RELATIONSHIP OF SERUM CALCIUM LEVEL WITH BASAL METABOLIC INDEX & HIP CIRCUMFERENCE IN OBESE FEMALES OF REPRODUCTIVE AGE

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Abstract:
Background: Obesity is a common health problem in urban population now-a-days.

Objective: The present study was carried out to assess the relationship of serum calcium levels with obesity.

Methods: This cross sectional study was done in Department of Physiology, Dhaka Medical College, Dhaka. For this purpose, 120 subjects within the age range of 25 to 50 years of both sexes were included in the study. Among them 60 non-obese, apparently healthy subjects were selected as control (Group A) and 60 obese subjects as case (Group B). Group A was further subdivided as group A1 (non-obese male) & group A2 (non-obese female). Group B was further subdivided as group B1 (obese male) & group B2 (obese female). Case and control subjects were selected from the Urban Primary Health Care Project (UPHCP), PA-2, Dhaka City Corporation, Dhaka, and by personal contact during the period from January 2010 to December 2010. All the subjects were apparently healthy. Post menopausal women were excluded.

Results: In this study, serum total calcium level was significantly and positively related with BMI & Hip C in group B2 (r = +0.397, +0.407; p=0.030, +0.026).

Conclusion: This study concludes that, serum calcium level increases with increase in BMI & Hip circumference in females of reproductive age.

Keywords: Serum total calcium level, Basal Metabolic Index (BMI), Hip Circumference.


Introduction

Overweight and obesity are important determinants of health and lead to adverse metabolic changes. Obesity is a predisposing factor for poor health and also a cause of increased mortality.1 Globally, there are more than 1 billion overweight adult people, at least 300 million of them are obese. Obesity has reached epidemic proportions.2 Basal Metabolic Index (BMI) greater than 30 is defined as “obesity”.3 As many as 30 health conditions are associated with obesity, including heart disease, diabetes, high blood pressure, stroke and some forms of cancer.4 World health report 2002 states, approximately 58% of diabetes, 21% of ischemic heart disease and 8-42% of certain cancers globally were attributable to a BMI above 21 kg/ m².2

It is also correlated with an increased risk of death. The relationship between obesity and associated morbidities is stronger among individuals younger than 55 years.5 It has been proved that obesity is influenced by genetic, chemical, environmental and behavioral factors.5

High level of calcium in the blood can be dangerous to a number of cells, including the
lining of the stomach and the pancreas, causing both of these organs to become inflamed and painful (ulcers and acute pancreatitis)\textsuperscript{6}.

Common presentation for persistently elevated calcium levels is the development of kidney stones. Since the major function of the kidney is to filter and clean the blood, they will be constantly exposed to high levels of calcium in patients with hyperparathyroidism.

Positive correlations between plasma calcium, BMI and waist circumference, and also between PTH, BMI and waist circumference have been found.\textsuperscript{7} The increased intracellular calcium is an important second messenger that triggers various pathways that promote the accumulation of fat in adipose tissue, including activation of lipogenesis by augmenting fatty acid synthase activity.\textsuperscript{8-9}

\section*{Methods}

The present cross-sectional study was done in the Department of Physiology, Dhaka Medical College, Dhaka, from January to December 2010. 120 subjects were selected within the age range of 25-50 years. Among them 60 non-obese, apparently healthy subjects were selected as control (Group A) and 60 obese subjects as case (Group B). Group A was further subdivided as group A\textsubscript{1} (non-obese male) & group A\textsubscript{2} (non-obese female). Group B was further subdivided as group B\textsubscript{1} (obese male) & group B\textsubscript{2} (obese female).

Non-obese (BMI <30 Kg/m\textsuperscript{2}) and obese (BMI>30 Kg/m\textsuperscript{2}) subjects of both male and female sex were included. Postmenopausal women, pregnant women, persons suffering from Hypo/Hyperparathyroidism, chronic kidney disease, having history of Thyroidectomy & parathyroidectomy and oral calcium vitamin D & supplementation were excluded from the study.

Sample was collected in fasting condition and anthropometric measurements were taken after evacuation of bowel and bladder. Serum total calcium was measured by bichromatic endpoint technique in Dimension\textsuperscript{®} clinical chemistry system.

Statistical analyses were performed by using SPSS for windows version 11.0. Comparison between two groups were done by using Student’s unpaired ‘t’ test. Correlation analysis was done by using Pearson’s correlation test. P value <0.05 was taken as level of significance.

\section*{Results}

\textbf{BMI:} The Mean\textpm SD of BMI were 24.08\textpm 2.88, 23.25\textpm 1.42, 33.57\textpm 4.05, 35.14\textpm 4.19 kg/m\textsuperscript{2} in group A\textsubscript{1}, A\textsubscript{2}, B\textsubscript{1} & B\textsubscript{2} respectively. The BMI in group B\textsubscript{1} was higher than that of group A\textsubscript{1} and group B\textsubscript{2} was higher than group A\textsubscript{2} which were statistically significant (P<0.001) (Table-I).

\textbf{Hip circumference:} The Mean\textpm SD of hip circumference were 80.33\textpm 5.17, 93.73\textpm 8.40, 96.77\textpm 9.81, 105.53\textpm 6.51 cm in group A\textsubscript{1}, A\textsubscript{2}, B\textsubscript{1} & B\textsubscript{2} respectively. The hip circumference in group B\textsubscript{1} was higher than group A\textsubscript{1} and in group B\textsubscript{2}, Hip C was higher than group A\textsubscript{2} which were statistically significant (P<0.001) (Table-II).

\begin{table}[h]
\centering
\caption{Mean (\textpm SD) BMI (kg/m\textsuperscript{2}) in different groups (n=120)}
\begin{tabular}{|c|c|c|}
\hline
Groups & n & Mean\textpm SD \\
\hline
A\textsubscript{1} & 30 & 24.08\textpm 2.88 \\
A\textsubscript{2} & 30 & 23.25\textpm 1.42 \\
B\textsubscript{1} & 30 & 33.57\textpm 4.05 \\
B\textsubscript{2} & 30 & 35.14\textpm 4.19 \\
\hline
\end{tabular}
\end{table}

The results are expressed as Mean\textpm SD. Unpaired Student’s ‘t’ test was performed to compare between groups. The test of significance was calculated and p values <0.05 was accepted as level of significance.

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Group A\textsubscript{1} : Nonobese male</th>
<th>Number of subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td>df</td>
<td>Group A\textsubscript{2} : Nonobese female</td>
<td>Degree of freedom</td>
</tr>
<tr>
<td>Group</td>
<td>***</td>
<td>Group B\textsubscript{1} : Obese male</td>
<td>Significant at p&lt;0.001 level</td>
</tr>
<tr>
<td>Group</td>
<td>B\textsubscript{2} : Obese female</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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The test of significance was calculated and p values <0.05 was accepted as level of significance.

Group A₁ : Nonobese male  n = Number of subjects
Group A₂ : Nonobese female  ns = Not significant
Group B₁ : Obese male  * = Significant at p<0.05 level
Group B₂ : Obese female

**Correlation of serum total calcium level with BMI of different groups:** In group B₁ and A₁ serum total calcium level showed negative correlation ($r = -0.174$, $-0.260$) with BMI. In group B₂ and group A₂ showed positive correlation ($r = +0.397$, $+0.349$) with BMI but these relationships were statistically non significant in all the groups (Table-III, Fig. 1,2).

![Fig-1: Correlation between serum calcium with BMI in male](image)

<table>
<thead>
<tr>
<th>Groups</th>
<th>n</th>
<th>r value</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A₁</td>
<td>30</td>
<td>0.260</td>
<td>0.165\text{ns}</td>
</tr>
<tr>
<td>B₁</td>
<td>30</td>
<td>0.174</td>
<td>0.357\text{ns}</td>
</tr>
<tr>
<td>A₂</td>
<td>30</td>
<td>+0.349</td>
<td>0.059\text{ns}</td>
</tr>
<tr>
<td>B₂</td>
<td>30</td>
<td>+0.397</td>
<td>0.030*</td>
</tr>
</tbody>
</table>

Pearson correlation test was performed to compare relationship between parameters.

![Fig-2: Correlation between serum calcium with BMI in female](image)
Correlation of serum total calcium level with hip circumference of different groups: In group B₂ serum total calcium level showed significant positive correlation \((r = +0.407)\) with hip circumference. In group B₁ showed statistically non-significant negative correlation \((r = -0.108)\) but in group A₁ and A₂ showed positive correlation \((r = +0.307, +0.053)\) with hip circumference but these relationships were statistically non significant in both groups (Table-IV, Fig. 3,4).

Table IV

<table>
<thead>
<tr>
<th>Groups</th>
<th>n</th>
<th>r value</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A₁</td>
<td>30</td>
<td>+0.307</td>
<td>0.099ns</td>
</tr>
<tr>
<td>B₁</td>
<td>30</td>
<td>0.108</td>
<td>0.569ns</td>
</tr>
<tr>
<td>A₂</td>
<td>30</td>
<td>+0.053</td>
<td>0.781ns</td>
</tr>
<tr>
<td>B₂</td>
<td>30</td>
<td>+0.407</td>
<td>0.026*</td>
</tr>
</tbody>
</table>

Pearson correlation test was performed to compare relationship between parameters. The test of significance was calculated and p values <0.05 was accepted as level of significance.

Group A₁ : Nonobese male

Group A₂ : Nonobese female

Group B₁ : Obese male

Group B₂ : Obese female

**Discussion:**

In the present study, serum calcium level in obese female \((B₂)\) showed significant positive relationship of serum calcium with BMI \((r = +0.397, p=0.030)\) and Hip C \((r = +0.406, p=0.026)\). This may be described by the role of estrogen causing both pear shaped obesity in females and increased calcium absorption.\(^{10}\)

Both male case and control groups \((A₁ & B₁)\) serum total calcium level showed statistically non-significant negative correlation with BMI. Both female case and control groups \((A₂ & B₂)\) serum total calcium level showed statistically non-significant positive correlation with BMI. Serum total calcium level showed statistically non-significant positive correlation with Hip C in male and female control group \((A₁ & A₂)\).

Some of these findings were similar to the finings of Kamycheva, Sundsfjord and Jorde (2004) and Ahlstrom et al. (2009).

Kamycheva, Sundsfjord and Jorde (2004) showed serum calcium has a significant positive relation with BMI in both genders, the present study findings agreed with their findings in male cases but present study found statistically non-significant negative relationship in female obese cases.

Ahlstrom et al. (2009) observed a positive correlation between plasma calcium level and BMI.
Conclusion
From the previous discussion it may be concluded that serum calcium level in obese female increases with BMI & Hip circumference.

References