Anthropometry for Patients with High Body Mass

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INTRODUCTION

- Approximately 72 million adults, 34% of the US adult population, are obese with a BMI greater than or equal to 30 kg/m² [1]
- Increased patient size can complicate even the most basic medical interventions, as can the lack of proper equipment to lift and move the patient [2]
- Obese patients have been associated with increased risk during patient handling maneuvers and dis-accommodation by medical device design
- Little data has been published on the physical attributes of people with high body mass index (BMI), or the population that might be described as "bariatric " in health care
- The intent of this research is to increase knowledge of the body shape of the nonstandard, obese demographic for use in the design and evaluation of medical devices and patient handling equipment

Study Objective

- The current protocol is part of a larger research effort to develop anthropometric database of adult body shapes with a BMI index of 30 or greater, in functionally relevant postures (e.g. standing, supported recline, supine) that represent patients in slings and lift assist devices

METHODS

Participants

- All participants were classified as obese (World Health Organization, 2014)
- 22 women and 20 men with a body mass index (BMI) of 30 kg/m² or greater

Standard Anthropometry

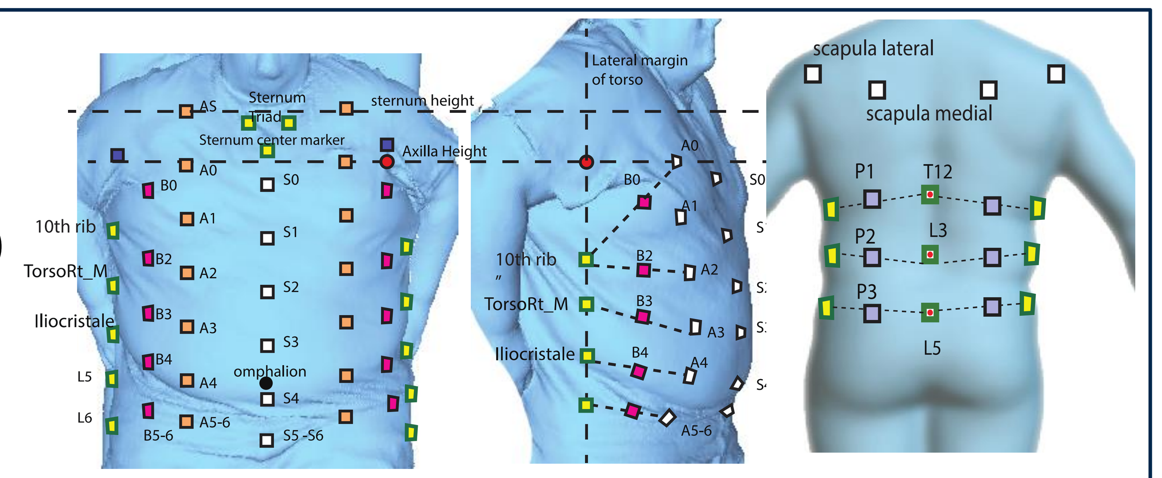
- Approximately 60 standard anthropometric dimensions, were taken on each participant
- Subsets of the anthropometric measures were obtained at multiple measurement site(s) to provide preliminary data on points of maximal protuberance
- Intent of these maximal measures was to capture body shape variability, particularly the location and contour of the panniculus during standing and seated postures

3D Anthropometry

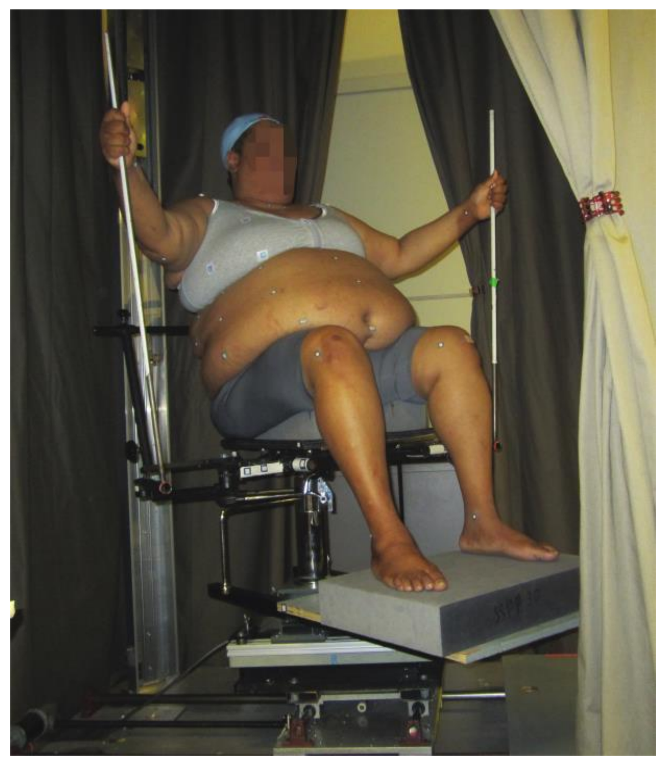
- Locations of landmarks on the participants were recorded via skin targets stamped on the skin
- A grid pattern of landmarks was used to track surface shape and deformation differences between the postures
- A Vitronic VITUS XXL full-body laser scanner and ScanWorX software by Human Solutions was used to record whole-body 3D surface geometry in *standing* and *supported seated* postures
- A table with transparent support surfaces was fabricated to capture *supine* whole-body body shape
- Handheld Artec 3D and Cubify Sense scanners were used to capture the supine scan posture on the transparent table and body regions of interest that were shadowed from the whole-body scanner

Data Processing

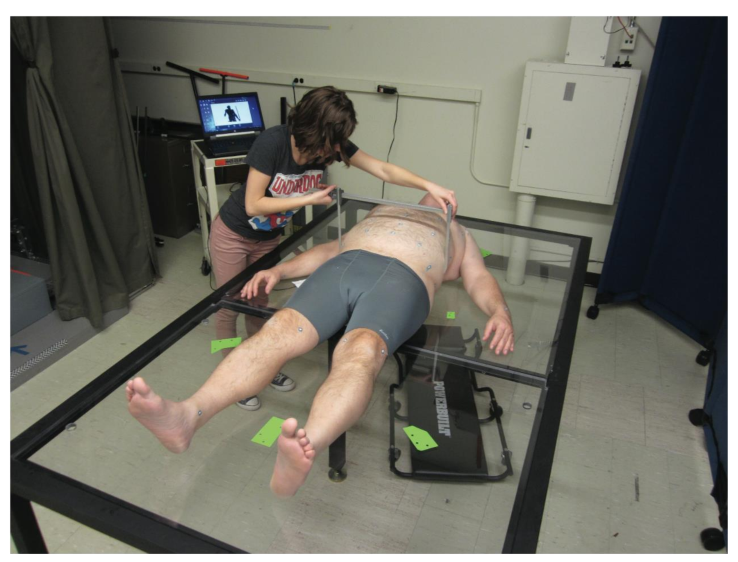
- ScanWorX, MeshLab, and Geomagic Studio software were used to process 3D surface geometry



Torso landmarks to track deformation



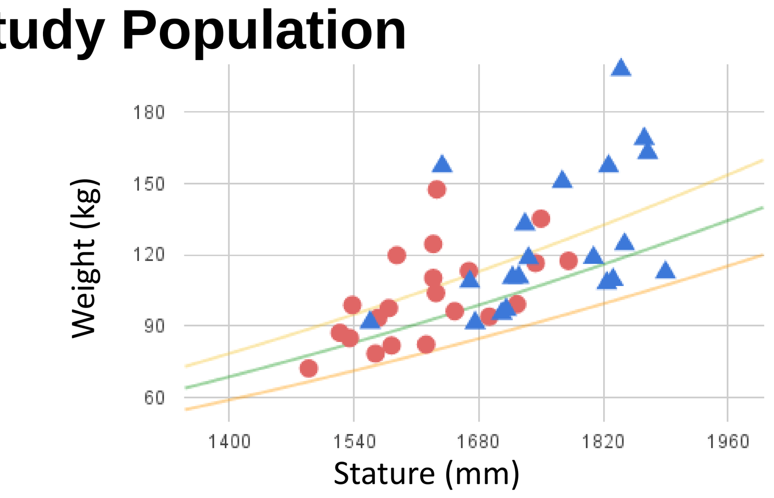
Adjustable seating fixture to replicate relevant postures



Transparent table for supine scans

RESULTS

Study Population



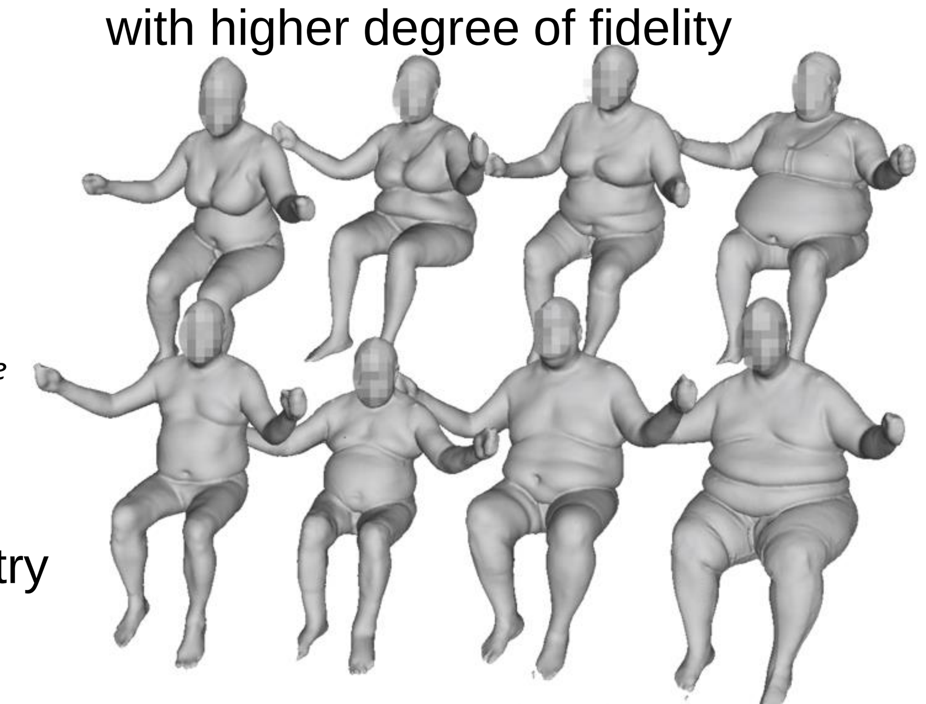
Weight vs. stature by gender of participants. Trend lines illustrate BMI (orange - BMI = 30; green – BMI = 35; yellow- BMI = 40).

Standard Anthropometry

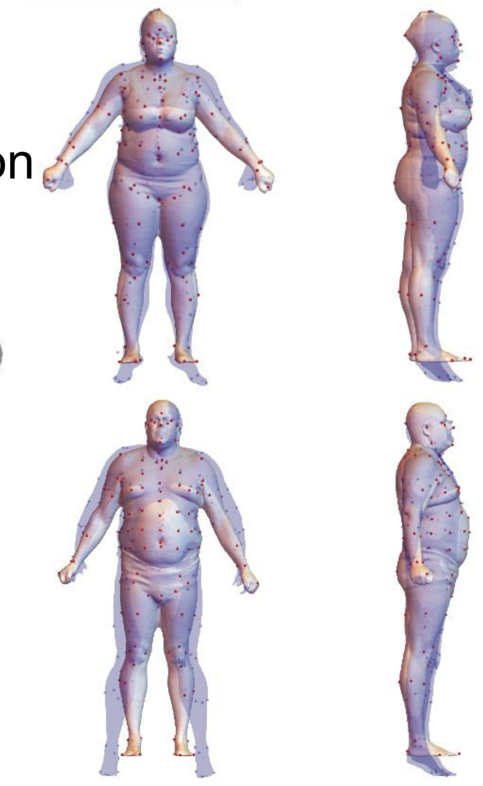
- Due to a lack of a standard, anthropometry data is dependent on the method of measurement
- Comparisons of waist circumference and maximum protrusion measurements using different measurement sites display variability

3D Anthropometry

- 3D body scans characterizes the participants' shape and fat distribution with higher degree of fidelity

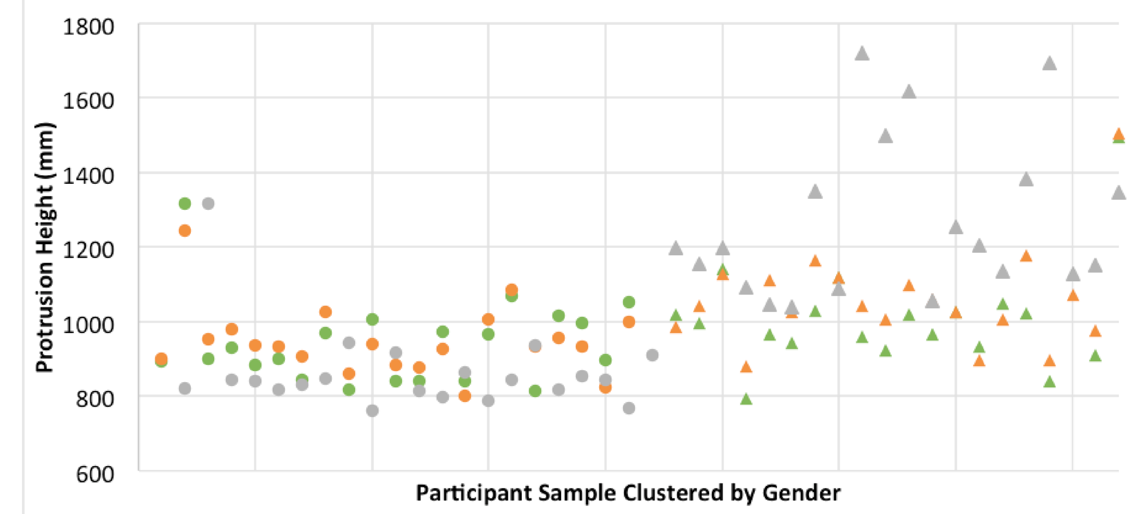


Body scan variability for 4 female and 4 male participants in a supported, seated posture



Overlay of supine and standing scans highlight differences in upper torso shape and shoulder posture

Heights at which the circumference measures were obtained at the level of the omphalion [green], maximum anterior [orange], and posterior protuberance [gray]; participant gender is coded by symbol [circle=female, triangle=male]



Circumference measures on the torso at the level of the omphalion [green], maximum anterior [orange], and posterior protuberance [gray]; participant gender is coded by symbol [circle=female, triangle=male]

CONCLUSIONS

- Manual anthropometric measures such as waist circumference or maximal circumferences, provide a surrogate measure of central fat distribution, however, there remains a lack of consensus on the appropriate measurement site(s)
- Capturing the body with 3D scanning techniques better characterizes fat distribution and provides full contour of the body shape
- Preliminary results have revealed variability of nonstandard obese body shapes and provide useful guidance for developing improved medical devices
- Data on body shape from a larger sample will enable statistical analysis of the body shape to be conducted

REFERENCES

[1] Flegal, KM, Carroll MD, Ogden CL, Curtin LR. (2010). Prevalence and trends in obesity among US adults, 1999–2008. *JAMA*. 303:235–241.

[2] Kumpar, D. (2014). Prepare to care for patients of size. *American Nurse Today*, 9(9), 20-22.

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