

## Changes in body weight, dietary intake and activity pattern of adolescents during Ramadan

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### ABSTRACT

A study was carried out on 117 schoolchildren comprising 51 boys and 66 girls between the ages of 10 and 13 years to evaluate the effect of Ramadan-fasting on body weight. The results revealed that more than 90% of the subjects experienced a decrease in body weight during Ramadan. The initial mean body weight of the boys and girls were  $35.7 \pm 6.7$  kg and  $35.2 \pm 6.1$  kg respectively. After four weeks' fast, the boys and girls significantly lost ( $p < 0.001$ ) an average of 4.2% and 3.7% of their initial body weight respectively. Dietary intake and activity pattern were also assessed in a subgroup of 20 boys and 30 girls during the same period. The mean daily energy intake during Ramadan-fasting {boys  $1230 \pm 363$  kcal ( $5.15 \pm 1.52$  MJ), girls  $1034 \pm 290$  kcal ( $4.33 \pm 1.21$  MJ)} was significantly lower ( $p < 0.001$ ) than intake assessed before Ramadan {boys  $1520 \pm 463$  kcal ( $6.36 \pm 1.94$  MJ), girls  $1344 \pm 428$  kcal ( $5.62 \pm 1.79$  MJ)}. Both values were found to be below the suggested daily dietary intake for Malaysians of similar sex and age group recommended by Teoh (1975). Both boys and girls significantly decreased their intakes of fat, carbohydrate and thiamine during Ramadan. However, intakes of protein, niacin, vitamins A and C were found to be comparable to non-fasting values. During Ramadan, the mean intake of all nutrients analysed except protein were lower than recommended values. The boys spent significantly more ( $p < 0.05$ ) time sitting and significantly less ( $p < 0.05$ ) time standing and in moderately active pursuits during Ramadan. During this period, the boys spent more time in prayers compared with the girls. Time spent on all other activities did not differ between the fasting and non-fasting months. The findings suggest that the decrease in body weight during Ramadan may be primarily due to the reduction in energy intake since activity pattern remain fairly constant. The nutrient intake pattern of the adolescents studied may be of great concern in the long-term, as it does not meet the requirements for the normal growth of adolescents.

### INTRODUCTION

Fasting is the act of voluntarily abstaining, partially or entirely, from food and drink. As a religious observance, fasting has been and still is a part of nearly all religions. An important event in the Islamic calendar is a full month of fasting for Muslims during Ramadan. Throughout the course of the month, all healthy individuals are enjoined to keep a strict fast from dawn to sunset. In Malaysia, Muslim children as young as six or seven years old are encouraged to keep a practice fast of at least a few hours each day. By the age of ten, most children are able to keep

fast for the entire daylight hours while food and fluid intakes are confined to the hours between sunset and sunrise.

Studies carried out previously among adult subjects have reported a reduction in meal frequency (Frost & Pirani, 1987) and energy intakes (Husain *et al.*, 1987) during Ramadan. On the other hand, Suriah & Zarina (1994) found no significant difference in the energy and nutrient intakes of elderly subjects between the fasting and non-fasting months. The changes in dietary and activity patterns during Ramadan had been found to significantly reduce body weight (Fedail *et al.*, 1982). However, other studies have reported slight decreases in body weight which did not reach statistical significance (Ismail *et al.*, 1985; Hussain *et al.*, 1987; El Ati, Beji & Danguir, 1995).

To date, studies carried out to evaluate the effects of Ramadan-fasting on adolescents had been rarely reported. This preliminary study was undertaken to determine the changes in body weight, dietary intakes and activity patterns of adolescents during the fasting month.

## **SUBJECTS AND METHODS**

### **Subjects**

The subjects involved in this study were participants of a larger, longitudinal study on the basal metabolic rate and growth of adolescents. Potential subjects in the 10 to 12 year age group in a primary school in Bandar Baru Bangi, a suburban community approximately 35 km from Kuala Lumpur, were screened for body weight and height. Subjects were volunteers from a group chosen for the larger study based on their age, and body weight and height conforming to normal weight for age and height for age according to the United States National Center for Health Statistics (NCHS) curves (WHO, 1983). Permission was obtained from the respective heads of the two schools involved in the study. This is because some of the children has moved on to secondary school since the main study began. Informed consent was obtained from the parents of the participants before the commencement of the study.

This study was carried out on a total of 117 schoolchildren comprising 51 boys and 66 girls aged between ten and thirteen years who observed fasting during the month of Ramadan. A number of eight girls (12.1%) had attained menarche, however only half that number had their menstrual period coinciding with Ramadan and consequently had to stop fasting for approximately a week during their menstruation.

### **Methods**

Body weight and height measurements were carried out on four occasions according to the following schedule: once during the week before Ramadan (pre fasting week), the second time after two weeks of fast, the third during the last week of Ramadan, and the fourth measurement was done two weeks into the following month of Syawal (post-fasting week). This allowed for the subjects' dietary and activity patterns to return to normal after the Hari Raya Aidil Fitri celebrations. All measurements were done by the same observer, using the same equipment at

the same hour on every occasion. Anthropometric measurements were carried out according to the methods described by Cameron (1984).

Body weight was measured with a beam balance (SECA Model 713) to the nearest 0.1 kg. The beam balance was carefully calibrated for accuracy with the use of a known weight before each measuring session. Weight measurements were taken with the child standing barefooted and in light clothing. Height measurements were read to the nearest 0.5 cm from a scale marked in centimeters up to a height of 2 metres and fixed to the beam balance. Subjects stand erect, without shoes, with heels, buttocks and shoulder blades in a vertical line. Although height was measured four times over a period of two months, only the readings from the first measurement taken during the pre-fasting month was reported as the change in height was negligible.

Each subject was requested to keep two three-day records of food intakes and activity patterns; once during the pre-fasting week and the second time during the third week of Ramadan or on other fasting days for girls who were menstruating during the third week. Food intake records made by the subjects were expressed in household measures. The subjects were instructed on standard household measures before the experimental period. Daily activities from getting out of bed in the morning to returning to bed at night were recorded in diary sheets. Standard procedures for record-keeping were explained clearly to the subjects and the records were reviewed by interview as they were submitted, thus enabling us to validate the accuracy and completeness of the records.

Energy and nutrient intakes were assessed from the three-day food intake records made in household measures as described by Marr (1971). These measures were then converted to weights in terms of edible portions. Energy and nutrient values of the items consumed were then calculated from the Malaysian Food Composition Table (Tee *et al.*, 1988).

The activities recorded in the diary sheets were classified under the following headings: lying down/sleeping, sitting, standing, walking, praying, personal activities, and moderately active pursuits. The phrase 'moderately active pursuits' encompass all moderately active activities such as running, cycling and playing badminton. Results were reported as minutes per day and percent of day spent on various activities.

Complete food intake and activity pattern records was obtained from 20 boys and 30 girls, thus food intake and activity pattern are reported only from these subjects while antropometric data is reported from both the entire group and the subgroup.

### **Statistical analysis**

All results are presented as mean  $\pm$  SD. Statistical analysis was done using the BMDP Statistical Software (1994). Student's paired t-test was used to compare body weight changes over the study period and also to compare food intakes and activity patterns during Ramadan-fasting with non-fasting.

## RESULTS AND DISCUSSION

The physical characteristics of the subjects are shown in Table 1a. The comparison of body weight measured before, during and after Ramadan shows a significant difference ( $p < 0.001$ ) when analyzed by Student's paired t-test, which was not evident when the group was analysed as a whole.

**Table 1a.** Physical characteristics and body weight changes of adolescent subjects (mean  $\pm$  SD)

Variables	Boys (n = 51)	Girls (n = 66)
Age (years)	12.0 $\pm$ 0.4	11.3 $\pm$ 0.4
Height (m)	1.43 $\pm$ 0.06	1.42 $\pm$ 0.06
Weight (kg)		
Pre-fast	35.7 $\pm$ 6.7 <sup>a</sup>	35.2 $\pm$ 6.1 <sup>a</sup>
After 2 weeks' fast	34.5 $\pm$ 6.6 <sup>b</sup>	34.2 $\pm$ 5.9 <sup>b</sup>
Last week of fast	34.2 $\pm$ 6.4 <sup>c</sup>	33.9 $\pm$ 5.9 <sup>c</sup>
Post-fast	35.5 $\pm$ 6.6 <sup>a</sup>	34.8 $\pm$ 6.1 <sup>d</sup>

a, b, c, d: Differences between results were analysed statistically using Student's paired t-test ( $p < 0.001$ ).

The average decrease in body weight during the fasting month was 3.4% and 4.2% among the boys and 2.8% and 3.7% among the girls after 2 weeks and 4 weeks of fasting respectively. The post-fasting mean value shows that two weeks after Ramadan the boys were only 0.6% below and not significantly different from their pre-fasting body weight. The girls had also regained some of their lost body weight two weeks into Syawal. However, their post-fasting mean weight was still an average of 1.1% lower, which is significantly lower ( $p < 0.001$ ) than pre-fasting values.

It can be seen from Table 1b that more than 80% of the subjects experienced a weight decrease during Ramadan, and regained most of their weight after two weeks of returning to normal eating pattern. There were 9.8% boys and 7.6% girls whose weight remained at least 1.5 kg below pre-fasting values when measured two weeks after Ramadan. Only 3.9% and 9.1% of the boys and girls respectively did not experience any change in body weight during Ramadan.

**Table 1b.** Percentage of subjects according to patterns of weight changes

Pattern of change	Boys (n = 51)	Girls (n = 66)
Weight decreased during Ramadan and subsequently returned to pre-fast value	86.3%	83.3%
Weight decreased during Ramadan and remained $\geq$ 1.5 kg below pre-fast value	9.8%	7.6%
No weight change during Ramadan, with 0-1.5 kg increase post-fast	3.9%	9.1%

a, b, c: Differences between results were analysed statistically using Student's paired t-test (boys,  $p > 0.05$ ; girls,  $p < 0.001$ ).

Table 2 shows the physical characteristics and body weight changes of the subgroup of 20 boys and 30 girls who completed the food intake and activity pattern study. Students paired t-tests comparing body weight before, during and after Ramadan show a similar trend of weight change as for the whole group.

Table 2. Physical characteristics and body weight changes of subgroup (mean  $\pm$  SD)

Variables	Boys (n = 20)	Girls (n = 66)
Age (years)	11.9 $\pm$ 0.3	11.3 $\pm$ 0.4
Height (m)	1.42 $\pm$ 0.06	1.42 $\pm$ 0.04
Weight (kg)		
Pre-fast	34.9 $\pm$ 7.5a	33.9 $\pm$ 5.6a
After 2 weeks' fast	33.7 $\pm$ 7.4b	33.1 $\pm$ 5.5b
Last week of fast	33.5 $\pm$ 7.2c	32.7 $\pm$ 5.5c
Post-fast	35.0 $\pm$ 7.1a	33.6 $\pm$ 5.6a

a, b, c: Differences between results were analysed statistically using Student's paired t-test (boys,  $p > 0.05$ ; girls,  $p < 0.001$ ).

The general trend of weight decrease during Ramadan-fasting found in this study is similar to those seen in studies carried out on adult subjects by Fedail *et al.* (1982), Ismail *et al.* (1985), Husain *et al.* (1987) and El Ati *et al.* (1995). Fedail *et al.* (1982) who studied 24 adult subjects found a significant fall in body weight over the Ramadan period when the results were analysed by paired data. Similar to this study, they also found that the weight reduction was not significant when the group was analysed as a whole. In contrast, the three latter studies found that the weight reduction which occurred during Ramadan did not reach statistical significance.

The energy and nutrient intake of the boys and girls are shown in Tables 3a and 3b respectively. The comparison between Ramadan-fasting and non-fasting values shows that the mean intakes of energy, fat, carbohydrate and thiamin were significantly lower during the fasting month for both the boys and girls. In the same period, the mean intakes of calcium and riboflavin among the boys and mean iron intake among the girls was also lower than non-fasting.

Detailed analysis of the dietary intake data showed that all the subjects had energy intakes below the suggested daily dietary intake for Malaysian populations of similar age and sex (Teoh, 1975). The mean energy intake of the boys and girls during fasting was 47.3% and 44.0% of the RDA respectively. And in the non-fasting period, energy intake was 58.5% and 57.2% of the RDA for the boys and girls respectively.

These values show that energy intake among the subjects both during Ramadan-fasting and non-fasting were too low when compared with the Malaysian RDA recommended by Teoh (1975). However, the 1975 Malaysian RDA for energy for the adolescent age group is higher than those recommended by other organizations. Work is currently being done to review the energy requirements of Malaysian adolescents based on basal metabolic rates and physical activity levels as proposed by FAO/WHO/UNU (1985).

*Nutritional changes of adolescents during Ramadan*

**Table 3a.** Daily energy and nutrient intake of adolescent boys during Ramadan-fasting and non-fasting (n = 20).

Nutrient	RDA	Fasting		Non-fasting	
		Mean ± SD	% below RDA <sup>1</sup>	Mean ± SD	% below RDA <sup>1</sup>
Energy (kcal)	2,600	1230 ± 363	100	1520 ± 463**	100
(MJ)	10.9	5.15 ± 1.52	42	6.36 ± 1.94	
Protein (g)	43	46.8 ± 17.9		53.8 ± 19.4	37
Fat (g)		40.0 ± 17.7		49.4 ± 16.3*	
Carbohydrate (g)		170.8 ± 48.3		215.8 ± 68.4**	
Calcium (mg)	650	205.7 ± 140.4	100	281.9 ± 165.3**	95
Iron (mg)	10	9.8 ± 5.4	58	12.2 ± 6.6	42
Vitamin A (µg RE)	575	371.6 ± 255.9	84	476.7 ± 291.4	74
Thiamin (mg)	1.0	0.52 ± 0.29	90	0.72 ± 0.33***	84
Riboflavin (mg)	1.6	0.79 ± 0.51	90	1.01 ± 0.52*	90
Niacin (mg)	17.2	8.66 ± 5.70	95	9.74 ± 4.93	90
Vitamin C (mg)	20	24.2 ± 21.4	52	32.0 ± 37.7	52

<sup>1</sup> Percentage of subjects with intakes below RDA (Teoh, 1975)

\* p < 0.005

\*\* P < 0.01

\*\*\* P < 0.001

**Table 3b.** Daily energy and nutrient intake of adolescent girls during Ramadan-fasting and non-fasting (n = 30).

Nutrient	RDA	Fasting		Non-fasting	
		Mean ± SD	% below RDA <sup>1</sup>	Mean ± SD	% below RDA <sup>1</sup>
Energy (kcal)	2,350	1034 ± 290	100	1344 ± 428***	100
(MJ)	9.8	4.33 ± 1.21		5.62 ± 1.79	
Protein (g)	41	46.3 ± 16.4	27	52.8 ± 22.7	33
Fat (g)		33.6 ± 10.7		44.6 ± 15.4**	
Carbohydrate (g)		136.3 ± 115.4		182.6 ± 57.5***	
Calcium (mg)	650	219.8 ± 115.4	100	245.6 ± 93.2	100
Iron (mg)	10	7.6 ± 4.0	77	11.2 ± 4.4	43
Vitamin A (µg RE)	575	429.7 ± 905.3	93	418.5 ± 195.7	77
Thiamin (mg)	0.9	0.44 ± 0.17	100	0.63 ± 0.19***	93
Riboflavin (mg)	1.4	0.73 ± 0.30	100	0.86 ± 0.31	97
Niacin (mg)	15.5	7.98 ± 4.06	97	9.42 ± 4.04	90
Vitamin C (mg)	20	19.2 ± 11.3	60	25.0 ± 17.4	47

<sup>1</sup> Percentage of subjects with intakes below RDA (Teoh, 1975)

\* p < 0.005

\*\* P < 0.01

\*\*\* P < 0.001

Comparison to the RDA recommended by FAO/WHO/UNU (1985) [boys 2190 kcal (9.16 MJ), girls 1945 kcal (8.14 MJ)] shows that the mean energy intake of the boys during Ramadan and non-fasting was 56.2% and 69.4% of the RDA respectively, while the mean energy intakes for the girls was 53.2% and 69.1% of the RDA during Ramadan and non-fasting respectively.

Although, we may suspect under-reporting of intakes among the subjects of this study, other food intake studies carried out on non-fasting adolescents have reported similar findings. Chan (1993) found that energy intake amongst 13 year old boys and girls was 69.0% and 58.0% of the

RDA recommended by Teoh (1975) respectively, while Onn (1995) reported that Malay primary schoolchildren in the Klang Valley aged between 10 and 12 years has an average energy intake of 57.3% RDA.

The results of this study also showed that more than 50% of the subjects had intakes below the RDA for all the nutrients studied except protein. Tables 3a and 3b also show that during Ramadan, the mean intakes of all nutrients, with the exception of protein and vitamin C were lower than recommended values.

The activity patterns of the adolescents during fasting and non-fasting are shown in Tables 4a and 4b. Analysis of the time spent on each activity shows no significant difference between the boys and girls for most activities. The boys spent significantly more time than girls in prayer during Ramadan ( $p < 0.001$ ) and in moderately active pursuits during non-fasting ( $p < 0.01$ ).

Table 4a. Activity pattern of adolescent boys during Ramadan-fasting and non-fasting (n = 20)

Types of activities	Fasting		Non-fasting	
	Minutes/day	% of day	Minutes/day	% of day
Lying/sleeping	564 ± 118	39.2	587 ± 71	40.8
Sitting	567 ± 107*	39.4	527 ± 101	36.6
Standing	70 ± 28	4.8	84 ± 31*	5.8
Walking	118 ± 73	8.2	131 ± 62	9.1
Personal	37 ± 13	2.6	40 ± 16	2.8
Praying	58 ± 49**	4.0	21 ± 10	1.4
Moderately active	26 ± 19	1.8	51 ± 40*	3.5

\*  $p < 0.05$

\*\*  $P < 0.01$

Table 4b. Activity pattern of adolescent girls during Ramadan-fasting and non-fasting (n = 30)

Types of activities	Fasting		Non-fasting	
	Minutes/day	% of day	Minutes/day	% of day
Lying/sleeping	575 ± 89	39.9	567 ± 50	40.8
Sitting	567 ± 94	40.0	557 ± 77	36.6
Standing	85 ± 32	5.9	102 ± 43	5.8
Walking	130 ± 62	9.0	128 ± 47	9.1
Personal	35 ± 13	2.4	42 ± 12***	2.8
Praying	21 ± 15+++	1.4	19 ± 13	1.4
Moderately active	20 ± 12	1.4	24 ± 20##	3.5

\*\*\* Shows significant difference between fasting and non-fasting ( $p < 0.001$ )

+++ Shows significant difference from boys [Table 4a] during fasting ( $p < 0.001$ )

## Shows significant difference from boys [Table 4a] during non-fasting ( $P < 0.01$ )

It is obvious from Table 4a that the boys spent significantly ( $p < 0.05$ ) more time sitting and less time standing and involved in moderately active pursuits during fasting. Among the girls, a similar trend can be seen, although statistical analysis does not show any significant difference (Table 4b). The amount of time spent on all other activities during Ramadan such as lying down/sleeping and walking is not significantly different from non-fasting. This may be due to

the fact that this study was carried out during a year when Ramadan fell on normal school-going days and not during the school holidays when the children may be expected to occupy themselves with more sedentary activities. On normal school-going days, the adolescents had few opportunities to adjust their activity pattern as many of them attended national school in the morning and religious school in the afternoon or vice versa.

This study revealed that there was a significant weight loss during Ramadan, although an average weight loss of 1.5 kg and 1.3 kg among the boys and girls respectively is not particularly alarming. Moreover, about 80% of the subjects had regained some of their lost weight by two weeks into the month of Syawal. Estimates of energy intake was significantly lower during fasting compared with non-fasting while overall activity pattern remains relatively similar. This has possibly resulted in a negative energy balance during fasting which is reflected in the decrease of body weight. Studies carried out on Malaysian adults by Ismail *et al.* (1985) and Husain *et al.* (1987) had similar findings which negates the common belief that Muslims tend to overcompensate in terms of food intake during Ramadan.

Notwithstanding the weight loss during Ramadan which may be due to the reduction in energy intake, the overall nutrient intake pattern of the adolescents studied should be of great concern in the long term as it does not meet the requirements of growth.

## **ACKNOWLEDGEMENTS**

The authors wish to thank the participants and their parents for their dedication, and the staff of both the schools involved in the study for their patience and assistance. The authors also thank Prof. Dr. Mokhtar Abdullah for his valuable help on statistical procedures. This study was supported in part by grant from the Nestle Foundation, Switzerland.

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