BNORC: Contribution over 25 years to evidence on obesity and cancer

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Boston July 10, 2017

Washington University in St. Louis
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The New York Times

Dr. George Blackburn, Who Worked to Help You Eat Better, Dies at 81

By **SAM ROBERTS** MARCH 7, 2017

Dr. George Blackburn was a leader in the study of nutrition and obesity and helped develop gastric bypass surgery. Beth Israel Deaconess Medical Center

Dr. George Blackburn, a surgeon, clinician, researcher, teacher and author who was considered pre-eminent in the study of obesity and nutrition, died on Feb. 20 at his home in Boston. He was 81.

The cause was malignant melanoma, said his wife, Susan Kelly.

In-depth reference and news articles about Melanoma.

Over his career, largely spent at Harvard Medical School and at Beth Israel Deaconess Medical Center in Boston, Dr. Blackburn correlated poor nutrition with obesity, advocated lower-fat diets and helped develop gastric bypass surgery and nutritional liquid diets.

He joined Dr. Bruce Bistrian and other colleagues in providing the foundation for what became the field of nutrition medicine.

https://tinyurl.com/ybmnqorq

Gastrointestinal Surgery for Severe Obesity

Consensus Development Conference Panel*

■ Surgeons, gastroenterologists, endocrinologists, psychiatrists, nutritionists, and other health care professionals, as well as members of the public convened to address nonsurgical treatments for severe obesity, surgical treatments for severe obesity, and criteria for selection, the efficacy, and risks of surgical treatments for severe obesity, and the need for future research on and epidemiologic evaluation of these therapies.

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height^2 [meters]).
with a BMI betwe
million Americans
m^2, and another 1
For an average ad
equivalent to bein
the highest risk

gastric restrictive or bypass procedures could be considered for well-informed and motivated patients in whom the operative risks were acceptable; that patients who are candidates for surgical procedures should be selected carefully after evaluation by a multidisciplinary team with medical, surgical, psychiatric, and nutritional expertise; that surgery be done by a surgeon who has substantial experience in the particular procedure and who works in a clinical setting with adequate support for all aspects of management and assessment; and that patients undergo lifelong medical surveillance after surgery.

Annals of Internal Medicine. 1991;115:956-961.

Economic costs of diabetes: JAMA 1989

The Economic Costs of Non–Insulin-Dependent Diabetes Mellitus

Daniel M. Huse, MA; Gerry Oster, PhD; Alice R. Killen, MBBS, MPH; Michael J. Lacey; Graham A. Colditz, MBBS, DrPH

Persons with diabetes experience elevated risks of a variety of other illnesses—including circulatory, visual, neurological, renal, and skin disorders—relative to their nondiabetic peers. Previous estimates of the economic burden of diabetes, however, have not taken full account of this related morbidity and mortality and have therefore understated the cost to the nation due to this disease. Accordingly, we estimated the economic costs of type II, or non–insulin-dependent, diabetes mellitus, reflecting its contribution to the total burden of disease in the United States. In 1986, non–insulin-dependent diabetes mellitus was responsible for $11.6 billion in health care expenditures, including $6.8 billion for diabetic care and $4.8 billion attributable to an excess prevalence of related (principally cardiovascular) conditions. The human toll of non–insulin-dependent diabetes mellitus included 144 000 deaths—about 6.8% of total US mortality—and the total disability of 951 000 persons. The total economic burden of non–insulin-dependent diabetes mellitus in 1986, including health care expenditures and productivity forgone due to disability and premature mortality, was $19.8 billion.

(*JAMA*. 1989;262:2708-2713)

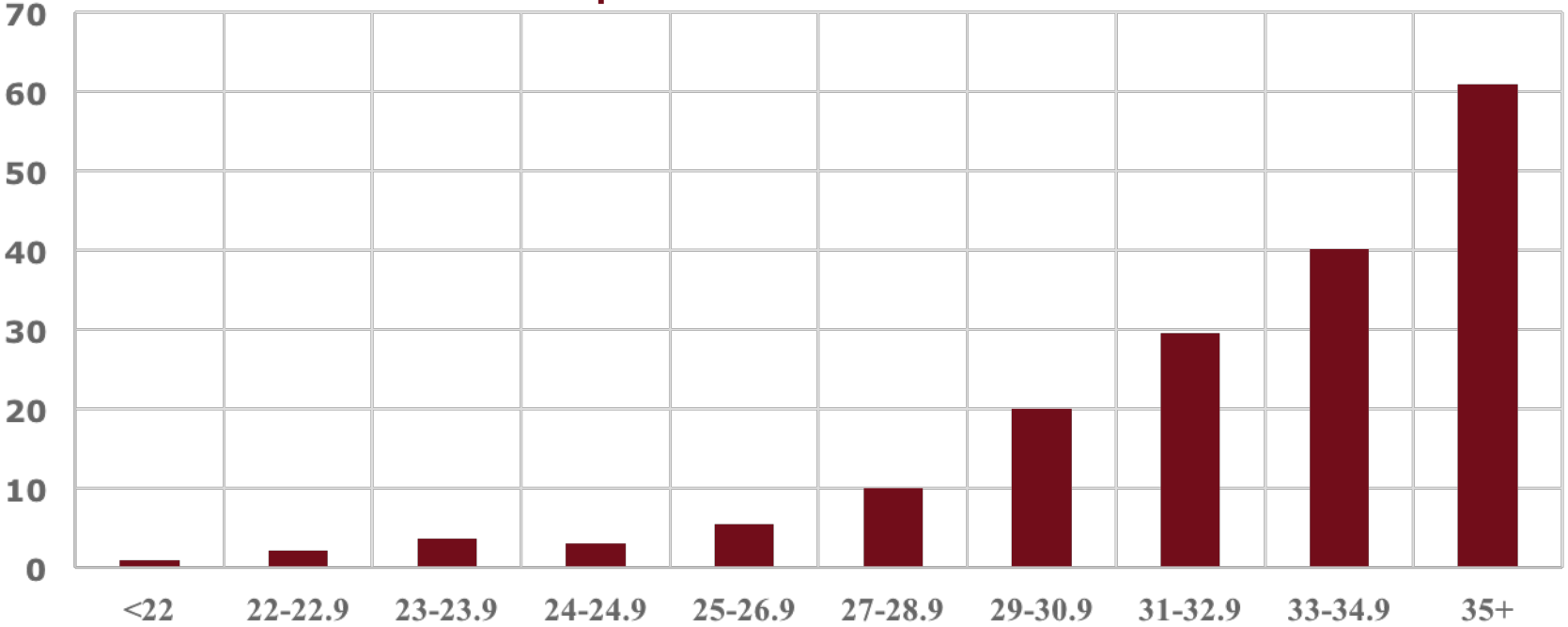
NIDDM to comprise health care expenditures and the value of productivity forgone due to disability and premature death. We used a two-step procedure to estimate costs directly attributable to NIDDM as well as those resulting from the excess prevalence of related disorders experienced by diabetics.

Step 1.—Using conventional prevalence-based cost-of-illness techniques,[7,8] we estimated the economic burden of all diabetes mellitus and related disease conditions. For each condition, we estimated total health care expenditures, number of persons completely disabled, numbers of deaths, and the value of productivity losses due to disability and death.

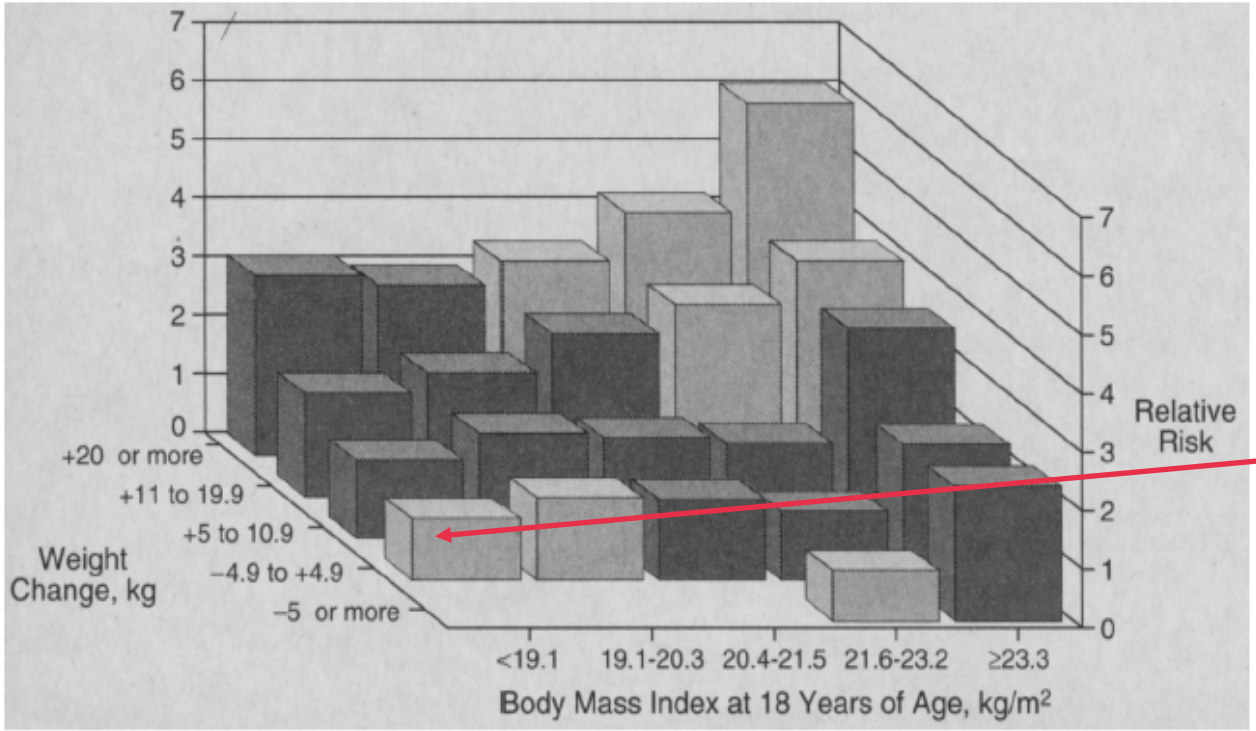
JAMA 1989

BMI and Relative Risk of incident diabetes over 8 years, NHS

Colditz et al Am J Epidemiol 1990



RR for CHD by BMI at age 18 and weight gain in the normal Weight range from 18 to 1976, Nurses' Health Study

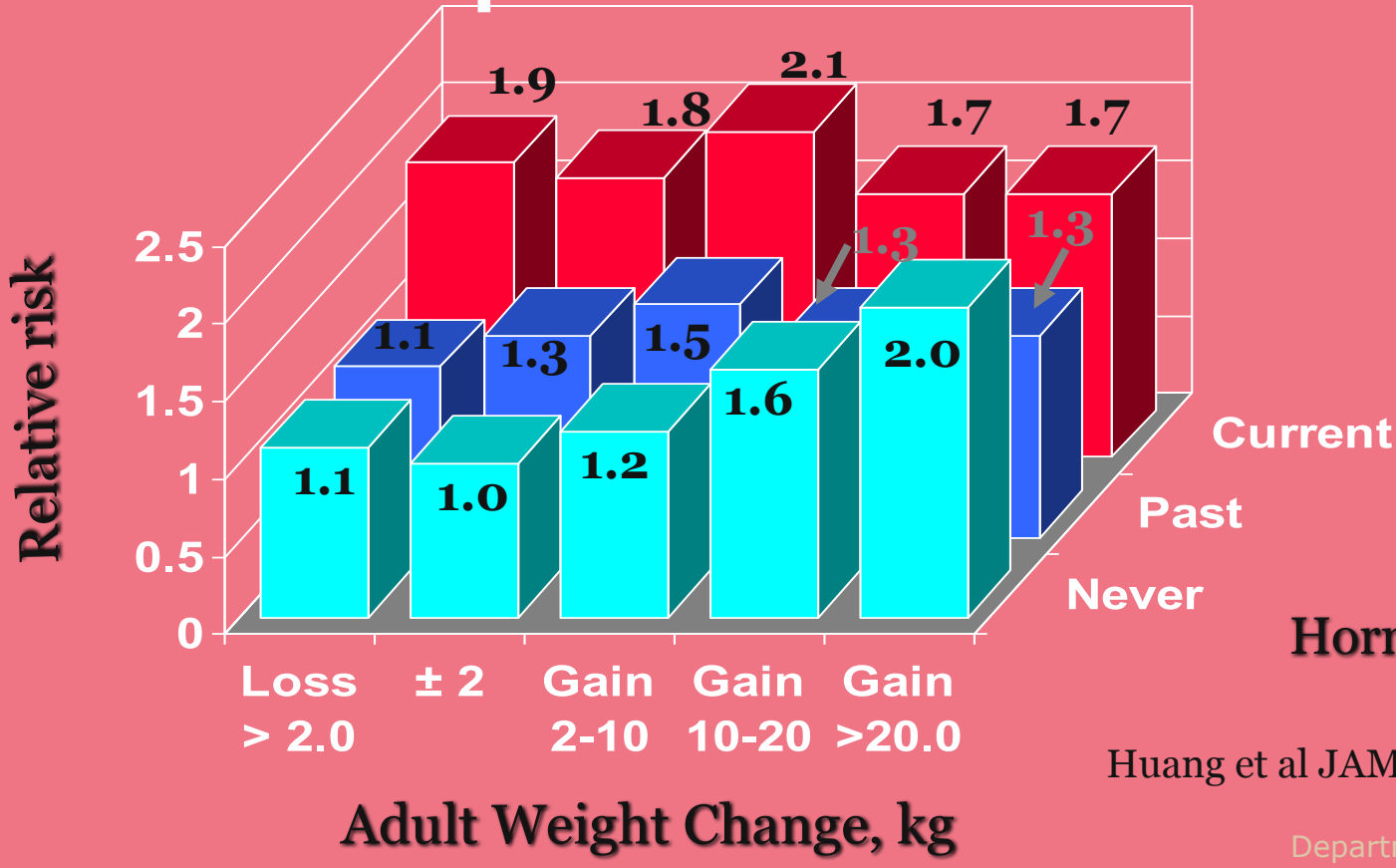


Reference group

Willett et al
JAMA 1995

Relative risk of coronary heart disease by level of body mass index (BMI) (defined as weight in kilograms divided by the square of height in meters) at 18 years of age and weight gain between 18 years of age and

Weight Change, Hormone Use and Postmenopausal Breast Cancer



Huang et al JAMA 1997

Department of Surgery
Division of Public Health Sciences

1980

Nutrition and Your Health

Dietary Guidelines for Americans

1. Eat a Variety of Foods page 4
2. Maintain Ideal Weight page 7
3. Avoid Too Much Fat, Saturated Fat, and Cholesterol page 11
4. Eat Foods with Adequate Starch and Fiber page 13
5. Avoid Too Much Sugar page 15
6. Avoid Too Much Sodium page 17
7. If You Drink Alcohol, Do So in Moderation page 19

U.S. Department of Agriculture
U.S. Department of Health and Human Services

1985

Nutrition and Your Health

Dietary Guidelines for Americans

1. Eat a Variety of Foods page 6
2. Maintain Desirable Weight page 9
3. Avoid Too Much Fat, Saturated Fat, and Cholesterol page 15
4. Eat Foods with Adequate Starch and Fiber page 17
5. Avoid Too Much Sugar page 19
6. Avoid Too Much Sodium page 21
7. If You Drink Alcoholic Beverages, Do So in Moderation page 23

Second Edition, 1985
U.S. Department of Agriculture
U.S. Department of Health and Human Services

1990

Nutrition and Your Health

Dietary Guidelines for Americans

1. Eat a variety of foods page 5
2. Maintain healthy weight page 8
3. Choose a diet low in fat, saturated fat, and cholesterol page 13
4. Choose a diet with plenty of vegetables, fruits, and grain products page 18
5. Use sugars only in moderation page 21
6. Use salt and sodium only in moderation page 23
7. If you drink alcoholic beverages, do so in moderation page 25

Third Edition, 1990
U.S. Department of Agriculture
U.S. Department of Health and Human Services

US Dietary guidelines

1985: “maintain a desirable weight”

- How do you determine what a desirable weight is for you?
- “There is no absolute answer.”

1990: Maintain a healthy weight.

- “There is no exact answer now”
- Suggested weight higher for those over 35 vs those 19-34

1995 USDA dietary guidelines

- Boston Obesity Nutrition Research Center - working group in analyses of obesity and weight gain
- Reported data on weight gain and disease from NHS and HPFS
- Published data formed a resource for committee

Barriers to change

More of US would be defined as overweight

- No effective treatment programs

Guideline

Balance the food you eat with physical activity. Maintain or improve your weight.

- note change in emphasis
- emphasis away from definition of obesity as some unique cut point

Supporting text

"Many Americans are overweight and gain weight as they grow older. Both overweight and adult weight gain are linked to high BP, heart disease, stroke, diabetes, certain types of cancer, arthritis, breathing problems and other illnesses. Therefore, most adults should not gain weight."

Changes in guideline

Less emphasis on weight loss

- More emphasis on weight maintenance

Weight control the essential first step toward a reduction in prevalence of obesity in the population

- Goal of weight maintenance differs from goal of achieving a healthy weight

Changes in guideline

- Weight maintenance at any level is higher priority than maintenance of healthy weight
- Use of BMI cutoff is based on pathologic sequalae, no longer arbitrary
- Cutoff varies depending on use of morbidity or mortality

Cutoff

- Mortality increases significantly above BMI 25 kg/m^2
- Morbidity, e.g., diabetes, increase well below this BMI
- If BMI 25 is used, over half of US is overweight
- Suggest BMI 25 upper bound of healthy weight

What is the supporting evidence?

Consider

- NIDDM
- CHD
- benign prostatic hypertrophy
- postmenopausal breast cancer
- total mortality

Weight Gain and Diabetes

Review evidence from Nurses' Health Study.

Evidence from Health Professionals Follow-up Study show parallel results.

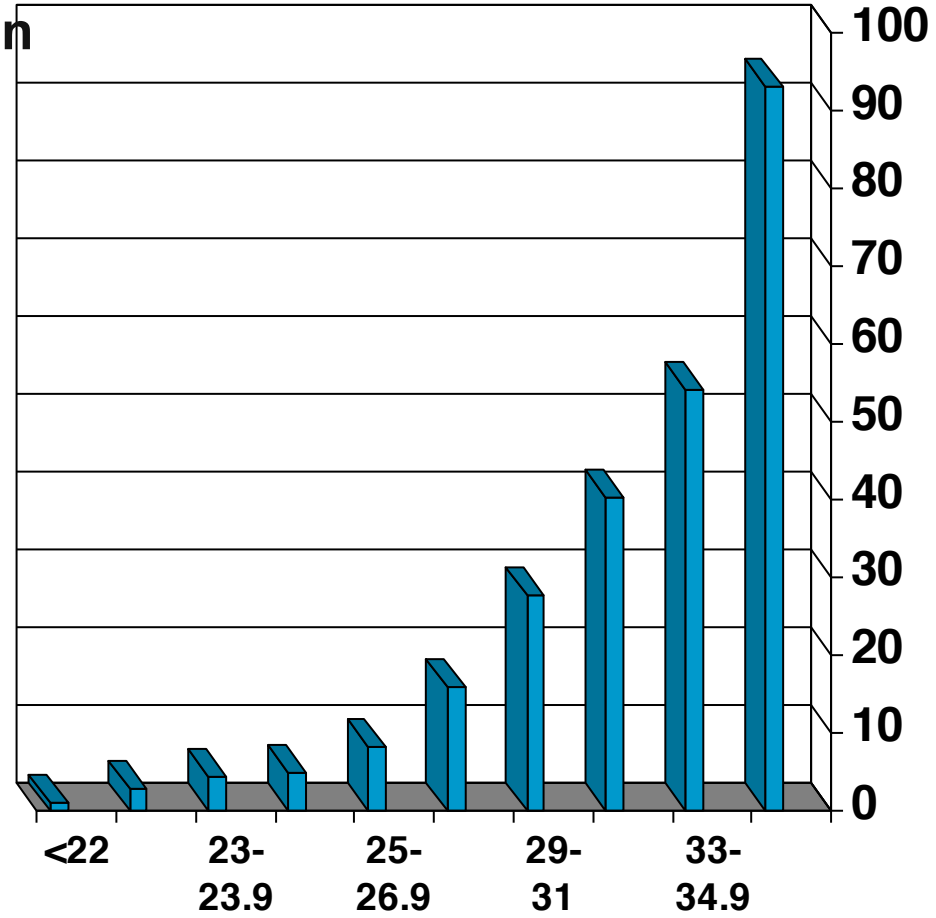
Nurses' Health Study

- 114,281 women free from NIDDM, CHD, stroke and cancer in 1976, followed through 1992
- follow-up questionnaires mailed every 2 years have over 90% response rate
- 2204 cases confirmed

Incident NIDDM

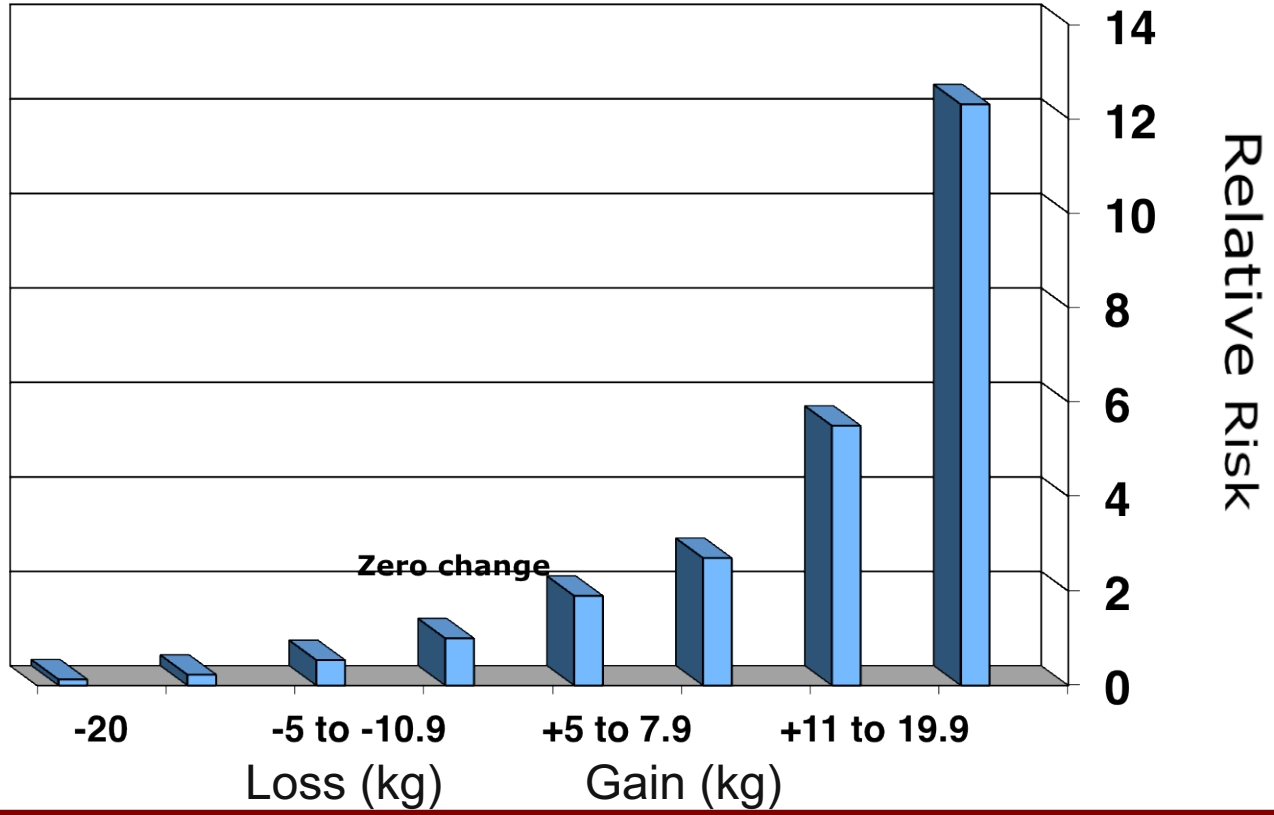
- Following self-reported diagnosis we send a validated questionnaire to women
- additional details of symptoms at diagnosis and blood sugar levels
- classify cases according to criteria of National Diabetes Data Group - except we do not use weight as criterion

BMI and risk of NIDDM in women



Colditz et al An Intern Med 1990

Weight change from age 18 to 1976 and risk of diabetes during 14 years follow-up



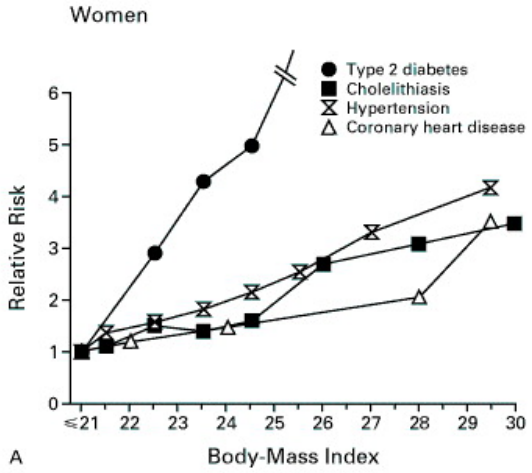
Incident disease

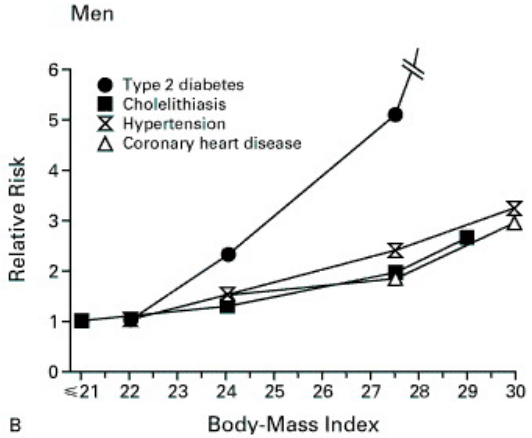
NHS, women who were not obese.

Health Professionals, men who are not obese.

Within normal and overweight range steady increase in risk with increasing BMI

Willett, Colditz Dietz,
NEJM 1999





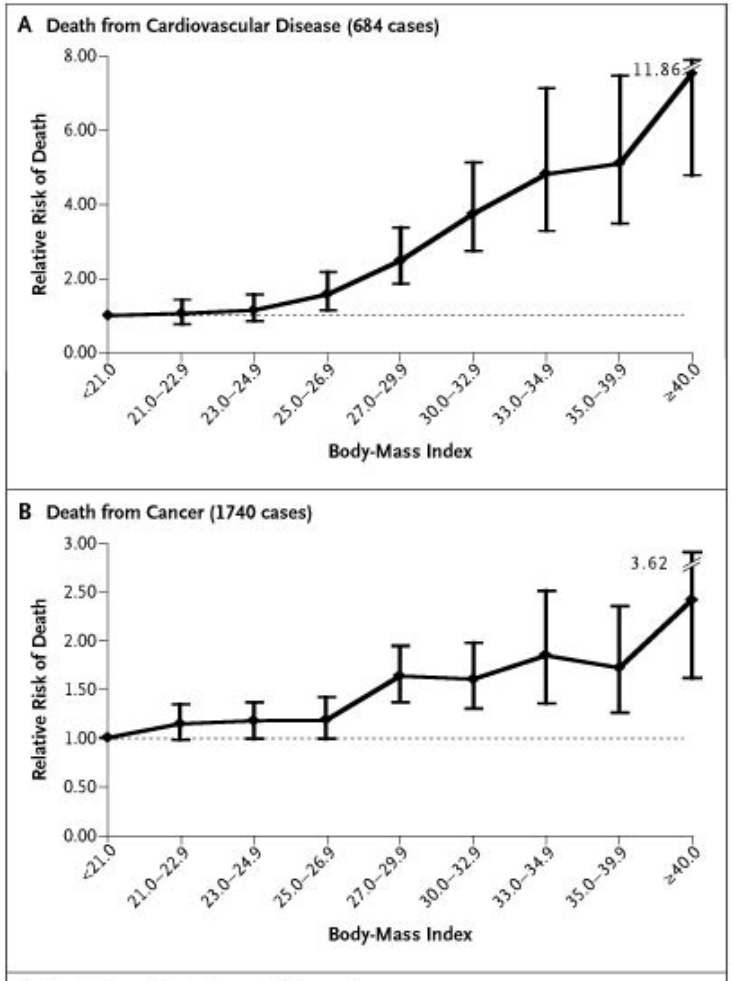
Mortality increases with BMI

NHS followed for mortality

Evaluate risk among non smokers to avoid confounding

Steady increase in mortality with BMI

Hu et al NEJM 2004



Shift from Quetelet's index to BMI and standard cut points

TABLE 1

Relative risks for breast cancer by quintiles of Quetelet's index according to menopausal status among 103,688 US female registered nurses initially surveyed in 1976 and followed for up to four years

		Quetelet's index quintile*					
		1	2	3	4	5	
	Mean weight (kg)	52.7	57.2	60.7	66.3	80.4	χ, Mantel extension test for trend (p value)
	Mean height (cm)	164	164	164	164	163	
Menopausal status							
Premenopausal	Cases	79	63	78	68	58	−2.82
	Total	15,631	12,653	14,914	14,091	13,727	(0.005)
	RR†	1.00	0.90	0.90	0.73	0.66	

Willett et al AJE 1985

BMI cut points, 1990 AJE

Body mass index (kg/m^2)
<22
22–22.9
23–23.9
24–24.9
25–26.9
27–28.9
29–30.9
31–32.9
33–34.9
≥35

OBESITY AND CANCER

IARC 2002 and Calle 2003

- Review of evidence on weight obesity and physical activity in relation to cancer
- Calle: ACS cohort published after the IARC review panel

IARC 2002

"Sufficient evidence in humans for cancer-preventive effect of avoidance of weight gain for cancers of the colon, esophagus (adenocarcinoma), kidney (renal cell), breast (postmenopausal), and corpus uteri"

Translate: Obesity causes cancer

IACR Handbooks of Cancer Prevention Vol 6, 2002

Review of Evidence, IARC 2002

Obesity

Level of Evidence	Risk Increase Associated with Obesity			
	Small (RR 1.09-1.34)	Moderate (RR 1.35 - 1.99)	Large (RR 2.0 - 4.9)	Very Large (RR 5.0+)
Convincing		Colon	Breast Uterus Kidney	Esophagus
Probable				

Calle et al 2003

The NEW ENGLAND JOURNAL of MEDICINE

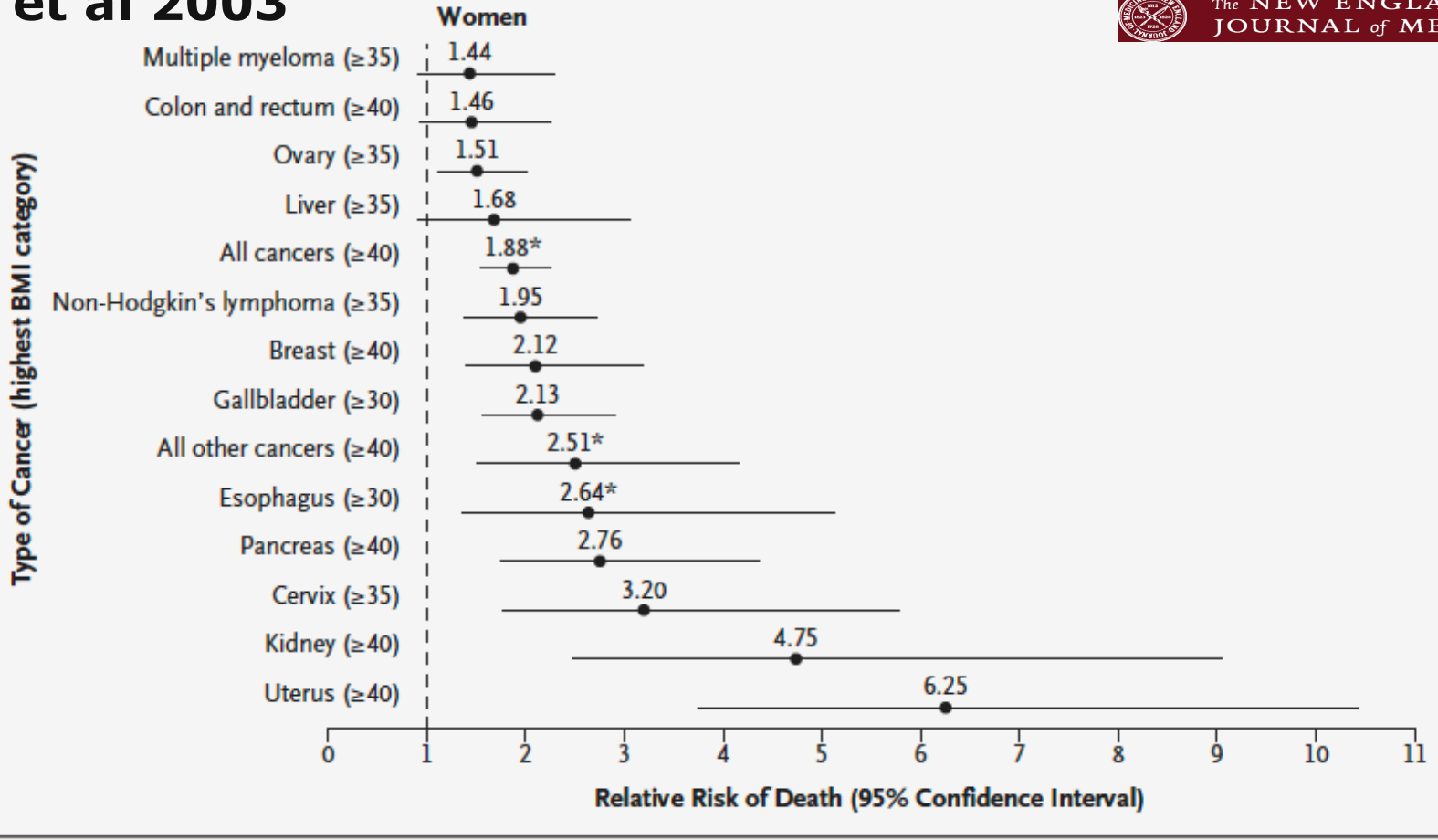


Figure 2. Summary of Mortality from Cancer According to Body-Mass Index for U.S. Women in the Cancer Prevention Study II, 1982 through 1998.

The NEW ENGLAND JOURNAL of MEDICINE

SPECIAL REPORT

Body Fatness and Cancer — Viewpoint of the IARC Working Group

Workgroup reviewed measures of adiposity; animal models; mechanisms; and epidemiologic evidence.
Concluded lack of body fatness lowers risk,
or obesity causes cancer.

NEJM August 25, 2016

Table 2. Strength of the Evidence for a Cancer-Preventive Effect of the Absence of Excess Body Fatness, According to Cancer Site or Type.*

Cancer Site or Type	Strength of the Evidence in Humans†	Relative Risk of the Highest BMI Category Evaluated versus Normal BMI (95% CI)‡
Esophagus: adenocarcinoma	Sufficient	4.8 (3.0–7.7)
Gastric cardia	Sufficient	1.8 (1.3–2.5)
Colon and rectum	Sufficient	1.3 (1.3–1.4)
Liver	Sufficient	1.8 (1.6–2.1)
Gallbladder	Sufficient	1.3 (1.2–1.4)
Pancreas	Sufficient	1.5 (1.2–1.8)
Breast: postmenopausal	Sufficient	1.1 (1.1–1.2)§
Corpus uteri	Sufficient	7.1 (6.3–8.1)
Ovary	Sufficient	1.1 (1.1–1.2)
Kidney: renal-cell	Sufficient	1.8 (1.7–1.9)
Meningioma	Sufficient	1.5 (1.3–1.8)
Thyroid	Sufficient	1.1 (1.0–1.1)§
Multiple myeloma	Sufficient	1.5 (1.2–2.0)
Male breast cancer	Limited	NA
Fatal prostate cancer	Limited	NA
Diffuse large B-cell lymphoma	Limited	NA
Esophagus: squamous-cell carcinoma	Inadequate	NA
Gastric noncardia	Inadequate	NA
Extrahepatic biliary tract	Inadequate	NA
Lung	Inadequate	NA
Skin: cutaneous melanoma	Inadequate	NA
Testis	Inadequate	NA
Urinary bladder	Inadequate	NA
Brain or spinal cord: glioma	Inadequate	NA

* BMI denotes body-mass index, CI confidence interval, and NA not applicable.
† Sufficient evidence indicates that the International Agency for Research on Cancer Handbook Working Group considers that a preventive relationship has been established between the intervention (in this case, the absence of excess body fatness) and the risk of cancer in humans — that is, a preventive association has been observed in studies in which

Evidence evolving

From only a couple of prospective cohorts in 2002, adding ACS mortality in 2003

- Now evidence from 30 to 50 or more prospective cohorts
- Pooled analysis of individual participant data from studies addressing BMI and less common cancers

Why prospective studies and pooled data

- Measure adiposity and risk of subsequent cancer
- Avoid weight change due to disease

Individual participant data – pooled analysis

IPD meta-analyses can improve the quality of data and the type of analyses that can be done and produce more reliable results (Stewart and Tierney 2002). For this reason they are considered to be a 'gold standard' of systematic review.

In fact, IPD meta-analyses have produced definitive answers to clinical questions, which might not have been obtained from summary data.

Cochrane Handbook Ch 18 and IPD methods

GI

- Gastric cardia
- Liver
- Pancreas
- Gall bladder

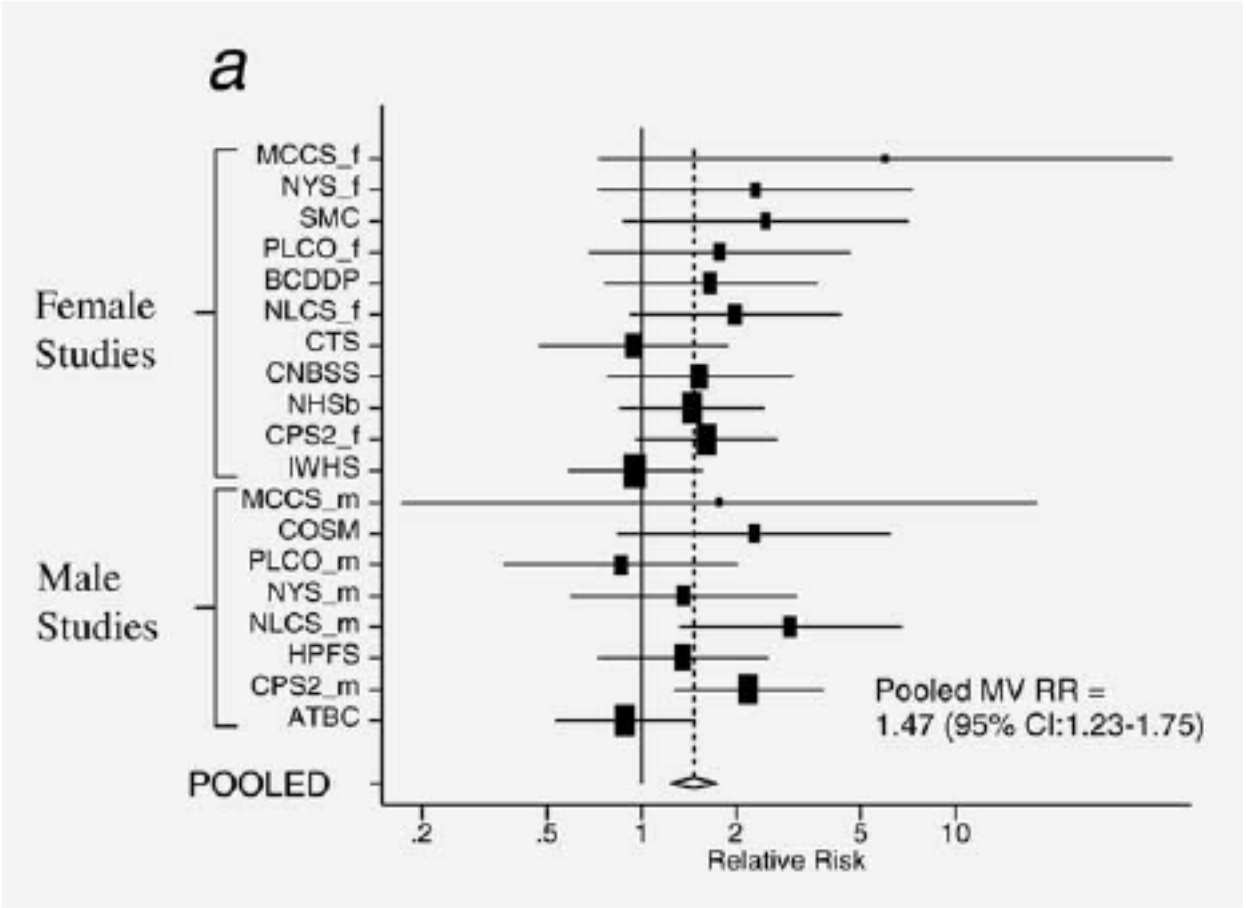
Pancreas

More than 20 prospective studies and case-control studies indicating a positive dose-response relation. Observed in the large majority of studies and in both genders. Compared to normal weigh, the RR for overweight was 1.18 (1.03-1.36) and for obesity 1.47 (1.23-1.75), estimated from pooled analysis of 14 cohorts [Genkinger 2011].

Baseline BMI

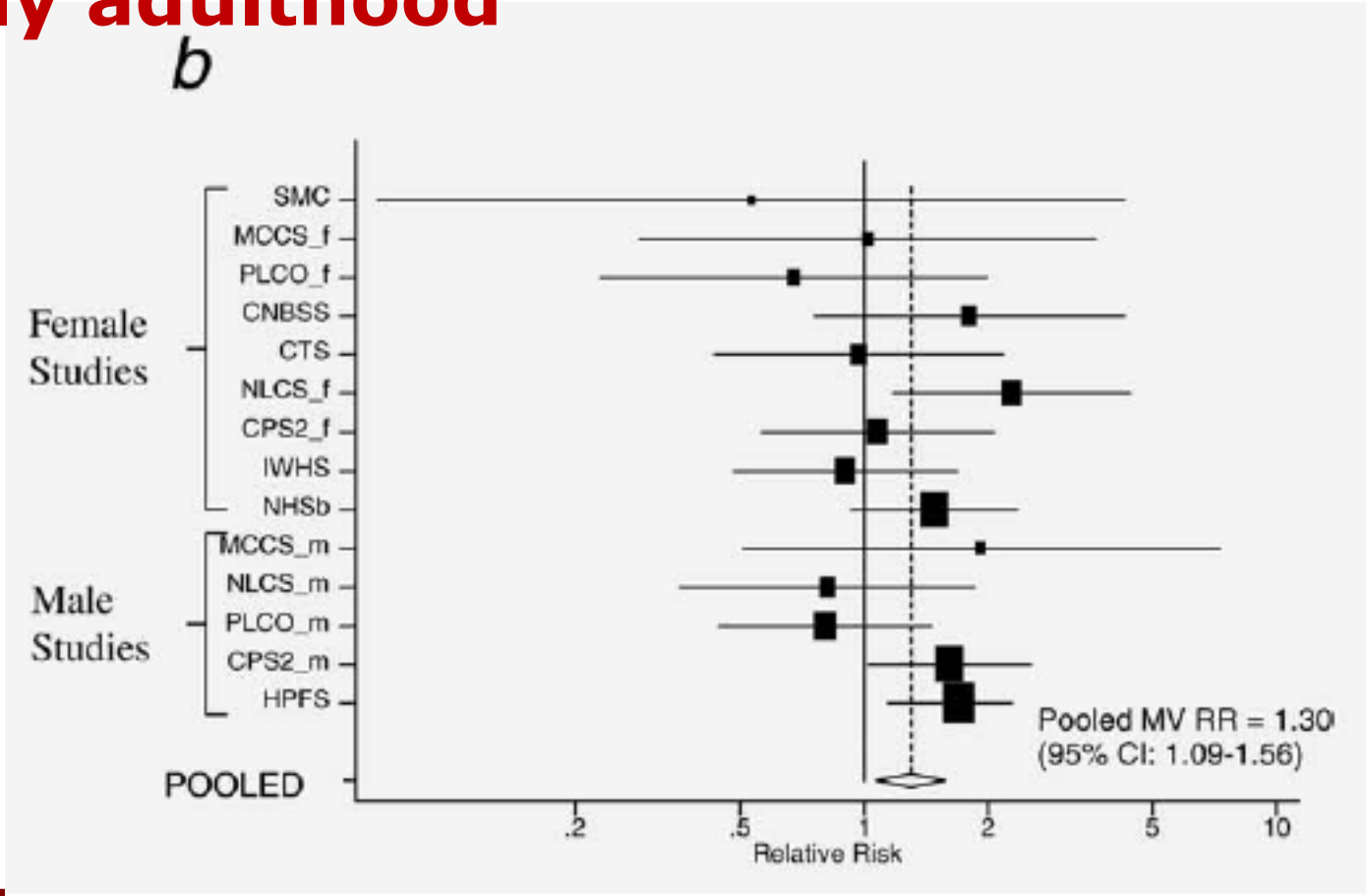
2135 cases
During 846,340 py

Forest plot of RR for BMI >30 vs 21-22.9

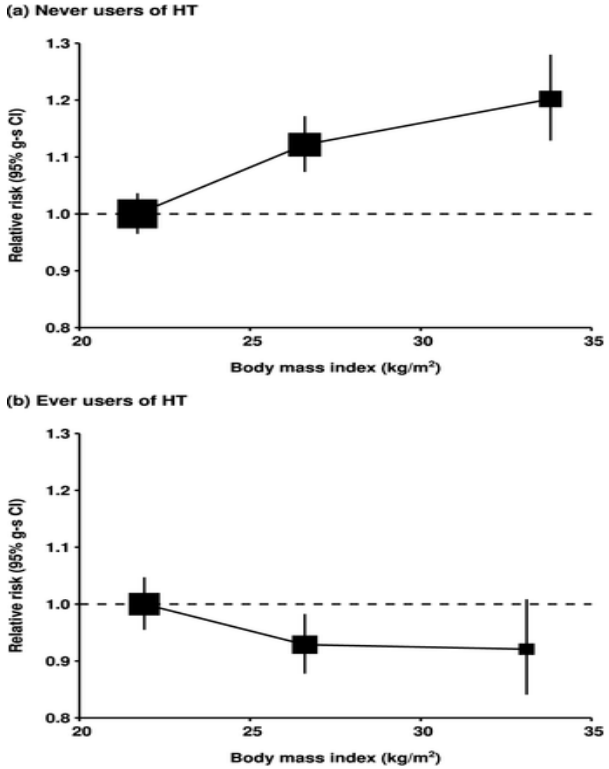


Genkinhger et al 2011

BMI in early adulthood



Relative risk of ovarian cancer by BMI and HT use



Never use HT

Ever use

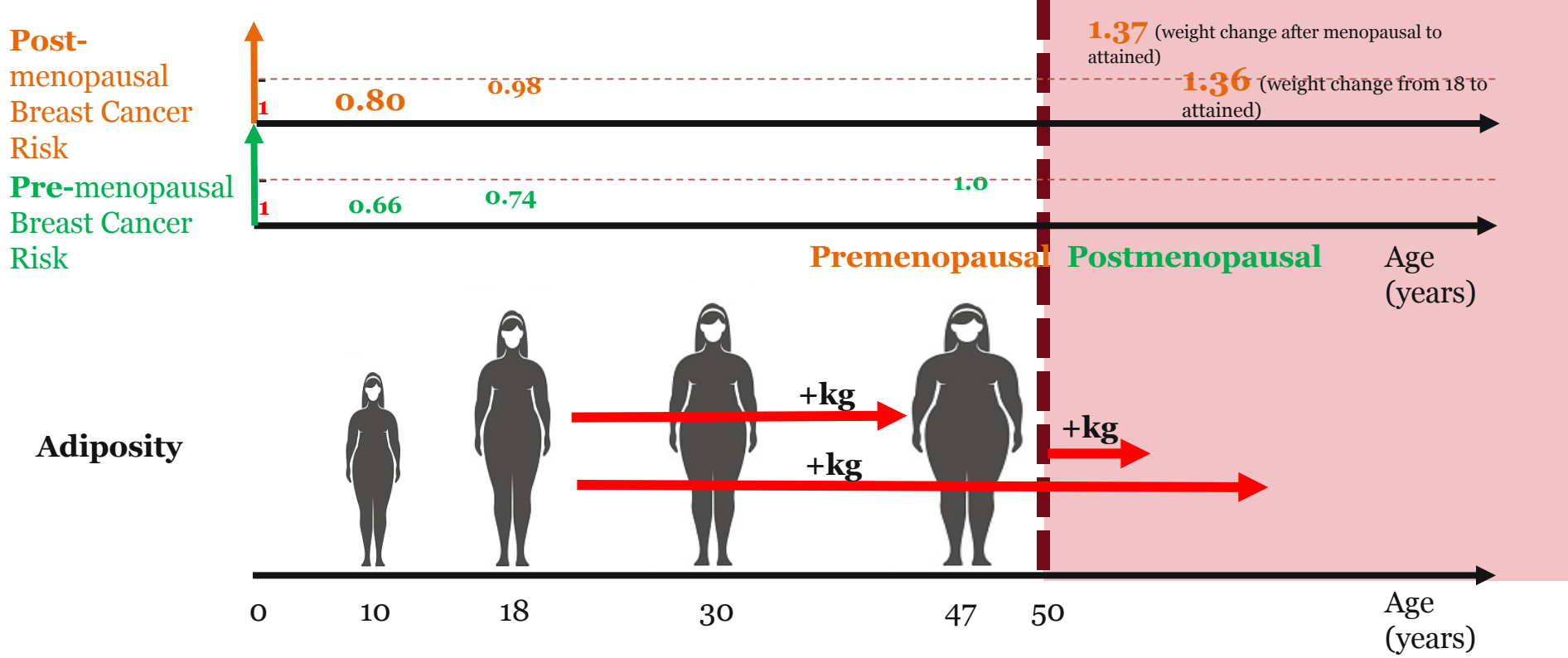
Collaborative Group on Epidemiological Studies of Ovarian Cancer (2012) Ovarian Cancer and Body Size: Individual Participant Meta-Analysis Including 25,157 Women with Ovarian Cancer from 47 Epidemiological Studies. PLoS Med 9(4): e1001200. doi:10.1371/journal.pmed.1001200 http://journals.plos.org/plosmedicine/article?id=info:doi/10.1371/journal.pmed.1001200

Evidence, 2016 Risk Increase Associated with Obesity

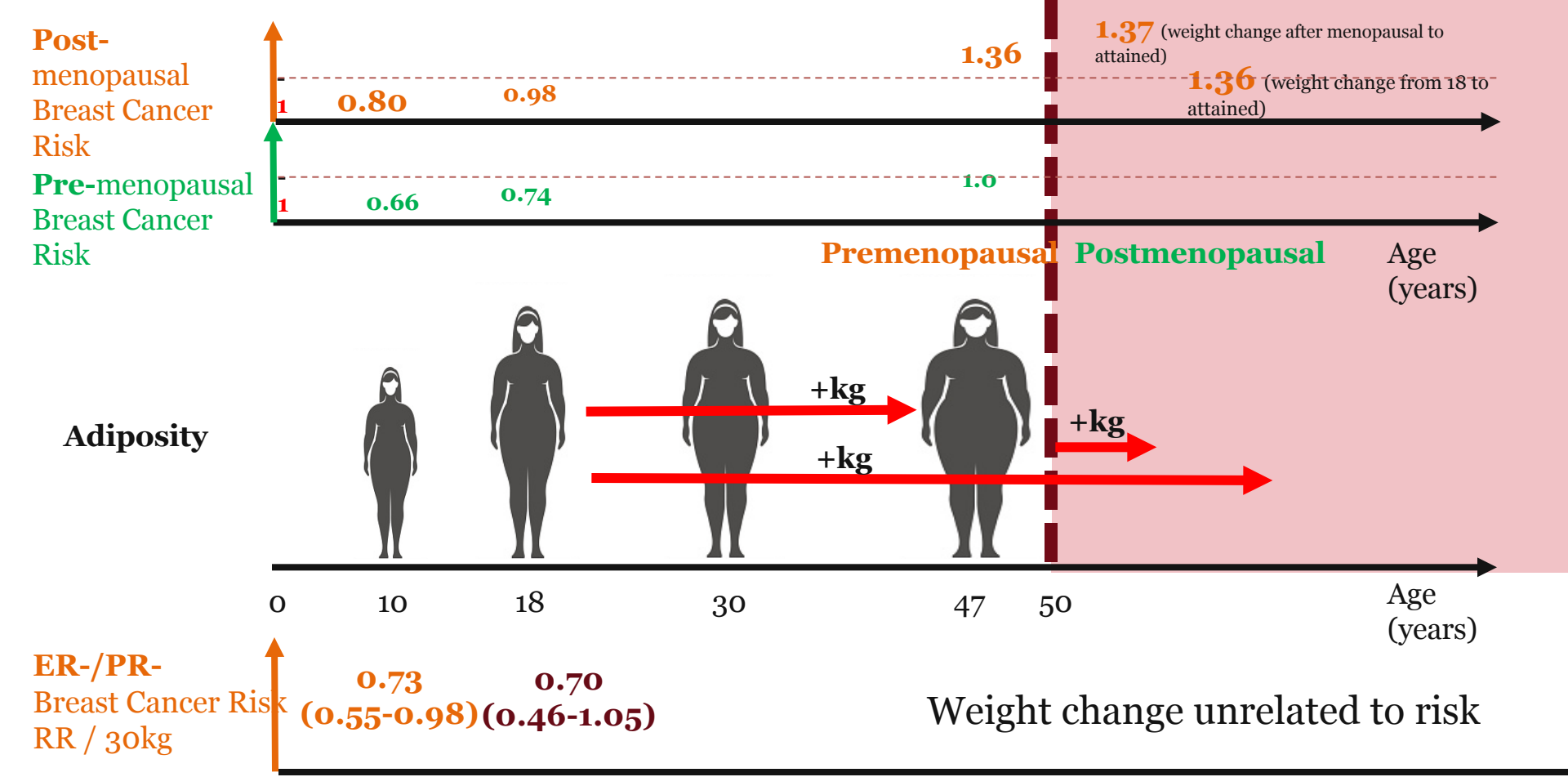
Level of Evidence	Small (RR 1.09-1.34)	Moderate (RR 1.35 - 1.99)	Large (RR 2.0 - 4.9)	Very Large (RR 5.0+)
Convincing				
	Ovary Thyroid	Colon Gastric cardia Liver Gall bladder Pancreas Meningioma Multiple myeloma	Breast Kidney	Esophagus Uterus
Probable				
		Male breast Fatal prost. Diffuse Large B-cell lymphoma		

Childhood and early adult adiposity

- Often consistent with adult adiposity and risk
- Analysis not always clear
  - Methods, correlated variables, and interpretation
- Challenges in breast cancer
  - Inverse relation with adiposity at ages 5, 10, before menarche
  - Weight gain increases risk
  - How does childhood adiposity reduce risk for life?



Reference: Rosner, B., Eliassen, A. H., Toriola, A. T., Chen, W. Y., Hankinson, S. E., Willett, W. C., ... & Colditz, G. A. (2017). Weight and weight changes in early adulthood and later breast cancer risk. *International journal of cancer*, *140*(9), 2003-2014.



Reference: Rosner, B., Eliassen, A. H., Toriola, A. T., Chen, W. Y., Hankinson, S. E., Willett, W. C., ... & Colditz, G. A. (2017). Weight and weight changes in early adulthood and later breast cancer risk. *International journal of cancer*, *140*(9), 2003-2014.

Other consistent relations TNBC

- Short term weight gain increases risk (Rosner et al 2015)
- Premenopausal short term weight gain increased risk of ER+/PR- and ER-/PR- but not ER+PR+ breast cancer
- Postmenopausal weight gain related to ER+PR+ (Rosner et al 2017)

Returning to Bariatric Surgery

Original Investigation

The Effectiveness and Risks of Bariatric Surgery

An Updated Systematic Review and Meta-analysis, 2003-2012

Su-Hsin Chang, PhD; Carolyn R. T. Stoll, MPH, MSW; Jihyun Song, PhD; J. Esteban Varela, MD, MPH; Christopher J. Eagon, MD; Graham A. Colditz, MD, DrPH

IMPORTANCE The prevalence of obesity and outcomes of bariatric surgery are well established. However, analyses of the surgery impact have not been updated and comprehensively investigated since 2003.

OBJECTIVE To examine the effectiveness and risks of bariatric surgery using up-to-date, comprehensive data and appropriate meta-analytic techniques.

DATA SOURCES Literature searches of Medline, Embase, Scopus, Current Contents, Cochrane Library, and Clinicaltrials.gov between 2003 and 2012 were performed.

STUDY SELECTION Exclusion criteria included publication of abstracts only, case reports, letters, comments, or reviews; animal studies; languages other than English; duplicate studies; no surgical intervention; and no population of interest. Inclusion criteria were a report of surgical procedure performed and at least 1 outcome of interest resulting from the studied surgery was reported: comorbidities, mortality, complications, reoperations, or weight loss. Of the 25 060 initially identified articles, 24 023 studies met the exclusion criteria, and 259 met the inclusion criteria.

DATA EXTRACTION AND SYNTHESIS A review protocol was followed throughout. Three reviewers independently reviewed studies, abstracted data, and resolved disagreements by consensus. Studies were evaluated for quality.

MAIN OUTCOMES AND MEASURES Mortality, complications, reoperations, weight loss, and remission of obesity-related diseases.

RESULTS A total of 164 studies were included (37 randomized clinical trials and 127 observational studies). Analyses included 161 756 patients with a mean age of 44.56 years and body mass index of 45.62. We conducted random-effects and fixed-effect meta-analyses and meta-regression. In randomized clinical trials, the mortality rate within 30 days was 0.08% (95% CI, 0.01%-0.24%); the mortality rate after 30 days was 0.31% (95% CI, 0.01%-0.75%). Body mass index loss at 5 years postsurgery was 12 to 17. The complication rate was 17% (95% CI, 11%-23%), and the reoperation rate was 7% (95% CI, 3%-12%). Gastric bypass was more effective in weight loss but associated with more complications. Adjustable gastric banding had lower mortality and complication rates; yet, the reoperation rate was higher and weight loss was less substantial than gastric bypass. Sleeve gastrectomy appeared to be more effective in weight loss than adjustable gastric banding and comparable with gastric bypass.

CONCLUSIONS AND RELEVANCE Bariatric surgery provides substantial and sustained effects on weight loss and ameliorates obesity-attributable comorbidities in the majority of bariatric patients, although risks of complication, reoperation, and death exist. Death rates were lower than those reported in previous meta-analyses.

JAMA Surg. doi:10.1001/jamasurg.2013.3654
Published online December 18, 2013.

Supplemental content at jamasurgery.com

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Role of the Sponsor: The sponsors had no role in the design and conduct of the study; collection, management, analysis, or interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

Disclaimer: The conclusions and opinions presented herein are solely the responsibility of the authors and do not necessarily represent the official views the National Institutes of Health or the Barnes-Jewish Hospital Foundation.

Author Affiliations: Division of Public Health Sciences, Department of Surgery, Washington University School of Medicine, St Louis, Missouri (Chang, Stoll, Colditz); Department of Statistics, Seoul National University, Seoul, South Korea (Song); Minimally Invasive and Bariatric Surgery, Department of Surgery, Washington University School of Medicine, St Louis, Missouri (Varela, Eagon); currently with ASAN Medical Center, Seoul, South Korea (Song).

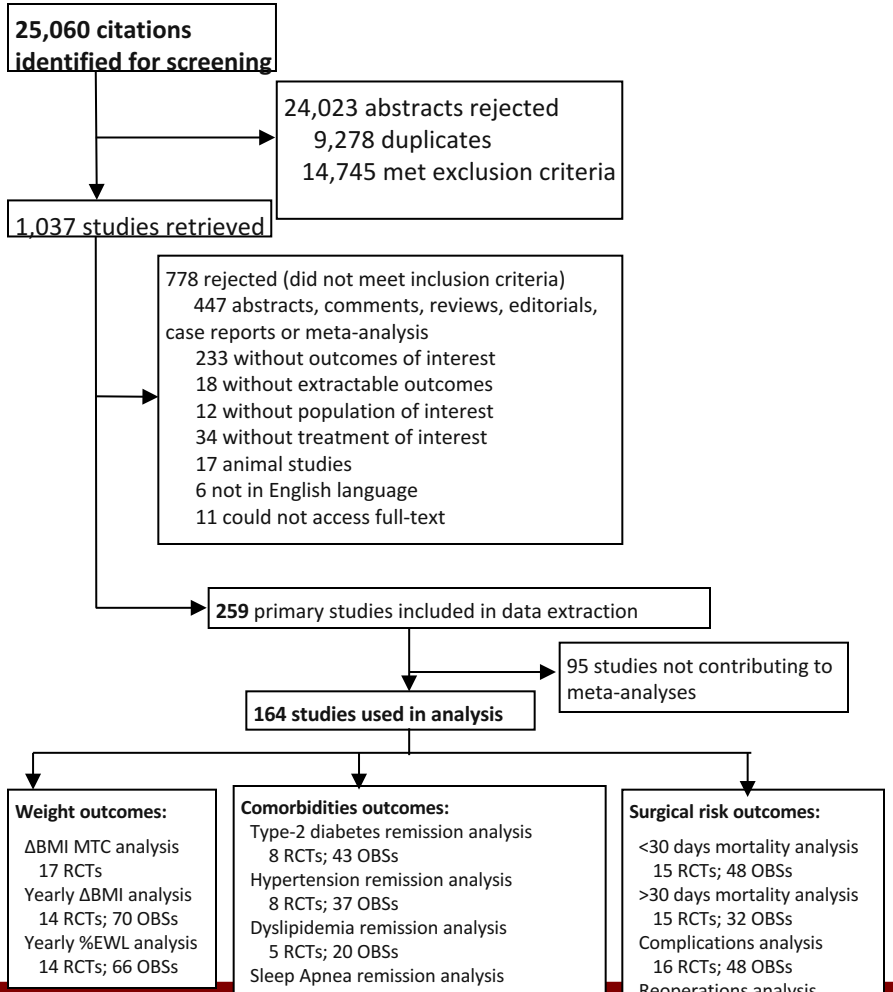
Corresponding Author: Su-Hsin Chang, PhD, Division of Public Health Sciences, Department of Surgery, Washington University School of Medicine, 660 S Euclid Ave, Campus Box 8100, St Louis, MO 63110 (changsh@wudosis.wustl.edu).

Objectives

- To generalize the risk and effectiveness outcomes of bariatric surgery reported in literature
- To conduct comparative effectiveness research
- To conduct up-to-date analyses based on published studies in the last decade because technology in surgery advances and surgeon's experience accumulates
- To include both observational studies and randomized controlled trials
- To use appropriate meta-analysis techniques including both Frequentist and Bayesian

Objectives (Contd.)

- Compare and contrast findings with Buckwald et al. (2004) and Maggard et al. (2005), using more recently studies and more appropriate meta-analytic techniques
- Compare and contrast our findings with Padwal et al. (2011), using only recently published studies and mixed treatment comparison (MTC) of repeated measurements, instead of general network meta-analysis.


25,060 citations identified for screening
24,023 abstracts rejected
9,278 duplicates
14,745 met exclusion criteria
1,037 studies retrieved
778 rejected (did not meet inclusion criteria)
447 abstracts, comments, reviews, editorials, case reports or meta-analysis
233 without outcomes of interest
18 without extractable outcomes
12 without population of interest
34 without treatment of interest
17 animal studies
6 not in English language
11 could not access full-text
259 primary studies included in data extraction
95 studies not contributing to meta-analyses
164 studies used in analysis
Weight outcomes:
ΔBMI MTC analysis
17 RCTs
Yearly ΔBMI analysis
14 RCTs; 70 OBSs
Yearly %EWL analysis
14 RCTs; 66 OBSs
Comorbidities outcomes:
Type-2 diabetes remission analysis
8 RCTs; 43 OBSs
Hypertension remission analysis
8 RCTs; 37 OBSs
Dyslipidemia remission analysis
5 RCTs; 20 OBSs
Sleep Apnea remission analysis
5 RCTs; 27 OBSs
Cardiovascular Disease remission analysis
1 RCTs; 3 OBSs
Surgical risk outcomes:
<30 days mortality analysis
15 RCTs; 48 OBSs
>30 days mortality analysis
15 RCTs; 32 OBSs
Complications analysis
16 RCTs; 48 OBSs
Reoperations analysis
12 RCTs; 25 OBSs

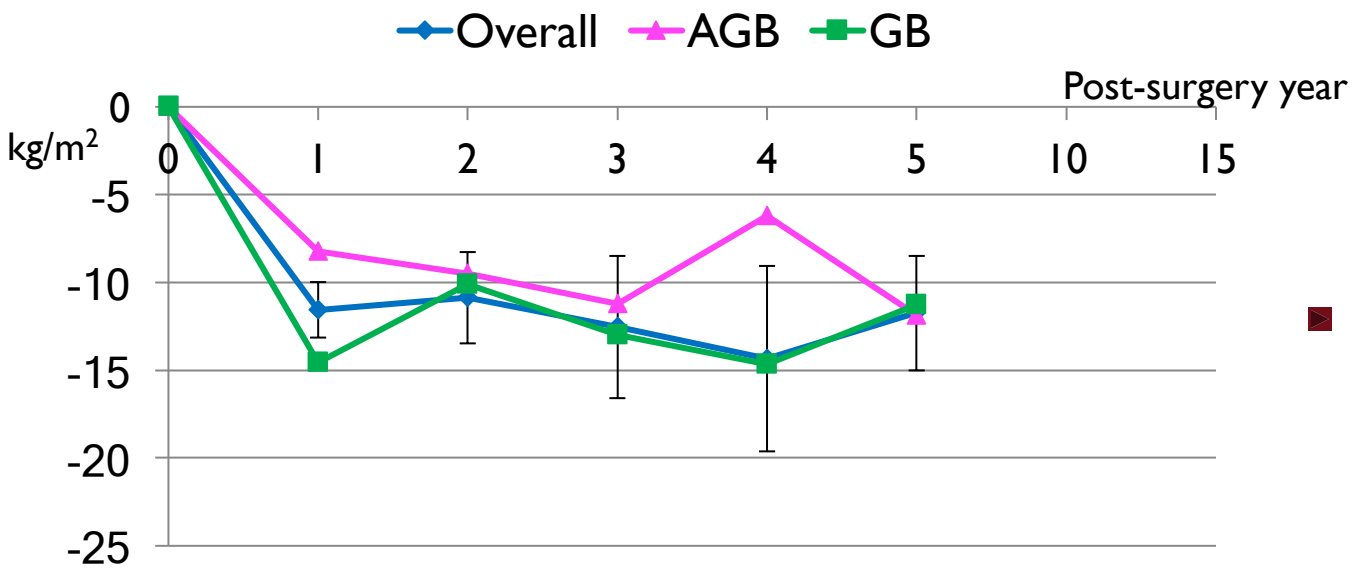
Study and Patient Characteristics

Study Characteristics	# of studies	# of patients	Patient Characteristics	No./Total (%)
Publication year			Sex	
2003-2007	62	41,382	Male	32,384/153,267 (21.13)
2008-2012	102	120,374	Female	120,883/153,267 (78.87)
Study design			Race	
RCT	37	3,385	White	87,653/117,430 (74.64)
OBS	127	158,371	Non-white	29,777/117,430 (25.36)
Follow-up years			Comorbidities	
>=2 years	91	28,671	Type 2 diabetes	19,258/73,378 (26.24)
<2 years	73	133,085	Hypertension	34,092/71,938 (47.39)
Study location			Cardiovascular diseases	1,913/26,752 (7.15)
North America	54	130,045	Dyslipidemia	11,533/41,235 (27.97)
Europe	72	22,703	Sleep apnea	11,794/46,609 (25.30)
Asia	13	3,099		
Others	25	5,909	Age (years)	44.56
Age	140	100,094	BMI (kg/m^2)	45.62
BMI	142	90,587	Weight (kg)	124.53
Weight	68	16,790		

BMI Change

$$BMI = \frac{weight(kg)}{height^2(m^2)}$$

$BMI_{\text{t-year post-surgery}} - BMI_{\text{pre-surgery}}$



GB: gastric bypass; AGB: adjustable gastric banding; Overall: GB, AGB, vertical banded gastroplasty, and sleeve gastrectomy.
Frequentist random-effects estimates for year 1-5 were obtained from observational studies

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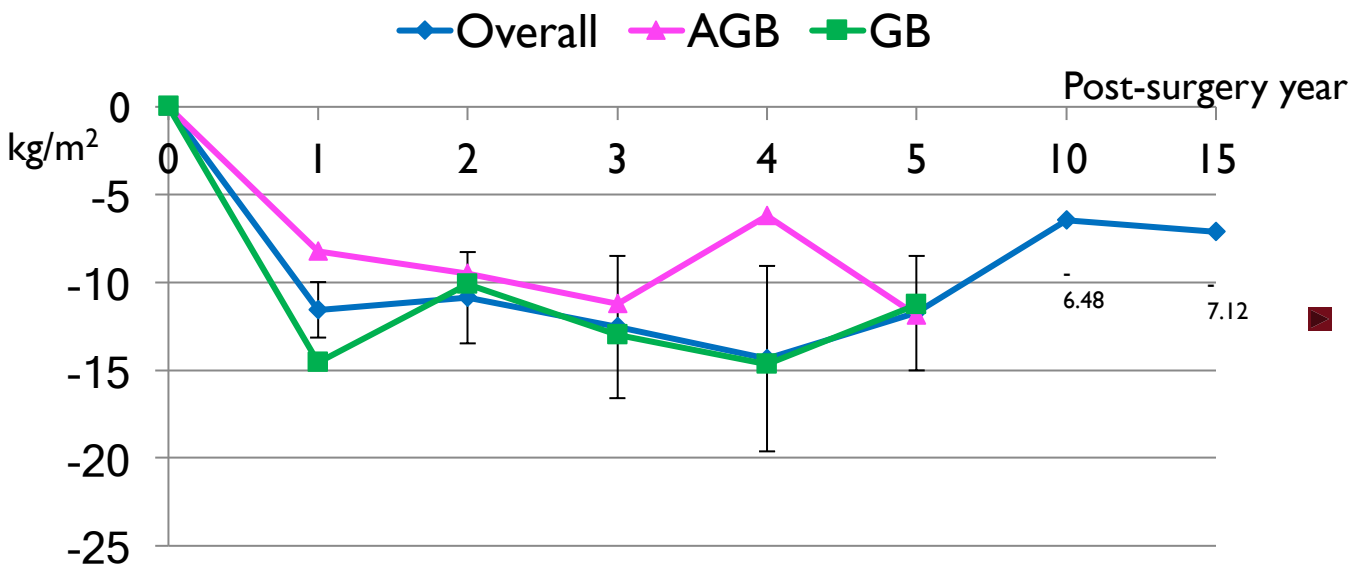

GB: gastric bypass; AGB: adjustable gastric banding; Overall: GB, AGB, vertical banded gastroplasty, and sleeve gastrectomy.
Frequentist random-effects estimates for year 1-5 were obtained from observational studies
Year 10 and 15 estimates are from the Swedish Obese Subjects (SOS).

Washington University in St.Louis
School of Medicine

Comparative effectiveness of bariatric surgery procedures in a pediatric population ages 15-21

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ObesityWeek 2016
New Orleans
November 2 - 2016

Washington University in St.Louis
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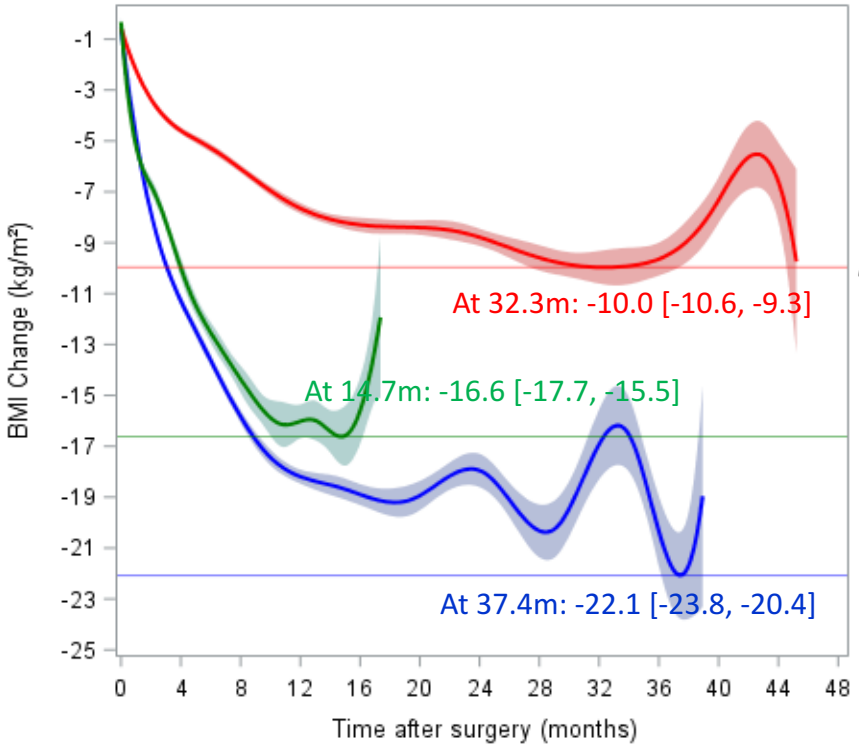
	Overall	RYGB	AGB	SG	p-value
N (%)	3,509 (100%)	1,681 (47.9%)	1,390 (39.6%)	438 (12.5%)	
Age, mean y (sd)	19.59 (1.30)	19.62 (1.26)	19.61 (1.29)	19.43 (1.43)	0.02†
Female sex (%)	2,798 (79.7)	1,332 (79.2)	1,120 (80.6)	346 (79.0)	0.60ǂ
Race (%)					<0.001ǂ
White	2,307 (65.8)	1,094 (65.1)	944 (67.9)	269 (61.4)	
Black	406 (11.6)	208 (12.4)	155 (11.2)	43 (9.8)	
Hispanic	508 (14.5)	279 (16.6)	149 (10.7)	80 (18.3)	
Other	288 (8.2)	100 (6.0)	142 (10.2)	46 (10.5)	
Pre-operative BMI, mean kg/m² (sd)	47.9 (8.2)	49.8 (8.6)	45.6 (7.1)	47.8 (8.2)	<0.001†
Follow-up, mean months, range	10.49 (0.07-52.87)	9.38 (0.10-52.87)	13.38 (0.07-49.63)	5.57 (0.10-40.23)	<0.001†
Surgical approach (%)					<0.001ǂ
Laparoscopic	3,348 (95.4)	1,540 (91.6)	1,381 (99.4)	427 (97.5)	
Laparoscopic - robotic assist	34 (1.0)	20 (1.2)	8 (0.6)	6 (1.4)	
Open	102 (2.9)	102 (6.1)	0 (0.0)	0 (0.0)	
Hand-assisted	10 (0.3)	6 (0.4)	1 (0.1)	3 (0.7)	
Converted to open	11 (0.3)	9 (0.5)	0 (0.0)	2 (0.5)	
Other	4 (0.1)	4 (0.2)	0 (0.0)	0 (0.0)	
Surgery history (%)					0.23ǂ
No history of surgery	3,205 (91.3)	1,527	1,283 (92.3)	395 (90.2)	

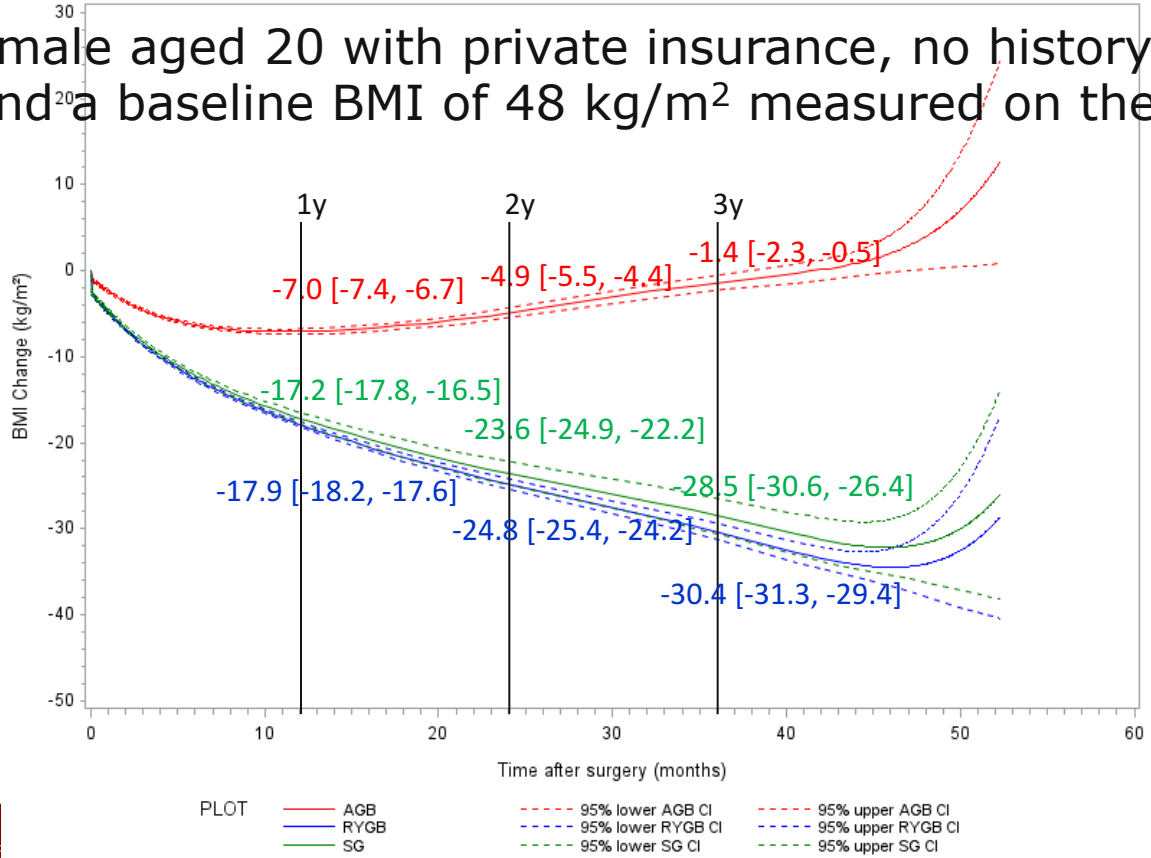
Unadjusted analysis

△BMI = post-surgery BMI – baseline BMI



Predicted △BMI trajectories

A white female aged 20 with private insurance, no history of prior surgery, and a baseline BMI of 48 kg/m^2 measured on the day of surgery



Top priorities to advance the science

Improved (consistent) approaches to modeling weight gain across life course and cancer risk

Quantify benefits of weight loss

Measures of adiposity

- Do we have it right, do measures vary by age; race/ethnicity; region of the world

Will we all have access to driverless cars?

What will our cancer risk be?

Wall-e
Captain


SIRIUS