Long-Term Mortality and Bone Fractures up to 38 Years after Surgery in a Retrospective Cohort

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Conflict of Interest Disclosure

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Utah Obesity Study – earlier mortality results

Ted D. Adams

Design: Retrospective cohort study, 7925 RYGB patients, 1:1 matched with 7925 non-surgical participants from the Utah population using driver license data
Follow-up: Average 7.1 years
Results: All-cause mortality risk decreased by 40%; 56% lower for coronary artery disease; 92% lower for diabetes. However, *accidents and suicides increased by 58%!*

Adams et al. *NEJM* 357:753-761, 2007.

Design: Reanalysis of NEJM dataset, exploring the effect of age at surgery and mortality
Results: All-cause mortality and morbidity benefit extended from youngest to oldest age categories (18 to 74 years). The increase in accident and suicide mortality observed earlier was focused *exclusively in female RYGB patients younger than 35*.

Davidson et al. *JAMA Surg* 151:651-657, 2016.

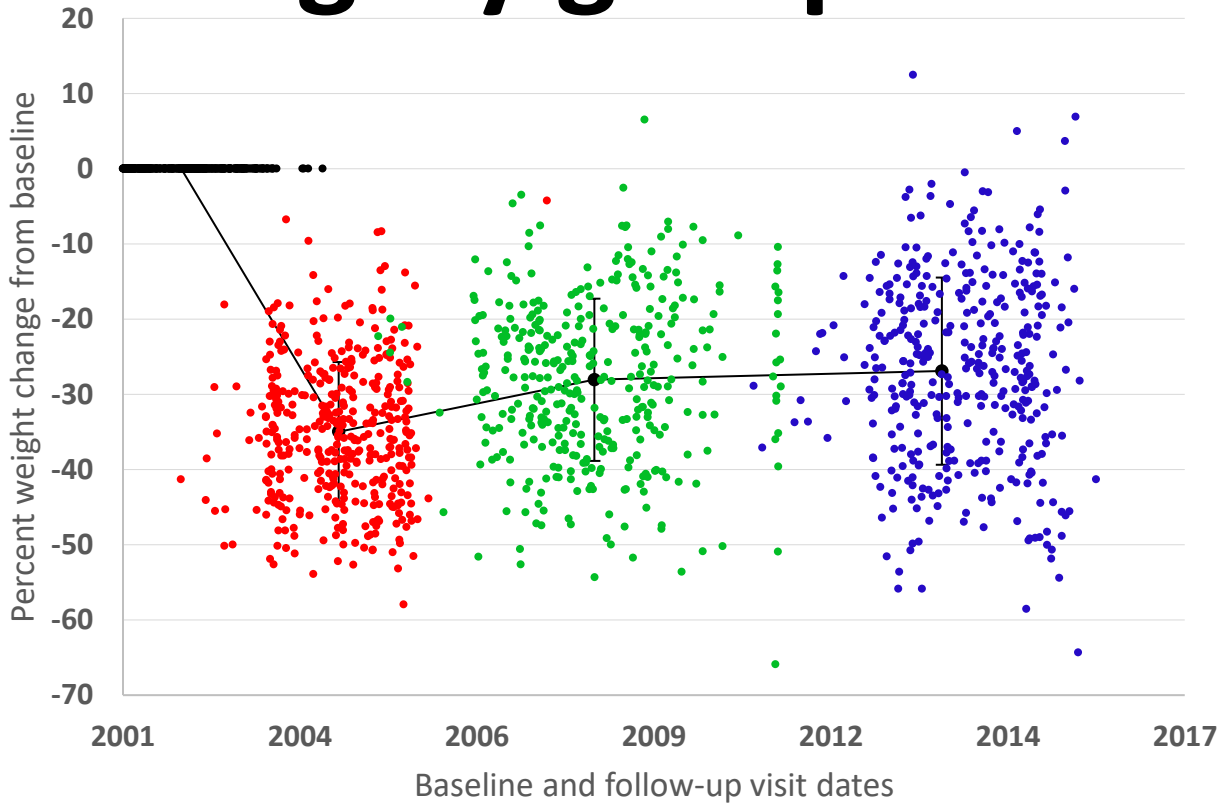
Prospective RYGB vs nonsurgery groups

1156 Participants followed 12 years

- 418 – Roux-en-Y gastric bypass patients
- 421 – Patients seeking surgery, but not having it
- 317 – Randomly selected from Utah population

Key findings:

- 12 years after surgery, average *weight is still 27% less* than before surgery
- Approximately *½ of patients with diabetes prior to surgery were still remitted* 12 years later
- Remission rates and incidence of *diabetes, hypertension, and dyslipidemia* were all still *significantly improved* compared to non-surgical controls after 12 years



	Baseline	2 Years	6 Years	12 Years
RYGB patients	• 418	• 409	• 379	• 387
Deaths	---	3	9	14
Total	418	412	388	401

96%

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Utah Obesity Study – Extended and Expanded

Primary Aim: Long-term mortality associated with metabolic-bariatric surgery procedures

Retrospective Study: 38-year follow-up (1982 through 2019); mean follow-up 10.3 years

Surgery patients: RYGB, SG, LAGB, and BPD/DS

Non-surgery patients: Utah driver license (DL) applicants

Matching: 1:1 on sex, BMI categories, age groups (5-year intervals), year of patient surgery with year DL renewed (±2 years)

Specific causes of death: all-cause, cardiovascular disease (ischemic heart, hypertensive, cerebrovascular, COPD), cancer, diabetes, chronic liver disease, Alzheimer's, external causes (all accidents and adverse effects, suicide)

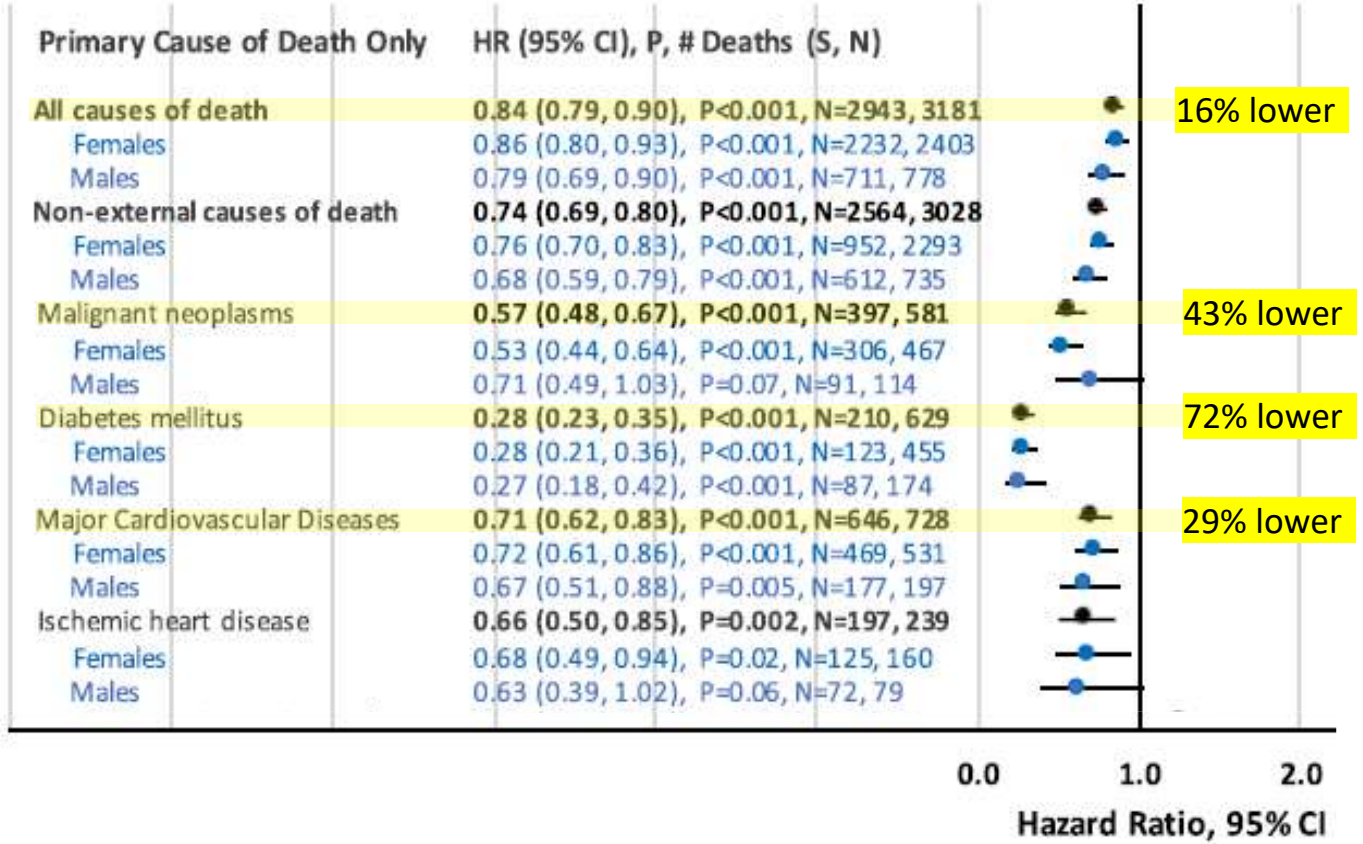
Adams, T. D. et al. *Obesity* 31: 574-585, 2023.

Utah Obesity Study – Participants

Characteristics	Non-surgery Group	Surgery Group
Total N	21,837	21,837
% Female	79.1	79.1
Roux-en-Y gastric bypass (RYGB)	-	15,110 (69.2%)
Gastric banding	-	2,629 (12.0%)
Sleeve gastrectomy	-	3,050 (14.0%)
Duodenal switch	-	1,048 (4.8%)
No surgery	21,837 (100%)	-

Adams, T. D. et al. *Obesity* 31: 574-585, 2023.

Utah Obesity Study – Non-external mortality



Key findings:

- ***Reduced*** all-cause specific mortality was durable for multiple decades, for multiple bariatric surgical procedures, for males and females, and for patients who were more than 34 years old at surgery.
- Compared to matched nonsurgical participants, patients who were 18-34 years old at surgery had a 40% ***higher*** all-cause mortality, and a 12% ***higher*** non-external cause mortality.

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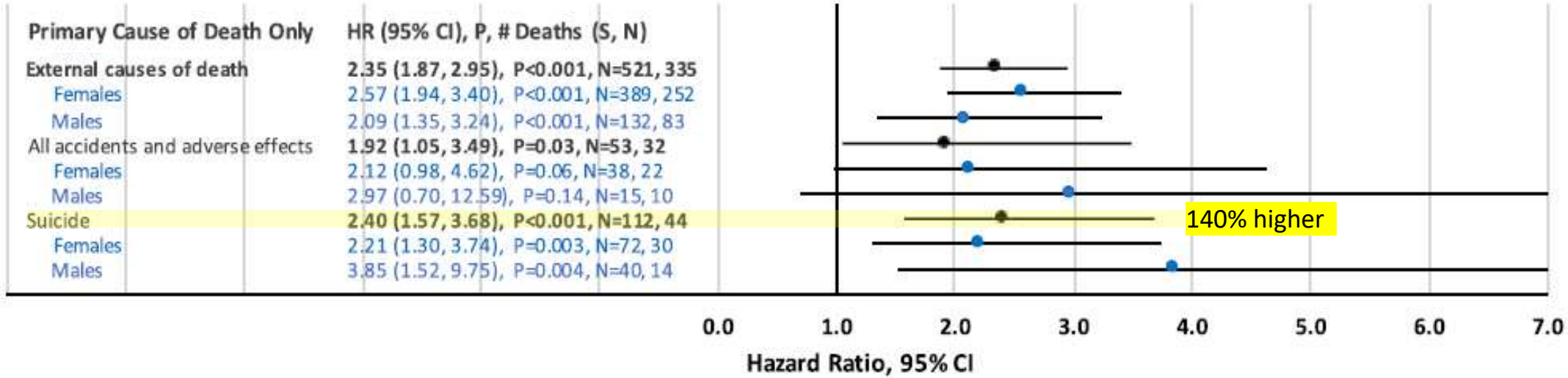
Utah Obesity Study – External mortality



Key findings:

- The rate of death from suicide was significantly ***higher*** in surgery vs non-surgery participants.
- This increase was observed only in the youngest age-at-surgery group.

Adams, T. D. et al. *Obesity* 31: 574-585, 2023.

Utah Obesity Study - Bone fractures

Methods

Design: retrospective cohort study

40,468 participants, 79% female

Bariatric surgery patients

- 14,555 RYGB
- 3,050 Sleeve gastrectomy
- 2,629 Gastric band (BAND)

Population (driver license) controls

- 20,234 matched 1:1 using age, sex, year of surgery, and presurgical BMI

Data Source: Electronic medical records from 1996-2020

Bone	Non-surgery	Surgery	HR (95% CI)	P-value
Humerus	203 (1.0%)	347 (1.6%)*	1.66 (1.34-2.06)	<0.001
Forearm	241 (1.1%)	678 (3.2%)*	2.80 (2.33-3.36)	<0.001
Femur	221 (1.0%)	423 (2.0%)*	2.00 (1.63-2.45)	<0.001
Tibia	280 (1.3%)	394 (1.9%)*	1.38 (1.15-1.65)	<0.001
Fibula	115 (0.5%)	151 (0.7%)*	1.20 (0.90-1.61)	NS
Ankle	269 (1.3%)	312 (1.5%)	1.03 (0.85-1.25)	NS

Key findings:

- Long-term bone fracture risk is 78% greater following gastric bypass (RYGB) surgery, but is NOT greater after gastric band or sleeve gastrectomy.
- Outcomes were similar between males and females and across age groups (<35, 35-50, and 50+ years).

Davidson, L. E. et al. Manuscript in preparation.

Utah Obesity Study – Fracture non-unions

- More fracture non-unions occurred after bariatric surgery in our study, but only because there were more fractures.
- We conducted two analyses to determine risk of fracture nonunion:
  1. Matching design on pairs who both had fractures
  2. Cohort design limited to all individuals with 1+ fracture
- In both analyses, *surgery was **not** associated with greater risk for non-union*

Davidson, L. E. et al. Manuscript in preparation.

Utah Obesity Study conclusions

- A reduction in all-cause mortality is an established benefit of MBS
- Benefits are particularly strong in major causes of death with metabolic etiology: diabetes, cancers, and cardiovascular diseases
- Obesity-related chronic diseases are profoundly effected by MBS such that they are still in remission or greatly improved for over a decade
- Mortality rates from external causes such as accidents and suicide may increase after MBS, particularly in younger adults
- Long-term bone fracture rates increase after RYGB
- Weigh long-term risks and benefits according to needs of specific patients seeking surgery