How has your research career to date led to your current focus on adiposity?

I’ve always had a strong interest in methodological aspects of research and the application of innovative techniques to health and nutrition research. As a dietician, I am aware of the importance of correctly assessing an individual’s body weight. The idea to study obesity and body shape using 3D body scanners was founded more than five years ago when I was introduced to body scanning used in research by another department at University College Ghent, Belgium.

What role does body mass index (BMI) play in measuring obesity?

The key to the success of BMI is associated with its simplicity. You only need to divide a person’s body weight in kilograms by the square of their height in metres. Although frequently used for assessment of body weight corrected for height at the individual level, BMI was designed to classify populations according to weight index. A BMI above or below certain cut-offs shows increased mortality at the population level, but high BMIs are not necessarily attributable to increased body fat at the individual level. For instance, a very muscular person might have an identical BMI to an overweight person of the same height. From a healthcare perspective, same height. From a healthcare perspective, BMI was designed to assess of body weight corrected for height. Although frequently used for classification of adiposity (ADEPS) project is to gauge body fat percentage from readily available anthropometric measures in clinical practice that don’t require sophisticated equipment.

How will body scans inform your body fat percentage measurements?

The usage of 3D body scanning to estimate body fat percentage is new. Theoretically, it makes sense that total body volume, and therefore body composition, can be derived from a 3D avatar. However, whether anthropometric circumferences and lengths produced by 3D body scans produce reliable predictors for body fat percentage remains to be demonstrated.

What are the principles behind the Bod Pod method? How will it validate your anthropometric data?

A Bod Pod makes use of air displacement plethysmography (ADP). The main principle behind ADP is that total body volume and weight are measured so that body density, fat mass and fat-free mass can be derived. In contrast to hydrostatic weighing, ADP does not require persons to be submerged in water. A Bod Pod is an airtight capsule with one seat. It determines the total volume of the person in the capsule using small fluctuations in air pressure and an oscillating membrane. ADP is the gold standard method for volume measurement. In our ADEPS project, we will use Bod Pods to validate total body volumes from body scans and anthropometric-based estimations of body fat percentage.

Almost halfway through the programme, what progress have you made in developing a novel method to calculate body fat percentage?

We have already collected a substantial number of body scans from a representative sample of Belgian adults during previous research projects. The body scans needed smoothing of their surfaces and some post-processing in order for total volumes to be calculated. From these previously collected 3D body scans, we are now identifying among the 150+ anthropometric measures available those that are most likely to predict body fat percentage. Given their differences in body shape and composition, these predictors will not be identical for males and females.

In the next phase of our project, we will conduct a validation study for which we will collect both body scans and ADP measures from a new sample enabling us to verify the predictive power of our models to calculate body fat percentage.

We will create nomograms from our prediction equations and create downloadable spreadsheets for calculating predictions of body fat percentage. A nomogram uses a graphic, like scaled lines with units for different predictors, which simplifies the use of somewhat complex equations so that calculations can be performed without the use of a computer or calculator. After successful development of regression equations to predict body fat percentage, we will convert those into nomograms in order for the equations to be easily used in clinical practice.
Obesity is a global epidemic and a worldwide public health crisis; its prevalence has doubled since 1980. A research project at University College Ghent in Belgium aims to develop a practical tool to assess adiposity using anthropometric data.

A COMMON MISCONCEPTION about obesity is that it is based on excess weight. In fact, the condition is characterised by the surplus of fat tissue, and its location around the abdominal area has been identified as the cause of numerous health risks. More generally, obesity has been associated with an increased risk of cardiovascular diseases, diabetes and various types of cancer, among other diseases.

In 2014, 13 per cent of the global population was obese. As obesity is a preventable disease, optimising the measurement of adiposity is important not only on an individual level, but also for informing epidemiological studies and public health efforts.

To classify obesity, many health and research practitioners and institutes, including the World Health Organization (WHO), make use of the body mass index (BMI). This index provides an estimation of a person’s body mass by dividing their weight by the square of their height. While BMI is a good predictor of weight-related morbidity on the population level, it is not as effective in individual cases. Body weight is influenced by more than fat tissue, including high muscle mass, and the relationship between BMI and health can vary with ethnicity.

Based at University College Ghent, Dr Willem De Keyzer is well aware of the problems inherent in using a weight-based measure of obesity such as BMI, but appreciates the ease of employing anthropometric measures in the clinic. In his research project, Anthropometric baseD Estimation of adiPoSity (ADEPS), De Keyzer aims to develop a method that, like BMI, uses anthropometric measures, but focuses on volumetric measurements rather than weight.

In 2014, 13 per cent of the global population was obese.

DETERMINING BODY VOLUME AND SHAPE

3D body scanning techniques are already being used in the fashion industry to optimally tailor clothes to body shape; but keeping in mind that body volume and shape are better predictors of obesity-related health risks than weight, De Keyzer uses 3D body scans to obtain these data for his adiposity research. “Because a body scan results in a digital avatar, the distribution of body mass and fat deposition can be visualised and processed on a higher level compared with manual measurements,” he explains. “An important task was to identify anthropometric measures from the body scans that would serve as potential predictors for body fat percentage.” Every body scan produces over 150 measures of obtained body shape and size that can be analysed for their correlation with body fat percentage.

Once the body scans have undergone the necessary digital post-processing, the data on body volume and areas of fat deposition can
ANTHROPOMETRIC-BASED ESTIMATION OF ADIPOSITY (ADEPS)

OBJECTIVES

- To study the extent to which body fat percentage can be predicted using anthropometric measurements obtained from 3D body scans using a structured white light full body scanner
- To create population-specific nomograms for clinical use

KEY COLLABORATORS

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DEVELOPING A PREDICTIVE MODEL

Once the data collection and optimisation stages of 3D scanning and Bod Pod body fat percentage measurements are completed, De Keyzer will analyse the correlative relationships between body volume, anthropometric measurements and body fat percentage. “We used a statistical technique called the ‘Design of Experiments’ approach to maximise the predictive capacity of our models to calculate body fat percentage,” he reveals. In this way, he aims to develop regression formulae that can be used to estimate body fat percentage on the basis of anthropometric variables.

In the screening phase of the model development stage of the research project, De Keyzer is looking to identify the anthropometric measurements most likely to predict body fat percentage. He is currently working to analyse circumference measurements of areas such as the upper arm, thigh and calf, as it is important to find measures that are easily translated to clinical practice. The correlation of such measures with the deposition of body fat in principal areas of the body will be analysed in order to develop a predictive model.

Once a predictive link between anthropometric measures and body fat percentage has been established, De Keyzer will optimise the model for clinical practice. While accuracy of adiposity measurement is important, it is essential for clinical uptake of his model that he keeps practical concerns of health practitioners in mind. Hence, a choice will have to be made between model quality and practical measurability. Finally, he will use visualisation software to create a so-called nomogram, a practical tool that can be used in the clinic to quickly convert the anthropometric measures into body fat percentage values. In developing this tool, the ADEPS project offers a practical contribution to getting a grip on obesity – the largest preventable health problem of our time.