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Self-Reported Teenage Body Size and Heart Failure in Adults $\geq$ 65 Years of Age

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Overweight during childhood and young adulthood has been associated with higher rates of all-cause and cardiovascular mortality in later adulthood [1-4]. However, the relationship between body size in early life and incidence of heart failure (HF) in later adulthood is not known. We hypothesized that self-reported heavier-than-average teenage body size as an early teenager (ages 11-14) would be associated with a higher rate of incident HF in adulthood. We examined this hypothesis in a cohort of community dwelling older adults.

Cardiovascular Health Study (CHS) includes 5,888 Medicare-eligible, community dwelling adults ≥ 65 years of age who were recruited between 1989 and 1993 from 4 areas in the US [5]. The CHS is conducted and supported by the Nation Heart Lung and Blood Institute (NHLBI) in collaboration with the CHS Study Investigators. This manuscript was prepared using a limited access dataset obtained from the NHLBI and does not necessarily reflect the opinions or views of the CHS or the NHLBI. After excluding participants who did not consent to being included in the limited access dataset ($n = 93$), those who had HF at baseline ($n = 274$), and those with missing data on self-reported teenage body size ($n = 210$) or baseline body mass index ($n = 18$), 5,293 CHS participants were included in the current analyses. The design and conduct of the CHS was approved by institutional review boards at the participating field centers. Participants provided informed consent.

During a baseline interview and clinic visit, participants provided demographic, physical activity, and medical history information, underwent a physical examination, and provided blood samples for cardiovascular risk biomarkers. The CHS participants were asked "In your early teens (11-14 years), were you heavier than average, about average, or thinner than average?" as part of the baseline personal history interview [6]. The outcome for this analysis was new-onset HF during a follow-up period of up to 13 years. Participants reported diagnosis of HF to study staff, and potential cases were centrally adjudicated through the examination of medical records for physician diagnosis, treatment with HF

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medications, and other supporting evidence as previously described [7]. We used Cox proportional hazards models to calculate hazard ratios (HR) and associated 95% confidence intervals (CI) for incident HF. The primary models were adjusted for age, sex, and race (African-American or non-African-American). Secondary models additionally adjusted for alcohol consumption, body mass index at baseline, physical activity, education, cigarette smoking, history of coronary artery disease, diabetes, hypertension, and left ventricular hypertrophy at baseline, and concentrations of high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, and triglycerides.

In this population, 57% reported having an average body size as a teenager, 34% reported being heavier than average, and 9% reported being thinner than average. Older adults who reported being thinner than average as a teenager had the highest average body mass index and those who reported being heavier than average had the lowest. Incident HF occurred in 1,072 participants during a median of 12 years of follow-up. Among those with average teenage body size, 20% (n = 616) of participants developed HF. A similar percentage of participants with heavier-than-average teenage body size (20%, n = 350) and thinner-than-average teenage body size (22%, n = 106) developed HF. There was no association between being heavier than average as a teenager and incidence of HF in the age-, sex-, and race-adjusted model (HR = 1.00, 95% CI 0.88-1.14, Figure) or in the multivariable adjusted model (HR = 0.98, 95% CI 0.86-1.12). Results were similar between women and men and between African-American and non-African-American participants.

Unlike previous studies [8, 9], larger body size early in life was not associated with obesity in adulthood in the CHS participants. A major difference between the current study and previous studies of early life adiposity and adult onset cardiovascular disease is the use of self-reported perceived body size rather than historical height and weight measurements. Because this study used self-report, there is a concern about biased recall of body size. This study queried body size at ages 11-14, a period of development when body size and shape can change rapidly, and it is not clear whether participants were reporting their body size in relation to their peers, in relation to their current body size, or in relation to a culturally defined idea. Finally, all participants in this study were ≥ 65 years of age at the time of enrollment, and obesity is associated with a shorter life span [10]. We cannot exclude the possibility that participants who were heavier than average as teenagers and were susceptible to the effects of that early life exposure did not survive to become eligible for the study.

Although we did not find associations between teenage body size and incident HF in this population, we do not believe that overweight in early life is unimportant. Several studies indicate that adult mortality is associated with excess adiposity in childhood [1-4]. Obese children are more likely to become obese adults than thin children [8, 9] and are more likely to have elevated blood pressure and elevated cholesterol both as children and as adults [8, 11]. Obesity in adulthood has been linked to greater incidence of cardiovascular diseases including HF, coronary heart disease, and stroke [10]. Additional studies with objectively measured body size are necessary to rule out an association between adiposity early in life and incidence of HF in adulthood.

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Figure 1. Hazard ratios and 95% confidence intervals for the association between perceived teenage body size and incidence of heart failure from a Cox proportional hazards model, adjusted for age, sex, and race.