Abstract:
**Introduction:** All over the world Muslims, during Islamic month of Ramadan observe fast. The aim of this study is to evaluate and study different anthropological and physiological changes taking place in healthy subjects who fast during ramadan. If beneficial effects are found, modified Ramadan diet can be advised to patients to prevent risk of developing lifestyle diseases like coronary artery disease, hypertension, diabetes etc.

**Materials and methods:** This is a prospective study in which 50 fasting Muslim healthy subjects both males and females in the age group 18-65 were included. Detailed history and anthropometric measurements was carried out in all the subjects, twice: once, a week before Ramadan and thereafter, after Ramadan month. A detailed questionnaire was provided to all the subjects regarding their mental status and sleep pattern.

**Observation:** Fasting caused significant reduction in weight, basal metabolic index, waist circumference in males as well as females. Neither systolic nor diastolic blood pressure changed significantly during Ramadan fasting. There is decrease in anxiety levels, however, there is day time sleepiness during this month.

**Conclusion:** Ramadan fasting is beneficial in a way that it caused significant reduction in weight, waist circumference, basal metabolic index and anxiety in people those who fast.

**Key words:** Anxiety, basal metabolic index, blood pressure, body weight, sleep pattern, waist circumference.
**Materials and methods:**
A prospective study was carried out in the month of Ramadan during July-August 2013 Islamic year 1434 Hijra. 50 fasting Muslim healthy subjects both males and females who fasted in Ramadan for at least 25 days were included in the study. The sample consisted of 23 males and 27 females. None of the subjects were smokers or on any medications at the time of study. The average duration of fast was 15±1 hours and maximum ambient temperature 32-35 degree C. Informed consent in vernacular language was taken from all the subjects. Detailed history of all the subjects was taken. All the physiological parameters like pulse, blood pressure, height, weight, waist circumference were recorded twice, first, at the beginning of Ramadan and then, at the end of Ramadan month. Blood pressure, both systolic and diastolic, was measured on the right arm in supine position twice 5 minutes apart by the same observer and average value calculated. Waist circumference was measured according to the World Health Organization’s protocol:; at the midpoint between the lower margin of the last palpable rib and the top of the iliac crest, using a stretch resistant tape that provides a constant 100 g tension. Body mass index (BMI) was calculated using the standard formula: weight (kg)/height^2 (m^2). A detailed questionnaire was provided to all the subjects regarding their mental status and sleep pattern. The subjects were asked to answer the questionnaire before the beginning of Ramadan and the same questionnaire was presented to them at the end of Ramadan. For evaluation of sleep Epworth sleepiness scale was used. The Epworth Sleepiness Scale (ESS) is a scale intended to measure daytime sleepiness that is measured by use of a very short questionnaire. A number in the 0–9 range is considered to be normal while a number in the 10–24 range indicates that there is day time sleepiness. For evaluating mental status, Hamilton scale was used. Hamilton scale is used to assess anxiety status of an individual. It has 14 items and each item is scored on a scale of 0 (not present) to 4 (severe), with total score range of 0-56.

**Observations:**
During the month of Ramadan in 2012-13, total number of fasting days was 29.

**Table I. Pre and post Ramadan values**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Pre Ramadan values (mean ±SD)</th>
<th>Post Ramadan values (mean ±SD)</th>
<th>‘p’ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body weight (kg)</td>
<td>65.78±14.58</td>
<td>64.8±14.01</td>
<td>p&lt;0.0001</td>
</tr>
<tr>
<td>Waist circumference (cms)</td>
<td>86.22±10.6</td>
<td>84.78±10.13</td>
<td>p&lt;0.0001</td>
</tr>
<tr>
<td>Basal metabolic index</td>
<td>25.73±4.57</td>
<td>25.35±4.34</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>Hamilton scale (score out of 25)</td>
<td>12.6±6.44</td>
<td>4.38±3.49</td>
<td>p&lt;0.0001</td>
</tr>
<tr>
<td>Sleep scale: score (0-10)</td>
<td>4.5±3.09</td>
<td>10.26±3.58</td>
<td>p&lt;0.0001</td>
</tr>
<tr>
<td>Systolic blood pressure (mmHg)</td>
<td>119.52±9.92</td>
<td>119.32±9.66</td>
<td>NS</td>
</tr>
<tr>
<td>Diastolic blood pressure (mmHg)</td>
<td>77.72±5.94</td>
<td>77.44±5.88</td>
<td>NS</td>
</tr>
</tbody>
</table>

(Values are mean ± standard deviation, NS Not significant).

According to our observations, (table 1), at the end of our study, there was decrease in weight in both males and females due to Ramadan fasting. The decrease in weight was highly significant (p< 0.0001). We also observed that waist circumference too was reduced. The reduction in waist circumference was statistically significant (p<0.0001). Basal metabolic index also showed significant (p<0.0001) reduction as compared...
to pre fasting levels. However we observed that neither systolic nor diastolic blood pressure changed significantly. Our observations show day time sleepiness during month of Ramadan compared to pre Ramadan. Epsworth score for daytime sleepiness before Ramadan month and post Ramadan month was statistically significant (p<0.0001). Subjects also showed statistical significant reduction in their anxiety levels compared to pre Ramadan fasting anxiety level. However, neither systolic nor diastolic blood pressure showed any significant change between pre and post fasting values.

Discussion:
During month of Ramadan, Muslims fast for approximately 28 days. It is a sort of intermittent fasting in which fasting individuals are not supposed to eat or drink anything during day time for approximately 16 hours. Various changes take place in the body during these long hours of fasting which include physiological, anthropological, psychological and metabolic changes.

Results of our study demonstrate no significant changes in blood pressure either systolic or diastolic, inspite of long hours of fasting. This may be due to the fact that people who fast are allowed to eat and drink before dawn and after dusk. This maintained homeostasis and blood pressure did not change. This finding is in accordance with studies conducted in past by Salhamoud\textsuperscript{5}, H Fakhrzadeh\textsuperscript{11}. However, study conducted by Shaheena Kamal\textsuperscript{3} et al showed significant decrease in the systolic & diastolic blood pressure after 4 weeks of Ramadan fasting.

In our study we detected reduction in weight of the subjects. In a similar study Kauser Sayyeda 2012\textsuperscript{4} and Salhamoud\textsuperscript{5} also concluded that there is decrease in weight in this type of fasting. There was significant reduction in body weight which has also been concluded by Ziaeae et al 2006\textsuperscript{6}, H. Fakhrzadeh MD et al\textsuperscript{3}, Mansi 2007\textsuperscript{12} Al Hourani 2007\textsuperscript{13}. It has been concluded by Takruri 1989\textsuperscript{14} that overweight persons loose more weight than normal and underweight subjects. Body weight decreased due to increase in free fatty acid oxidation to provide energy due to depletion of glycogen stores. Same theory has been put forward by El-Ati, J., C. Beji and J.Danguri, 1995\textsuperscript{5}. The changes in the body during Ramadan occur after continuous fasting for approximately 8 hours up to which nutrients from previous diet are absorbed from the gut. Normally glucose stored in the muscles and liver is the main source of energy for the body. During Ramadan, initially in the fasting condition, glucose stored is used as source of energy. After some hours, after the glucose stores get exhausted, fat becomes the next source of energy. The use of fat as source of energy reduces the fat stores in the body, thus, aids weight loss, decreases cholesterol and helps in better control of diabetes, blood pressure and other lifestyle related diseases.

In our study we observed that, waist circumference decreased significantly in both males and females. This observation is similar to works done by Shaheena\textsuperscript{3}, Salhamoud et al\textsuperscript{5,11}. Waist circumference is more reliable indicator of visceral obesity which in turn is linked to insulin resistance, diabetes, dyslipidemia, and hypertension. Abdominal fat accumulation increases the incidence of cardiovascular diseases and death. It has been established by Sonnenberg and Krakower (1994)\textsuperscript{16} that cardiovascular related morbidity and mortality are affected by regional distribution of fat. Hence, reduction of waist circumference during Ramadan fasting shows that modified Ramadan type of diet can be used by obese people to reduce central obesity and hence prevent lifestyle diseases like diabetes, hypertension etc. R M Yousuf, A R M Fauzi et al\textsuperscript{17} have concluded that as there is weight loss, better glycaemic control can be achieved by following a diet similar to Ramadan diet with slight modifications. There is significant decrease in basal metabolic index (BMI) in our study which is consistent with similar study done by Ziaee in 2006\textsuperscript{6} and Amir Hossein Memari, Ramin Kordi in 2011\textsuperscript{18}. Both these studies concluded that there is decrease in basal metabolic index after Ramadan fasting.

Before Ramadan the Hamilton score\textsuperscript{17} of subjects showed 12.6±6.44, which decreased to 4.38±3.49 post Ramadan. There is significant improvement in anxiety status of subjects post Ramadan. This may be due to the fact that during Ramadan, fasting individuals try to spend as much time as possible praying, leading inner peace and tranquility. It has positive effects on mental and emotional health of individuals. Hostility during month of Ramadan is minimum. However, effects of restriction on smoking, caffeine, alcohol or any type of addiction also contributes to this altered sense of well being during this month. Epworth sleepiness scale score pre Ramadan was 4.5±3.09 and post Ramadan it was 10.26±3.58. Before Ramadan, the score was in
normal range, but during Ramadan, the score indicated sleepiness during daytime. People change their sleeping habits and remain awake for more hours during night than during non Ramadan time. This significantly changes the circadian rhythm leading to daytime sleepiness, as was shown by Epworth sleepiness scale score of pre and post Ramadan. This finding is consistent with findings of Taoudi Benchekroun, Roky et al (2001).

Conclusion:
According to our study, Ramadan fasting reduces the weight, waist circumference and BMI and thus, has beneficial effects on the body especially for obese people. It also reduces the anxiety levels in people who fast. However, sleep disturbances in the form of day time sleepiness are more common.

Hence, according to our study, Ramadan fasting is healthy non pharmacological means for improving cardiovascular risk factors. However, since many metabolic, biochemical, physiological, spiritual and psychological changes take place in body, we recommend large scale coordinated studies to throw more light on this topic.

References: