Abdominal adiposity and cardiometabolic disease in adult female reporing at isra university hospital

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ABSTRACT
The present study was conducted to determine the count of the number of adipocytes subcutaneous and intra-abdominal compartments and association with cardiometabolic diseases. Cross sectional study. March 2012 to April 2013 at the Departments of Anatomy, Obstetrics and Gynecology, Isra University Hospital, Hyderabad. A sample of 80 subjects was selected through non-probability purposive sampling including obese and non obese female undergoing elective cesarean section. Adipose tissue from subcutaneous and intra-abdominal sites was obtained during surgery. Tissue sections of 4µm thickness were stained with haematoxylin and eosin (H & E). Counting of the number of adipocytes per unit area was carried out through ocular grid. The data was analyzed on Statistical Package for Social Sciences (SPSS) version 21.0. A p-value of ≤ 0.05 was taken statistically significant. The number of adipocytes in obese and non-obese from subcutaneous and intra-abdominal compartments showed significant differences. (p<0.01). An increased number of adipocytes were observed in intra-abdominal adipose tissue (IAT) from abdomen of obese compared to non-obese and subcutaneous compartment (p=0.0001). Significant differences were observed in obese and non-obese for the diabetes mellitus, coronary artery disease, hypertension and dyslipidemia. (p<0.01). An increased number of adipocytes were observed in intra-abdominal adipose tissue and was associated with cardiometabolic diseases.

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Introduction
Obesity is associated with cardiometabolic risk factors, such as hypertension,1 dyslipidemia,2 insulin resistance,3 diabetes mellitus,4 etc. Fat deposition and distribution patterns are one of the risk factor for such disorders. It is reported that the subcutaneous adipose tissue (SAT) carries low risk compared to visceral adiposity as risk factor, the later carries more adverse risk of cardiometabolic events. Variations in fat distribution may mediate such risks, with visceral adipose tissue (VAT) associated with more adverse risk factor profiles than abdominal subcutaneous adipose tissue.5,6

Thus, prevention of abdominal obesity is key to reducing cardiometabolic risk.7,8 Preferential intra-abdominal adipose tissue (IAT) accumulation, as measured by IAT adjusted for percent body fat or IAT to subcutaneous adipose tissue (SAT) ratio, depends on genetic factors (e.g., ethnicity or gender), smoking,9 and the hormonal milieu (e.g., postmenopausal status).10,11 The IAT compartment is highly active during changes in balance between energy intake (food consumption) and energy expenditure (physical activity). Rapid IAT accumulation occurs in acute overfeeding experiments,12 and preferential reduction of IAT volume is characteristic of immediate and acute weight loss,13 but mitigated after 12–14 weeks of intervention.14 We have shown that lack of regular moderate physical activity (not meeting physical activity guidelines for healthy adults) is associated with preferential IAT accumulation in midlife women, independent of age, menopausal status, income, smoking, and percent body fat,15 suggesting that a sustained change in lifestyle may affect preferential IAT accumulation. However, physical activity may not be the only lifestyle target for preventing IAT accumulation.9

Although energy intake is linked to IAT in laboratory studies, no population-based studies have been conducted and no studies have determined whether or not energy intake is associated with preferential IAT accumulation, independently of physical activity. The rationale of present study was to determine size and count of adipose cells per unit area in superficial and intra-abdominal fat in adult women present at the surgical and gynecology wards. It was hypothesized that the subcutaneous and intra-abdominal adiposity are independent of each other.

Subjects & Methods
A sample of 80 subjects was studied over from March 2012 to April 2013 at the Departments of Anatomy, Obstetrics and Gynecology. Practical laboratory work was carried out at the Postgraduate laboratory of Isra University. Study design was cross sectional comparative study. The subjects were selected through non-probability purposive sampling. Volunteer female patients, included obese and non obese undergoing elective Cesarean section were asked to enter study protocol if willing. Study subjects were divided into two groups as Group I: obese (n=40) and Group II: non-obese (n=40). Patients with morbidity obesity, pulmonary tuberculosis, and major systemic disease were excluded from study protocol. Informed written consent was taken from patients or their family members. Subjects were further informed that they can withdraw from study protocol if feeling worrisome or feeling fear because of any reason.
Diabetes mellitus, hypertension, coronary artery disease and dyslipidemia were enquired and noted in both groups.

Adipose tissue from subcutaneous and intra-abdominal sites was obtained from Operation Theater. The tissue pieces washed with normal saline and fixed in 10% formalin. The tissue was processed for routine paraffin embedding technique, and tissue sections of 4µ thickness were subjected to haematoxylin and eosin (H & E). The size of adipose cells was measured by micrometry under light microscope with the help of stage and ocular micrometer. Counting of the number of cells per unit area was carried out through ocular grid.

The data was entered into Statistical Package for Social Sciences (SPSS) version 21.0. Continuous variables were analyzed by student t-test, and presented as mean±S.D. The categorical variables were analyzed by Chi-square test and results were presented as frequencies and percentage. A p-value of ≤ 0.05 was taken statistically significant.

Results

Age calculated as mean± SD was 31±6.9 and 32±5.7 in obese and non-obese female. (p=0.07) The obesity related medical problems are shown in table I. Statistically significant differences were observed in obese and non-obese for the diabetes mellitus, coronary artery disease, hypertension and dyslipidemia. (p<0.01) In subcutaneous adipose tissue (SAT), in obese, the mean number of adipocytes was 119.02±5.81 mm⁻¹ with range of 100-140 mm⁻¹ and in non-obese, the mean number of adipocytes was 79.02±6.02 mm⁻¹ with range of 50-98 mm⁻¹. (p=0.0001) while in Intrabdominal adipose tissue (IAT) in obese, the mean number of adipocytes was 3119.02±102.81 mm⁻¹ with range of 4150-1240 mm⁻¹ and in non-obese, the mean number of adipocytes was 1879.02±6.02 mm⁻¹ with range of 1355-2398 mm⁻¹ (p=0.0001) (Chart I). The adipocytes of obese and non-obese in SAT is shown in figure 1 and 2. Number of adipocytes per unit area different significantly in all comparisons (p<0.001) was found significant. While there was increased number of adipocytes observed intra-abdominal adipose tissue (IAT) from abdomen of obese and non-obese female is shown in figure 3 and 4. These findings correlate the differences between obese and non-obese women.

<table>
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<th>Table I. Frequency of obesity related medical problems in study population</th>
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<td>Diabetes mellitus</td>
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Figure: 1. Photomicrograph of 4um thick H & E stained section of subcutaneous adipose tissue from abdomen of non obese showing decreased number of adipocytes at power X 100.

Figure: 2. Photomicrograph of 4um thick H & E stained section of subcutaneous adipose tissue of obese showing increased number of adipocytes at power X 100. Superficial epidermis layers are also visible.

Figure: 3. Photomicrograph of 4um thick H & E stained section of intra-abdominal adipose tissue in non obese showing decrease number of adipocytes at power X 100.
The number of adipocytes differed significantly in obese and non-obese female as mentioned in results. The findings are consistent with previous studies. The study of Lester B et al (2000)\cite{16} reported that the adipocytes were more in the omentum tissue (in non obese was 23-65 x 10^6 and in obese was 37-237 x 10^6) and smallest in gluteal (in non obese was 20 – 41 x 10^6 and in obese was 28 – 128 x 10^6). The findings of intra-abdominal adipocytes counts are consistent with present study.

Also Yourka D et al (2008)\cite{17} reported that mean number of subcutaneous abdominal adipocytes in non obese was 11.6 ± 5.5 and in obese was 15.7 ± 4.4 as our study also in agreement with such study shows the mean number of subcutaneous abdominal adipocytes in non obese was 79.02 ± 6.02 but in obese was 119.02 ± 5.81.

The study of swati et al (2011)\cite{18} support our findings as it was reported the mean number of subcutaneous abdominal adipocytes per unit area was 116 ± 6.5 which is in keeping with our study.

Cardiometabolic risk increases with increasing visceral adiposity. Although total adiposity is strongly associated with metabolic and cardiovascular risk, it is becoming increasingly clear that different fat compartments contribute differentially to these risks. Abdominal visceral fat is a stronger correlate of cardiovascular disease risk than BMI, waist circumference, or abdominal subcutaneous fat.\cite{3,4} Central obesity, in which fat mass is predominantly intra-abdominal, is more strongly associated with insulin resistance, dyslipidemia, and atherosclerosis than is peripheral obesity, in which fat mass is predominantly gluteofemoral.\cite{21,22} The findings are supporting our present results as cardiometabolic problems were observed in intra-abdominal adiposity.

Weight loss through diet and exercise, which results in reductions in visceral fat,\cite{23} is associated with improvements in insulin sensitivity,\cite{24} blood pressure,\cite{25} serum lipids,\cite{26} and inflammatory markers.\cite{27} Similarly, loss of VAT by omentectomy leads to decreases in glucose and insulin levels,\cite{28} whereas loss of SAT by liposuction does not always produce the same beneficial effects,\cite{29,30} suggesting that VAT is more likely to be responsible for the metabolic abnormalities associated with obesity. The findings of present support and are consistent with previous studies in medical literature as mentioned above.

**Conclusion**

The adipocytes differed significantly in amount in the subcutaneous and intra-abdominal compartiment in present study. The intra-abdominal (visceral) obesity is associated with cardiometabolic diseases which are major health problems of the era. Therefore measure may be taken to minimize obesity related problems through life style modification, diet, exercise and physical exertions.

**References**