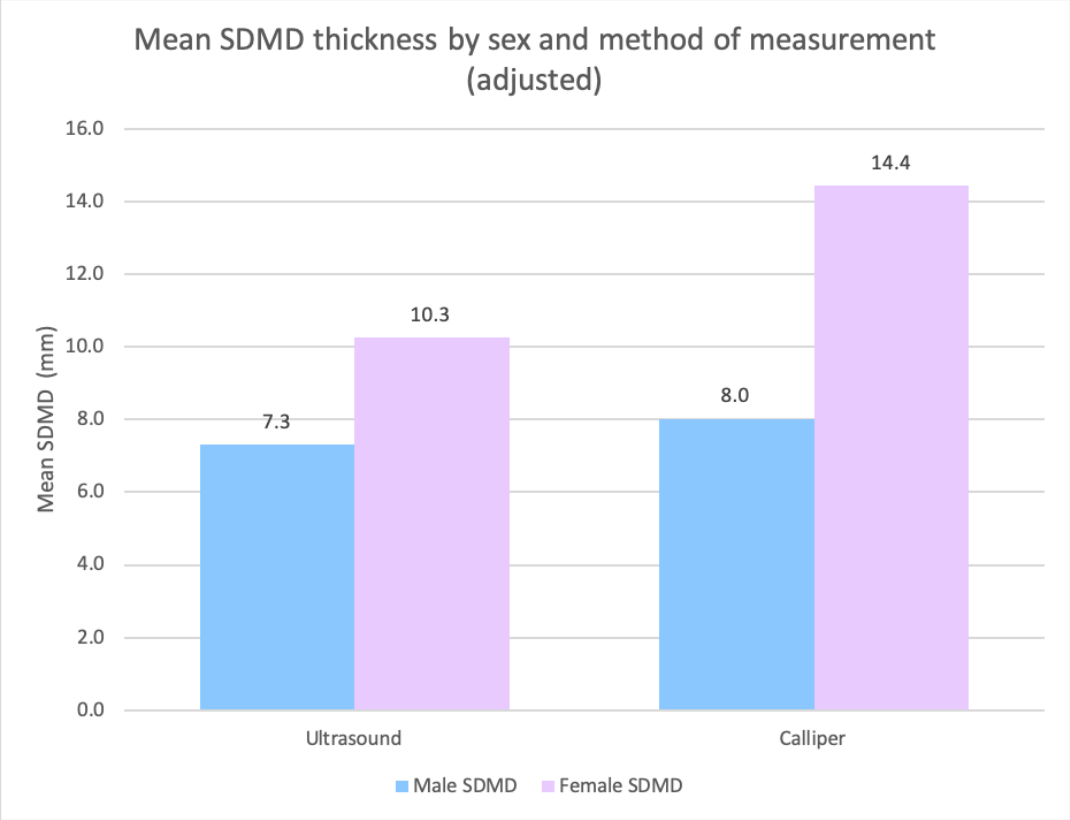
Supplemental materials

Relating to manuscript: What variables should inform needle length choice for deltoid intramuscular injection? A systematic review.

Contents

Supplemental Figure 1



Supplemental figure 1: *Mean SDMD by sex and method of measurement based on extracted data from reviewed studies. Where multiple measurements of SDMD were taken per participant (in both arms,[1,2] or different IM injection sites on the same arm)[3,4] the mean of SDMDs for all sites measured was used so that each participant was only counted once. The overall mean SDMDs were then calculated for each sex and method of measurement, by weighting each mean SDMD by the proportion of total participants contributing to it. Figure prepared from publication data extracted in Microsoft Excel.*

Supplemental material A: Search strategy

SDMD was defined as the distance from the skin surface to the deltoid muscle. A search strategy was designed to identify literature reporting the SDMD in adults at the deltoid intramuscular (IM) injection site. Studies were also reviewed for reports of the association between SDMD and other participant characteristics: deltoid muscle point of measurement, age, sex, ethnicity, weight, height, body mass index (BMI), arm circumference, whether measurements were taken from the dominant arm, and the method of measurement; including callipers, x-ray, computed tomography (CT), magnetic resonance imaging (MRI) and ultrasound. Lastly, we reviewed studies for description of limits of agreement between radiologic and physical measures.

Data Sources and Searches

The search strategy developed with a University Medical Librarian was built around three concepts: 'deltoid region', 'subcutaneous tissue thickness', and 'methods of measurement'. The online databases searched were: MEDLINE, EMBASE, Clinicaltrials.gov, Cochrane Library, CINAHL, and SCOPUS, between 27/6/21 and 8/7/21. 'Covidence' was used to manage the identified studies including duplicates and screening of abstracts.[5] Searches had no past date limit for inclusion.

Study Selection

To maximise relevance to living adult patients undergoing IM injection; the inclusion criteria selected were non-experimental or experimental clinical trials, in living humans aged 16 years or older, reporting SDMD at the site of IM injection, using radiologic or physical evaluation. Exclusion criteria included cadaveric study, studies only reporting participants who were aged 15 years or younger, if a publication full text was not available in English, or the full text was not able to be located.
Six reviewers (CK, CH, ED, LH, PB, SK) took part in screening and data extraction. Before starting, each reviewer completed a calibration exercise with a random sample of 25 papers and a guide sheet for inclusion/exclusion criteria, and achieved 100% agreement with eachother. Titles and abstracts for each paper identified in the search strategy were screened independently by two reviewers. Disagreements were discussed between reviewers in a subsequent session until a consensus decision was reached, with arbitration by a third reviewer where necessary. Full-text review was conducted with the same method.

Data Extraction

Data was extracted from each study that met all inclusion criteria by a single reviewer using a custom Microsoft Excel[6] template. Each data point was then independently double-checked by a second reviewer. Discrepancies identified were resolved through discussion and re-review of the full-text papers. Where further information, clarification, or extraction of a data subset was required to determine if a potentially eligible paper could be included in data extraction, attempts were made to contact the publication authors over a minimum period of 12 weeks. Where contact could not be established or queries resolved, the affected publications were excluded at this stage.

Data interpretation notes

- Skinfold thickness measures have been halved to convert to SDMD for comparisons.
- Lippert 2008 - figure data was extracted manually from a publication figure by consensus of two investigators as this data could not be found elsewhere.
- Jutte 2012 – mean DSCT and BMI were derived from mean height and weight

Figure preparation notes

- **Figure 2**: Prepared from publication data extracted in Microsoft Excel, with colour, key, and labels added using Adobe Photoshop.

- **Figure 3**: Prepared from publication data extracted in Microsoft Excel, with colour, key, and labels added using Adobe Photoshop.
- **Supplemental figure 1**: Figure prepared from publication data extracted in Microsoft Excel.

Data items

The following data were extracted from eligible publications:

1. Publication details
    a. Date, title, authors, journal, and DOI of publication
2. Deltoid site(s) of measurement(s)
3. SDMD at any deltoid IM injection site reported including mean, standard deviation, standard error, confidence intervals, range, number of participants
4. Population demographics including: age, sex, ethnicity, count
5. Population anthropomorphic measurements including weight, height, BMI, arm circumference, and arm dominance
6. Method of measurement(s) (e.g. calliper, ultrasound)
7. Population summary

Quality / risk of bias Assessment

Each shortlisted publication was independently reviewed by two reviewers for risk of bias using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for analytical cross sectional studies.[7] Disagreements were discussed until an agreement was reached. Only papers deemed to have low risk of bias and which had no outstanding major queries were considered.

Statistical Analysis

Although it was planned to synthesise quantitative data using meta-analytic techniques in the event, and on review of the extracted data, this was precluded by heterogeneous study sample characteristics, different anatomical sites measured, and inconsistent measurement methods. Where appropriate, and where not reported in individual studies, point estimates and confidence intervals for particular comparisons for individual studies, are estimated from reported summary data.

Data Synthesis and Analysis

For each review question, relevant extracted study data was tabulated in a custom Microsoft Excel[6] template. Where calliper measurements of skinfold were reported, these were halved to convert the two layers of skin and subcutaneous tissue captured in a skinfold to SDMD.[8] Two papers presented potentially useful data in figures which was not available elsewhere in the publication, and the authors were not able to be successfully contacted to request the relevant data.[9,10] In these two cases, data was independently manually extracted from the figures by two reviewers and cross-checked; this is noted where discussed. The figures in question are Figure 9 in Lippert et al,[9] from which tissue depth for participants 16 years or older was extracted, and the only figure in Poland et al (which is not numbered),[10] from which data points for weight against skin-to-muscle-distance were extracted.

Search strategies

Ovid MEDLINE(R) ALL <1946 to June 14, 2021>

1	Deltoid Muscle/	452
2	deltoid.mp.	5329
3	1 or 2	5329
4	Adipose Tissue/	81989
5	Subcutaneous Tissue/	3413
6	Skinfold thickness/	6145

7 (fat or subcutaneous or sub-cutaneous or cutis or subcutis or hypoderm* or skin-to-deltoid or skin-to-muscle or muscle-to-bone or skin thickness or (epiderm* adj3 thick*) or (derm* adj3 thick*) or skinfold or (thick* adj3 skin) or adipose or superficial fascia or tela subcutanea or DSCT).mp. 540731
8 4 or 5 or 6 or 7 540731
9 "Weights and Measures"/ 2637
10 Biometry/ 27655
11 exp Ultrasonography/ 452804
12 exp tomography/ 967412
13 Imaging, Three-Dimensional/ 75479
14 (echograph* or tomograph* or ultrasonograp* or ultrasound* or caliper* or calliper* or MRI or magnetic resonance imag* or 3d imag* or 3-d imag* or three-dimensional imag* or CT or CAT or thick* or measur* or depth or deep or distance or length or long*).mp. 8148863
15 9 or 10 or 11 or 12 or 13 or 14 8267792
16 3 and 8 and 15 174
17 arm/ or shoulder/ or Upper Extremity/ 54714
18 (arm or shoulder or "upper limb" or "upper extremity").ti,kw. 63238
19 17 or 18 94753
20 8 and 15 and 19 1815

EMBASE query: (Link:
https://ovidsp.ovid.com/ovidweb.cgi?T=JS&NEWS=N&PAGE=main&SHAREDSEARCHID=1BWzBqWHJcR4s33GfaXxP6limay1b4aiP2QNOv3nzFXUe9nNq4oPDliZlGmkWkKCX
EMBASE - All years <1947-Present with Daily Update>

Embase

Search history sorted by search number ascending

#	Searches
1	deltoid muscle/
2	deltoid.mp.
3	1 or 2
4	adipose tissue/
5	subcutaneous tissue/
6	skinfold thickness/
7	(fat or subcutaneous or sub-cutaneous or cutis or subcutis or hypoderm* or skin-to-deltoid or skin-to-muscle or muscle-to-bone or skin thickness or (epiderm* adj3 thick*) or (derm* adj3 thick*) or skinfold or (thick* adj3 skin) or adipose or superficial fascia or tela subcutanea or DSCT).mp.
8	4 or 5 or 6 or 7
9	"Weights and Measures"/
10	biometry/
11	exp echography/
12	exp tomography/
13	three-dimensional imaging/

14	(echograph* or tomograph* or ultrasonograp* or ultrasound* or cal?iper* or MRI or magnetic resonance imag* or 3d imag* or 3-d imag* or three-dimensional imag* or C?T or thick* or measur* or depth or deep or distance or length or long*).mp.
15	9 or 10 or 11 or 12 or 13 or 14
16	3 and 8 and 15
17	shoulder/ or shoulder girdle/ or shoulder muscle/ or arm/ or upper limb/
18	(shoulder* or arm* or upper limb* or upper extremity).ti,kw.
19	17 or 18
20	8 and 15 and 19
21	limit 20 to english language

ClinicalTrials.gov query:
Filters: Completed studies; Adult; Older adult; with results
(deltoid OR shoulder OR upper arm OR upper limb) AND (fat OR subcutaneous OR skin OR adipose OR dermis OR skinfold)

Cochrane library query:
(deltoid OR shoulder OR arm OR "upper limb" AND "upper extremity") AND (adipose OR fat OR "subcutaneous tissue" OR "sub-cutaneous" OR cutis OR subcutis OR hypoderm* OR "skinfold thickness" OR skin OR "skin to muscle" OR "skin to deltoid" OR "skin to bone" OR "DSCT") AND (depth OR deep OR thick* OR distance OR length OR long OR deep OR measur* OR caliper* OR calliper* OR ultrasound OR mri OR ct OR cat OR "magnetic resonance" OR "tomography" OR "3d imag*" OR "3-d imag*" OR "three-dimensional imag*") in Title Abstract Keyword

SCOPUS
((TITLE-ABS-KEY (*deltoid*) AND TITLE-ABS-KEY ((*fat* OR *subcutaneous* OR *sub-cutaneous* OR *cutis* OR *subcutis* OR *hypoderm** OR *skin-to-deltoid* OR *skin-to-muscle* OR *muscle-to-bone* OR *"skin thickness"* OR (*epiderm** W/2 *thick**) OR (*derm** W/2 *thick**) OR *skinfold* OR (*thick** W/2 *skin*) OR *a dipose* OR *"superficial fascia"* OR *"tela subcutanea"* OR *dsct*)) AND TITLE-ABS-KEY ((*echograph** OR *tomograph** OR *ultrasonograp** OR *ultrasound** OR *caliper** OR *calliper** OR *mri* OR *"magnetic resonance imag*"* OR *"3d imag*"* OR *"3-D imag*"* OR *"three-dimensional imag*"* OR *ct* OR *cat* OR *thick** OR *measur** OR *depth* OR *deep* OR *distance* OR *length* OR *long**)))) OR (((TITLE (*arm* OR *"upper limb"* OR *shoulder* OR *"upper extremity"*) OR KEY (*arm* OR *"upper limb"* OR *shoulder* OR *"upper extremity"*))) AND (TITLE-ABS-KEY (*fat* OR *subcutaneous* OR *sub-cutaneous* OR *cutis* OR *subcutis* OR *hypoderm** OR *skin-to-deltoid* OR *skin-to-muscle* OR *muscle-to-bone* OR *"skin thickness"* OR (*epiderm** W/2 *thick**) OR (*derm** W/2 *thick**) OR *skinfold* OR (*thick** W/2 *skin*) OR *a dipose* OR *"superficial fascia"* OR *"tela subcutanea"* OR *dsct*) AND TITLE-ABS-KEY (*echograph** OR *tomograph** OR *ultrasonograp** OR *ultrasound** OR *caliper** OR *calliper** OR *mri* OR *"magnetic resonance imag*"* OR *"3d imag*"* OR *"3-D imag*"* OR *"three-dimensional imag*"* OR *ct* OR *cat* OR *thick** OR *measur** OR *depth* OR *deep* OR *distance* OR *length* OR *long**)))

CINAHL (Narrow by English)
Full text search
(TX deltoid OR arm OR shoulder OR "upper limb" OR "upper extremity") AND(TX (fat OR subcutaneous OR "sub-cutaneous" OR cutis OR subcutis OR hypoderm* OR "skin-to-deltoid" OR "skin-to-muscle" OR "muscle-to-

bone" OR "skin thickness" OR (epiderm* N2 thick*) OR (derm* N2 thick*) OR skinfold OR (thick* N2 skin) OR adipose OR "superficial fascia" OR "tela subcutanea" OR DSCT)) AND (TX (echograph* OR tomograph* OR ultrasonograp* OR ultrasound* OR caliper* OR calliper* OR MRI OR "magnetic resonance imag*" OR "3d imag*" OR "3-d imag*" OR "three-dimensional imag*" OR "CT" OR CAT OR thick* OR measur* OR depth OR deep OR distance OR length OR long))

Link:
https://search.ebscohost.com/login.aspx?direct=true&db=cin20&bquery=(TX+deltoid+OR+arm+OR+shoulder+OR+%26quot%3bupper+limb%26quot%3b+OR+%26quot%3bupper+extremity%26quot%3b)+AND(TX+(fat+OR+subcutaneous+OR+%26quot%3bsub-cutaneous%26quot%3b+OR+cutis+OR+subcutis+OR+hypoderm*+OR+%26quot%3bskin-to-deltoid%26quot%3b+OR+%26quot%3bskin-to-muscle%26quot%3b+OR+%26quot%3bmuscle-to-bone%26quot%3b+OR+%26quot%3bskin+thickness%26quot%3b+OR+(epiderm*+N2+thick*)+OR+(derm*+N2+thick*)+OR+skinfold+OR+(thick*+N2+skin)+OR+adipose+OR+%26quot%3bsuperficial+fascia%26quot%3b+OR+%26quot%3btela+subcutanea%26quot%3b+OR+DSCT))+AND+(TX+(echograph*+OR+tomograph*+OR+ultrasonograp*+OR+ultrasound*+OR+caliper*+OR+calliper*+OR+MRI+OR+%26quot%3bmagnetic+resonance+imag*%26quot%3b+OR+%26quot%3b3d+imag*%26quot%3b+OR+%26quot%3b3-d+imag*%26quot%3b+OR+%26quot%3bthree-dimensional+imag*%26quot%3b+OR+%26quot%3bCT%26quot%3b+OR+CAT+OR+thick*+OR+measur*+OR+depth+OR+deep+OR+distance+OR+length+OR+long))&type=1&searchMode=Standard&site=ehost-live

References

1. Shankar N, Saxena D, Lokkur PP, Kumar NM, William NC, Vijaykumar N. Influence of skin-to-muscle and muscle-to-bone thickness on depth of needle penetration in adults at the deltoid intramuscular injection site. Medical Journal Armed Forces India. 2014 Oct;70(4):338–43.

2. Hobbins S, Johnstone J, O'Hickey S. Subcutaneous tissue precludes intramuscular injection in the majority of patients prescribed epinephrine auto injectors. Allergy. 2014 Sep;69:277.

3. Nakajima Y, Fujii T, Mukai K, Ishida A, Kato M, Takahashi M, et al. Anatomically safe sites for intramuscular injections: a cross-sectional study on young adults and cadavers with a focus on the thigh. Human Vaccines & Immunotherapeutics. 2020 Jan 2;16(1):189–96.

4. Nakajima Y, Mukai K, Takaoka K, Hirose T, Morishita K, Yamamoto T, et al. Establishing a new appropriate intramuscular injection site in the deltoid muscle. Human Vaccines & Immunotherapeutics. 2017 Sep 2;13(9):2123–9.

5. Covidence systematic review software [Internet]. Melbourne, Australia: Veritas Health Innovation; 2021 [cited 2021 Oct 18]. Available from: www.covidence.org

6. Microsoft Excel. Microsoft; 2018.

7. Joanna Briggs Institute. Checklist for Analytical Cross Sectional Studies [Internet]. Joanna Briggs Institute; 2020 [cited 2021 Jun 25]. Available from: https://jbi.global/critical-appraisal-tools

8. Eaton-Evans J. Nutritional Assessment: Anthropometry. In: Encyclopedia of Human Nutrition [Internet]. Elsevier; 2013 [cited 2021 Oct 15]. p. 227–32. Available from: https://linkinghub.elsevier.com/retrieve/pii/B9780123750839001975

9. Lippert WC, Wall EJ. Optimal Intramuscular Needle-Penetration Depth. PEDIATRICS. 2008 Sep 1;122(3):e556–63.

10. Poland GA, Borrud A, Jacobson RM, McDermott K, Wollan PC, Brakke D, et al. Determination of Deltoid Fat Pad Thickness: Implications for Needle Length in Adult Immunization. JAMA. 1997 Jun 4;277(21):1709.

Supplemental Material B – Joanna Briggs Institute Checklist for Analytical Cross Sectional Studies Risk of Bias Summary

Study	Were the criteria for inclusion in the sample clearly defined?	Were the study subjects and the setting described in detail?	Was the exposure measured in a valid and reliable way?	Were objective, standard criteria used for measurement of the condition?	Were confounding factors identified?	Were strategies to deal with confounding factors stated?	Were the outcomes measured in a valid and reliable way?	Was appropriate statistical analysis used?	**Overall Risk of Bias**	Reviewer 1 notes	Reviewer 2 notes
Jutte 2012	Unclear	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Low	Division 1 vs recreational athletes had skinfold measures for the intention of informing cryotherapy guidelines. Deltoid measure is of interest and data presented appears usable. Sex, age, weight, height, available for two groups in large numbers.	389 college students recruited into study, athletes or recreationally active at enrolement, no clear exclusion criteria listed (such as BMI range or medical Hx). Significantly more men than women in study population.
Hastings 2011	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Not enough information	Weight and age-based criteria for obese/severely obese adolescents and young adults. Reason for age cutoffs unclear, ? vaccination window. Limitations clearly stated. Standard procedures used. Dietician-measured skinfold thicknesses using formal guidance. Appropriate measuring instruments. Anatomy-based point of measurement for consistency. Mean of 3 skinfold measurements.	It appears that this study is a secondary analysis of data obtained from the Middleman 2010 study. DST measured by calipers at 3cm distal to medial head (this information was not made clear in original paper). I assume repeat data should not be included. This paper seems more focused on anthropometric measures so ?may be more relevant than original paper which focused on HBV titres as primary outcome

Nakajima 2020	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Low	1-5 14 yrs participants included - need raw data to extract these or unusable. Clear description of subjects, setting, and methods. I cannot think of any obvious confounding factors that may have affected these results. The limitations are clear. Valid and reliable measure with no pressure, 90 degree plane, and mean of three measures. Mean +/- SD with range min/max clearly identified in Table 2. No other statistical analysis conducted appears relevant to our extraction / comment on the paper.	Small study of young adult healthy volunteers only with BMI cut off of <30. Deltoid SCT thickness meaurement by US with repeatable method described in detail. Statistical methods section brief but main outcome of tissue thickness reported by mean +/- SD seems appropriate.
Nakajima 2017	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Low	Nursing students trained by doctor and investigators trained in basic nursing skills to perform tests. Small sample of 30 conducted in University laboratory in Japan. There is a table of mean distance from mid-acromion lateral border to examined sites, so may be able to correlate with other sites, e.g 1/3bb' is 3.5-4.6cm below acromion, e.g 1/2bb' is 5.3-6.9cm from acromion.	30 participants age 18 and older in Japan.
Sim 2014	Yes	Unclear	Yes	Yes	Yes	No	Yes	Yes	Some concerns	Not clear if any sites are over deltoid - clarification has been sought with author. No response to date.	Study of 156 adults in Korea with diabetes. SCT measured by ultrasound in 8 sites on the upper arm, one of which appears to be at the deltoid (site 1 or 2)
Cook 2006	Yes	Unclear	Yes	Yes	Yes	Yes	Yes	Yes	Low	256 adults US measured deltoid SCT. Note measures appear to be single, but by a single expert sonographer. Unclear if +/- are SE or SD, MW may be able to determine.	256 adults had SCT measured at the deltoid with ultrasound by a qualified sonographer.

Shankar 2014	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Low	Purposive sampling used during particular working hours of investigators, to get a distribution of BMI and age in attendants of patients to radiology department during particular hours. Non random but this may have alleviated confounding by these properties which were measured. Measures appear to be single but rigorous approach.	200 adults had SCT measured at the site of deltoid injection by ultrasound
Li 2007	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Low	A prospective study of 36 people undergoing transradial catheterisation; 18 who experienced significant haematoma, and for each, a control person immediately after them who did not experience significant haematoma; no other matching for demography. BMI and skinfold thickness correlation noted.	Skinfold thickness at Deltoid muscle area measured by calliper. Sample of 36 patients undergoing cardiac catheterisation in Taiwan
Lippert 2008	No	Unclear	Yes	Yes	Yes	Yes	Unclear	Yes	Some concerns	Usable data for 30 children between 16 and 18 years. Normal shoulders included in CT/MRI for any reason were retrospectively reviewed for children meeting the study age group in the study time period. Manually extracted data from Figure 9 makes this paper usable for 30 participants. Requested raw data for increased accuracy but think this is usable if another reviewer can confirm extracted values.	CT/MRI imaging of "normal shoulder" used to measure deltoid SCT thickness (5cm distally from acromion). Children age 12 months to 18yrs inlcuded from a hospital population. Exclusion criteria outside of above parameters not described. Statistical plan not clearly described, regression approach as reported seems appropriate.

Middleman 2010	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Low	Note same data as Hastings 2011 but MEDIAN not mean SCT presented. Note 1-5 participants were under our lower age threshold of 16. Seeking raw data from author but may not be usable as not enough raw data so far to tie age to the other variables - don't know which to exclude from the set. Well conducted otherwise and useful data if can remove these. Seek further info.	Study population 14-24y + obese. Anthropometric measures (including deltoid skinfold) obtained using "standard methods" - deltoid skinfold reported in mm but no detail given regarding method used. Smaller sample size than anticipated and little variability in demographics of participants. Statistical plan adjusted for small sample size. Include only if possible to extract data for those age 16 and over. See also study #2.
Poland 1997	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Low	Sample of 220 healthcare workers presenting to HBV vaccine clinic representing <65's. Apparently similar to a population sample of non healthcare workers but this is a known caveat/confounder. Callipers and US measurements.	220 healthcare workers age 18 and older. US Measurement of Deltoid SCT . Mean value for men and women reported.
Ludescher 2011	Unclear	Yes	Unclear	Unclear	Yes	Unclear	Yes	Not applicable	High	CT/MRI appear to be appropriate measures but skin thickness not included. An allowance of 2mm for skin thickness appears reasonable but is a noted caveat that SCAT measurements do not include the true skin thickness component of measurements. I don't think we can reverse engineer linear regression fitting to get the mean SCAT for site 17. Nothing necessarily wrong with the statistics presented, just not sure they are usable for our meta-analysis or statistical comment. Probably need Allie/M Weatherall's advice on this.	Study of 116 healthy volunteers, no clear exclusion criteria listed. SCT thickness measured by MRI at the upper arm (in the middle and 70 degrees lateral). Skin thickness determined in 24 participants at abdominal site via CT ?skin thickness not included in MRI SCT measurement at relevant site.

Gwinup 1971	No	No	Unclear	Unclear	Yes	No	Yes	Yes	High	Broad and poorly defined inclusion criteria and study setting. 20 Tennis players 6hrs/week for two years or more vs a (unknown number of) selection of medical staff who did not play tennis or do one-arm-favouring activities. Despite this, measurements were made in a reliable way and presented in a usable format. Good numbers for inclusion. Debatable whether should be included for good data collection or excluded for vague participant group. Leaning towards include.	Study population of 20 tennis players (+controls) SCT thickness measured by calliper at lateral prominence of deltoid. Control group matched for age and dominant hand but not BMI.
Kyriakopoulos 1979	No	No	No	No	Yes	No	Yes	Unclear	High	Inclusion criteria, study setting, participant characteristics, and actual SCT measurements are not presented. Unusable without access to raw data, large risk of bias and confounding from an unclear selection process. Xray method validation done in a very small subset and may not be statistically valid. Not usable.	152 subjects studied. No clear inclusion/exclusion criteria provided. Measurement at Deltoid SCT measurement by Calliper and X-ray however only correlation between radiological indices and skinfold reported.
Arslan 2012	Unclear	Yes	Yes	Yes	Yes	No	Yes	Yes	Not enough information	Data for 3-18 yrs merged; need to isolate in order to use in the analysis. Up to 23 participants in 3-18yrs category recruited from a paediatric endocrine clinic included if obese and excluded if any pathology that would affect SCT. Exclusion not clearly defined and underlying comorbidities are potentially confounding and unaccounted for in the analysis. Linear array US transducer measurements by 2 radiologists.	Paediatric study population (age range 5-18) - to include if separate data available for 16-18year olds.

Hobbins 2014	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	Not applicable	Low	Patients prescribed auto injectors for anaphylaxis had US measurements of deltoid SCT to see if needle penetration would be adequate. Limited methodology information from the supplement but author sent raw data which appears to be usable. Clarification for US measurement units is required. Contact line established however so may be able to clarify any other helpful information.	STMD measured at deltoid area by US. Only data for anterolateral thigh reported in Johnstone paper - authors contacted to query and deltoid data was shared.