Degree of Cardiometabolic Risk Factor Normalization in Individuals Receiving Bariatric Surgery: Evidence From NHANES 2015–2018

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Bariatric surgery leads to clinically significant weight loss and improvements in cardiometabolic risk factors (1–3). However, population-based evidence evaluating the degree of improvements in cardiometabolic outcomes among those receiving bariatric surgery is limited. Using the National Health and Nutrition Examination Survey (NHANES) 2015–2018, we examined cardiometabolic risk factors among individuals who had undergone bariatric surgery, those eligible for but not receiving bariatric surgery, and normal-weight adults.

This study included adults aged ≥18 years who responded to bariatric surgery questions during the NHANES 2015–2018 cycles. The NHANES uses a stratified multistage probability method to sample the nationally representative U.S. population (https://www.cdc.gov/nchs/nhanes/index.htm). We analyzed six cardiometabolic measures—systolic blood pressure (SBP), diastolic blood pressure (DBP), hemoglobin A_{1c} (HbA_{1c}), total cholesterol (TC), HDL cholesterol (HDL-C), and hs-CRP—measured in a mobile examination center.

We used survey design–adjusted descriptive statistics to characterize the study population into three groups: *1*) individuals with normal weight (BMI 18.5–24.9 kg/m^2), *2*) individuals reporting receipt of bariatric surgery, and *3*) individuals medically eligible for bariatric surgery but reporting they had not received it. Surgery eligibility criteria include BMI ≥40 kg/m^2 or BMI ≥35 kg/m^2 and one or more obesity-related comorbidity (4). Rao-Scott χ^2 tests were used to compare the study group characteristics. For the main analyses, propensity score weighting (5) was used to minimize selection bias of receiving bariatric surgery using potential confounding factors given in Table 1 (except current BMI). We then fitted general linear models to compare levels of cardiometabolic outcomes between groups. All analyses were conducted with SAS 9.4 and considered an adjusted $P < 0.05$ for multiple comparisons to be significant. This study was deemed exempt from review by the University of Florida Institutional Review Board because we used deidentified, publicly available data.

Of 6,274 participants (mean age 49.8 years, 55.4% women, 64.9% White), 132 (2.1%) reported having bariatric surgery and 2,698 (43.0%) were eligible for bariatric surgery. Compared with normal-weight individuals, those receiving bariatric surgery were more likely to be older, female, White, and highly educated and to have higher family income. After the propensity score weighting, there were no significant differences in these characteristics.

Despite significantly lower BMI among individuals with normal weight (22.3 kg/m^2) relative to individuals receiving bariatric surgery (34.9 kg/m^2), SBP, DBP, HbA_{1c}, TC, and hs-CRP were not significantly different between groups (Table 1). Individuals who were eligible for bariatric surgery but did not have it had significantly higher levels of SBP, DBP, HbA_{1c}, and hs-CRP and lower HDL-C compared with normal-weight individuals. As sensitivity checks, we tested the robustness of the main findings by including individual characteristics as covariates and excluding individuals diagnosed with diabetes or heart diseases from the analytic sample. Results remained consistent across groups.

This population-based study included a weighted sample size of 3.6 million adults who reported receiving bariatric surgery. No statistically significant differences in numerous cardiometabolic risk factors were observed between normal-weight and bariatric surgery groups, despite those having received bariatric surgery having BMI values in the obesity range. Moreover, cardiometabolic risk factors in individuals reporting having

e-LETTERS – OBSERVATIONS

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Table 1—Propensity score–weighted comparisons of cardiometabolic measures, NHANES 2015–2018[a]

Outcomes	Normal weight	Had bariatric surgery	Eligible but did not have bariatric surgery
SBP (mmHg)	119.4 (116.9–121.8)	121.8 (117.0–126.6)	127.9 (126.0–129.8)
Difference	Ref.	2.42 (−2.54 to 7.39)	8.56 (4.99–12.13)
P value	—	0.315	<0.001
Adjusted *P* value[b]	—	0.344	0.002
DBP (mmHg)	69.2 (68.3–70.0)	69.3 (65.9–72.7)	71.9 (70.7–73.1)
Difference	Ref.	0.13 (−3.23 to 3.48)	2.72 (1.78–3.66)
P value	—	0.937	<0.001
Adjusted *P* value[b]	—	0.937	0.002
HbA_{1c} (%)	5.5 (5.4–5.6)	5.8 (5.5–6.2)	6.3 (6.1–6.4)
Difference	Ref.	0.37 (0.04–0.70)	0.80 (0.62–0.99)
P value	—	0.032	<0.001
Adjusted *P* value[b]	—	0.055	0.002
TC (mg/dL)	196.3 (189.7–202.8)	187.5 (174.4–200.6)	193.9 (187.0–199.0)
Difference	Ref.	−8.76 (−19.45 to 1.93)	−3.17 (−9.38 to 3.03)
P value	—	0.101	0.293
Adjusted *P* value[b]	—	0.135	0.344
HDL-C (mg/dL)	65.2 (62.9–67.5)	55.1 (48.1–62.1)	49.9 (48.1–51.6)
Difference	Ref.	−10.09 (−17.31 to −2.87)	−15.34 (−17.26 to −13.41)
P value	—	0.009	<0.001
Adjusted *P* value[b]	—	0.018	0.002
hs-CRP (mg/dL)	2.4 (1.8–2.9)	4.2 (2.5–5.8)	6.9 (5.9–7.9)
Difference	Ref.	1.81 (−0.02 to 3.63)	4.69 (3.18–6.20)
P value	—	0.052	<0.001
Adjusted *P* value[b]	—	0.078	0.002

Data are estimates (95% CI) unless otherwise indicated. Ref., reference. [a]Propensity score weighting adjusted for age, sex, race, education, employment, family income, health insurance type, general health status, current smoking, and the number of comorbidities. [b]Adjusted for multiple comparisons using the Benjamin-Hochberg method.

undergone bariatric surgery were significantly different versus individuals eligible but not having undergone surgery, suggesting that even in the absence of achieving a normal-weight BMI following bariatric surgery, the cardiometabolic risk factor profile appears to normalize substantially.

Study limitations included the cross-sectional design, small sample size for bariatric surgery, and self-reported measures. Although propensity weighting helps to account for potential confounders, lack of baseline information before or at the time of surgery made it difficult to have well-matched comparison groups (5). Long-term follow-up studies with larger samples will be necessary to confirm the effect of bariatric surgery on cardiometabolic health benefits and potential harms (3).

In summary, this population-based study adds to the growing body of evidence suggesting that bariatric surgery can meaningfully improve a number of cardiometabolic risk factors to a degree roughly equivalent to those factors in normal-weight individuals despite residual adiposity.

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