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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 4µ 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 $\leq$ 0.05 was taken statistically significant. The number of adipocytes in obese and non-obese from subcutaneous and intra-abdominal compartments showed significant differences. ($p \leq 0.01$). 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.

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,[11] 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 morbid 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.

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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 micrometery 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. Continous 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 I. Frequency of obesity related medical problems in study population

	Obese (n=40)*		Non-Obese (n=40)*	
	n	%	n	%
Diabetes mellitus	11	27.5	3	7.5
Coronary artery disease	6	15	0	0
Hypertension	23	57.5	7	17.5
Dyslipidemia	13	32.5	4	10

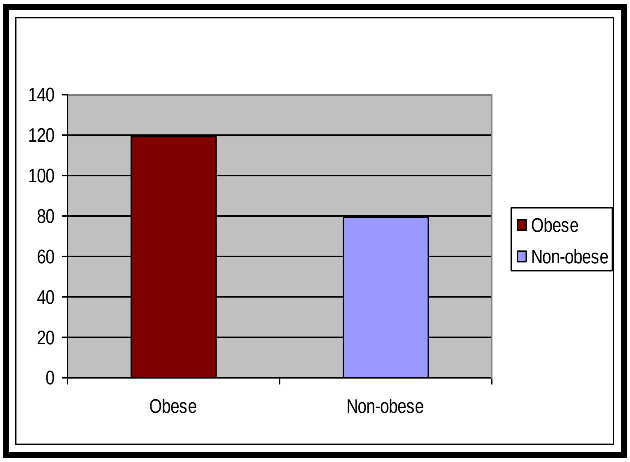

Chart: I. Bar chart showing adipocytes numbers n obese and non-obese subjects from intra-abdominal adipose tissue.

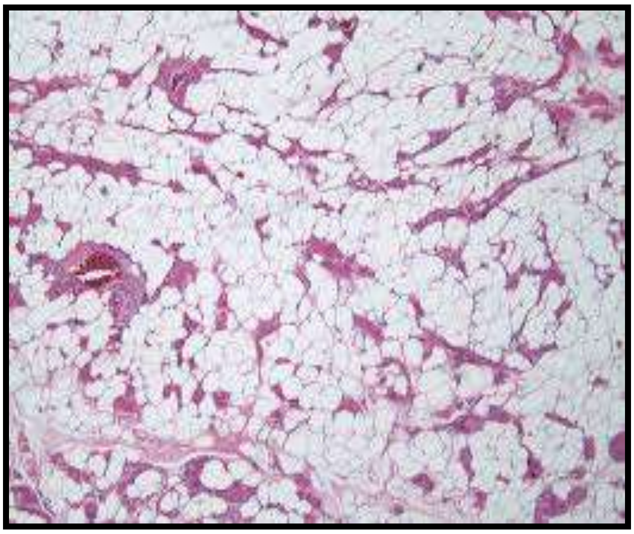

Figure: 1. Photomicrograph of 4um thick H & E stained section of subcutaneous adipose tissue from abdomen of non obese showing decreased number of adipocytes at power X 100

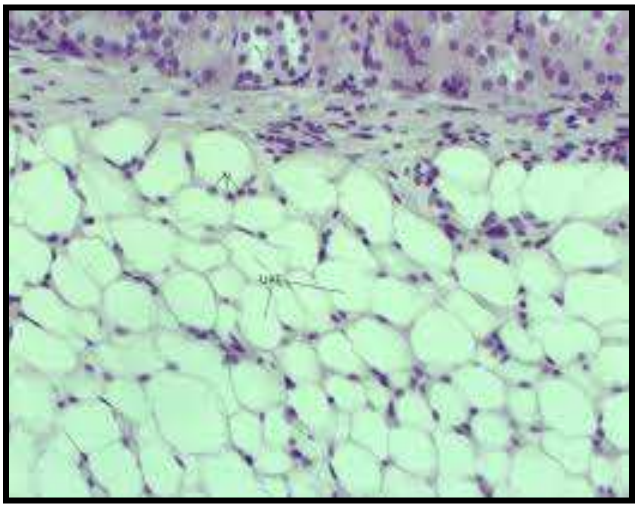

Figure: 2. Photomicrograph of 4um thick H & E stained section of subcutaneous adipose tissue of obese showing increased number of adipocytes at power X 100. Superficial epidermis layers are also visible.

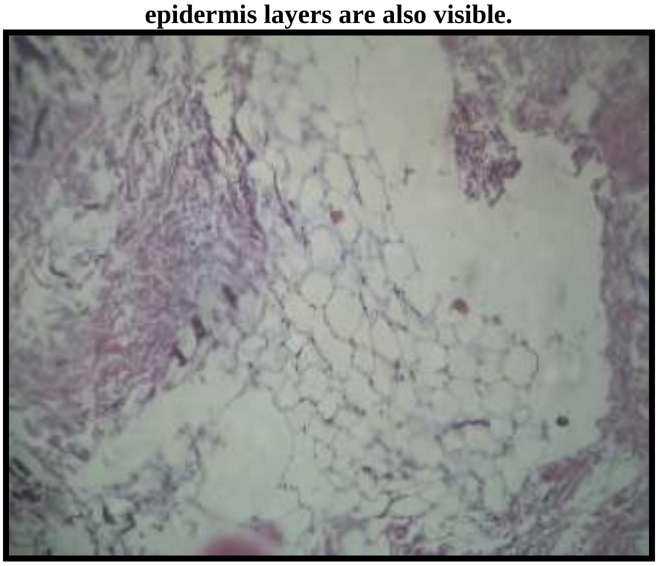

Figure: 3. Photomicrograph of 4um thick H & E stained section of intra-abdominal adipose tissue in non obese showing decrease number of adipocytes at power X 100.

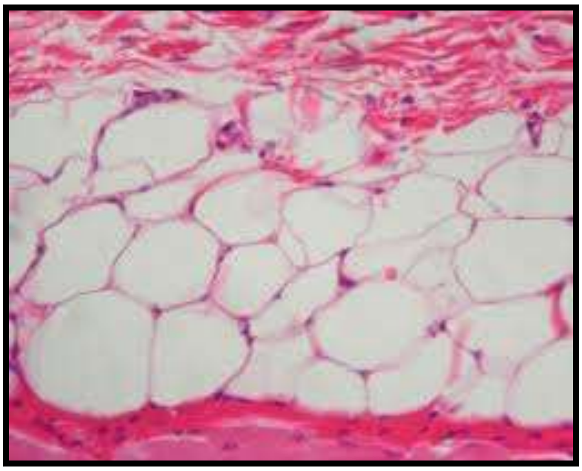

Figure 4. Photomicrograph of 4um thick H & E stained section intra-abdominal adipose tissue in obese showing increased number of adipocytes at power X 100. Blood vessels are also shown in cut section

Discussion

The present study was a prospective case control study based on cesarean section availability of adipose tissue from subcutaneous and intra-abdominal sites. The SAT and IAT reveled major differences in regards of adipocytes counts and relationship with the cardiometabolic conditions as shown in table I.

The number of adipocytes differed significantly in obese and non-obese female as mentioned in results. The findings are consistent with previous studies. [6,8,15]

The study of Lester B et al (2000)[16] reported that the adipocytes were more in the omentum tissue (in non obese was 23-65 x 10^9 and in obese was 37-237 x 10^9) and smallest in gluteal (in non obese was 20 – 41 x 10^9 and in obese was 28 – 128 x 10^9). The findings of intra-abdominal adipocytes counts are consistent with present study.

Also Yourka D et al (2008) [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) [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.[19,20] 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 is predominantly gluteofemoral.[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,[23] is associated with improvements in insulin sensitivity,[24] blood pressure,[25] serum lipids,[26] and inflammatory markers.[27] Similarly, loss of VAT by omentectomy leads to decreases in glucose and insulin levels, [28] whereas loss of SAT by liposuction does not always produce the same beneficial effects, [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 compartment 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

1. Harris MM, Stevens J, Thomas N, Schreiner P, Folsom AR. Associations of fat distribution and obesity with hypertension in a bi-ethnic population: the ARIC study. Atherosclerosis Risk in Communities Study. Obes Res 2000;8:516–524

2. Lemieux I, Pascot A, Couillard C, Lamarche B, Tchernof A, Almeras N, Bergeron J, Gaudet D, Tremblay G, Prud'homme D, Nadeau A, Despres JP. Hypertriglyceridemic waist: A marker of the atherogenic metabolic triad (hyperinsulinemia; hyperapolipoprotein B; small, dense LDL) in men? Circulation 2000;102:179–184

3. Mokdad AH, Ford ES, Bowman BA, Dietz WH, Vinicor F, Bales VS, Marks JS. Prevalence of obesity, diabetes, and obesity related health risk factors, 2001. JAMA 2003;289:76–79

4. Despres JP. The insulin resistance-dyslipidemic syndrome of visceral obesity: effect on patients' risk. Obes Res 1998;6 (Suppl. 1):8S–17S.

5. Despres JP, Lemieux S, Lamarche B, Prud'homme D, Moorjani S, Brun LD, Gagne C, Lupien PJ. The insulin resistance- dyslipidemic syndrome: contribution of visceral obesity and therapeutic implications. Int J Obes Relat Metab Disord 1995;19 (Suppl. 1):S76–S86.

6. Porter SA, Massaro UM, Hoffmann U, Vasan RS, O`Donnei CJ, Fox CS. Abdominal subcutaneous adipose tissue: A protective fat depot? Diabetes Care 2009;32:1068–75.

7. M. A. M. Jacobs-Van Der Bruggen, G. Bos,W. J. Bemelmans, R. T. Hoogenveen, S. M. Vijgen, and C. A. Baan, "Lifestyle interventions are cost-effective in people with different levels of diabetes risk: results from a modeling study," *Diabetes Care*, vol. 30, no. 1, pp. 128–134, 2007.

8. Kazlauskaite R, Karavolos K, Janssen I, Carlson K, Ship KJ, Dugan SA, et al. The association between self reported energy intake and intra-abdominal adipose tissue in premenopausal women. J Obes 2012;

9. E. A. Molenaar, J. M. Massaro, P. F. Jacques et al., "Association of lifestyle factors with abdominal subcutaneous and visceral adiposity the framingham heart study," *Diabetes Care*, vol. 32, no. 3, pp. 505–510, 2009.

10. I. Janssen, L. H. Powell, R. Kazlauskaite, and S. A. Dugan, "Testosterone and visceral fat in midlife women: the study of women's health across the nation (SWAN) fat patterning study," *Obesity*, vol. 18, no. 3, pp. 604–610, 2010.

11. S. A.Dugan, S. A. Everson-Rose, K. Karavolos, E. F. Avery,D. E. Wesley, and L. H. Powell, "Physical activity and reduced intraabdominal fat in midlife african-American and white women," *Obesity*, vol. 18, no. 6, pp. 1260–1265, 2010.

12. Y. D. Tchoukalova, S. B. Votruba, T. Tchkonia, N. Giorgadze, J. L. Kirkland, and M. D. Jensen, "Regional differences in cellular mechanisms of adipose tissue gain with overfeeding," *Proceedings of the National Academy of Sciences of the United States of America*, vol. 107, no. 42, pp. 18226–18231, 2010.

13. C. E. Hallgreen and K. D. Hall, “Allometric relationship between changes of visceral fat and total fat mass,” *International Journal of Obesity*, vol. 32, no. 5, pp. 845–852, 2008.
14. T. B. Chaston and J. B. Dixon, “Factors associatedwith percent change in visceral versus subcutaneous abdominal fat during weight loss: findings from a systematic review,” *International Journal of Obesity*, vol. 32, no. 4, pp. 619–628, 2008. Article ID 567320. doi:10.1155/2012/567320.
15. Karpe R, Fielding BA, Ilic V, McDonald IA, Summers LKM, Frayn KN, et al. Impaired postprandial adipose tissue blood flow response is related to aspects of insulin sensitivity. J Physiol .2002; 51:2467–73.
16. Lester B, Samuel SW, Cushman, Weismann RE. Studies of human adipose tissue. J Clin Inv 1973; 52:929-41.
17. Yourka D, Tchoukalova, Koustari C, Maksym V, Susane KB, Votruba EW, et al. Subcutaneous adipocytes size and body fat distribution. Am J Clin Nutr 2008; 8:56-63.
18. Bhardwaj S, Misra A, Misra R, Goel K, Bhatt SP, Rastogi K, et al. High Prevalence of Abdominal, Intr-Abdominal and Subcutaneous Adiposity and Clustering of Risk Factors among Urban Asian Indians in North India. Int`l J Obes 2011; 6:1-6.
19. Despres JP, Lemieux S, Lamarche B, Prud’homme D, Moorjani S, Brun LD,et al. The insulin resistance-dyslipidemic syndrome: contribution of visceral obesity and therapeutic implications. Int J Obes Relat Metab Disord 1995; 19 (Suppl. 1):S76–S86.
20. Fox CS, Massaro JM, Hoffmann U, Pou KM, Maurovich-Horvat P, Liu CY, et al. Abdominal visceral and subcutaneous adipose tissue compartments: association with metabolic risk factors in the Framingham Heart Study. Circulation 2007;116: 39–48 .
21. Despres JP. The insulin resistance-dyslipidemic syndrome of visceral obesity: effect on patients’ risk. Obes Res 1998;6 (Suppl. 1):8S–17S.
22. Scherzer R, Shen W, Bacchetti P, Kotler D, Lewis CE, Shlipak MG, et al. Simple anthropometric measures correlate with metabolic risk indicators as strongly as magnetic resonance imaging-measured adipose tissue depots in both HIV-infected and control subjects. Am J Clin Nutr 2008; 87:1809–17.
23. Langendonk JG, Kok P, Frolich M, Pijl H, Meinders AE. Decrease in visceral fat following diet-induced weight loss in upper body compared to lower body obese premenopausal women. Eur J Intern Med 2006; 17:465–9.
24. Uusitupa M, Lindi V, Louheranta A, Salopuro T, Lindstrom J, Tuomilehto J. Long-term improvement in insulin sensitivity by changing lifestyles of people with impaired glucose tolerance: 4-year results from the Finnish Diabetes Prevention Study. Diabetes 2003; 52:2532–8.
25. Stevens VJ, Obarzanek E, Cook NR, Lee IM, Appel LJ, Smith WD, et al. Long-term weight loss and changes in blood pressure: results of the Trials of Hypertension Prevention Phase II. Ann Intern Med 2001; 134:1–11
26. Dattilo AM, Kris-Etherton PM. Effects of weight reduction on blood lipids and lipoproteins: a meta-analysis. Am J Clin Nutr 1992; 56:320–8.
27. Ziccardi P, Nappo F, Giugliano G, EspositoK, Marfella R, Cioffi M, et al. Reduction of inflammatory cytokine concentrations and improvement of endothelial functions in obese women after weight loss overoneyear. Circulation2002; 105:804–9.
28. Thorne A, Lonnqvist F, Apelman J, Hellers G, Arner P. A pilot study of long term effects of a novel obesity treatment: omentectomy in connection with adjustable gastric banding. Int J Obes Relat Metab Disord 2002;26:193–199
29. Klein S, Fontana L, Young VL, Coggan AR, Kilo C, Patterson BW, et al. Absence of an effect of liposuction on insulin action and risk factors for coronary heart disease. N Engl J Med 2004; 350:2549–57.
30. Giugliano G, Nicoletti G, Grella E, Giugliano F, Esposito K, Scuderi N, et al.Effect of liposuction on insulin resistance and vascular inflammatory markers in obese women. Br J Plast Surg 2004; 57:190–4.