BMI and Mortality: Do conflicting results alter interpretation of BMI and cancer outcomes research?

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Outline/Purpose

- Overview of BMI and cancer outcomes
 - Incidence and Mortality in Cancer Patients
- Overview results in two papers on BMI and all cause mortality that were asking very different questions and used different methods
 - Flegal et al, JAMA 2013
 - Berrington et al NEJM 2010
- Discuss how question being addressed and methods influence interpretation and implications of results
- Global Burden of Disease 2010 increased contribution of morbidity to disease burden
- If time highlights of research on physical activity and mortality

Obesity and Cancer Risk Bulk of Evidence is on Cancer Incidence

Type of cancer	Relative riskª with BMI of 25–30 kg/m²	Relative riskª with BMI of ≥30 kg/m²
Colorectal (men)	1.5	2.0
Colorectal (women)	1.2	1.5
Female breast (post- menopausal)	1.3	1.5
Endometrial	2.0	3.5
Kidney (renal cell)	1.5	2.5
Esophageal (adeno- carcinoma)	2.0	3.0
Pancreatic	1.3	1.7
Liver	ND	1.5-4.0
Gallbladder	1.5	2.0
Gastric cardia (adeno- carcinoma)	1.5	2.0

Fair AM, Montgomery K. Methods Mol Biol. 2009;472:57-88.

Cancer Incidence (I) and Mortality (M) Rates Between Bariatric Surgical and Nonsurgical Obese Groups

Men

Author	N	Surgical Obese Cancer Rate	Nonsurgical Obese Cancer Rate	Reduction in Cancer RR
Adams, 2009	942	I = 4.14% M = 1.06%	l = 4.14% M = 1.53%	I = No change M = 30%
McCawley, 2009	Effect o	n Cancer Outcomes N	Not Reported	
Sjostrom, 2009	590	I = 6.4%	l = 6.6%	I = 3%

Women

Author	N	Surgical Obese Cancer Rate	Nonsurgical Obese Cancer Rate	Reduction in Cancer RR
Adams, 2009	5654	l = 3.8% M = 0.55%	l = 5.23% M = 1.05%	l = 27.3% (p<0.05) M = 47.6% (p<0.05)
McCawley, 2009	1482	I = 3.6%	I = 5.8%	I = 38% (p<0.05)
Sjostrom, 2009	1447	I = 5.56%	I = 8.98%	I = 38% (p<0.05)

Ashrafian et al, Cancer 2011

Obesity and Survival in Breast Cancer Patients

Meta-Analysis

43 studies published 1963-2005

• comparison of obese vs. non-obese subjects

Subgroup	No. of estimates	Pooled HR (95% CI)	P-value
Survival measure			
All-cause	36	1.33 (1.21-1.47)	0.91
Breast cancer specific	19	1.33 (1.19-1.50)	
Obesity measure			
BMI	55	1.33 (1.23-1.44)	0.95
WHR	6	1.31 (1.14-1.50)	
Study design			
Observational cohort	48	1.36 (1.23-1.49)	0.53
Treatment cohort	7	1.22 (1.14-1.31)	
Menopausal status			
Pre-menopausal	16	1.47 (1.19-1.83)	0.25
Post-menopausal	12	1.22 (0.95-1.57)	
Both	36	1.33 (1.23-1.43)	
Year of diagnosis			
Pre-1995	30	1.31 (1.16-1.46)	0.17
Post-1995	11	1.49 (1.31-1.68)	

Protani M et al. BCRT 2010: 123:627-635

BMI and Quality of Dosing for Breast Cancer Adjuvant Chemotherapy

Table 4. Multivariate Analy	vsis of Init Standard (ial Chemotherapy N = 737)	Dose <	85% of
Characteristic	Odds Ratio	95% CI		Р
Age, years	1.01	0.98 to 1.05	.49	
$CCI \ge 1$	1.16	0.60 to 2.25	.67	
BMI				
Normal	1.00			
Overweight	1.18	0.74 to 1.87	.65	.0004
Obese	2.47	1.36 to 4.51	.003	
Severely obese	4.04	1.46 to 11.19	.007	
Median household income, \$ (in thousands)	1.02	0.85 to 1.22	.81	
Education less than high school	3.07	1.57 to 5.99	.001	
Non-white race	1.30	0.49 to 3.47	.60	
Region				
Northeast	1.00			
Central	1.67	0.43 to 6.44	.46	< .0001
West coast	0.90	0.26 to 3.18	.87	
South	5.58	2.20 to 14.14	.0003	

Griggs JJ, et al. JCO 2007; 25:3

BMI and Colorectal Cancer Outcomes

Author		<u>Stage</u>	<u>HR or P</u>
Tartter	1984	Colon – B1, C1, C2 (n=279)	Recurrence: p=0.03 (weight > vs. < median)
Meyerhardt	2003	Colon – B2, B3, C (n=3759)	DFS: HR 1.11 (0.94-1.30) OS: HR 1.11 (0.96-1.29) (BMI kg/m ² ≥ 30 vs. < 30 kg/m ²)
Meyerhardt	2004	Rectal – I, II (n=1792)	DFS:HR 1.10 (0.91-1.32)OS:HR 1.09 (0.90-1.33)Local:HR 1.31 (0.91-1.88)(BMI kg/m² \geq 30 vs. < 30 kg/m²)
Dignam	2006	Colon – B, C (n=4288)	 DFS: HR 1.27 (1.05-1.53) Events: HR 1.38 (1.10-1.73) (BMI ≥ 35 kg/m² vs. < 30 kg/m²)
Meyerhardt	2008	Colon – III (n=1053)	DFS:HR 1.24 (0.83-1.83)RFS:HR 1.27 (0.85-1.89)OS:HR 0.87 (0.54-1.42)(BMI \geq 35 kg/m² vs. < 30 kg/m²)

Meyerhardt JA, J Clin Oncol;2010;28:4066-4073

BMI and Prostate Cancer Specific Mortality

RRs per 5 kg/m² increase in BMI and prostate cancer–specific mortality

RRs per 5 kg/m² increase in BMI and biochemical recurrence after treatment



Cao Y, Ma J, Cancer Prev Res;2011;4:486-501

Two Studies Different Questions, Methods and Results

- Flegal et al JAMA 2013: All-Cause Mortality, Overweight and Obesity
 - Research Question: How are the standard BMI categories associated with mortality in published literature?
 - Methods: Meta-analysis of 97 studies with standardized measures of overweight (25 - <30), obesity (>30), grade 1 (30-<35), grade 2,3 (>35); sample of 2.88M people with 270,000 deaths
 - Included adults of all ages, and populations covered in existing studies, with FU of 5 to 42 years
 - Conclusion: Relative to normal weight (BMI <25),
 - Overall obesity (>30), and higher grade (2,3) obesity (>35) are associated with higher all-cause mortality (21% and 34% respectively)
 - Grade 1 obesity (30-<35) is not associated
 - Overweight (25-<30) is associated with modest decreased mortality (6%)

Risk of All Cause Mortality for Overweight and Obesity Relative to Normal Weight for All Ages



Flegal KM, et al. JAMA 2013;309:71-82

Two Studies with Different Questions, Methods and Results

Berrington et al, NEJM 2010: BMI and Mortality

- Research Question: What is the independent effect of BMI on mortality in healthy non-smoking, white adults?
- Methods: Pooled analysis of 19 studies with 1.49 M people; in examining the effect of BMI on mortality in healthy non-smokers used 560,000 health people among the 670,000 never smokers
- Included healthy, non-smoking non-Hispanic white adults 19 to 84 years of age with BMI range of 15-49.9; studies with at least 5 yrs of FU and >1000 deaths in NHW adults, baseline year 1970
- Conclusions:
 - In non-Hispanic white adults, overweight and obesity and underweight are associated with increased all-cause mortality.
 - All-cause mortality in healthy, non-smoking non-Hispanic white adults is lowest among the group with a BMI of 20.0-24.9

All Cause Mortality Increases with Progressively Higher and Lower BMIs



BMI and Mortality Stratified by Age



BMI and Mortality by Smoking Status – Men without Cancer or CVD at Baseline



BMI and Cause Specific Mortality among Healthy Never Smokers



Waist Circumference and Mortality by BMI



BMI category and Waist Circumference category (5cm groups)

WC cutpoints (cm) for men: <90.0, 90.0-94.9, 95.0-99.9, 100.0-104.9, 105.0-109.9, 110.0+ WC cutpoints (cm) for women: <70.0, 70.0-74.9, 75.0-79.9, 80.0-84.9, 85.0-89.9, 90.0+.

Cerhan JR, et al. Submitted 2013

Years of Life Lost with Physical Inactivity across BMI Categories



Moore SC, et al. PLoS Med 2012;9(11)

Issues in Interpretation

- Critical to consider the question being addressed
- BMI correlates with obesity but is not a precise measure of metabolically active fat mass
- Epidemiologic analysis of independent effect of BMI is addressed by analyses of healthy, non-smokers
 - Removes bias from two strong predictors of mortality
 - But difficult to extrapolate to other patient groups

BMI/mortality and cause-specific mortality may differ by

- Age at time BMI is assessed
- Smoking status
- Gender and racial/ethnic population mix
- Elimination of people with comorbid disease at baseline
- Body fat distribution
- Other risk factors for overweight/obesity PA, Diet, Alcohol

Global Years of Life Lost Ranks for the Top 25 Causes, 1990 and 2010

Mean rank (95% UI)	Disorder	Disorder	Mean rank (95% UI)	% change (95%
1-0 (1 to 2)	1 Lower respiratory infections	1 Ischaemic heart disease	1.1 (1 to 2)	28 (20 to 33)
2.0 (2 to 2)	2 Diarrhoea	2 Lower respiratory infections	1.9 (1 to 3)	-45 (-49 to -4
3.3 (3 to 5)	3 Preterm birth complications	3 Stroke	3.1 (3 to 4)	177 (2 to 24)
4-0 (3 to 5)	4 Ischaemic heart disease	4 Diarrhoea	4.8 (4 to 7)	-54 (-60 to -47
5·1 (4 to 6)	5 Stroke	5 Malaria	5.5 (3 to 8)	19 (-11 to 63)
6.9 (6 to 11)	6 Malaria	6 HIV/AIDS	5.6 (4 to7)	372 (302 to 43
8-3 (6 to 11)	7 COPD	7 Preterm birth complications	6.3 (4 to 8)	-28 (-39 to -1
8-8 (6 to 12)	8 Protein–energy malnutrition	8 Road injury	7.9 (5 to 9)	35 (8 to 69)
9.7 (7 to 12)	9 Tuberculosis	9 COPD	9-8 (9 to 12)	-19 (-24 to-1
9-8 (6 to 13)	10 Neonatal encephalopathy*	10 Neonatal encephalopathy*	10-8 (9 to 14)	-20 (-33 to -2
11·2 (7 to 14)	11 Congenital anomalies	11 Tuberculosis	11.2 (9 to 14)	-22 (-39 to-8
12·2 (3 to 25)	12 Measles	12 Neonatal sepsis	11.3 (7 to 17)	-3 (-25 to 27
12.4 (6 to 18)	13 Neonatal sepsis	13 Self-harm	13.4 (11 to 18)	24 (-1 to 42)
12.7 (9 to 14)	14 Road injury	14 Congenital anomalies	13.6 (11 to 17)	-30 (-46 to -1
14-7 (13 to 16)	15 Meningitis	15 Protein-energy malnutrition	15.5 (12 to 19)	-44 (-53 to -3
16-5 (14 to 20)	16 Self-harm	16 Lung cancer	15.6 (12 to 19)	36 (18 to 47
16-9 (15 to 20)	17 Drowning	17 Cirrhosis	16.5 (14 to 19)	27 (19 to 36
18-8 (17 to 22)	18 Cirrhosis	18 Meningitis	18-3 (16 to 20)	-23 (-34 to -1
19-3 (16 to 23)	19 Lung cancer	19 Diabetes	18-7 (17 to 21)	70 (54 to 78
21.0 (15 to 29)	20 Tetanus	20 Interpersonal violence	19.9 (16 to 22)	31 (19 to 48
21-3 (19 to 25)	21 Maternal	21 Drowning	22.1 (20 to 25)	-31 (-40 to -6
23·2 (20 to 31)	22 Interpersonal violence	22 Liver cancer	22-4 (20 to 25)	45 (32 to 68
23·5 (19 to 29)	23 Stomach cancer	23 Fire	24-4 (21 to 32)	10 (-18 to 4
25·4 (21 to 30)	24 HN/AIDS	24 Chronic kidney disease	24.5 (22 to 28)	51 (38 to 64
25·7 (18 to 37)	25 Syphilis	25 Stomach cancer	26-1 (21 to 32)	-11 (-18 to -4
	26 Fire	28 Maternal		
	27 Diabetes	37 Syphilis		
	30 Liver cancer	38 Measles		
	32 Chronic kidney disease	52 Tetanus		

Lozano R, et al. Lancet 2012; 380: 2095-128

Non-communicable diseases

Injuries

----- Ascending order in rank ---- Descending order in rank

Global Years Lived with Disability Ranks for the 25 Most Common Causes, 1990 and 2010

	1990	_	20	10		
Mean rank (95% UI)	Disorder		Disorder	Mean rank (95% UI)	% change (95% UI)	
1-3 (1 to 3)	1 Low back pain		1 Low back pain	1-1 (1 to 2)	43 (34 to 53)	
2-2 (1 to 3	2 Major depressive disorder		2 Major depressive disorder	1.9 (1 to 3)	37 (25 to 50)	
2.5 (1 to 3)	3 Iron-deficiency anaemia		3 Iron-deficiency anaemia	3·3 (2 to 6)	-1 (-3 to 2)	
4-4 (4 to 7)	4 Neck pain		4 Neck pain	4-3 (3 to 7)	41 (28 to 55)	
6-0 (4 to 8)	5 Other musculoskeletal disorders		5 COPD	5.8 (3 to 10)	46 (32 to 62)	
6-1 (4 to 9)	6 COPD		6 Other musculoskeletal disorders	5-9 (4 to 8)	45 (38 to 51)	
6-1 (4 to 9)	7 Anxiety disorders		7 Anxiety disorders	6-4 (4 to 9)	37 (25 to 50)	
8-7 (6 to 15)	8 Migraine		8 Migraine	8-9 (6 to 15)	40 (31 to 51)	
10-0 (7 to 14)	9 Falls		9 Diabetes	9-1 (6 to 13)	68 (56 to 81)	
11-4 (8 to 16)	10 Diabetes		10 Falls	10-1 (7 to 14)	46 (30 to 64)	
12-1 (8 to 17)	11 Drug use disorders		11 Osteoarthritis	12.3 (9 to 17)	64 (50 to 79)	
12-2 (6 to 19)	12 Hearing loss		12 Drug use disorders	12.5 (9 to 16)	40 (27 to 54)	
14·0 (9 to 19)	13 Asthma		13 Hearing loss	13.5 (7 to 20)	29 (22 to 36)	
14·9 (10 to 21)	14 Alcohol use disorders		14 Asthma	15·3 (10 to 20)	28 (21 to 34)	
15-0 (11 to 21)	15 Osteoarthritis		15 Alcohol use disorders	15.8 (12 to 21)	32 (16 to 50)	
15-2 (11 to 20)	16 Road injury		16 Schizophrenia	16-0 (9 to 22)	48 (37 to 60)	
17-1 (9 to 25)	17 Bipolar disorder		17 Road injury	16-1 (12 to 20)	30 (13 to 49)	
17-1 (9 to 24)	18 Schizophrenia		18 Bipolar disorder	16-6 (9 to 23)	41 (31 to 51)	
19-5 (12 to 27)	19 Dysthymia		19 Dysthymia	18-6 (13 to 26)	41 (34 to 48)	
19-8 (13 to 25)	20 Diarrhoea		20 Epilepsy	21.8 (18 to 27)	36 (27 to 47)	
22-2 (13 to 35)	21 Eczema		21 Ischaemic heart disease	21.9 (17 to 29)	48 (40 to 57)	
22-7 (19 to 28)	22 Epilepsy		22 Eczema	22-3 (16 to 35)	29 (19 to 39)	
23-9 (18 to 32)	23 Tuberculosis		23 Diarrhoea	23-1 (19 to 28)	5 (-1 to 11)	
24-5 (19 to 34)	24 Ischaemic heart disease		24 Alzheimer's disease	25-9 (21 to 33)	80 (71 to 88)	
25-3 (21 to 33)	25 Neonatal encephalopathy*		25 BPH	26-3 (20 to 35)	84 (48 to 120)	
	30 Alzheimer's disease		26 Tuberculosis		e, maternal,	
	35 BPH		27 Neonatal encephalopathy* neonatal, and nutrition			
	n rank Descending order in rank			Non-commun	licable diseases	
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Vos T, et al. Lancet 2012; 380: 2163-96

Global Risk Factor Ranks for All Ages and Sexes Combined, 1990 and 2010

Mean rank (95% UI)	Risk factor		Risk factor	Mean rank (95% UI)	% change (95% UI)		
1-1 (1-2)	1 Childhood underweight	k -	1 High blood pressure	1-1 (1-2)	27% (19 to 34)		
2-1 (1-4)	2 Household air pollution		2 Smoking (excluding SHS)	1-9 (1-2)	3% (-5 to 11)		
2-9 (2-4)	3 Smoking (excluding SHS)		3 Alcohol use	3-0 (2-4)	28% (17 to 39)		
4-0 (3-5)	4 High blood pressure		4 Household air pollution	4-7 (3-7)	-37% (-44 to-29)		
5-4 (3-8)	5 Suboptimal breastfeeding		5 Low fruit	5-0 (4-8)	29% (25 to 34)		
5-6 (5-6)	6 Alcohol use	\times \times	6 High body-mass index	6-1 (4-8)	82% (71 to 95)		
7-4 (6-8)	7 Ambient PM pollution		7 High fasting plasma glucose	6.6 (5-8)	58% (43 to 73)		
7-4 (6-8)	8 Low fruit		8 Childhood underweight	8-5 (6-11)	-61% (-66 to -55)		
9-7 (9-12)	9 High fasting plasma glucose		9 Ambient PM pollution	8-9 (7-11)	-7% (-13 to -1)		
10-9 (9-14)	10 High body-mass index		10 Physical inactivity	9.9 (8-12)	0% (0 to 0)		
11-1 (9-15)	11 Iron deficiency		11 High sodium	11-2 (8-15)	33% (27 to 39)		
12-3 (9-17)	12 High sodium		12 Low nuts and seeds	12-9 (11-17)	27% (18 to 32)		
13-9 (10-19)	13 Low nuts and seeds	1	13 Iron deficiency	13-5 (11-17)	-7% (-11 to -4)		
14-1 (11-17)	14 High total cholesterol		14 Suboptimal breastfeeding	13-8 (10-18)	-57% (-63 to -51)		
16-2 (9-38)	15 Sanitation		15 High total cholesterol	15-2 (12-17)	3% (-13 to 19)		
16-7 (13-21)	16 Low vegetables		16 Low whole grains	15-3 (13-17)	39% (32 to 45)		
17-1 (10-23)	17 Vitamin A deficiency		17 Low vegetables	15-8 (12-19)	22% (16 to 28)		
17-3 (15-20)	18 Low whole grains		18 Low omega-3	18-7 (17-23)	30% (21 to 35)		
20-0 (13-29)	19 Zinc deficiency		19 Drug use	20.2 (18-23)	57% (42 to 72)		
20-6 (17-25)	20 Low omega-3		20 Occupational injury	20-4 (18-23)	12% (-22 to 58)		
20-8 (18-24)	21 Occupational injury		21 Occupational low back pain	21-2 (18-25)	22% (11 to 35)		
21-7 (14-34)	22 Unimproved water	L LA	22 High processed meat	22-0 (17-31)	22% (2 to 44)		
22-6 (19-26)	23 Occupational low back pain	ATT	23 Intimate partner violence	23-8 (20-28)	0% (0 to 0)		
23-2 (19-29)	24 High processed meat		24 Low fibre	24.4 (19-32)	23% (13 to 33)		
24-2 (21-26)	25 Drug use	K it it	25 Lead	25-5 (23-29)	160% (143 to 176)		
	26 Low fibre		26 Sanitation				
	30 Lead		29 Vitamin A deficiency				
		- · · · · ·	31 Zinc deficiency		A		
			33 Unimproved water	1	 Ascending order in rank Descending order in rank 		

Lim SS, et al. Lancet 2012; 380: 2224-60

Risk Factors Ranked by Attributable Burden of Disease, 2010

Instruction Instruction	Global	High-income Asia Pacific	Western Europe	Australasia	High-income North America	Central Europe	southern Latin America	fastern Europe	EastAsia	Tropical Latin America	Central Latin America	southeast Asia	Central Asia	Andean Latin America	NorthA frica and Middle East	Caribbe an	SouthAsia	Oceania	southern sub-Saharan Africa	lastern ub-Saharan Africa	Central sub-Saharan Africo	Vestern
High blood pressure	1	1	2	3	4	1	2	2	1	2	4	1	1	2	1	1	3	6	2	6	5	Ĺ
Tobacco smoking, including second-hand smoke	2	2	1	2	1	3	3	3	2	4	5	2	3	5	3	3	2	3	5	7	12	
Akohol use	3	3	4	4	3	2	4	1	6	1	1	6	2	1	11	5	8	5	1	5	6	
Household air pollution from solid fuels	4	42				14	23	20	5	18	11	3	12	7	13	9	1	4	7	2	2	
Diet low in fruits	5	5	7	7	7	5	6	5	3	6	7	4	5	10	6	8	5	9	8	8	11	
High body-mass index	6	8	3	1	2	4	1	4	9	3	2	9	4	3	2	2	17	2	3	14	18	
High fasting plasma glucose	7	7	6	6	5	7	5	10	8	5	3	5	7	6	4	4	7	1	6	10	13	
Childhood underweight	8	39	38	37	39	38	38	38	38	32	23	13	25	18	21	14	4	8	9	1	1	
Ambient particulate matter pollution	9	9	11	26	14	12	24	14	4	27	19	11	10	24	7	19	6	32	25	16	14	
Physical inactivity and low physical activity	10	4	5	5	6	6	7	7	10	8	6	8	9	8	5	7	11	7	11	15	15	
Diet high in sodium	11	6	10	11	11	9	11	9	7	9	13	7	6	13	8	15	14	16	13	21	17	
- Diet low in nuts and seeds	12	11	9	8	8	8	8	8	12	10	8	15	8	12	9	10	13	13	16	22	16	
Iron deficiency	13	20	32	21	35	22	17	21	19	14	12	12	17	4	12	6	9	11	10	4	4	
Suboptimal breastfeeding	14						27		24	22	15	14	16	9	15	13	10	10	4	3	3	
High total cholesterol	15	12	8	9	9	10	9	6	13	11	10	16	14	16	10	16	20	14	19	28	27	
Diet low in whole grains	16	10	16	16	17	11	12	11	11	12	14	26	13	17	14	12	15	15	32	24	19	
Diet low in vegetables	17	14	13	12	13	13	10	12	15	16	20	10	11	14	18	11	16	12	15	23	23	
Diet low in seafood omega-3 fatty acids	18	17	15	13	16	16	14	13	17	17	18	19	15	23	16	17	18	20	23	27	25	+
Drug use	19	13	14	10	10	20	13	17	18	13	16	18	20	11	19	18	22	19	12	19	24	┢
Occupational risk factors for injuries	20	24	24	20	25	26	16	25	20	19	22	23	21	21	23	31	12	22	22	20	22	t
Occupational low back pain	21	15	17	15	23	18	20	24	14	15	24	17	24	22	20	26	23	17	24	17	21	t
Diet high in processed meat	22	22	12	14	12	15	18	15	29	7	9	27	19	15	27	24	25	27	28	31	28	t
Intimate partner violence	23	18	22	23	22	25	21	22	21	23	26	22	27	19	25	23	21	25	14	18	20	
Diet low in fibre	24	16	18	18	18	19	15	16	16	25	28	20	18	28	22	22	33	21	33	36	34	
Unimproved sanitation	25	38	39	39	41	42	40	40	40	40	38	30	37	31	32	28	19	18	18	9	8	T
Lead exposure	26	23	21	19	24	17	19	23	22	20	25	24	23	20	26	21	24	30	20	25	26	t
Diet low in polyunsaturated fatty acids	27	19	19	17	20	21	22	18	26	24	27	21	22	29	24	25	32	23	30	33	30	t
Diet high in trans fatty acids	28	29	23	24	15	23	28	19	28	21	21	33	26	27	17	38	28	34	35	37	36	t
Vitamin A deficiency	29	40	40	38	40	41	41	42	43	41	37	32	34	34	37	33	30	31	17	11	7	
Occupational particulate matter, gases, and fumes	30	34	33	32	28	32	33	31	23	29	32	28	29	33	31	34	26	33	29	29	29	
Zinc deficiency	31	37	37	36	37	39	39	39	39	39	29	29	28	25	35	27	31	28	21	13	10	
Diet high in sugar-sweetened beverages	32	28	31	31	19	33	26	27	37	26	17	25	32	30	28	20	27	26	26	32	32	
Childhood sexual abuse	33	26	25	22	21	30	25	26	30	28	30	37	30	26	29	30	29	35	31	26	31	t
Unimproved water source	34	41	41	40	38	40	42	41	42	42	40	31	36	35	30	29	34	24	27	12	9	
Low bone mineral density	35	21	20	25	26	24	30	28	25	30	33	35	35	36	34	32	36	37	38	35	37	
Occupational noise	36	33	35	34	36	35	35	35	33	33	31	34	31	32	36	35	37	36	34	30	33	
Occupational carcinogens	37	31	26	29	31	34	32	34	27	38	35	38	33	40	38	40	39	41	37	41	42	
Diet low in calcium	38	25	28	27	29	27	29	30	31	34	39	39	39	39	40	37	40	39	39	38	39	
Ambient azone pollution	39	36	36	41	33	36	43	37	34	43	43	43	43	43	43	43	35	43	43	42	38	
Residential radon	40	32	27	35	27	28	36	33	32	36	41	41	38	42	41	42	41	42	42	43	43	
Diet low in milk	41	27	29	30	30	29	34	32	35	37	42	40	41	41	42	39	42	40	41	39	41	
Occupational asthmagens	42	35	34	33	34	37	37	36	41	35	36	36	42	37	39	36	38	29	36	34	35	
Planking and an ext	42	20	20	70	22	21	21	20	76		24	42	40	20	22	41	42	20	40	40	40	

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BMI and Hypertension Incidence

									Overwei	ght				(Obese		
								0.5	1 2	4	16	C	.5 1	2	4	16 32	
Study	Obesity	Sex	Age	F-up	Country	Ν	Outcome	e			Risk Est (95% CI)			•	·	Risk Est (95%	CI)
Hu (2004) [83]	BMI	м	25-64	11	Finland	8302	IRR		-		1.28 (1.09 - 1.50)					1.84 (1.51 - 2.	24)
Radi (2004) [84]	BMI	М	15-69	1	France	9691	RR-P			-	2.34 (1.85 - 2.98)				_	5.93 (4.39 - 8.	00)
		IR	R:	All st	tudies (1)				•		1.28 (1.10 - 1.50)			+		1.84 (1.51 - 2.	24)
		RF	ŀ-P:	All st	tudies (1)				-	_	2.34 (1.85 - 2.98)				-	5.93 (4.39 - 8.	00)
Folsom (2000) [19]	wc	F	55-69	5.9	US	31702	IRR				1.38 (1.27 - 1.51)					1.90 (1.77 - 2.	03)
		IRF	R:	All st	tudies (1)				•		1.38 (1.27 - 1.51)			♦	()))	1.90 (1.77 - 2.	03)
Huang (1998) [85]	BMI	F	30-55	16	US	82473	IRR				2.32 (2.25 - 2.40)					4.01 (3.83 - 4.	19)
Folsom (2000) [19]	BMI	F	55-69	5.9	US	31702	IRR				1.44 (1.34 - 1.54)					2.06 (1.89 - 2.	24)
Hu (2004) [83]	BMI	F	25-64	11	Finland	9139	IRR		-		1.40 (1.20 - 1.63)					1.59 (1.32 - 1.	93)
Radi (2004) [84]	BMI	F	15-69	1	France	7774	RR-P			_	2.04 (1.33 - 3.12)					3.48 (2.12 - 5.	71)
		IRE	R:	All st	udies (3)	175.	6(0)*				1.65 (1.24 - 2.19)				_	2.42 (1.59 - 3.	67)
		RB	-P:	All st	tudies (1)					-	2.04 (1.33 - 3.12)			_		3.48 (2.12 - 5.	71)
		IRE	R:	F-up	>=10 yrs (2)	40.1	(0)*				1.81 (1.27 - 2.57)				<u> </u>	2.54 (1.34 - 4.	82)
		IRE	R:	min.a	age<55 (2)	40.1	(0)*				1.81 (1.27 - 2.57)				<u> </u>	2.54 (1.34 - 4.	82)
		IRE	R:	min.a	age>=55 (1)				•		1.44 (1.34 - 1.54)			•		2.06 (1.89 - 2.	24)
		IRE	R & RR-P	min.a	age<55 (3)	40.3	(0)*				1.89 (1.45 - 2.46)			-	<u> </u>	2.76 (1.72 - 4.	45)
		IRE	R:	US s	tudies (2)	148.	3(0)*				1.83 (1.31 - 2.55)			_	•	2.88 (1.81 - 4.	57)
		IRE	R & RR-P	Euro	pe studies (2)	2.6(0.11)*		-		1.64 (1.24 - 2.18)			-		2.23 (1.30 - 3.	83)
								·			1						
								0.5	1 2	4	16	0	.5 1	2	4	16 32	
									RR						RR		

BMI and CHD Incidence in Women

									Ov	erwei	ght				Obese		
								0.5	1	2	4	16	0.5	1 2	4	16 32	
Study	Obesity	Sex	Age	F-up	Country	Ν	Outcome					Risk Est (95% CI)				Risk Est	(95% CI)
Rexrode (1998) [20]	wc	F	40-65	8	US	44702	IRR					1.82 (1.41 - 2.36)		-	•	2.69 (2.0)	5 - 3.53)
Rexrode (1998) [20]	WC	F	40-65	8	US	44702	RR-P					1.82 (1.40 - 2.36)		-	-	2.66 (2.03	3 - 3.49)
		IRF	t:	All s	tudies (1)					-		1.82 (1.41 - 2.36)		_	◆-	2.69 (2.05	5 - 3.53)
		RR	-P:	All s	tudies (1)					-		1.82 (1.40 - 2.36)		-	~ -	2.66 (2.03	3 - 3.49)
Li (2006) [99]	BMI	F	34-59	20	US	88393	IRR					1.81 (1.65 - 1.99)				3.15 (2.8)	4 - 3.48)
Wilson (2002) [94]	BMI	F	35-75	44	US	433	IRR		+	•		1.54 (0.97 - 2.46)				2.13 (1.2)	5 - 3.65)
Kannel (2002) [97]	BMI	F	30-74	16	US	2798	RR-P		+			1.33 (0.93 - 1.91)			—	2.33 (1.60	0 - 3.39)
Tuomilehto (1987) [98]	BMI	F	30-59	9	Finland	4037	RR-P	-	_	•		1.32 (0.69 - 2.51)				1.98 (0.9	9 - 3.94)
Seeman (1993) [96]	BMI	F	65-98	6	US	1262	RR-P		•	_		0.82 (0.44 - 1.53)	-	┼∙──		1.32 (0.76	8 - 2.30)
Wessel (2004) [91]	BMI	F		3.9	US	906	RR-P		•			0.79 (0.27 - 2.30)				1.47 (0.5)	8 - 3.72)
		IRF	:	All st	tudies (2)	0.4	0.51)*			•		1.80 (1.64 - 1.98)			•	3.10 (2.8	1 - 3.43)
		RR	P:	All st	tudies (4)	2.4	(0.49)*		-•	-		1.14 (0.88 - 1.48)		-	-	1.91 (1.4)	5 - 2.50)
		RR	P:	F-up	<10 yrs (3)	1.3	(0.53)*	-	+	_		0.99 (0.66 - 1.50)		-		1.53 (1.0/	4 - 2.27)
		RR	P:	F-up	>=10 yrs (1)				+	-		1.33 (0.93 - 1.91)		-	-	2.33 (1.60	0 - 3.39)
		IRF	& RR-P:	min.	age<=40 (5)	5.8	0.21)*			•		1.50 (1.25 - 1.80)		-	-	2.46 (1.96	8 - 3.09)
		RR	·P:	US s	tudies (3)	2.2	0.33)*		-	-		1.14 (0.85 - 1.54)			-	1.85 (1.3)	3 - 2.58)
		IRF	& RR-P:	US s	tudies (5)	10.7	7(0.03)*			-		1.32 (1.02 - 1.71)		-	-	2.15 (1.59	9 - 2.91)
								_	-		1		Г	· ·	1		
								0.5	1	2	4	16	0.5	1 2	4	16 32	
										RR					RR		

BMI and Post Menopausal Breast Cancer Risk

								Overv	veight					С	bese			
							0.5	1 3	2 4	16		0.5	1	2	4	16	32	
														1				
Study	Obesity	Sex Age	F-up	Country	N	Outcome				Risk Est (959	% CI)						Risk Est (95% CI)
Huang (1999) [44] Folsom (2000) [19]	WC WC	F 55+ F 55-6	8 9 10.1	US US	5865 31702	IRR IRR		∖∰ -		1.22 (1.04 - 1.05 (0.90 -	1.42) 1.23)						1.26 (1.05	5 - 1.52) 3 - 1.48)
Sellers (2002) [32]	WC	F 55-6	9 13 Alls	US studies (2)	32573 1.6(0	RR-P		-		1.16 (1.02 - 1.13 (1.01 -	1.32) 1.27)		-				1.34 (1.20) - 1.49) 7 - 1.44)
		RR-P:	Alls	studies (1)						1.16 (1.02 -	1.32)						1.34 (1.20) - 1.49)
Sweeney (2004) [33] Dirx (2001) [34]	BMI	F 56-8	4 16	US Netherlands	36658	IRR				1.20 (1.09 -	1.33)						1.30 (1.17	(-1.43)
Tornberg (1994) [35]	BMI	F 55-7	5 20.3	Sweden	47003	IRR				1.13 (0.98 -	1.30)		-				1.21 (1.04	4 - 1.42)
Jonsson (2003) [36] Navarro Silvera (2006) [37]	BMI	F 44-8	3 26 9 16.4	Canada	40318	IRR				1.10 (1.00 - 1.09 (0.98 -	1.40)	-					1.20 (0.80) - 1.60) 3 - 1.22)
Chang (2006) [38] Suzuki (2006) [39]	BMI	F 55-7	4 9.3 0 8.3	US Sweden	27541 51823	IRR				1.09 (0.93 -	1.28)	-	₽				0.99 (0.82	2 - 1.19)
Tehard (2004) [40]	BMI	F 40-6	5 9.7	France	41427	IRR		<u>آ</u>		1.06 (0.92 -	1.20)						1.38 (1.10) - 1.75)
Lukanova (2003) [41]	BMI	F 50-/ F 49+	9 4.7 8.3	Sweden	35362	IRR		.		0.97 (0.87 - 0.92 (0.74 -	1.09)	-					1.02 (0.91	- 1.14) 1 - 1.39)
Sellers (2002) [32]	BMI	F 55-6	9 13	US	32549	RR-P				1.27 (1.14 -	1.41)						1.38 (1.22	2 - 1.57)
Suzuki (2006) [39]	BMI	F 49+	0 8.3	Sweden	51823	RR-P				1.10 (0.98 -	1.24)						1.40 (1.07	- 1.83)) - 1.39)
Barlow (2006) [43]	BMI	F 45-8	4 6	US	729129	RR-P				1.06 (0.99 -	1.13)						1.09 (1.01	- 1.18)
	DIVII	IRR:	All s	studies (10)	12(0	.22)*		•		1.08 (1.03 -	1.14)		•				1.13 (1.05	5 - 1.22)
		RR-P:	All s B-P·All s	studies (5) studies (12)	13.8 25.8	(0.01)* (0.03)*				1.11 (1.01 -	1.22)		2				1.17 (1.04	- 1.32) 7 - 1.23)
		IRR:	E-u	o>=5 yrs (9)	7.7(0	0.47)*		*		1.10 (1.05 -	1.16)						1.15 (1.07	/ - 1.24)
		IRR & R	F-u R-P: F-u	0>=5 yrs (4) 0>=5 yrs (11)	7.9(0	(0.21)*		-		1.15 (1.05 -	1.25)		•				1.23 (1.09	9 - 1.37)
		IRR:	min	age>=55 (5)	3.1(0	0.54)*		2		1.13 (1.07 -	1.21)						1.17 (1.07	/ - 1.28
		IRR & R	R-P: min	.age>=55 (2) .age>=55 (6)	6.7(0	0.35)*		X		1.15 (1.08 -	1.23)		×				1.20 (1.12) - 1.31)
		IRR:	US/	Canada studie	s (4) 7.3(0	0.06)* 0.47)*		1		1.08 (0.99 -	1.18)		▶_				1.10 (0.98	3 - 1.23)
		RR-P:	ŬS	studies (3)	13(0)*		÷.		1.09 (0.95 -	1.24)		×				1.14 (0.97	7 - 1.34)
		RR-P:	Eur R-P·US/	ope studies (2) Canada studie	0.4(0 (6) 20.5	0.54)* (0)*				1.12 (1.01 -	1.24)		2				1.23 (1.06	3 - 1.42) 3 - 1.26)
		IRR & R	R-P: Eur	ope studies (6)	5.2(0	0.63)*		•		1.09 (1.02 -	1.15)		-				1.30 (1.02	2 - 1.65)
								1		τ			1	1	1		ī	
							0.5	1 2	2 4	16		0.5	1	2	4	16	32	
								R	R						RR			

BMI and Endometrial Cancer Risk

									Ove	erweię	ght				C	Obese		
								0.5	1	2	4	16	0.5	1	2	4	16	32
Study	Obacity	Sov	A.g.o	Euro	Country	N	Outcomo					Pick Ect (05% CI)					Dick	Ect (05% CI)
Study	Obesity	Sex	Age	r-up	Country	IN .	Outcome					HISK ESI (95% CI)					nise	Est (95% OI)
Wise (2005) [31]	WC	F	21-Pre-M**	4	US	17876	IRR		H			1.15 (1.01 - 1.31)					0.96	(0.85 - 1.08)
Folsom (2000) [19]	WC	F	55-69	7	US	31702	IRR			_		1.14 (0.79 - 1.65)				-	2.17	(1.67 - 2.82)
			IRR:	All st	tudies (2)	0(0.9	18)*					1.15 (1.02 - 1.30)		+	-		1.42	(0.80 - 2.49)
Deep (0005) [45]	DM	-	05.54	10.0	Austria	70404				_	_	0.00 (1.50, 0.00)					4.00	(0.05 0.05)
Rapp (2005) [45]	BIMI	F	30-04	10.2	Austria	/8484					-	2.26 (1.58 - 3.22)			_		4.82	(3.35 - 6.95)
Tomberg (1994) [35]	BMI	-	25-75	20.3	Sweden	47003						1.77 (1.40 - 2.25)					2.92	(2.28 - 3.74)
Schouten (2004) [46]	BMI	-	55-69	9.3	Netherlands	1/39	IKK					1.60 (1.19 - 2.14)			_		3.30	(2.32 - 4.69)
Bjorge (2006) [47]	BWI	-	20-74	24.3	Norway	1036877	IKK					1.58 (1.50 - 1.65)			•	•	2.91	(2.76 - 3.06)
Silvera (2005) [48]	BMI	+	40-59	16.4	Canada	34391	IKK					1.53 (1.22 - 1.92)				-	3.73	(2.94 - 4.72)
Lukanova (2006) [42]	BMI	F	30-61	8.3	Sweden	35362	IRR					1.34 (0.87 - 2.07)					2.90	(1.85 - 4.54)
Jonsson (2003) [36]	BMI	F	44-83	26	Sweden	11598	IRR					1.30 (0.90 - 1.90)		L		-	3.20	(2.00 - 5.20)
Wise (2005) [31]	BMI	F	21-Pre-M**	4	US	21506	IRR					1.17 (1.05 - 1.29)		•			1.06	(0.96 - 1.18)
Folsom (2003) [49]	BMI	F	55-69	13.1	US	23335	IRR		╞			1.09 (0.84 - 1.41)			-		3.41	(2.69 - 4.31)
Rapp (2005) [45]	BMI	F	35-54	10.2	Austria	78484	RR-P				-	2.30 (1.61 - 3.28)					4.58	(3.18 - 6.60)
Lukanova (2006) [42]	BMI	F	30-61	8.3	Sweden	35362	RR-P		-			1.76 (1.15 - 2.71)			_	- -	3.59	(2.29 - 5.62)
Tornberg (1994) [35]	BMI	F	25-75	20.3	Sweden	47003	RR-P		-	-		1.68 (1.33 - 2.14)				F	2.61	(2.04 - 3.34)
			IRR:	All st	tudies (9)	41.5	(0)*			•		1.55 (1.42 - 1.69)				┝─	2.86	(2.17 - 3.78)
			RR-P:	All st	tudies (3)	2.1(0	.35)*			-		1.90 (1.53 - 2.36)			-	◆-	3.39	(2.51 - 4.58)
			IRR:	min.a	age>=55 (2)	3.7(0	.05)*			-		1.30 (1.00 - 1.69)			-	◆	3.37	(2.77 - 4.10)
			IRR:	US/0	Canada studie	s (3) 5.2(0	.07)*			•		1.27 (1.13 - 1.42)		-	-		2.36	(1.22 - 4.54)
			IRR:	Euro	pe studies (6)	6.3(0	.28)*		•	•		1.59 (1.52 - 1.66)			•	•	2.95	(2.80 - 3.10)
			IRR:	exclu	ude black coho	ort (8) 14.4	0.05)*			•		1.53 (1.45 - 1.61)				•	3.22	(2.91 - 3.56)
																1		
								0.5	1	2	4	16	0.5	1	2	4	16	32
										RR						RR		

BMI and Type 2 Diabetes Risk

							Over	weigł	nt					(Obese			
						0.5	1	2	4	16		0.5	1	2	4	16	5 33	2
Study	Obesity Sex	Age	F-up Country	N	Outcome					i i	Risk Est (95% CI)							Risk Est (95% CI)
Wang (2005) [82] Meisinger (2006) [77] Wang (2005) [82] Meisinger (2006) [77]	WC M WC M WC M WC M	40-75 35-74 40-75 35-74 IRR: RR-P:	13 US 9.5 Germany 13 US 9.5 Germany All studies (2) All studies (2)	27270 3055 27270 3055 <u>3.3(0</u> <u>3.8(0</u>	IRR IRR RR-P RR-P .07)* .05)*		-			2 1 2 1 2 2	.77 (2.27 - 3.37) .87 (1.29 - 2.71) .72 (2.24 - 3.31) .81 (1.26 - 2.60) .36 (1.76 - 3.15) .27 (1.67 - 3.10)					F ⊦ 		6.47 (5.51 - 7.60) 4.67 (3.43 - 6.38) 6.16 (5.26 - 7.21) 4.07 (3.02 - 5.48) 5.67 (4.46 - 7.20) 5.13 (3.81 - 6.90)
Wannamethee (2005) [79] Koh-Banerjee (2004) [80] Meisinger (2006) [77] Oguma (2005) [81] Wannamethee (2005) [79] Meisinger (2006) [77] Oguma (2005) [81]	BMI M BMI M BMI M BMI M BMI M BMI M BMI M	40-59 40-75 35-74 40-59 35-74 IRR: IRR: IRR: IRR: IRR:	17.6 UK 3.7 US 9.5 Germany 23.8 US 17.6 UK 9.5 Germany 23.8 US All studies (4) All studies (3) F-up<10 yrs (2 F-up>=10 yrs (2) US studies (2)	7176 22172 3055 20187 7176 3055 20187 2.9(0 2.9(0 0.0.4(0 2) 2.3(0 1.4(0	IRR IRR IRR RR-P RR-P 23)* -53)* -13)* 24)*					2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	$\begin{array}{c} .69 & (2.12 - 3.40) \\ .63 & (1.99 - 3.46) \\ .20 & (1.37 - 3.53) \\ .19 & (1.95 - 2.47) \\ .63 & (2.09 - 3.32) \\ .16 & (1.36 - 3.43) \\ .11 & (1.88 - 2.36) \\ .40 & (2.12 - 2.72) \\ .29 & (1.98 - 2.64) \\ .51 & (1.98 - 3.19) \\ .28 & (2.06 - 2.54) \\ .34 & (2.03 - 2.71) \end{array}$	 						$\begin{array}{c} 7.12 & (5.40 & - 9.40) \\ 8.79 & (6.34 & - 12.19) \\ 6.10 & (3.84 & - 9.69) \\ 5.60 & (4.51 & - 6.97) \\ 6.46 & (4.97 & - 8.40) \\ 5.53 & (3.52 & - 8.68) \\ 4.56 & (3.74 & - 5.56) \\ 6.74 & (5.55 & - 8.19) \\ 5.36 & (4.32 & - 6.65) \\ 7.78 & (5.96 & - 10.16) \\ 6.14 & (5.17 & - 7.29) \\ 6.84 & (4.96 & - 9.43) \\ \end{array}$
Carey (1997) [78] Meisinger (2006) [77] Folsom (2000) [19] Meisinger (2006) [77]	WC F WC F WC F WC F	30-55 35-74 55-69 35-74 IRR: RR-P:	7.6 US 9.5 Germany 9.4 US 9.5 Germany All studies (3) All studies (1)	42492 2957 31702 2957 15.4(IRR IRR IRR RR-P 0)*		-			4 2 2 2 3 2	.85 (3.89 - 6.06) .99 (1.76 - 5.05) .63 (2.12 - 3.26) .80 (1.67 - 4.70) .40 (2.42 - 4.78) .80 (1.67 - 4.70)	 			-		-	15.26 (12.43 - 18.72) 9.81 (6.23 - 15.43) 8.88 (7.49 - 10.52) 8.39 (5.38 - 13.09) 11.10 (8.23 - 14.96) 8.39 (5.38 - 13.09)
Hu (2001) [75] Weinstein (2004) [76] Folsom (2000) [19] Meisinger (2006) [77] Weinstein (2004) [76] Meisinger (2006) [77]	BMI F BMI F BMI F BMI F BMI F BMI F	30-55 45+ 55-69 35-74 45+ 35-74 IRR: IRR: IRR: IRR: IRR:	16 US 6.9 US 9.4 US 9.5 Germany 6.9 US 9.5 Germany All studies (4) All studies (2) F-up<8 yrs (1) F-up>=8 yrs (3) US studies (3)	84941 37878 31702 2957 37878 2957 <u>26.2(</u> 0.8(0.) 25.1((24.9()	IRR IRR IRR RR-P <u>BR-P</u> 0)* .37)*					5 4 3 3 3 3 3 4 3 4 3	$\begin{array}{cccc} .47 & (4.82 - 6.22) \\ .01 & (3.37 - 4.78) \\ .27 & (2.77 - 3.85) \\ .26 & (1.97 - 5.39) \\ .97 & (3.34 - 4.72) \\ .12 & (1.90 - 5.11) \\ .92 & (3.10 - 4.97) \\ .64 & (2.93 - 4.52) \\ .01 & (3.37 - 4.78) \\ .88 & (2.84 - 5.28) \\ .17 & (3.24 - 5.37) \\ \end{array}$	 					₽	$\begin{array}{c} 19.58 \left(17.37 - 22.06 \right) \\ 13.47 \left(11.45 - 15.86 \right) \\ 9.49 \left(8.09 - 11.14 \right) \\ 8.34 \left(5.37 - 12.97 \right) \\ 12.83 \left(10.93 - 15.07 \right) \\ 7.41 \left(4.81 - 11.42 \right) \\ 10.47 \left(7.31 - 15.00 \right) \\ 10.47 \left(7.31 - 15.00 \right) \\ 13.47 \left(11.45 - 15.86 \right) \\ 11.96 \left(7.79 - 18.37 \right) \\ 13.60 \left(9.70 - 19.07 \right) \end{array}$
						0.5	1 1	2 RR	4	16		0.5	1	2	4 RR	16	5 33	2

Prevalence of Common Comorbidities among Patients with the Three Most Common Cancers

	All claims (%)								
Condition	Breast	Prostate	Colorectal- female	Colorectal- male					
Chronic pulmonary disease	7.2	16.2	4.7	4.8					
Diabetes	10.2	17.4	6.4	5.4					
Congestive heart failure	5.7	9.8	5.1	3.6					
Cerebrovascular disease	3.6	7.4	2.4	2.2					
Peripheral vascular disease	2.1	4.6	1.5	1.5					
Old myocardial infarction	0.8	2.9	0.5	1.0					

Klabunde CN, et al. Ann Epidemiol 2007;17:584–590. Medicare data from 1992-1996.

Risk of Death Varies by Comorbidity for Patients with the Three Most Common Cancers

			- 1
Condition	Breast n=13,247 (841 non-CA deaths)	Prostate n=26,766 (2,122 non-CA deaths)	Colorectal n=16,829 (1,756 non-CA deaths)
Mod./severe renal disease	3.28	1.97	2.63
Congestive heart failure	2.33	2.40	2.16
Dementia	3.29	2.17	1.92
Chronic pulmonary disease	1.60	2.06	1.40
Cerebrovascular disease	2.04	1.30	1.41
Paralysis	1.23	1.48	1.65
Diabetes	1.57	1.27	0.99

Hazard Ratios (HRs)

Klabunde CN, et al. Ann Epidemiol 2007;17:584–590. Medicare data from 1992-1996.

Conclusion

- A number of health behaviors, different obesity phenotypes, and health conditions may alter BMI and mortality association
- Associations may vary across racial/ethnic or immigrant populations but this may vary in US vs country of origin
- Disease burden is shifting from mortality to morbidity, particularly in developed countries – estimated to be 50% for the US in 2010
- This change in disease burden suggests a need for a shift from a focus on mortality as a predominant measure of disease burden
- Obesity is a complex multi-factorial health problem that is being explored with complex systems science approaches

Complex Adaptive Systems: Challenges for Science and Policy

- Features (nonlinearity, interdependence, spatial and dynamic complexity, heterogeneity) make system behavior difficult to capture fully using traditional scientific tools or analyses
- "Mental models" and intuition can be very limiting, misleading
- Policy Resistance
 - Policies that do not take complexity into account may have unanticipated consequences... or even backfire
 - Interventions that are successful in one area alone may be offset by response elsewhere in system
 - Heterogeneity means policy solutions may not be "one size fits all"
- Multiple levels of scale (neurons to nations) necessitate interdisciplinary communication, make policy focus challenging
- The best policies may be subtle, novel, unconventional; may leverage hidden synergies; and may need to use "systems" approach

Ross Hammond, Brookings Institution

US Continues to Lead the World in Obesity Rates



OECD Obesity Update 2012

Questions?

Highlights on Physical Activity and Cancer

Television viewing and mortality



*Age, sex, education, race, smoking, diet quality, and moderate-vigorous physical activity

Matthews CE, George SM, et al. AJCN 2012;95:437–45.

Joint-effects of television viewing and physical activity on cardiovascular mortality



Matthews, C.E. George, S.M, et al. AJCN 2012;95:437–45.

Physical Activity & Cancer Prognosis

Cancer	Number of Studies	Decrease Risk of Cancer Death	Decrease Risk of All Cause Death			
Breast	17	Yes	Yes			
Colorectal	6	Yes	Yes			
Prostate	1	Too few	studies			
Ovarian	2	to reach conclusion on the				
Brain	1	effect				

HRs for Physical Activity and Mortality Outcomes in Women with Breast Cancer



Ballard-Barbash R et al. JNCI 2012