2015; 10(1):51-68.
7. Havenetidis K. Ramadan fasting and endurance running performance in army officer cadets. *Int Rev Arm Forc Med Serv.* 2011; 84(1):68-72.
8. Havenetidis K, Paxinos T. Delineation and classification of physical conditioning in Greek army officer cadets. *J Mil Vet Health.* 2013; 21(2):19-25.
9. Knapik JJ, Rieger W, Palkoska F, Van Camp S, Darakjy S. United States Army physical readiness training: rationale and evaluation of the physical training doctrine. *J Strength Cond Res.* 2009; 23(4):1353-62.
10. Nieman DC. Exercise testing and prescription: a health related approach. 4th ed. New York: McGraw-Hill Companies; 2003.
11. Military Pentathlon Regulations. International Military Sports Council (CISM). Available at: URL: <http://www.milsport.one>; 2016.
12. Durnin JV, Womersley J. Body fat assessed from total body density and its estimation from skin fold thickness: measurements on 481 men and women aged from 16 to 72 years. *Br J Nutr.* 1974; 32(1):77-97.
13. Hetzler RK, Stickley CD, Lundquist KM, Kimura IF. Reliability and accuracy of handheld stopwatches compared with electronic timing in measuring sprint performance. *J Strength Cond Res.* 2008; 22(6):1969-76.
14. Kirkendall DT, Leiper JB, Bartagi Z, Dvorak J, Zerguini Y. The influence of Ramadan on physical performance measures in young Muslim footballers. *J Sports Sci.* 2008; 26(Suppl 3):S15-27.
15. Chaouachi A, Leiper JB, Chtourou H, Aziz AR, Chamari K. The effects of Ramadan intermittent fasting on athletic performance: recommendations for the maintenance of physical fitness. *J Sports Sci.* 2012; 30(Suppl 1):S53-73.
16. Raglin JS. Overtraining and staleness: psychometric monitoring of endurance athletes. In: Murphey M, Tennant LK, editors. *Handbook of research on sport psychology.* New York: Macmillan; 1993. P. 166-208.
17. McArdle WD, Katch FL, Katch VL. *Exercise physiology: nutrition, energy and human performance.* 4th ed. Philadelphia: Lippincott, Williams and Wilkins Publishers; 2001.
18. Crombie AP, Funderburk LK, Smith TJ, McGraw SM, Walker LA, Champagne CM, et al. Effects of modified foodservice practices in military dining facilities on ad libitum nutritional intake of US army soldiers. *J Acad Nutr Diet.* 2013; 113(7):920-7.