

# Plus Size Anthropometry: Is designing for the 95<sup>th</sup> percentile enough?

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**Abstract.** Over 60% of the adult population in the United Kingdom is now overweight/obese or classed as ‘plus size’. As the incidence of being plus size rises the demographics of the working population have also changed. This paper will present, the results of a plus size anthropometry study, using self-reported anthropometric data taken for 14 key anthropometric measurements. 101 participants, recruited via a non-probability sampling strategy completed the study which aims to identify the body size and shapes of plus size working age people.

**Keywords.** Plus size, anthropometry, workplace design, self-measurement.

## 1. Introduction

Overweight and obesity is defined as an “abnormal or excessive fat accumulation that may impair health” (WHO 2014) and is recognized as a major health problem in many countries of the world (Wearing et al 2006). The clear majority of the adult population (62.1%) in the United Kingdom is now either overweight or obese (hscic 2013) or classed as ‘plus size’ (Rush 2013) – meaning large. This is higher than almost all other developed countries in the world. Even with numerous public health interventions such as ‘Change4Life’ (Department of Health 2009), Food labelling systems (for example Traffic Light System) and widespread weight management guidance (NICE 2006) the incidence of being plus size continues to rise changing the demographics of the working population.

The economic consequences of an increased percentage of plus size workers are well documented and include increased absence from work (Han et al 2009) and reduced productivity (Bhattacharjee et al 2003). Being plus size also represents a major risk factor for premature job leave (Jushot et al 2008). These issues associated with plus size workers are a concern, as increasing employment, supporting people into work and maintaining people at work are key elements of the UK Government’s public health and welfare reform agendas (DWP 2013). There are economic, social and moral arguments that work is the most effective way to improve the well-being of individuals, their families and their communities and there is a strong evidence base showing that work is generally good for physical and mental health (Burton and Waddell 2006).

The changing demographics of the working population presents a challenge to those involved in workplace design. The design process relies upon the utilization of anthropometric data to establish the percentage of the user population that will be

accommodated by the design. A first stage scoping study (Masson et al 2014) found that fit (equipment, tools, furniture, uniforms and personal protective equipment) and space (circulation and shared spaces within the working environment) were issues of concern to plus size people. This suggests that aspects of the current design of the workplace are not suitable, and may even exclude plus size people. A better understanding of the anthropometric requirements of plus size workers is therefore needed to be able to answer the question: ‘Is designing for the 95<sup>th</sup> percentile enough?’

Self-reported anthropometric data is an efficient way (in terms of cost and resources) of studying large and geographically diverse populations and may assist in accessing the hard to reach plus size working population. Masson et al (2015) established that self-measurement of 14 key anthropometric measurements, using a self-measurement instruction guide, was both a reliable and feasible data collection method for a larger scale anthropometric study to further understand the body size and shape for plus size people at work. A unique measure of knee splay (in a non-pregnant population) was included. Defined as the distance between the outer borders of the knees whilst seated in the preferred sitting position (Serpil and Weeks 2006) it represents the observed sitting postures of plus size individuals.

This paper will present, the results of a plus size anthropometry study, using self-reported anthropometric data, which aims to identify the body size and shape of a plus size working age people sample. Via the collection of 14 key anthropometric measurements and the comparison of this newly acquired anthropometric data to existing datasets this data will help inform the design of safe, comfortable, inclusive and productive working environments.

## 2. Methods

### 2.1 Self-Measurement

The self-measurement guide developed and piloted by Masson et al (2015) was utilised in this plus size anthropometry study (Fig. 1). This included detailed narrative and photographs to enable participants to complete the self-measurement of 14 anthropometric measurements (Table 1) using a standardised 300cm fabric tape measure.

Table 1. *Anthropometric Measurements Taken*

<b>Anthropometric Measure</b>	
<b>In Standing</b>	<b>In Sitting</b>
Weight	Sitting Shoulder Height
Height	Abdominal Depth
Chest Circumference	Hip Breadth
Abdominal Circumference	Thigh Thickness
Hip Circumference	Buttock to Front of Knee
Shoulder Breadth (Bideltoid)	Popliteal Height
Forward Fingertip Reach	Knee Splay

<p><b>1. Hip Breadth</b></p> <ul style="list-style-type: none"> <li>• <b>Sitting</b> – on a hard surface. Feet should be supported and thighs should be horizontal.</li> <li>• Sitting upright, looking ahead. Hands in lap</li> <li>• Bring knees and thighs together as much as you are able.</li> <li>• <b>Measure horizontally across the widest part of your hips.</b></li> <li>• Re check measurement</li> </ul> <p>My hip breadth is <input type="text"/> cms</p>	
<p><b>2. Thigh Thickness</b></p> <ul style="list-style-type: none"> <li>• <b>Sitting</b> – on a hard surface. Feet should be supported and thighs should be horizontal.</li> <li>• Sitting upright, looking ahead. Hands in lap.</li> <li>• <b>Measure vertically from the seat surface to the upper surface of your thigh at the point where the thigh is thickest.</b></li> <li>• Be careful not to compress the thigh when measuring.</li> <li>• Re check measurement</li> </ul> <p>My thigh thickness is <input type="text"/> cms</p>	

Fig. 1 Example from Self-Measurement Instruction Guide

Participants were required to record basic identifying information, working status and detail clothing worn during the measurements in line with BS EN ISO 15535:2012 (BSI 2012).

## 2.2 Sampling

Due to the target population being relatively unknown and potentially so widely dispersed, the online self-measurement guide took on a non-probability sampling strategy using a combination of ‘purposive’ and ‘snowball sampling’. BS EN ISO 15535:2012 (BSI 2012) acknowledges this as acceptable as the sampling method has been defined. The inclusion criteria for recruitment were; that participants were aged 18 years of age or above, were working (or had worked in the 12 months prior to the study) either on an employed or self-employed basis, and classified themselves as ‘plus size’ or ‘larger than average’. The online nature of the survey meant that non UK based responses could be received. These were identified from the response IP address and excluded from analysis. Ethical approval for the study was gained from the Loughborough University Ethical Advisory Committee.

## 2.3 Data Collection

The self-measurement guide was distributed using Survey Monkey. Respondents were

required to indicate their consent before completing and submitting online.

### 3. Results

Data sets have been recorded for 101 participants (female n= 54 male n=47) aged between 18-64 years of age. This paper will present a full analysis of the results of the plus size anthropometric study to include detailed demographic reporting, presentation of actual data for each of 14 anthropometric measurements recorded, comparison between existing and study anthropometric data including exclusion rate for each measurement (where exclusion rate is calculated as a proportion of respondents that might be excluded from design) that accommodates up to 95th and 99th percentile as detailed in the anthropometric data currently available in the literature and identification of key anthropometric variables which may help define the shapes of the plus size working population.

### 4. Discussion and Conclusion

The analysis of the results, in combination with the discussion of the findings will provide an insight into the anthropometric requirements of the plus size working population helping to answer the question 'Is designing for the 95<sup>th</sup> percentile enough?' This new data will assist in making recommendations (including design requirements) for an employer's toolkit to support more inclusive, healthier and safer working environments for plus size people

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