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BRIEF REPORT

Preliminary data on dermis and subcutis thickness in adults with type 1 and 2 diabetes mellitus

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ABSTRACT

We compared the thickness of both dermis and subcutis (measured using ultrasound) in overweight and obese adults with type 1 ($n = 10$) or type 2 ($n = 8$) diabetes mellitus. When adjusted for confounding factors, patients with type 1 diabetes had thicker subcutis than those with type 2 diabetes, with this difference being particularly marked in the abdomen. There were no observed differences in dermal thickness between the groups.

Key words: adults, dermis, diabetes, obese, overweight, subcutis.

INTRODUCTION

Children and adults with type 1 diabetes tend to have thicker dermis than non-diabetics,[1,2] although such observations are not always consistent.[3] Type 2 diabetes also affects skin thickness,[4] but in the absence of overt dermatoses it is unclear whether there are any differences between them and non-diabetic persons. To date, there do not appear to be any published data comparing skin thickness between patients with type 1 and type 2 diabetes. Thus, we assessed whether such differences exist among overweight and obese diabetic adults.

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METHODS

Adults with type 1 and type 2 diabetes were recruited from the Auckland Diabetes Centre, New Zealand. Only overweight or obese patients body mass index ([BMI] ≥ 25 kg/m^2) were selected to ensure the comparability of the groups. Exclusion criteria were lipohypertrophy, other medical conditions such as coeliac disease or autoimmune thyroid disease, associated syndromes and other secondary causes of diabetes.

Dermis and subcutis (subcutaneous fat layer) thicknesses were assessed using ultrasound in the anterior abdomen 3–4 cm lateral to the umbilicus and at the lateral mid-thigh. Dermal thickness was defined as the distance between the air and skin surface interface and the proximal aspect of the subcutaneous tissue layer, and included the small contribution of the epidermis. Subcutis thickness was measured from the proximal subcutaneous fat boundary to the underlying muscle fascia. Assessments were performed using a Phillips IU-22 ultrasound machine (Phillips Healthcare, Best, The Netherlands) and a 17 MHz linear array transducer with an axial resolution of 0.08 mm.[5] A single ultrasound measurement was obtained mid-transducer, with cursors centered at the air–skin interface, the skin–subcutaneous fat interface and the fat–muscle fascia interface (Fig. 1). Note that a standoff was used to optimise image quality by increasing the distance between the transducer and the skin. The study was approved by the institutional review committee, and written informed consent was obtained from all participants.

Baseline characteristics were compared with Fisher's exact test and one-way ANOVA, with the latter also used to compare skin thickness in the two groups (all in Minitab v.16, Pennsylvania State University, PA, USA). In addition, random effects mixed models with repeated measures were used to compare dermis and subcutis thicknesses between the groups (SAS vers. 9.3, SAS Institute, Cary, NC, USA). Models included important confounding factors, namely

Abbreviation:

BMI	body mass index

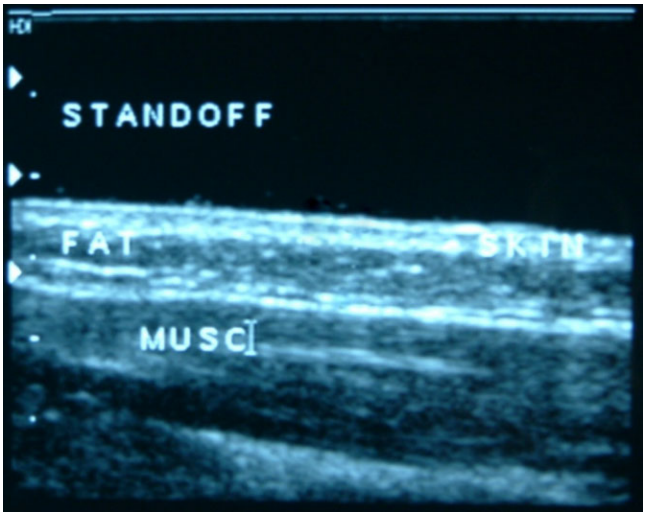

Figure 1 Ultrasound image showing a cross-sectional view of the standoff, dermis (skin), subcutis (fat) and muscle tissue (musc).

BMI, age, sex, ethnicity and, where appropriate, anatomical region. Unless otherwise stated, data are means ± SD; data from multivariate analyses are presented as model-adjusted means (estimated marginal means adjusted for the confounding factors in the models), with associated 95% confidence intervals.

RESULTS

We studied 18 adults aged 43.1 ± 16.5 years with a BMI of 32.7 ± 6.0 kg/m². In the whole study population, dermal thickness varied according to anatomical region, being greater in the abdomen than the thigh (2.35 *vs* 1.97 mm; $P = 0.008$), but was unaffected by sex ($P = 0.84$), ethnicity ($P = 0.27$), BMI ($P = 0.62$) or age ($P = 0.65$). In contrast, subcutis thickness across the population was significantly associated with sex, anatomical region and BMI. Women had a subcutis that was thicker than that of men (26.6 *vs* 15.3 mm; $P = 0.001$). The subcutis was considerably thicker in the abdomen than the thigh (28.5 *vs* 14.7 mm; $P < 0.0001$) and, not surprisingly, increased with increasing BMI ($P = 0.048$). Subcutis thickness was not affected by age ($P = 0.61$) or ethnicity ($P = 0.60$).

Ten of the 18 patients had type 1 diabetes and eight had type 2 (Table 1). The type 2 participants were older ($P < 0.0001$) and had a considerably greater BMI ($P = 0.027$) than those with type 1 diabetes (Table 1). Surprisingly, although type 2 diabetes participants were mostly women (75%) and almost all obese (88%), univariate analyses showed no significant differences in dermal or subcutis thickness according to diabetes type (Table 1).

However, when multivariate models were run adjusting for confounding factors (namely age, sex, BMI and ethnicity), patients with type 1 diabetes had considerably thicker subcutis than those with type 2 (23.4 *vs* 12.4 mm; $P = 0.048$) (Table 2). This difference was particularly marked in the abdomen (35.1 *vs* 19.6 mm; $P = 0.049$) (Table 2). There were no observed differences in dermal thickness between groups (Table 2).

Table 1 Patients' characteristics and thickness of dermis and subcutis in patients with type 1 and type 2 diabetes

	Type 1	Type 2	*P* value
n	10	8	
Characteristics			
Age (years)	32.5 ± 12.9	56.3 ± 9.3	**< 0.001**
Sex ratio (men : women)	6:4	2:6	0.13
Ethnicity (New Zealand European, %)	20	25	0.99
BMI (kg/m²)	29.9 ± 5.3	36.3 ± 4.9	**0.027**
Obese (n/total)	3/10	7/8	**0.025**
Dermis thickness (mm)			
Overall	2.08 ± 0.44	2.26 ± 0.78	0.50
Abdomen	2.25 ± 1.6	2.48 ± 0.81	0.47
Thigh	1.91 ± 0.33	2.04 ± 0.74	0.63
Subcutis thickness (mm)			
Overall	21.7 ± 14.1	21.4 ± 12.9	0.93
Abdomen	28.1 ± 12.3	28.9 ± 11.7	0.69
Thigh	15.3 ± 7.6	13.9 ± 9.7	0.62

Statistically significant results ($P < 0.05$) are shown in bold. Where appropriate, data are means ± standard deviations. BMI, body mass index.

Table 2 Model-adjusted data for dermis and subcutis thickness in patients with type 1 and type 2 diabetes

	Type 1	Type 2	*P* value
n	10	8	
Dermis thickness (mm)			
Overall	2.18 (1.62–2.75)	2.37 (1.71–3.03)	0.70
Abdomen	2.21 (1.54–2.88)	2.76 (1.97–3.55)	0.33
Thigh	2.16 (1.58–2.74)	1.97 (1.29–2.65)	0.70
Subcutis thickness (mm)			
Overall	23.4 (16.4–33.5)	12.4 (8.1–18.8)	**0.048**
Abdomen	35.1 (25.2–48.7)	19.6 (13.3–28.9)	**0.049**
Thigh	15.7 (9.5–25.8)	7.8 (4.4–14.0)	0.11

Statistically significant results ($P < 0.05$) are shown in bold. Data are means and 95% confidence intervals, adjusted for age, sex, body mass index, and ethnicity (as well as anatomical region for overall analyses).

CONCLUSIONS

These preliminary data suggest that diabetes type differentially affects the thickness of the subcutaneous adipose layer, with an apparent increase in subcutaneous fat deposition in patients with type 1 diabetes compared with those with type 2. Although we did not observe an effect of age on skin thickness, previous studies have shown a thinning of the subcutis with increasing age in adults.[6,7] However, Derraik and colleagues[6] observed a decrease of approximately 0.082 mm per year; a figure that, when applied to our cohort, would suggest an age-related difference of

2.0 mm between our two groups. Thus, the age gap between type 1 and type 2 diabetics would explain only a small fraction of the estimated 11 mm difference in subcutis thickness between groups.

Fat is a major component of the human body with approximately 80% of adipose tissue stored in the subcutis and the remainder surrounding internal organs. Visceral and subcutaneous fat are biologically and genetically distinct.[8] A study of 732 obese adults showed that increased visceral fat was an important risk factor for the development of type 2 diabetes, while abdominal subcutaneous fat was not.[9] There appears to be a discordance between the amount of subcutaneous and visceral fat in patients with type 2 diabetes. As a result, it is possible that our patients with type 2 diabetes had most of their adipose tissue stored as visceral fat rather than subcutaneously. On the other hand, it is possible that type 1 diabetes may be associated with an increased deposition of subcutaneous fat, which may actually reduce the risk of inappropriate i.m. insulin injections.

It is important to acknowledge the preliminary nature of our data, particularly in light of our small sample size. Although our multivariate models have accounted for important demographic and anthropometric differences, ideally both groups should have been better matched. We speculate that, had our groups been well-matched for age, sex and BMI, the observed differences in subcutaneous fat layer would have been more marked. In addition, only one measurement was taken at each anatomical region, and contralateral measurements would have more precisely accounted for intra-individual variations in dermis and subcutis thickness.

Nonetheless, our findings are novel in that they suggest that diabetes type may affect the distribution of adipose tissue, and this needs to be ascertained in future studies. In addition, further work is needed to determine whether the apparently greater deposition of subcutaneous fat in patients with type 1 diabetes is associated with a corresponding change in visceral fat deposition. Such change may be of importance, as it may be associated with altered metabolic or cardiovascular risks.

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Contribution statement: PLH, WSC, and JGBD were responsible for the design of the research; PLH and JMP carried out the research; JGBD and SG compiled and analysed the data and JGBD and MR wrote the manuscript with input from other authors.

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