Does Ramadan fasting affect expiratory flow rates in healthy subjects?

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ABSTRACT

Objectives: To assess whether Ramadan fasting affects if these effects correlate to a change in other variables.

Methods: This unmatched case-control longitudinal study includes 46 non-smoking healthy subjects who undertook lung function testing at the Aga Khan University, Pakistan. 3 Islamic months, corresponding to November 2001 to

Results:

compared to the pre Ramadan period. However, forced

Conclusion: This study shows that Ramadan fasting will Ramadan values did show an increase in FEF\textsubscript{75} and FEF\textsubscript{75-85}, possibly due to changes in body water and fat content. The reductions in body mass were most probably due to lack of nutrition and not dehydration as the fasts were performed in winter. Collection of reference values or early phase be affected by Ramadan fasting.

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Lung function testing has become a part of the routine health examination in pulmonology, public health screening, occupational and sports medicine. Spirometry is the most basic, widely used, cost effective test in pulmonology. Measurements discriminate restrictive from obstructive categories of respiratory disease.\textsuperscript{1}

As fasting is one of the 5 major pillars of Islam, up to 400 million Muslims worldwide observe the fast during the Islamic month of Ramadan.\textsuperscript{2} The Lunar Islamic months are of 29-30 days and have a total of 355 days in a year. Therefore, relative to the Gregorian calendar, Ramadan can rotate to either the winter or summer seasons. The total hours of fasting from dawn to sunset varies according to the season and also the geographical location.

The effects of Ramadan fasting on public health are of importance to physicians and health care personnel wherever there is a sizable Muslim population. Various studies have seen the effects of Ramadan fasting on changes in body function, including body

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A history and physical examination was performed to select healthy subjects and to exclude those with gross abnormalities of the vertebral column or thoracic cage, known history of malignancy, diabetes mellitus, respiratory, neuromuscular or cardiovascular disease and those who had undergone major abdominal or thoracic surgery. Subjects who had a FEV₁/FVC ratio (BMI) were also excluded. In addition, subjects with current or previous drug or tobacco (smoked or chewed) addictions or who chewed betel nut were also excluded. Betel nut chewing is common in Pakistan and has been associated with asthma.

Pulmonary function tests were performed on an electronic spirometer (Compact Vitalograph, Buckingham, UK). All these tests were performed after 11 am and preferably between 2 and 4 pm to minimize diurnal variation. Four FEF values were measured, all in l/s. FEF$_{25}$ related, but less commonly used alternative to PEF. The FEF$_{50}$ remains to be expired, and the FEF$_{75}$, the maximal in airways of diameter more than 3 mm and less than 3 mm, respectively. Both are commonly assessed during respiratory surveys. Both the FEF$_{75}$ and the FEF

FEF$_{25}$ were also measured. Their data has been previously presented.

The apparatus was calibrated daily with a 1 liter calibration syringe (Vitalograph, UK) and operated within a temperature range of 20-23°C. The maneuver was explained to the subjects and 3-5 maneuvers were performed after adequate rest. Maneuvers were performed in an upright sitting position without a nose through the nose during a forceful expiration, and disposable mouthpieces were used for each individual. Tests were conducted according to American Thoracic Society recommendations. The subject was asked to take in a deep breath as hard as possible and then expire forcefully into the mouthpiece of the spirometer values were chosen, irrespective of the test. All lung volumes were corrected to body temperature and pressure saturated with water vapor.

Comparisons of 5 variables of anthropometry and lung function were made between pre Ramadan, mass, glucose metabolism, and exercise. Two studies have investigated the effects of Ramadan fasting on spirometric variables. In one, Ramadan variables were compared with post-Ramadan variables. The limitations of this study are that only 13 subjects were studied, that post-Ramadan values were taken measured. The other showed that PEF and FEF$_{25,75}$ did not change before, during and after Ramadan fasting.

In a Muslim population, it is important to compare fasting states in healthy subjects, particularly when collecting data on reference values in normal and also in clinical trials, involving healthy subjects. No study has investigated the effect of Ramadan fasting on the FEF$_{50}$, FEF$_{75}$, and FEF$_{75}$.

The aim of this study was to see whether Ramadan if there were changes, did these correlate with any anthropometric or spirometric variable. We, therefore, studied the effects of Ramadan fasting on expiratory

Methods. This was a prospective longitudinal case-control study, in which unmatched healthy subjects underwent lung function testing. Tests were performed during a 10-day period before Ramadan (during the and after Ramadan (during the Islamic month of Shawwal). In the year 2001-2002 these 3 Islamic months corresponded to the Gregorian months of

Forty-six non-smoking healthy male subjects were recruited by personal request from the staff and students of the Aga Khan University (AKU). This study was conducted at the Aga Khan University, Karachi, Pakistan. Their mean age was 24.2 years (SD ± 6.4), range 16-41 years. Informed consent was obtained before the study commenced and the study was approved by the AKU ethical committee and performed according to the Declaration of Helsinki included anthropometric data and a consent form. Body mass and height in indoor clothing and without shoes were measured (Seca, Hamburg, Germany). The weighing machine was regularly checked with a 25 kg standard weight. Female subjects were not to fast during their menses and lung function is also slightly lower during menses.
Ramadan fasting and post Ramadan values. The results were obtained by applying repeated measures correction was used to adjust for type-1 errors. The pulmonary function data was correlated against changes in body mass. Linear regression was applied to this correlation, and the equation y=mx+c was data, outliers at both ends were found in box plots and were excluded from the regression analysis, if they were greater than 3 standard deviations from the mean. The Statistical Package for Social Sciences software version 10.01 was used. The level of probability taken was p<0.05).

**Results.**

1.1 cm (± SEM) and BMI was 23.5 ± 0.57 kg m⁻² (± SEM). Their mean body mass in the 3 time points (Pre Ramadan, Ramadan and Post Ramadan) is displayed in Table 1. Body mass in Ramadan was and post Ramadan (p = 0.04) difference in body mass between pre Ramadan and post Ramadan readings.

Table 1. Relative to pre Ramadan values, Ramadan fasting and FEF both showed a (p=0.02 and p=0.035). The FEF₂₅ and FEF₅₀ showed post Ramadan.

Regression analyses were performed to see any correlations between differences in body mass and differences in body mass and FEF₂₅ (r² correlation (p=0.03). In this correlation there were 2 outliers (>3 SD), which were subsequently removed.

**Discussion.**

investigate the effects of Ramadan fasting on FEF₂₅, FEF₅₀, FEF₇₅ and FEF rates in healthy subjects. Other distinctive aspects of this study over a previous study⁹ are that the present study used pre Ramadan values as the baseline and all subjects in the present study were non-smokers. The present study shows that there were no changes relative to pre Ramadan values, however, post to Ramadan.

Duncan et al⁹ reductions in PEF and the ratio of dead space to tidal fasting on pulmonary function. Apart from PEF, they fall in PEF could include the fact that their study was most likely performed in summer. No details of when the study commenced were given but the paper was published in 1990. Therefore, it was most likely the that the 2nd week of Ramadan was on approximately weather in Malaysia is tropical and in summer, hot and humid. At a higher temperature early fatigue can set in, which may result in a decrease in submaximal effort, which can decrease PEF.¹⁵⁻¹⁷ Also, the duration longer fasting hours could also have decreased the PEF by causing more fatigue and dehydration.

Limitations of this previous study⁹ are that only 13 subjects were studied, that post-Ramadan values were taken as the baseline and some subjects could have been smokers, as the authors mention “none of the subjects were heavy smokers”. The present study recruited only life-time non-smokers, as apart from the direct negative effect of smoking on lung function, evidence also suggests smokers are more irritable than non-smokers in Ramadan and psychological stress has been shown to affect pulmonary function in healthy subjects.¹⁹

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pre-Ramadan (n=46)</th>
<th>Ramadan (n=46)</th>
<th>Post-Ramadan (n=46)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body mass (kg)</td>
<td>69.96 ± 2.22</td>
<td>69.96 ± 2.22</td>
<td>69.96 ± 2.22</td>
</tr>
<tr>
<td>FEF₂₅ (l s⁻¹)</td>
<td>7.59 ± 0.25</td>
<td>7.59 ± 0.25</td>
<td>7.59 ± 0.25</td>
</tr>
<tr>
<td>FEF₅₀ (l s⁻¹)</td>
<td>4.50 ± 0.19</td>
<td>4.59 ± 0.19</td>
<td>4.59 ± 0.19</td>
</tr>
<tr>
<td>FEF₇₅ (l s⁻¹)</td>
<td>1.70 ± 0.12</td>
<td>1.60 ± 0.09</td>
<td>1.60 ± 0.09</td>
</tr>
<tr>
<td>FEF (l s⁻¹)</td>
<td>1.13 ± 0.11</td>
<td>1.13 ± 0.11</td>
<td>1.13 ± 0.11</td>
</tr>
</tbody>
</table>

†significantly different from Ramadan values (p<0.01)
Ramadan fasting in the present study has been previously reported. Other studies have also shown decreases in body mass, albeit, they did studies is one which showed no change in body mass and another which showed an increase in body mass, both with Ramadan fasting. There are many complications with comparisons of changes in body mass, which can lead to variations in body mass loss diet, season during Ramadan (winter/summer), time measurement was taken during the day, when measurements were made in the month of Ramadan and whether baseline measurements were made pre or post Ramadan.

During Ramadan fasting could also affect normal physiological lung function. Hussain et al have ruled out the possibility of dehydration by measuring the study. Another study showed that subjects were shown by increases in serum electrolytes and protein, yet these differences normalized in the last week of Ramadan. In another study by Ramadan et al, subjects compared to the sedentary subjects, as the osmolarity at the end of Ramadan fasting.

In a study where healthy subjects were hypohydrated by administering a diuretic, PEF, FEF, and FEF increased. The hypohydration produced blood urea nitrogen and creatinine. These values returned to normal on rehydration. Interestingly, the maximum increases in FEF, FEF, and PEF mirrored the maximum fall in body weight, with FEF increasing the most. The authors suggest that the reason for this change might be a loss of water in the airway mucosa and bronchovascular sheath, causing a potential fall in airway resistance. They concluded that hypohydration caused an increase in the lung function, which is mechanistically opposite to pulmonary edema, where excess lung water could explain the increases in post Ramadan FEF and FEF in the present study, as markers of hydration or airway resistance were not measured.

Post Ramadan fasting, both FEF and FEF The fact that all FEF values were higher post-Ramadan relative to Ramadan does show there is internal both are effectively independent of effort. Although mean data showed an increase in both post Ramadan body mass and FEF, using linear regression, there changes in body mass and FEF, where a fall in body mass was related to an increase in FEF, and vice versa. This relationship may not necessarily be causal and it is possible that there is a common underlying mechanism accommodating both these variables. Changes in body hydration being responsible for this relationship cannot be ruled out.

Changes in body mass have been shown to result in changes in lung function, where a reduction of weight in obese asthmatics improved lung function, primarily FVC and FEV. Chinn and co-workers have shown that increases in BMI were associated with decreases in both FEV.

The body mass changes in their subjects were primarily an increase in body fat and they suggest that increases lower lung function. Subjects do lose body fat after Ramadan fasting though it is unclear as to whether rates and also it is not known where the sites of fat removal are. Therefore whether this could explain the post Ramadan increase in FEF values in the present study is uncertain.

Limitations of the present study are that the sample size was relatively small and only males were studied. However, given the large number of Muslim patients and an increase in the prevalence and detection of respiratory diseases, we feel this study addresses an important concern. The fact that no effect of Ramadan this to patients with respiratory disease. Further work needs to be conducted on selected patient groups to rule out any effect of Ramadan fasting on their lung function.

In conclusion, the present study found no change and FEF relative to Ramadan fasting did occur and possible mechanisms for these include changes in both body water and fat content, though both need were most probably due to lack of food and liquid ingested, and not due to dehydration as the fasts were performed in winter.
References

1. Ruppel GL. Spirometry. Respir Care Clin N Am
2. Rashed AW. Fast of Ramadan. BMJ
5. Gumaa KA, Mustafa KY, Mahmoud NA, Gader AM. The effects of fasting in Ramadan. 1. Serum uric acid and lipid concentrations. Br J Nutr
6. Iraki I, Bogdan A, Hakkou F, Amrani N, Abkari A, Touitou Y. Ramadan diet restrictions modify the circadian time structure in humans. A study on plasma gastrin, insulin, glucose, and calcium and on gastric pH. J Clin Endocrinol Metab
7. composition, blood constituents and physical performance? Med Princ Pract


Betel-nut chewing and asthma. Lancet 1136.

lung function in subgroups from two Dutch Populations. Consequences of longitudinal analysis. Am J Respir Crit Care Med


D. Irritability during the month of Ramadan. Psychosom Med


Baughman RP. Effects of Hypohydration on Lung Functions in Humans. Am Rev Respir Dis

Ylikahri M, Mustajoki P. Immediate and long term effects of weight reduction in obese people with asthma: randomized controlled study. BMJ

in body mass on measurements of ventilatory capacity. Thorax