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ORIGINAL ARTICLE

Changes in maternal abdominal subcutaneous fat layers using ultrasound: A longitudinal study

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Summary
Background: Abdominal adiposity and subcutaneous fat (SF), an important endocrine organ for health outcomes, can be divided into two layers, superficial (SSAT) and deep subcutaneous adipose tissue (DSAT) each with a different histological and metabolic function. The aim was to investigate longitudinal changes in maternal abdominal SF thickness and its layers throughout pregnancy and post-partum within body mass index (BMI) categories.
Methods: A prospective longitudinal study of 214 women was performed measuring abdominal SF using ultrasound at 12—14(M1), 18—20(M2), 26—29(M3) and 33—36 weeks' gestation (M4) and 6—8 weeks post-partum. SF thickness (SFT), SSAT and DSAT were measured. A ratio of DSAT/SSAT (D/S) was calculated. Measurements were compared to baseline and BMI evaluating for interaction with changes over time.

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Results: Of the 214 women, 43.5%(93) were normal weight, 25.7%(55) overweight and 30.8%(66) obese. SFT and SSAT decreased from M1 to M4 for the overweight and obese whilst remaining stable for normal weight women. For all BMI categories SFT and SSAT increased post-partum. DSAT decreased significantly in the obese and overweight and increased significantly in the normal weight. Obese women had a higher D/S at M1 that decreased at M2 and remained constant to post-partum. D/S increased at M2 then decreased in the overweight. Normal weight women increased D/S at M2—M4.
Conclusion: The results indicate a difference in distribution and mobilisation of fat in SSAT, and DSAT abdominal subcutaneous compartments within the different BMI categories in pregnancy. Understanding how fat mobilises during pregnancy may be fundamental to understanding obesity related complications.

Introduction

Adipose tissue historically, until the1980s was thought to be a stagnant depot for energy accumulation but has since been discovered to be an important endocrine organ that influences metabolic functions [1]. Excess abdominal body fat correlates highly with insulin resistance and cardiovascular disease. Paradoxically those with high body mass index (BMI) who do not have metabolic disease are labelled the metabolically healthy obese (MHO) [2,3]. Extensive research into adipose tissue has demonstrated that fat distribution can affect metabolic health [4]. Peripheral subcutaneous fat (SF) is protective of metabolic disease [5,6] and abdominal (central) fat is predictive of obesity related disease [7,8].

Abdominal subcutaneous fat is divided into two separate compartments by the superficial (Scarpa's) fascia, called superficial subcutaneous fat (SSAT) and deep subcutaneous fat (DSAT) each has a different morphological and metabolic function [9,10]. Deep subcutaneous fat has metabolic functions similar to visceral fat, where SSAT has a more protective effect akin to peripheral fat [11,12]. Theories concerning fat accumulation suggest when the superficial subcutaneous compartment, a primary more stable compartment for fat storage, reaches capacity, secondary deposits such as DSAT, visceral fat (VF) and the abdominal organs take over the role of storage of excess triglycerides increasing abdominal capacity for fat accumulation [13—15]. Abdominal fat distribution measured with computed tomography has demonstrated the volume of adipose tissue within the two subcutaneous compartments varies amongst those of the same BMI category [16].

Ultrasound has been used in research to measure abdominal adipose tissue thickness. Marinou et al. [17] was the first to use ultrasound to measure SSAT and DSAT thickness on the abdomen and demonstrated a correlation between DSAT, insulin resistance and cardiovascular disease and others have suggested it may be useful to differentiate between SSAT and DSAT in pregnancy [18]. The SSAT and DSAT measures were validated using MRI correlation r = 0.75—0.85 [17].

Research of adiposity in pregnancy demonstrates maternal fat variance in the subcutaneous and preperitoneal fat [19,20], using Suzuki's technique [21], and a difference in fat mobilisation in an overweight/obese group compared to a normal weight category [20]. The potential of maternal abdominal subcutaneous fat thickness (SFT) measured with ultrasound for risk assessment of adverse pregnancy outcomes [22,23] has also been established.

The purpose of this study was to report the different measures of maternal fat within three BMI categories. To observe any longitudinal changes of subcutaneous fat distribution in SSAT and DSAT throughout pregnancy and post-partum. We hypothesised that the mobilisation of abdominal subcutaneous fat differs between the various BMI categories in pregnancy.

Methods

Study participants

Women in the first trimester of pregnancy who presented for a nuchal translucency ultrasound