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Online version at https://www.minervamedica.it
Gazzetta Medica Italiana - Archivio per le Scienze Mediche 2023 September;182(9):552–9
DOI: 10.23736/S0393-3660.23.04998-7

ORIGINAL ARTICLE

Effects of time-restricted nutrition on urinary density, body composition and athletic performance: model Ramadan fast

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ABSTRACT

BACKGROUND: Fasting is a restriction of foodstuff covering a certain period of time during the day. It is one of the religious services which people render due to their faith. Fasting is one of the intermittent starvation diets and, likewise, there are such diets that are designed in different styles and forms. This study has been carried out in order to study the effects of the Ramadan fast which is one of the time restricted nutritional models on the urinary density, body composition athletic performance.

METHODS: Twenty-seven students whose age average is 20,57±1,59, who study at the Faculty of Sports Sciences and who play sports recreationally participated in the study. All participants recorded all the food which they took during the hours between the breaking and starting times of fasting when having food is allowed during the month of Ramadan. At the same time, the amount of water consumed, exercising and sleeping times, number of cigarettes smoked were recorded as well. In determining the somatotypes, a skinfold caliper, a tape and a digital compass were used in order to measure skin fold thickness, perimeter and diameter respectively. Body mass, fat, muscle, bone and water rates were measured by means of a digital body analysis scale. Urine chemistry was measured by the reflectance photometry method. A WAnT and Yo-Yo intermittent recovery test were performed in order to determine the anaerobic power level and the aerobic power level respectively. Shapiro-Wilk analysis, descriptive statistics and frequency analysis and T test were employed in the distribution of data, in the averages and preliminary test and final test comparison respectively.

RESULTS: Consequently, fasting may be a benefit for either the reduction or stopping of cigarette smoking. At the same time, effective results may be obtained in losing weight despite the biological rhythm. If the exercise level is increased in a controlled manner and well organized, it may lead to an increase in muscular mass.

CONCLUSIONS: As a result of this study, it was determined that the anaerobic power of fasting people increased and their aerobic power decreased.

(*Cite this article as*: Tetik Dündar S. Effects of time-restricted nutrition on urinary density, body composition and athletic performance: model Ramadan fast. Gazz Med Ital - Arch Sci Med 2023;182(9):552-9)

KEY WORDS: Intermittent fasting; Religion; Athletic performance.

Fasting is one of the religious services which people render due to their faith. It is one of the religious services which people render due to their faith.

Fasting is one of the intermittent starvation diets and, likewise, there are such diets that are designed in different styles and forms.[1] "Alternate day fasting" in which there is no consumption of energizing food and drinks and which also includes free nutrition days is one of such diets. Also known as intermittent energy restriction, the "modified fasting diets" (5 days regular and 2 days energy-restricted) also take place among these sorts of diets.[1] Also being one of the types of intermittent diet and containing the fasting, the "time-restricted nutrition" is characterized by

the fact that nutrient intake takes place at certain times during the day.[2, 3]

Fasting is a practice which Muslims have in order to be able to fulfil their worship during the month of Ramadan. In common words, it is based on not taking any nutrients from the sunrise to the sunset. While fasting, no food and drink including water, chewing gum, medicine, cigarettes, etc. is absolutely taken in. Starvation time and timing in the month of Ramadan varies by the country where people are living. That is to say, geographical position and seasonal differences affect the hours when people fast. Depending on geographical actors, it contains starvation periods of 11-22 hours during the day (daylight).[1]

While Ramadan fasting takes place for religious reasons, it has recently gained awareness of being fulfilled in order to be able to be healthy. Such important benefits as relaxation of the body and especially the gastrointestinal system and weight loss have further enhanced such awareness. Therefore, people benefit from the modified time-restricted nutritional diets in similar ways at times other than the month of Ramadan.[4]

Even though the diets of this type have been considered to be a popular diet current in recent years, it is not difficult at all to think that the number of meals and the nutrient taken in are lower due to the living conditions and struggle for life as from the rise of humanity. That is to say, this nutritional culture which appears to be popular may, in fact, be said to contain a past that started before everything.[5]

The most important issue which should be paid attention in Ramadan fasting is that the body mass in which reduction is seen is gradually recovered in the post-fasting period.[5, 6] Further, nutrition which corresponds to the night hours and starvation condition which corresponds to the daylight hours are not usual for biological (circadian) rhythm. This may be considered to be a significant restrictor for those who expect a reduction in the body mass. Changing hours in eating and drinking habit are also effective on the sleeping and wakefulness cycle. That is to say, there is usually a condition in which one reverses the circadian rhythm for 30 days. Moreover, it is thought that the daily living balance may be disturbed and the performance may be adversely affected when it combines with such reasons as the long-starvation during the hours of daylight.[4, 6]

Common reasons for popularly preferring these types of diet are the fact that there is reduction in the body weight, triglyceride, LDL cholesterol[7, 8] and pre-prandial blood glucose[6] levels and increase in HDL cholesterol. In addition to all these, it has been reported that it may have such benefits as the reduction in the insulin level, insulin sensitivity, body composition, cardiovascular indicators, ageing, resistance to oxidative stress, inflammation.[9-12]

Study carried out is not sufficient for being able to apply the intermittent starvation and time-restricted nutritional forms for a lifetime or for longer periods of time. For any clear benefit may not yet be mentioned for age groups, what form is more effective and long-term use.[7, 12-14]

This study has been carried out in order to study the effects of the Ramadan fasting which is one of the time-restricted nutritional models on urinary density, body composition and athletic performance.

Materials and methods

Research ethics

This study has been considered appropriate in terms of the provisions of the regulations concerning the "Scientific Study Publication Ethics" and unanimously accepted and approved by the "Ethics Committee of Human Study Health and Sports Sciences" of the Binali Yildirim University at Erzincan (protocol no. 01/25, date approved: 31.01.2023).

Group of participants

Study was carried out in the design of the scanning method, one of the non-empiric quantitative study forms. The study group was selected in a randomized manner from among the students studying at the Faculty of Sports Sciences and playing sports recreationally (27 students).

Before the study, all the details of the study were shared with the participants. The participants were informed that participation is based on volunteering and provided with the opportunity of abandoning the study at any time. Afterwards,

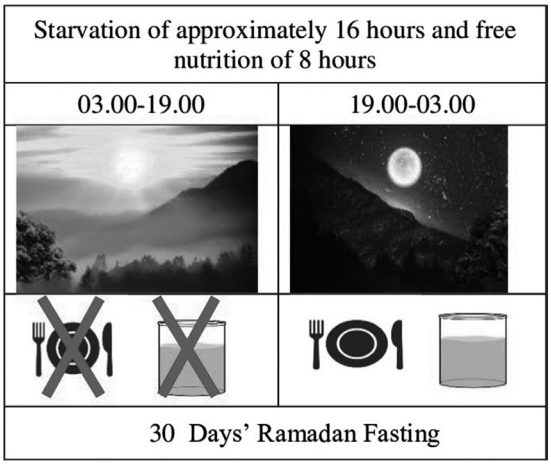


Figure 1.—Starvation of approximately 16 hours and free nutrition of 8 hours.

all participants were caused to sign a voluntary consent form and handed printed questions concerning the reasons for their smoking and fasting. All participants recorded all the food which they took during the hours between the breaking and starting times of fasting when having food is allowed during the month of Ramadan and shared the same on daily basis (Figure 1).

At the same time, the amount of water consumed, sleeping time, number of cigarettes smoked and, if any, exercises taken during the day (type-time-force) were required to be recorded and shared as well. All data were reported from day to day and calories take-burned calculated by the scholars.

Physical measurements

Age and height data of the participants were determined by standard methods. In determining the somatotypes (ectomorph, mesomorph, endomorph), a skinfold caliper (Holtain), a tape and a digital compass (Holtain anthropomorphic set) were used in order to measure skin fold thickness, perimeter and diameter respectively and calculated by formulae.[15, 16] Body mass (kg), fat (%), muscle (%), bone (%) and water (%) rates were measured by means of a digital body analysis scale. Urine chemistry was measured by the reflectance photometry method. Strips containing 11 test zones and Flow Cytometry were performed by the urine microscopy principle. In order to determine the anaerobic power level, a WAnT (Momark 894-E bicycle ergometer) was performed and thus the maximum anaerobic power/peak power (PP), maximum anaerobic capacity/average power (AP), minimum power/lowest power (MP), power drop (PD) parameters were studied. A Yo-Yo intermittent recovery test was performed in order to determine the aerobic power level and the total running distance and maximum oxygen consumption (VO_{2max}) was calculated.[17] For regeneration purposes, WAnT and Yo-Yo tests were performed in different days. All tests were performed as preliminary test (in the state of starvation 3 days prior to the start of fasting) and final test in the state of starvation in the last day of fasting) at the afternoon hours (as of 1:00 PM).[18, 19]

Statistical analysis

Data obtained from the study were analyzed in the IBM SPSS version 24.0 (IBM Statistical Package for the Social Sciences Corporation, Armonk, NY, USA) package program. Shapiro-Wilk analysis and descriptive statistics and frequency analysis were performed for the distribution of the data respectively. Paired Sample t-test (Dependent Sample t-test) was employed for the comparison of the preliminary and final tests in the aerobic and anaerobic power outputs. The results were given as arithmetic average and standard deviation ($\bar{x}\pm s$), smallest observation value (minimum) and largest observation value (maximum). The significance level was accepted as $P<0.05$.

Results

When Table I was reviewed, it was found out that the percentage of those participants who some was 37,07%, of those who did not smoke was

TABLE I.—*Status of cigarette smoking and reasons for fasting.*

Item	Status	*f*	%
Cigarette	Smoking	10	37.04
	Not Smoking	17	62.96
Reason for Fasting	Religion	24	88.88
	Health	1	3.7
	Religion+health	1	3.7
	Religion+weight loss	1	3.7

f: number of participants, %: percentage of participants.

62.96%, of those who fasted for their religious faith was 88,88%, of those who fasted for being healthy was 3.7% and of those who fasted for both their religious faith and for being healthy was 3.7% and of those who fasted for both their religious faith and losing weight was 3.7%.

When Table II was reviewed, it was found out that the age average of the participants was 20.57±1.59 years, height average was 174.83±8.42 cm and that their somatotype structures were dominantly endomorphic.

When Table III was reviewed, it was found out that pre-fasting body mass and fat percentage were higher and the muscle, bone and water percentage was lower.

When Table IV was reviewed, it was found out that the average of the sleeping hours during the period of fasting was 7.02±0.82, that of the water consumption was 1.10±0.15, that of the calories of food consumed at the start of fasting was 735±90, that of the calories of food consumed at the breaking of fasting was 1160.50±103.51, that of the quantity of cigarettes smoked was 4.97±2.96, and that of the calories taken through exercises was 364.72±105.78.

When Table V was reviewed, it was found out that the average of the pre-fasting urinary density was lower and that the pH level was higher.

When Table VI was reviewed, it was thought that the reason for the positive results in the chemical examination, urine turbidity and color in the visual examination was that the water balance could not be maintained in each participant, that is to say, that water consumption was low/insufficient particularly in the results of the preliminary test.

When Table VII was reviewed, it was found out that the running distance and VO_{2max} level measured before fasting was higher.

When Table VIII was reviewed, it was found out that of the post-fasting WAnT results, PP [W/kg], AP [W/kg], MP [W/kg], PD [W/kg], PP [W], AP [W], PD [W] values were higher than those determined before fasting and that MP [W] value was lower in the post- fasting period.

When Table IX was reviewed, it was found out

TABLE II.—*Average values of body profiles of participants.*

Variables	Minimum	Maximum	$\bar{X}$±Ss
Age (years)	18	24	20.57±1.59
Height (cm)	153	187	174.83±8.42
Endomorph	3.11	8.12	5.16±1.23
Mesomorph	0.23	4.28	2.42±1.04
Ectomorph	0.38	5.67	3.03±1.14

TABLE III.—*Average values of body analysis before and after Ramadan fasting.*

Test		Body Mass (kg)	Fat (%)	Muscle (%)	Bone (%)	Water (%)
Preliminary test	Minimum	42.40	10.8	47.9	34.7	11.1
	Maximum	85	30.3	61.3	45	15.5
	$\bar{X}$±Ss	67.40±10.06	22.70±4.70	53.06±3.22	39.91±2.46	13.59±1.14
Final test	Minimum	41	14.9	47.9	36.9	11.6
	Maximum	85	30.2	58.5	44.6	15.2
	$\bar{X}$±Ss	66.51±10.04	22.07±4.60	53.52±3.17	40.54±2.45	13.87±1

TABLE IV.—*Calorie values taken and burned during Ramadan fasting (30 days).*

Variables	Minimum	Maximum	$\bar{X}$±Ss
Sleep (hours)	5.80	8.33	7.02±.82
Water (L)	0.73	1.29	1.10±.15
Start of Fast (kcal)	632.46	905.42	735±90
Breaking of Fast (kcal)	995.33	1315.31	1160.50±103.51
Cigarettes (pieces)	7.02	11.40	4.97±2.96
Calories Burned(kcal)	223.50	534.33	364.72±105.78

Calories burned is only calculated as calories burned through exercises.

TABLE V.—*Urinary density and acidity level before and after Ramadan fasting.*

Item	Status	Preliminary test		Final test	
		f	%	f	%
Clearness Turbidity	Clear	26	96.3	26	96.3
	Slightly turbid	1	3.7	1	3.7
Color	Straw yellow	16	59.3	18	66.7
	Yellow	10	37.0	9	33.3
	Amber (honey)	1	3.7	-	-
Bilirubin (µmol/L)	Negative	26	96.3	27	100.0
	Positive	1	3.7	-	-
Urobilinogen (µmol/L)	Negative	26	96.3	27	100.0
	Positive	1	3.7	-	-
Ketone	Negative	27	100.0	26	96.3
	Positive	-	-	1	3.7
Ascorbic acid	Negative	27	100.0	26	96.3
	Positive	-	-	1	3.7
Glucose (mmol/L)	Negative	27	100.0	27	100.0
Protein (g/L)	Negative	25	92.6	27	100.0
	Positive	2	7.4	-	-
Blood (mg/L)	Negative	20	74.1	25	92.6
	Positive (+)	6	22.2	-	-
	Positive (++)	1	3.7	-	-
	Positive (+++)	-	-	2	7.4
Nitrite	Negative	27	100.0	27	100.0
Leucocyte (HPF)	Negative	23	85.2	27	100.0
	Positive (++)	2	7.4	-	-
	Positive (+++)	2	7.4	-	-

f: number of participants, %: percentage of participants.

TABLE VI.—*Urine analysis chemical and visual examination before and after Ramadan fasting.*

Variables		Minimum	Maximum	$\bar{X}$±Ss
Preliminary test	Density	1007	1033	1020.96±6.31
	pH	5.0	7.5	5.53±.70
Final test	Density	1018	1029	1022.11±3.0
	pH	5.0	6.0	5.09±.27

TABLE VII.—*Results of aerobic power tests before and after Ramadan fasting.*

	Variables	Minimum	Maximum	$\bar{X}$±Ss
Preliminary Test	Total Distance (m)	200	2560	879.17±606.44
	VO_{2max} (mL.dk^{-1}.kg^{-1})	38.08	57.90	43.78±5.09
Final Test	Total Distance (m)	280	1720	784±496.45
	VO_{2max} (mL.dk^{-1}.kg^{-1})	38.75	50.84	42.98±4.17

Total distance run and maximum O_2 (VO_{2max}) calculated as a result of the Yo-Yo test

that there was a significant difference between the results of the preliminary test in body mass, fat percentage, muscle percentage, bone percentage, PP [W/kg], PD [W/kg], PP [W], PD [W] parameters.

Discussion

It is reported that the results that time-restricted nutrition gives about body mass display variances in studies.[2]

A clear answer has not yet been given to the question of which type of intermittent starvation (fasting) diets, which is a derivative of time-restricted nutrition, will be more effective when applied. That is to say, it has not yet been clarified what form of diet is better and feasible in the longer term. In particular, it does not really seem possible that those people who should be continuously active and need more energy in their everyday life use such diets for a long time.[12, 20]

TABLE VIII.—*Results of anaerobic power test before and after Ramadan fasting.*

Variables		Minimum	Maximum	$\bar{X}$±Ss
Preliminary Test	PP [W/kg]	6.93	14.51	10.87±1.84
	AP [W/kg]	5.47	9.16	7.55±1
	MP [W/kg]	2.63	6.81	4.36±.80
	PD [W/kg]	3.54	9.82	6.50±1.55
	PP [W]	409.10	1044.00	730.19±180.85
	AP [W]	280.80	712.80	507.66±113.42
	MP [W]	134.10	422.50	291.26±64.95
	PD [W]	233.50	717.50	438.94±139.25
Final Test	PP [W/kg]	7.86	14.48	11.57±1.95
	AP [W/kg]	5.41	9.22	7.81±1.05
	MP [W/kg]	3.22	5.33	4.44±.61
	PD [W/kg]	3.74	9.79	7.12±1.59
	PP [W]	422.40	1102.00	746.53±186.80
	AP [W]	280.80	711.40	508.67±114.69
	MP [W]	134.10	399.90	287.18±64.12
	PD [W]	250.10	717.50	459.35±136.17

PP: peak power, AP: average power, MP: minimum power, PD: power drop, W: Watt, W/kg: Watt/body mass.

TABLE IX.—*Results of comparison before and after Ramadan fasting.*

Variables	$\bar{X}$±Ss	t	P
VO_{2max} ($mL.dk^{-1}.kg^{-1}$)	-0.01±1.95	-0.027	0.979
Total distance	-2.0±233.32	-0.027	0.979
Body Mass	0.88±1.36	3.567	0.001
Fat (%)	1.37±1.76	2.917	0.012
Muscle (%)	-0.94±1.21	-2.903	0.012
Bone (%)	-0.46±0.82	-2.113	0.055
Water (%)	0.10±0.46	0.812	0.431
PP [W/kg]	-0.41±0.63	-2.699	0.016
AP [W/kg]	-0.02±0.18	-0.588	0.565
MP [W/kg]	0.15±0.82	0.775	0.450
PD [W/kg]	-0.57±0.80	-2.953	0.009
PP [W]	-16.33±36.41	-2.457	0.020
AP [W]	-1.00±9.31	-0.590	0.560
MP [W]	4.08±36.91	0.606	0.549
PD [W]	-20.40±44.15	-2.531	0.017

PP: peak power, AP: average power, MP: minimum power, PD: power drop, W: Watt, W/kg: Watt/body mass.
P<0.05.

Time-restricted nutrition diets are effective in the reduction and regulation of the body mass, plasma types, pre-prandial blood glucose, insulin level, cholesterol (LDL), triglyceride, insulin sensitivity and inflammatory cytokines.[9, 10] At this point, the drop in body mass as a result of our study supports the literature stated.

In Muslim societies, fasting worship which is one of the pillars of Islam is fulfilled by not having any nutrients (food, drink, etc.) from the call to morning prayer to the call to evening prayer. One can take in any nutrients without any restriction after the call to evening prayer. Muslim athletes may fast in order not to fail in their worship.[21, 22]

In a study carried out in order to determine the effects of fasting on an athlete's performance, athletes who both take exercises and fast have been studied. In the results of the study, it has been found out that there is a drop in the body mass, fat percentage, LDL cholesterol values of those who fast as compared to those who do not fast and that there is an apparent increase in the HDL cholesterol level.[23] When compared to the result of our study, it is seen that similar results are obtained due to the drops in the body mass and fat percentage. It may be said that, even though the sample group is not one that regularly works out, results similar to those of the other athletes may be obtained in the students of the Faculty of Sports Sciences who may be considered active in their everyday life.

In a study carried out on strength athletes who were monitored during the month of Ramadan, it was reported that there was a significant difference in the body mass, fat percentage and Body Mass Index.[19] When compared to the result of our study, it is seen that a similar effect is achieved even though they do not have the same athletics.

In another study in which the effect of fasting on athletes is studied, it is reported that fasting does not have any effect on the short-term maximal performance.[24] To the contrary, improvement has been observed in the WAnT results in

our study. It may be thought that this improvement in our study may be a motivational change as well.

In a study in which aerobic power (VO_{2max}) was determined by the Yo-Yo intermittent recovery test, a single test was performed and it was reported that power reduced and that fatigue index increased with maximum speed.[18] We also employed the Yo-Yo test in order to determine the aerobic power in our study and it was found out that the VO_{2max} level was high before the month of Ramadan and that it dropped in the month of Ramadan. At this point, it may be said that similar results were achieved in both studies.

In a study carried out on soccer players, the Cooper test was applied and it was reported that the distance run reduced (16%) by the end of the months of Ramadan. In the test repeated 14 days after the months of Ramadan, it was stated that the distance run reached the levels in the initial measurements.[25] Known to be characterized by the measurement of the total distance taken as a result of 12 minutes' run, the Cooper test is performed in order to determine the aerobic power (VO_{2max}). Accordingly, when compared to the result of our study, due to the fact that the VO_{2max} level and running distance as obtained before fasting is higher than the level obtained during fasting (end of the month of Ramadan), it is seen that similar results are obtained as a result of both studies.

In a study carried out on athletes (middle distance runners [N.=9] and the sedentary [N.=9]), 5000m running performance was compared. It was reported that, at the end of the month of Ramadan, there was improvement (5%) in the running times of the sedentary.[26] However, it was found out as a result of our study that pre-fasting VO_{2max} level and total running distance were high and that, to the contrary, they reduced during the month of Ramadan.

In another study carried out in the month of Ramadan, it was reported that there was not any change in the aerobic power and capacity as a result of the WAnT applied during the afternoon hours.[19] To the contrary, improvement was observed in the anaerobic power (PP) and anaerobic capacity (AP) in our study in which tests were performed during the afternoon hours as in this study. It was naturally thought that such improvement might be motivational as well.

Conclusions

Of the participants a great majority of who fasted for religious faith (88.88%), a reduction occurred in cigarette smoking, body mass and fat percentage and an increase in muscle, bone and water percentage during the month of Ramadan. It was found out that water consumption and exercise level was low, that the calories taken at the breaking of fasting were higher than those taken at the start of fasting, that the urinary density was lower and that the pH level was higher before fasting during the month of Ramadan. It was seen that the VO_{2max} level and total running distance before fasting was high but reduced during the month of Ramadan. Despite this, an improvement was observed in the results of WAnT. In the comparison of the preliminary test and final test, it was found out that there was a significant difference in the body mass, body fat percentage, muscle percentage, bone percentage and WAnT (PP and PD) parameters.

As a consequence, fasting may be a benefit for reducing or stopping cigarette smoking. At the same time, effective results may be obtained in weight loss despite the biological rhythm. If the exercise level is increased in a controlled manner and organized well, it may lead to an increase in the muscular mass. As a result of this study, it was determined that the anaerobic power of fasting people increased and their aerobic power decreased.

Studies that increase the number of subjects, examine and compare citizens (sedentary/athlete) from different Islamic countries, physiological responses of fasting and non-fasting, and hormonal and physical responses evaluated together with biological rhythm will provide significant support to the literature in explaining the effects of Ramadan fasting.

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Conflicts of interest.—The author certifies that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

Authors' contributions.—Sibel Tetik Dündar designed and reported all the lines of the article. The author read and approved the final version of the manuscript.

History.—Manuscript accepted: January 20, 2023. - Manuscript received: December 26, 2022.