

Does obesity mediate or moderate the association between socioeconomic position and multiple long-term conditions?

Lewis Steell^{1,2}, Snehal M Pinto Pereira³, Susan J Hillman^{1,2}, Miles D Witham^{1,2}, Avan A Sayer^{1,2}, Rachel Cooper^{1,2}

¹AGE Research Group, Translational and Clinical Research Institute, Faculty of Medical Sciences, Newcastle University. ²NIHR Newcastle Biomedical Research Centre. ³Division of Surgery and Interventional Science, University College London.

Background

- Multiple long-term conditions (MLTC) is the co-occurrence of two or more long-term conditions (LTC) in an individual.
- Socioeconomic inequalities in MLTC are widely recognised; people of lower socioeconomic position (SEP) = greater risk of MLTC onset at younger ages.
- Despite this, few studies have investigated the pathways through which SEP may affect MLTC risk.
- Lower SEP also associated with higher levels of obesity across the life course, which has been implicated in onset of numerous LTC.
- Obesity may therefore be a plausible pathway through which lower SEP leads to increased MLTC risk.

Aim

- To investigate the mediating and moderating roles of overall and central obesity on the association between SEP and incident MLTC.

Methods

Population



UK Biobank participants with no self-reported LTC at baseline (n = 194,038).

Exposure



Socioeconomic position indicated by highest educational attainment (4 groups).

Mediators



Overall obesity (BMI $\geq 30\text{kg/m}^2$) or Central obesity (WHR >0.9 [male]/ >0.85 [female]).

Outcome



Incident MLTC drawn from hospital inpatient data. Defined as two diagnoses from a prespecified list of 55 LTC.

Statistical Analyses

- Associations between educational attainment, obesity and incident MLTC assessed using logistic and Poisson regression models.
- Counterfactual analysis:
 - Four-way decomposition (Figure 1).
 - Estimates on excess relative rate scale.
 - + proportion mediated & proportion eliminated.
- Fixed five-year follow up.
- Covariates: Sex, birth year, ethnic group, physical activity, smoking, alcohol intake.
- Multiple imputation used to handle missing data.

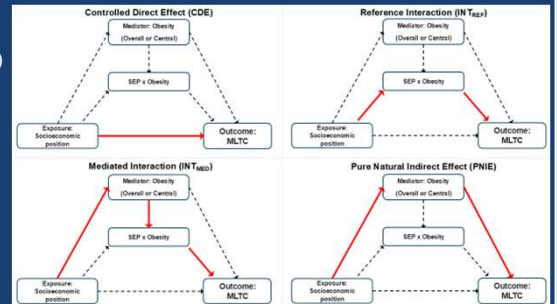


Figure 1. Conceptual framework of four-way decomposition analyses. Red arrows indicate the four decomposed estimands of interest, which sum to the total effect.

Results

- 11,071 participants developed MLTC.
- SEP → Obesity:
 - Lower educational attainment = higher likelihood of obesity.
 - ~90% higher likelihood of overall or central obesity for lowest educational attainment (vs highest).
- Obesity → MLTC:
 - Overall obesity = 55% higher MLTC incidence.
 - Central obesity = 40% higher MLTC incidence.
- SEP → MLTC:
 - MLTC incidence increased as educational level decreased.
 - 30-35% higher rate of MLTC for middle educational attainment groups (vs highest).
 - 70% higher rate of MLTC for lowest educational attainment (vs highest).

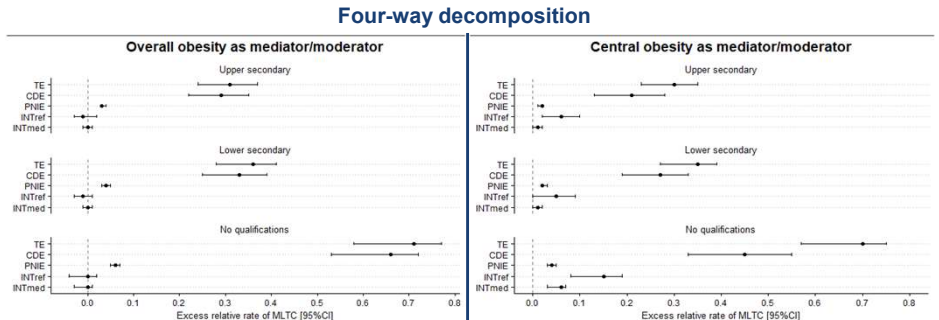


Figure 2. Four-way decomposition when overall obesity (left) and central obesity (right) used as binary mediating variables. Estimates on excess relative rate scale comparing lower SEP groups to highest SEP reference group (degree or higher education).

- Overall obesity** mediated ~8 – 10% of socioeconomic inequalities in MLTC.
- No moderating effect of overall obesity.
- Intervening on overall obesity = limited effect on mitigating socioeconomic inequalities in MLTC.
- Central obesity** mediated ~9 – 13% of socioeconomic inequalities in MLTC.
- 14 – 22% of total effect attributable to central obesity*SEP interaction.
- Intervening to eliminate central obesity would reduce socioeconomic inequalities in MLTC by 24 – 35%.

Conclusions

- Lower SEP (indicated by educational attainment) = higher incidence of MLTC.
- Obesity partly mediates the association between educational attainment and incident MLTC.
- Overall and central obesity displayed different mediating and moderating roles.
- Targeting different indices of obesity in treatment and prevention strategies may reduce socioeconomic inequalities in MLTC.

Implications & future directions

- This work directly addresses the NIHR's call to investigate causal pathways between SEP and MLTC [link*], highlighting a role for different indices of obesity.
- Future work should investigate the mediating role of obesity and excess adiposity across the life course on socioeconomic inequalities in MLTC, using repeated measures where such data are available.
- Renewed focus on targeting upstream determinants of obesity is required to help alleviate socioeconomic inequalities in MLTC.

For further information, please contact lewis.steell@newcastle.ac.uk or visit <https://research.ncl.ac.uk/ageresearchgroup/>