

# Association of body mass index and waist-to-hip ratio with brain structure

UK Biobank study

Mark Hamer, PhD, and G. David Batty, DSc

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Correspondence

Dr. Hamer

m.hamer@lboro.ac.uk

## Study objective

To determine whether body mass indices (BMIs) and waist-to-hip ratios (WHRs) are associated with brain volumes.

## Summary results

Greater BMIs and WHRs are independently and jointly associated with reduced gray matter (GM) volumes.

## What is known and what this paper adds

Some small-scale studies have shown that greater BMIs and WHRs are independently associated with reduced GM volumes. This study confirms the independent associations and shows that an interactive association exists.

## Participants and setting

This study reviewed data from 9,652 individuals (47.9% male; mean age,  $55.4 \pm 7.5$  years) who were recruited to the UK Biobank study between 2006 and 2010 and assessed through 22 clinics in England, Wales, and Scotland. Neuroimaging occurred between 2014 and 2016 at 3 imaging centers.

## Design, size, and duration

Nurses measured the body weights, fat masses, heights, and waist and hip circumferences of all UK Biobank study participants. BMIs and WHRs were calculated from these data. The participants underwent structural MRI scans that were analyzed to determine white matter and GM volumes. Multiple linear regression models were used to study associations between obesity measures and compartmental brain volumes.

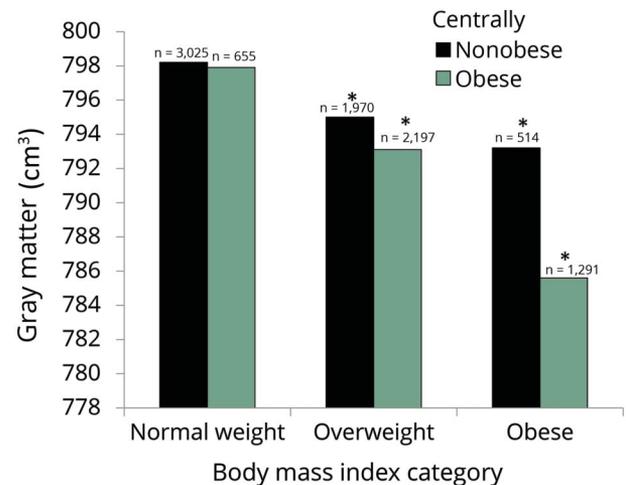
## Primary outcome measures

The primary outcomes were the independent and interactive associations of BMIs and WHRs with compartmental brain volumes.

## Main results and the role of chance

Greater BMIs and WHRs were both independently associated with reduced GM volumes ( $p < 0.001$ ). Among individuals with BMIs  $\geq 30$  kg/m<sup>2</sup>, those with central obesity (i.e., WHRs  $>0.85$  for women and  $>0.90$  for men) had lower GM volumes than persons without central obesity did

**Figure** GM volumes in persons with and without central obesity in normal-weight (BMIs of 18.5–24.99 kg/m<sup>2</sup>), overweight (BMIs of 25–29.99 kg/m<sup>2</sup>), and obese (BMIs  $\geq 30$  kg/m<sup>2</sup>) groups



\* $p < 0.05$  relative to normal-weight participants without central obesity.

( $p = 0.04$ ). No such associations were observed with white matter volumes.

## Bias, confounding, and other reasons for caution

This study partly relied on self-reported medical history data. The possibility of unmeasured residual confounders cannot be excluded. The UK Biobank study's sample might have been biased towards relatively healthy individuals.

## Generalizability to other populations

The reliance on data from the UK may limit the international generalizability of this study's results.

## Study funding/potential competing interests

This study was funded by the National Institute Health Research (UK government). The authors report no competing interests. Go to [Neurology.org/N](https://www.neurology.org/N) for full disclosures.

A draft of the short-form article was written by M. Dalefield, a writer with Editage, a division of Cactus Communications. The authors of the full-length article and the journal editors edited and approved the final version.

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