# Body mass index is negatively associated with telomere length: a collaborative cross-sectional meta-analysis of 87 observational studies

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*Am J Clin Nutr* 2018;108:453–475. Printed in USA. 

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## ABSTRACT

**Background:** Even before the onset of age-related diseases, obesity might be a contributing factor to the cumulative burden of oxidative stress and chronic inflammation throughout the life course. Obesity may therefore contribute to accelerated shortening of telomeres. Consequently, obese persons are more likely to have shorter telomeres, but the association between body mass index (BMI) and leukocyte telomere length (TL) might differ across the life span and between ethnicities and sexes.

**Objective:** A collaborative cross-sectional meta-analysis of observational studies was conducted to investigate the associations between BMI and TL across the life span.

**Design:** Eighty-seven distinct study samples were included in the meta-analysis capturing data from 146,114 individuals. Study-specific age- and sex-adjusted regression coefficients were combined by using a random-effects model in which absolute [base pairs (bp)] and relative telomere to single-copy gene ratio (T/S ratio) TLs were regressed against BMI. Stratified analysis was performed by 3 age categories ("young": 18–60 y; "middle": 61–75 y; and "old": >75 y), sex, and ethnicity.

**Results:** Each unit increase in BMI corresponded to a −3.99 bp (95% CI: −5.17, −2.81 bp) difference in TL in the total pooled sample; among young adults, each unit increase in BMI corresponded to a −7.67 bp (95% CI: −10.03, −5.31 bp) difference. Each unit increase in BMI corresponded to a $-1.58 \times 10^{-3}$ unit T/S ratio (0.16% decrease; 95% CI: $-2.14 \times 10^{-3}$, $-1.01 \times 10^{-3}$) difference in age- and sex-adjusted relative TL in the total pooled sample; among young adults, each unit increase in BMI corresponded to a $-2.58 \times 10^{-3}$ unit T/S ratio (0.26% decrease; 95% CI: $-3.92 \times 10^{-3}$, $-1.25 \times 10^{-3}$). The associations were predominantly for the white pooled population. No sex differences were observed.

**Conclusions:** A higher BMI is associated with shorter telomeres, especially in younger individuals. The presently observed difference is not negligible. Meta-analyses of longitudinal studies evaluating change in body weight alongside change in TL are warranted. *Am J Clin Nutr* 2018;108:453–475.

**Keywords:** BMI, telomere length, obesity, low-grade inflammation, meta-analysis, observational studies

## INTRODUCTION

Telomeres, the nucleoprotein structures at the ends of chromosomes, shorten with each cell division in somatic cells (1). When telomere length (TL) reaches a critical value, cells either enter a state of senescence or undergo apoptosis (2). Oxidative stress and chronic inflammation are suggested to play a role in accelerated telomere attrition (3–5). Even before the onset of age-related diseases, obesity might be a contributing factor to the cumulative burden of oxidative stress and chronic inflammation throughout the life course, and obesity may therefore contribute to accelerated shortening of telomeres.

Obesity is a growing health problem, and worldwide its prevalence has more than doubled since 1980 (6). In addition, the burden of diabetes and cardiovascular disease is partly attributable to being overweight and obese (6). Tackling obesity might be a starting point to delay telomere shortening and the onset of age-related diseases. Although obesity is associated with shorter telomeres overall (7), studies in the elderly found no relation between TL and obesity and no relation between TL and mortality (8, 9). We hypothesized that obese persons will have shorter telomeres, compared with those of normal weight of the

The authors reported no funding received for this study.

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Supplemental Methods, Supplemental Results, Supplemental Figures 1 and 2, Supplemental Tables 1–3, and Study Protocol for Participating PIs are available from the "Supplementary data" link in the online posting of the article and from the same link in the online table of contents at https://academic.oup.com/ajcn/.

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Abbreviations used: bp, base pair; PI, principal investigator; qPCR, quantitative polymerase chain reaction; TL, telomere length; T/S ratio, telomere to single-copy gene ratio.

Received May 15, 2017. Accepted for publication April 27, 2018.

First published online September 11, 2018; doi: https://doi.org/10.1093/ajcn/nqy107.