

ABSENCE OF EXCESS BODY FATNESS

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Table 2.2.9b Cohort studies of body mass index and cancer of the breast in premenopausal women

Reference Cohort Location Follow-up period	Total number of subjects Incidence/mortality	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Lahmann et al. (2004) EPIC cohort Europe 1992–2002	73 542 Incidence	BMI, quintiles Q1 Q2 Q3 Q4 Q5 [<i>P</i> _{trend}]	132 114 85 75 68	1.00 0.95 (0.73–1.23) 0.78 (0.59–1.04) 0.80 (0.59–1.09) 0.82 (0.59–1.14) [0.10]	Age, centre, education level, smoking, alcohol consumption, parity, age at first pregnancy, age at menarche, use of medication	WC and WHR both showed no association
MacInnis et al. (2004) Australia 1990–2003		BMI < 25 25–29.9 ≥ 30 [<i>P</i> _{trend}]	357	1.0 1.2 (0.9–1.5) 1.4 (1.0–1.9) [0.02]	Age, education level, country of birth, use of HRT	Association limited to ER+ cases
Weiderpass et al. (2004) Population-based cohorts Norway and Sweden 1991–1999	99 717 Incidence	BMI < 20 20–24.9 25–29.9 ≥ 30 [<i>P</i> _{trend}]	123 466 104 23	1.20 (0.98–1.47) 1.00 0.79 (0.63–0.99) 0.62 (0.40–0.97) [0.0003]	Age, parity, age at first birth, OC use, age at menarche, family history of BC, breastfeeding	BMI at age 18 yr showed similar association with risk
Silvera et al. (2006) Canadian mammography screening cohort Canada 1980–2000	40 318 Incidence	BMI < 25 25–29.9 ≥ 30 [<i>P</i> _{trend}]	818 total	1.00 1.11 (0.91–1.35) 1.01 (0.74–1.37) [0.82]	Age, alcohol consumption, smoking, HRT use, age at menarche, age at first birth, family history of BC	
Lundqvist et al. (2007) Twin cohort studies (younger women) Sweden and Finland 1961–2004	22 432 younger twins (mean age at baseline, 30 yr) Incidence	BMI < 18.5 18.5–24.9 25–29.9 ≥ 30 [<i>P</i> _{trend}]	67 688 112 14	0.9 (0.7–1.2) 1.0 1.1 (0.9–1.3) 0.8 (0.4–1.3) [0.33]	Smoking, physical activity, education level, diabetes	

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Reeves et al. (2007) Population-based cohort United Kingdom 1996–2001	1.2 million Incidence	BMI < 22.5 22.5–24.9 25.0–27.4 27.5–29.9 ≥ 30 per 10 kg/m ²	271 352 239 151 166	0.96 (0.85–1.08) 1.00 0.93 (0.82–1.05) 0.99 (0.84–1.16) 0.79 (0.68–0.92) 0.86 (0.73–1.00)	Age, region, SES, reproductive history, smoking, alcohol consumption, physical activity, HRT use	
Reinier et al. (2007) Mammography screening cohort in Vermont USA 1996–2002	23 970 Incidence	BMI < 22.0 22–24.9 25.0–27.4 27.5–29.9 ≥ 30	231	1.0 0.6 (0.5–0.9) 0.7 (0.5–1.1) 0.8 (0.5–1.3) 0.9 (0.6–1.3)	Age, family history of BC, age at first birth, breast density	Analysis of invasive BC only
Harris et al. (2011) Nurses' Health Study 2 cohort USA 1993–2005	116 430 Incidence	BMI < 20.5 20.5–22 22.1–23.9 24–27.4 ≥ 27.5 [P _{trend}]	132 128 129 135 96	1.00 0.98 (0.76–1.25) 0.94 (0.74–1.20) 0.94 (0.74–1.20) 0.75 (0.57–0.99) [0.03]	Age, height, benign breast disease, family history of BC, age at menarche, age at first birth, parity, OC use, alcohol consumption, physical activity	(Update of study by Michels et al., 2006) WC and WHR both showed no association
Michels et al. (2012) NHS1 and NHS2 USA 1976–2008	NHS, 56 223; NHS2, 109 385 Incidence	Weight change (kg) since age 18 yr Loss ≥ 5 Loss 2–4.9 Stable Gain 2–4.9 Gain 5–9.9 Gain 10–14.9 Gain 15–19.9 Gain 20–24.9 Gain ≥ 25 [P _{trend}]	49 63 147 232 447 342 181 128 222	0.75 (0.52–1.09) 0.87 (0.65–1.18) 1.00 0.98 (0.79–1.20) 0.97 (0.80–1.17) 0.97 (0.80–1.19) 0.85 (0.68–1.06) 0.89 (0.67–1.20) 0.78 (0.55–1.10) [0.08]	Age, family history of BC, history of benign breast disease, height, age at menarche, age at first birth, parity, alcohol consumption, physical activity, current and past OC use, weight at age 18 yr	

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Bandera et al. (2015) Pooled data in 4 cohorts on African American women USA 1995–2013	15 234 Incidence ER+	BMI				Age, education level, study, family history of BC, age at menarche, parity, breastfeeding, age at first birth, HRT use, OC use	Similar association with young adult BMI WHR positively associated with risk
		< 25	187	1.00			
		25–29.9	205	0.96 (0.77–1.21)			
		30–34.9	169	1.14 (0.89–1.46)			
	ER–	BMI				No association with young adult BMI	
		< 25	113	1.00			
		25–29.9	154	1.18 (0.90–1.54)			
		30–34.9	100	1.08 (0.80–1.47)			
Dartois et al. (2016) E3N cohort France 1990–2008	67 634 Incidence	BMI				Age, family history of BC, education level, height, age at menarche, age at menopause, tobacco use, parity, physical activity, alcohol consumption, OC use, HRT use	Update of study by Tehard & Clavel- Chapelon (2006)
		< 18.5	18	1.03 (0.59–1.80)			
		18.5–24.9	404	1.15 (0.91–1.45)			
		25–29.9	62	1.00			
	≥ 30	13	–				
		[<i>P</i> _{trend}]	[0.26]				
		[<i>P</i> _{trend}]	[0.45]				
		[<i>P</i> _{trend}]	[0.45]				

BC, breast cancer; BMI, body mass index (in kg/m²); CI, confidence interval; EPIC, European Prospective Investigation into Cancer and Nutrition; ER, estrogen receptor; HRT, hormone replacement therapy; OC, oral contraceptive; SES, socioeconomic status; WC, waist circumference; WHR, waist-to-hip ratio; yr, year or years

Table 2.2.9d Case-control studies of body mass index and cancer of the breast in premenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
de Vasconcelos et al. (2001) Brazil May 1995–February 1996	177 377 Hospital/population; visitors at hospital; 27 relatives of BC patients	Current BMI < 22.79 22.79–26.47 26.48–30.23 ≥ 30.23 [<i>P</i> _{trend}]	13/16 11/18 10/20 7/22	1.00 0.74 (0.24–2.21) 0.55 (0.18–1.68) 0.25 (0.07–0.93) [0.03]	Age, parity, family history of BC, education level
Shu et al. (2001) China August 1996–March 1998	Aged 25–64 yr enrolled from Shanghai Cancer Registry 1459 of 1602 1556 of 1724 Population; randomly selected from female residents of Shanghai (Shanghai Resident Registry), matched to cases by age, 5-yr interval	BMI at diagnosis < 20.70 20.70–22.79 22.80–25.09 25.10–27.90 ≥ 28.0 [<i>P</i> _{trend}]	231/281 254/282 253/234 159/142 52/50	1.0 1.1 (0.8–1.4) 1.2 (0.9–1.6) 1.1 (0.8–1.5) 1.1 (0.7–1.7) [0.34]	Age, education level, family history of BC, ever had fibroadenoma, age at menarche, age at first live birth, exercise
Yoo et al. (2001) Japan 1988–1992	1154 aged ≥ 25 yr, with no previous history of cancer 21 714 Hospital	BMI per 1 kg/m ²		1.01 (0.98–1.04)	Age at interview, occupation, family history of BC, age at menarche, age at first full-term pregnancy, number of full-term pregnancies, months of breastfeeding, alcohol consumption, cigarette smoking, weight, height
Friedenreich et al. (2002) Canada 1995–1997	1233 1241 Population, using Waksberg method; frequency-matched to cases by age, 5-yr intervals, and place of residence (urban/rural)	BMI < 23.1 ≥ 23.1–< 25.7 ≥ 25.7–< 29.2 ≥ 29.2 [<i>P</i> _{trend}]	145/118 102/119 113/119 102/119	1.00 0.75 (0.52–1.10) 0.81 (0.55–1.17) 0.69 (0.47–1.02) [0.17]	Current age, total energy intake, total lifetime physical activity, education level, ever use of HRT, ever diagnosed with benign breast disease, first-degree family history of BC, ever alcohol consumption, current smoking
Adebamowo et al. (2003) Nigeria, urban 1998–2000	234 273 Population	BMI ≥ 30 vs < 30	29/25	1.21 (0.56–2.60)	Age, age at onset of menarche, later age at first full-term pregnancy, regularity of periods

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Wrench et al. (2003) USA Diagnosed in 1997–1999	285 aged < 50 yr 286 Population; frequency- matched by age and ethnicity Interviews: December 1999– September 2001	BMI, highest after age 21 yr < 25 ≤ 25–30 ≥ 30 [<i>P</i> _{trend}]	60/52 17/22 7/11	1.00 0.52 (0.19–1.4) 0.30 (0.08–1.2) [0.05]	Cancer in first-degree relative, previous radiation treatment, age at menarche, menopausal status, reproductive history, OC use, HRT use, number of mammograms, SES, highest degree obtained, religion, alcohol consumption, tobacco use
Gilani & Kamal (2004) Pakistan 1997–1998	498 996 Population; matched by age	BMI, all women ≤ 24.9 25–29.9 ≥ 30	172/641 88/263 87/80	1.00 1.36 (0.86–2.16) 4.67 (2.68–8.12)	Aged < 45 yr
Pan et al. (2004) Canada, National Enhanced Cancer Surveillance System (NECSS) 1994–1997	21 022 5039 Population 2364 BC 2492 female controls 913 premenopausal 1449 postmenopausal	BMI 25–30 ≥ 30 [<i>P</i> _{trend}]		0.89 (0.70–1.14) 1.13 (0.82–1.52) [0.82]	
Chow et al. (2005) Hong Kong Special Administrative Region 1995–2000	Chinese women aged 24– 85 yr 198 353 Hospital; followed up for benign breast disease; no BC	BMI at diagnosis < 19 19–23 23–27 27–31 > 31 [<i>P</i> _{trend}]	14/48 35/115 14/41 5/8 0/0	1.00 1.19 (0.61–2.32) 1.49 (0.82–2.71) 1.32 (0.39–4.43) – [0.39]	Age

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Nichols et al. (2005) Viet Nam, China 1993–1999	Cases were simultaneously participants in randomized clinical trial on oophorectomy and tamoxifen 682 649 Visitors of non-cancer patients in the participating hospitals; matched to cases by single year of age	BMI 13.2–18.5 18.6–20.0 20.1–21.6 21.7–40.8 [<i>P</i> _{trend}]	682/649 195/159 156/160 131/155 169/156	1.00 0.79 (0.58–1.08) 0.67 (0.49–0.93) 0.85 (0.62–1.16) [0.2]	Age, hospital, parity, age at first birth, alcohol consumption, spouse's education level
Verla-Tebit & Chang-Claude (2005) Germany 1992–1995	558 women with no previous cancer, aged ≤ 51 yr, with in situ or invasive BC 1116 Population; women with no previous history of BC; matched by age and study region	Current BMI < 21.3 21.3–23.2 23.3–26.0 > 26.0 [<i>P</i> _{trend}]	115/327 99/289 81/255 82/244	1.00 1.03 (0.75–1.42) 0.98 (0.70–1.39) 1.05 (0.74–1.50) [0.85]	Age at menarche, OC use, first-degree family history of BC, total months of breastfeeding, mean daily alcohol consumption
Zhu et al. (2005) USA Diagnosed in 1995–1998; interviews 1–3 yr after diagnosis	African American women without previous cancer history, aged 20–64 yr 304 305 Population; without history of BC, matched to cases by age in 5-yr intervals and county; women offered money for participation	BMI, at diagnosis < 25 25– < 30 ≥ 30 [<i>P</i> _{trend}]	42/48 31/26 37/36	1.00 3.27 (1.00–10.67) 2.49 (0.82–7.59) [0.108]	Family history of BC, history of benign breast disease, alcohol consumption, smoking, menstrual status, age at menarche, length of menstrual cycle, parity, age at first birth, miscarriages, history of radiotherapy, history of losing weight, history of taking iron pills, age at first sexual intercourse, daily energy intake, physical activity, use of electric bedding devices, history of infertility, demographic variables

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Ma et al. (2006) USA 1998–2003	Aged 20–49 yr 1794 (1585 White including Hispanic, 209 African American) 444 (409 White including Hispanic, 35 African American) Population; neighbourhood walk algorithm	BMI 1 yr before reference date < 25 25–29 30–34 ≥ 35 [<i>P</i> _{trend}]	 939/257 425/95 221/51 140/37	 1.00 1.18 (0.89–1.55) 1.01 (0.70–1.44) 0.88 (0.58–1.34) [0.82]	Race, age, education level, first-degree family history of BC, age at menarche, gravidity, number of full-term pregnancies, combined OC use, average number of alcoholic drinks per week in recent 5 yr
Okobia et al. (2006) Nigeria September 2002–April 2004	250 250 Hospital; patients recruited from the same hospitals as cases, treated for non- malignant and non-hormonal surgical disorders	BMI, mean (± SD) Cases: 24.45 (± 4.32) Controls: 24.83 (± 4.54)	 142	 0.82 (0.49–1.36)	Age
Garmendia et al. (2007) Chile 2005	Cases recruited within 2 months after diagnosis, aged 33–86 yr 170 170 Population; mammography service of the same hospitals; matched to cases by 5-yr age interval and place of residence	BMI ≥ 30 vs < 30	48/54	1.00 (0.40–2.52)	Crude OR
Kruk (2007) Poland 2003–2007	858 1085 Hospital; frequency-matched by 5-yr age group and place of residence (urban/rural)	Current BMI < 22.5 22.6–< 25.0 25.0–< 30.0 ≥ 30.0	 103/148 84/129 90/154 33/44	 1.00 0.94 (0.61–1.45) 0.75 (0.49–1.16) 1.34 (0.72–2.49)	Age, recreational activity, breastfeeding, stress, passive smoking

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Tian et al. (2007) Taiwan, China 2004–2005	244 aged 22–87 yr 244 Hospital; recruited from health examination clinics at the same hospital and time, free of cancer history, matched by menopausal status, date of enrolment, duration of fasting	BMI ≤ 24.65 > 24.65	 116/106 25/35	 1.00 0.60 (0.32–1.09)	Age at enrolment, fasting status, levels of adiponectin
Wu et al. (2007) USA 1995–2001	Asian American women aged 25–74 yr at diagnosis 1277 (450 Chinese, 352 Japanese, 475 Filipinos) 1160 (486 Chinese, 311 Japanese, 363 Filipinos) Population (neighbourhood); frequency-matched by specific ethnicity, 5-yr age group	BMI, recent ≤ 20.43 > 20.43–22.32 > 22.32–24.60 > 24.60 [<i>P</i> _{trend}]	 175/175 135/167 142/145 120/126	 1.00 0.74 (0.53–1.04) 0.82 (0.58–1.17) 0.67 (0.46–0.98) [0.070]	Age, ethnicity, duration of residence in the USA, education level, age at menarche, number of live births, menopausal status, age at menopause, intake of tea and soy during adolescence and adult life, years of physical activity, height
Mathew et al. (2008) India 2002–2005	1866 1873 Accompanying persons to cancer cases; matched by age ± 5 yr and residence status (urban/rural)	BMI < 25 25–29.9 ≥ 30	898/1182 560/845 256/268 65/60	 1.00 1.33 (1.05–1.69) 1.56 (1.03–2.35)	Age, centre, religion, marital status, education level, SES, residence status, parity, age at first childbirth, duration of breastfeeding, physical activity
Nemesure et al. (2009) Barbados 2002–2006	Women of African descent, aged > 21 yr 222 454 Population; Barbados Statistical Services; frequency- matched by 5-yr age group	BMI < 25 25–30 ≥ 30	Aged < 50 yr 33/43 20/55 24/67	 1.0 0.46 (0.20–1.08) 0.44 (0.19–1.01)	Current age, parity, family history of BC, history of benign breast disease, age at first pregnancy, age at menarche, physical activity, other body size variable

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Shin et al. (2009) China 1996–1998 (1st phase) 2002–2005 (2nd phase)	3452 aged 20–64 yr (1st phase), 20–70 yr (2nd phase) 2474 Population; controls frequency-matched by age	Current BMI				
		≤ 20.9	535/586	1.0		
		21–22.9	537/532	1.1 (0.9–1.3)		
		23–24.9	492/435	1.2 (1.0–1.4)		
		≥ 25	512/406	1.3 (1.1–1.5)		
		[<i>P</i> _{trend}]		[0.005]		
Berstad et al. (2010) USA, 5 sites 1994–1998	Study included African American women 4575 (2953 Caucasian, 1622 African American) 4682 (3021 Caucasian, 1661 African American) Population	BMI 5 yr before reference date				Age, race, education level, study site, first-degree family history of BC, parity, age at menopause, HRT use, BMI at the other time point
		< 25	1 342/1 266	1.00		
		25–29	472/466	0.93 (0.79–1.10)		
		30–34	168/175	0.89 (0.70–1.14)		
		≥ 35	115/128	0.89 (0.66–1.21)		
		[<i>P</i> _{trend}]		[0.27]		
Ogundiran et al. (2010) Nigeria 1998–2009	Aged ≥ 18 yr 1233 1101 Population; community register of Ibadan	BMI				Age at diagnosis or interview, ethnicity, education level, age at menarche, number of live births, age at first live birth, duration of breastfeeding, menopausal status, age at menopause, family history of BC, benign breast disease, OC use, alcohol consumption, height
		< 21	153/219	1.00		
		21–23.9	172/202	0.89 (0.64–1.24)		
		24–27.9	170/206	0.74 (0.53–1.04)		
		≥ 28	187/192	0.70 (0.50–0.98)		
		[<i>P</i> _{trend}]		[0.027]		
Cribb et al. (2011) Canada 1999–2002	207 621 Population; women presenting for routine mammography screening; matched by age, menopausal status, and family history of BC	BMI > 25	70%/60%	1.90 (1.05–3.43)		

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John et al. (2011) USA Hispanic: 1995–2002 African American: 1995– 1999 Non-Hispanic White: 1995– 1999	702 of 2258 (1119 Hispanic, 543 African American, 596 non-Hispanic White) 846 of 2706 (1462 Hispanic, 598 African American, 646 non-Hispanic White) Population; controls randomly selected and frequency- matched by race/ethnicity and the expected 5-yr age distribution of cases	Current BMI < 25.0 25.0–29.9 ≥ 30 [<i>P</i> _{trend}]	298/262 195/274 179/272	1.00 0.65 (0.52–1.06) 0.60 (0.45–0.79) [< 0.01]	Age, race/ethnicity, place of birth, education level, family history of BC, history of benign breast disease, age at menarche, number of full-term pregnancies, months of breastfeeding, lifetime physical activity, alcohol consumption, daily total energy intake, current height
Ronco et al. (2012) Uruguay 2004–2009	367 545 Hospital; non-hospitalized women; age 23–69 yr; age- matched, with normal mammography	BMI Normal weight Overweight Obesity		1.00 (0.72–1.40) 2.43 (0.42–14.1) 3.00 (0.70–12.9)	Age, residence, family history of BC in first- degree relatives, age at menarche, number of live births, age at first delivery, months of breastfeeding
Noh et al. (2013) Republic of Korea 1995–2011	270 540 Population; women attending routine health examination, with no evidence of malignant disease, matched by age (within 1 yr), menopausal status, and time of visit to Health Promotion Center	BMI < 25 ≥ 25	132/266 32/62	1.00 1.19 (0.69–2.05)	Number of live births, family history of BC, age at menarche, smoking, alcohol consumption, physical activity
Sangrajrang et al. (2013) Thailand May 2002–March 2004; August 2005–August 2006	1126 1135 Hospital/population; female visitors of hospital patients admitted for conditions other than breast or ovarian cancer	Current BMI < 18.5 18.5–24.9 ≥ 25.0	44/80 362/450 230/214	1.01 (0.53–1.93) 1.00 1.08 (0.81–1.43)	

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Singh & Jangra (2013) India August 2009–July 2010	128 cases aged 20–80 yr 128 Hospital; enrolled from the general surgical ward, without history of any type of cancer, matched to cases within 2-yr age interval	BMI < 18.5 18.5–23.0 23.0–25.0 25.0–30.0 > 30.0 [<i>P</i> _{trend}]	0/13 12/35 9/12 4/10 11/4	0 1.00 1.050 0.560 3.850 [0.002]	
Troisi et al. (2013) USA 1974–2009	22 646 aged < 85 yr, with primary in situ or invasive cancer 224 721 Population; women frequency-matched by parity, age, calendar year of delivery, and race/ethnicity	Pre-pregnancy BMI, after 1992 < 18.5 18.5–< 25 25–< 30 ≥ 30	Aged < 50 yr at diagnosis 68/627 1031/9529 312/3070 169/2084	0.96 (0.74–1.26) 1.00 0.95 (0.83–1.08) 0.76 (0.64–0.90)	Age at delivery, race/ethnicity, parity at index birth, year of index birth
Amadou et al. (2014) Mexico 2004–2007	1000 1074 Population	BMI < 25 25–29.0 ≥ 30 [<i>P</i> _{trend}]	100/74 182/200 133/202	1.00 0.72 (0.49–1.05) 0.48 (0.32–0.72) [< 0.001]	Age, health care system, region, SES, breastfeeding, family history of BC, alcohol consumption, physical activity, total energy intake, height, current BMI
Elkum et al. (2014) Saudi Arabia 2007–2012	Arab women 534 638 Population/unmatched, randomly selected from primary health care visitors, free of BC	BMI 18.5–24.9 ≥ 25		1.00 2.73 (1.79–4.18)	Age, marital status, age at menarche, breastfeeding, education level

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Kawai et al. (2014) USA 2004–2010	1021 aged 20–44 yr 939 Population	BMI at reference				Age at reference, reference year, race/ethnicity, age at first birth
		< 21.7	295/235	1.0		
		21.7– < 24.2	235/231	0.9 (0.7–1.2)		
		24.2– < 28.8	253/241	0.9 (0.7–1.3)		
		≥ 28.3	238/232	0.9 (0.7–1.2)		
		[<i>P</i> _{trend}]		[0.68]		
		BMI at reference				
		< 25	600/526	1.0		
25– < 30	243/241	1.0 (0.8–1.3)				
≥ 30	178/172	1.1 (0.8–1.4)				
[<i>P</i> _{trend}]		[0.81]				
Minatoya et al. (2014) Japan September 2012–July 2013	66 66 Hospital; hospitalized for cardiovascular diseases, hypertension, arrhythmia, nephritis, nephrosis; no BC or diabetes; matched by age ± 3 yr and menopausal status	BMI			Age at menarche, smoking, alcohol consumption, parity, OC/HRT use	
		< 19.6	2/7	0.04 (0.00–0.69)		
		≥ 19.6– < 22.5	9/8	1.00		
		≥ 22.5	11/7	1.17 (0.23–6.10)		
Trentham-Dietz et al. (2014) USA Pooled analysis of 5 case- control studies 1988–2008	Aged < 75 yr 23 959 28 304 Population	BMI	6135 total		Age, state of residence, study period, family history of BC, BMI, alcohol consumption, age at menarche, parity, age at first pregnancy, OC use, smoking status	
		< 18.5		0.88 (0.70–1.11)		
		18.5–24.9		1.00		
		25–29.9		0.91 (0.84–0.99)		
		≥ 30		0.78 (0.70–0.86)		

Table 2.2.9d Case-control studies of body mass index and cancer of the breast in premenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
O'Brien et al. (2015) USA and Puerto Rico 2008–2010 (subanalysis of Sister Study, 2003–2009)	1419 women diagnosed with BC before age 50 yr, 1185 invasive, 221 DCIS 1648 Sisters of cancer cases	BMI at age 30–39 yr < 24.9 25.0–29.9 ≥ 30.0	1022/1191 281/310 97/143	1.00 1.03 (0.82–1.29) 0.74 (0.51–1.03)	Education level, childhood physical activity, alcohol consumption, smoking, parous at age 30 yr, age at menarche, birth order

BC, breast cancer; BMI, body mass index (in kg/m²); CI, confidence interval; DCIS, ductal carcinoma in situ; HRT, hormone replacement therapy; OC, oral contraceptive; OR, odds ratio; SES, socioeconomic status; yr, year or years

^a In this table, the study population describes the population of the entire study, and the numbers of cases and controls refer to the number of women in the study, not necessarily the number of premenopausal women.

Table 2.2.9e Case-control studies of weight and cancer of the breast in postmenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates	
Li et al. (2000) USA 1988–1990	Caucasian women 479 435 Population	Weight (lb) 1 yr before reference date	≤ 129	106/127	1.0	Age, height, family history of BC, parity, use of HRT and OC	
			130–145	146/118	1.5 (1.1–2.2)		
			146–164	97/93	1.3 (0.8–1.9)		
		≥ 165	130/97	1.6 (1.1–2.4)			
		Weight (lb) at age 18 yr	≤ 110	120/111	1.0		Age, height, family history of BC, age at menarche
			111–120	136/122	1.0 (0.7–1.4)		
121–130	118/109		0.9 (0.6–1.4)				
Trentham-Dietz et al. (2000) USA 1992–1994	5031 aged 50–79 yr 5255 Population; matched by age	Recent weight (kg)	32.65–57.14	745/1033	1.0	Logistic conditional models on age and state; adjusted for parity, age at first full-term pregnancy, family history of BC, recent alcohol consumption, education level, age at menopause, height	
			57.15–63.49	820/936	1.2 (1.0–1.4)		
			63.50–69.84	1078/1094	1.4 (1.2–1.6)		
			69.85–78.92	1098/1118	1.3 (1.1–1.5)		
			78.93–158.75	1290/1074	1.8 (1.5–2.0)		
		[<i>P</i> _{trend}]		< 0.001			
Weight (kg) at age 20 yr	33.57–47.62	430/544	1.0				
	47.63–52.15	488/522	1.1 (0.9–1.4)				
	52.16–54.42	442/470	1.1 (0.9–1.3)				
	54.43–58.05	603/666	1.0 (0.8–1.2)				
	58.06–113.40	647/586	1.1 (0.9–1.4)				
[<i>P</i> _{trend}]		[0.4]					
Hirose et al. (2001) Japan 1988–1997	1584 15 331 Hospital; first-visit outpatients (screening) without any previous diagnosis of cancer	Current weight (kg)	Without family history of BC			Age, age at menarche, menstrual regularity in the 20s, age at first birth, parity	
			≤ 47	123/1386	1.00		
			48–51	99/1016	1.14 (0.86–1.50)		
			52–56	168/1316	1.52 (1.20–2.00)		
			≥ 57	214/1294	1.96 (1.50–2.50)		
[<i>P</i> _{trend}]		< 0.001					

Table 2.2.9e Case-control studies of weight and cancer of the breast in postmenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
Shu et al. (2001) China August 1996–March 1998	1459 aged 25–64 yr enrolled from Shanghai Cancer Registry 1556 Population; randomly selected from female residents of Shanghai (Shanghai Resident Registry), matched by age, 5-yr interval	Weight (kg) at diagnosis	< 52	501/562	1.0	Age, education level, family history of BC, ever had fibroadenoma, age at menarche, age at first live birth, exercise, age at menopause
			52–56.9	74/122	1.4 (0.9–2.2)	
			57–63.9	87/106	1.6 (1.1–2.3)	
			≥ 64	150/172	2.0 (1.4–3.0)	
			[<i>P</i> _{trend}]	189/162	[< 0.0001]	
		Weight (kg) at age 20 yr		501/562 (%)		
			< 45	22.6/21.9	1.0	
			45–48.9	27.0/25.8	0.8 (0.6–1.3)	
			49–52.9	25.0/27.8	0.7 (0.5–1.1)	
			≥ 53	25.4/24.5	0.8 (0.5–1.2)	
			[<i>P</i> _{trend}]		[0.17]	
Yoo et al. (2001) Japan 1988–1992	1154 aged ≥ 25 yr, no previous history of cancer 21 714 Hospital	Weight	per 5 kg		1.17 (1.10–1.25)	Age at interview, occupation, family history of BC, age at menarche, age at menopause, age at first full-term pregnancy, number of full- term pregnancies, months of breastfeeding, alcohol consumption, cigarette smoking, BMI, height
		Weight	All		1.21 (1.11–1.32)	
			ER+		1.14 (1.00–1.30)	
			ER–		1.22 (1.01–1.35)	
			PR+		1.16 (1.06–1.28)	
		PR–				
Friedenreich et al. (2002) Canada 1995–1997	1233 1241 Population, using Waksberg method; frequency-matched to cases by age, 5-yr intervals, and place of residence (urban/rural)	Weight (kg)	< 61.8	1533	1.00	Current age, total energy intake, total lifetime physical activity, education level, ever use of HRT, ever diagnosed with benign breast disease, first-degree family history of BC, ever alcohol consumption, current smoking
			≥ 61.8– < 70.3	192/189	0.92 (0.68–1.24)	
			≥ 70.3– < 81.1	172/192	1.09 (0.81–1.46)	
			≥ 81.1	196/189	1.11 (0.83–1.49)	
			[<i>P</i> _{trend}]	211/192	[0.35]	

Table 2.2.9e Case-control studies of weight and cancer of the breast in postmenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates	
Wenten et al. (2002) USA 1992–1994	712 (332 Hispanic, 380 non-Hispanic White) aged 30–70 yr diagnosed with invasive or in situ BC 1039 (511 Hispanic, 528 non-Hispanic White) Population	Weight (kg) at age 18 yr	Hispanic:				Age, family history of BC in first-degree relative, total METs, parity, OC use, months of breastfeeding, age at first full-term birth, HRT use
			< 49			1.00	
			49–53			1.12 (0.53–2.36)	
			54–57			1.33 (0.56–3.17)	
			> 57			1.55 (0.64–3.75)	
			[<i>P</i> _{trend}]			[0.30]	
			Non-Hispanic White:				
			< 4			1.00	
			4–7			0.85 (0.43–1.60)	
			8–14			1.17 (0.56–2.43)	
> 14			0.71 (0.32–1.60)				
[<i>P</i> _{trend}]			[0.72]				
Hirose et al. (2003) Japan 1988–1999	2032 17 848 First-visit outpatients (screening) without any previous diagnosis of cancer	Current weight (kg)	Parous:				Age, first-visit year, age at menarche, menstrual regularity in the 20s, family history of BC
			< 47		135/1323	1.00	
			47–57		360/3150	1.13 (0.91–1.39)	
			≥ 57		300/1599	1.84 (1.47–2.29)	
			[<i>P</i> _{trend}]			[< 0.001]	
			Nulligravid:				
			< 47		24/161	1.00	
			47–57		47/244	1.34 (0.78–2.31)	
			≥ 57		27/104	1.74 (0.95–3.20)	
			[<i>P</i> _{trend}]			[0.07]	
Li et al. (2003) USA 1997–1999	975 1007 Population	Weight (lb) at reference date	≤ 130		216/289	1.0	Age
			131–149		223/204	1.5 (1.1–1.9)	
			150–174		265/272	1.3 (1.0–1.7)	
			≥ 175		260/228	1.5 (1.2–2.0)	

Table 2.2.9e Case-control studies of weight and cancer of the breast in postmenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates		
Li et al. (2003) (cont.)		Weight (lb) at age 30 yr	≤ 118	235/255	1.0	Age		
			119–128	258/283	1.0 (0.8–1.3)			
			129–139	226/211	1.2 (0.9–1.5)			
			≥ 140	247/247	1.1 (0.8–1.4)			
		Weight (lb) at reference date	Ductal carcinoma	656/1007				
				≤ 130	145/289		1.0	
				131–149	147/204		1.4 (1.1–1.9)	
				150–174	181/272		1.3 (1.0–1.7)	
		Weight (lb) at age 30 yr	Ductal carcinoma	656/1007				
				≤ 118	146/255		1.0	
				119–128	166/283		1.0 (0.8–1.4)	
				129–139	156/211		1.3 (1.0–1.7)	
		Weight (lb) at reference date	Lobular carcinoma	196/1007				<i>P</i> value ductal vs lobular, 0.70
				≤ 130	49/289		1.0	
131–149	50/204			1.5 (0.9–2.2)				
150–174	47/272			1.0 (0.7–1.6)				
Weight (lb) at age 30 yr	Lobular carcinoma	196/1007			<i>P</i> value ductal vs lobular, 0.10			
		≤ 118	55/255	1.0				
		119–128	61/283	1.0 (0.7–1.5)				
		129–139	37/211	0.8 (0.5–1.3)				
Weight (kg) at age 20 yr	Population; frequency- matched by 5-yr age group	36.29–49.88	289/301	1.00	Age at reference date, number of pregnancies, months of HRT use, history of BC in a first-degree relative, history of benign breast disease			
		49.89–54.42	185/154	1.14 (0.85–1.52)				
		54.43–58.95	298/294	1.02 (0.79–1.31)				
		58.96–106.14 [<i>P</i> _{trend}]	214/228	1.04 (0.80–1.37) [0.88]				

Table 2.2.9e Case-control studies of weight and cancer of the breast in postmenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
Eng et al. (2005) (cont.)		Weight (kg) 1 yr before reference date	36.29–58.97 58.98–67.59 67.60–77.11 77.12–170.55 [<i>P</i> _{trend}]	182/224 275/271 260/266 285/224	1.00 1.40 (1.06–1.87) 1.38 (1.04–1.83) 1.87 (1.40–2.51) [0.0001]	
Okobia et al. (2006) Nigeria September 2002–April 2004	250 250 Hospital; patients recruited from the same hospitals as cases, treated for non-malignant and non-hormonal surgical disorders	Weight (kg)	Mean (± SD) Cases: 64.67 (± 19.01) Controls: 65.30 (± 15.46)	108	1.00 (0.98–1.01)	Age
Kruk (2007) Poland 2003–2007	858 1085 Hospital; frequency- matched by 5-yr age group and place of residence (urban/rural)	Current weight (kg)	< 62 62–70 > 70 [<i>P</i> _{trend}]	540/610 139/226 178/171 231/213	1.00 1.70 (1.26–2.30) 1.80 (1.35–2.39) [< 0.0001]	Age, recreational activity, breastfeeding, stress, passive smoking <i>P</i> _{interaction} = 0.04
Wu et al. (2007) USA 1995–2001	Asian American women aged 25–74 yr at diagnosis 1277 (450 Chinese, 352 Japanese, 475 Filipinos) 1160 (486 Chinese, 311 Japanese, 363 Filipinos) Population (neighbourhood); frequency-matched by specific ethnicity, 5-yr age group	Weight (kg) at age 18 yr Recent weight (kg)	≤ 43.1 > 43.1–47.0 > 47.0–51.3 > 51.3 [<i>P</i> _{trend}] ≤ 49.9 > 49.9–55.4 > 55.4–61.3 > 61.3 [<i>P</i> _{trend}]	158/114 195/160 142/127 154/112 158/132 154/132 187/154 206/129	1.00 0.93 (0.66–1.32) 0.86 (0.59–1.26) 1.04 (0.69–1.55) [0.97] 1.00 1.10 (0.78–1.57) 1.12 (0.79–1.60) 1.62 (1.11–2.36) [0.015]	Age, ethnicity, duration of residence in the USA, education level, age at menarche, number of live births, menopausal status, age at menopause, intake of tea and soy during adolescence and adult life, years of physical activity, height

Table 2.2.9e Case-control studies of weight and cancer of the breast in postmenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
Montazeri et al. (2008) Islamic Republic of Iran 1996–2000	116, in situ and invasive cancers 116 Hospital; women attending for clinical breast examination	Weight (kg)	≤ 62 63–67 68–75 ≥ 76	24/30 25/28 35/30 32/28	1.00 1.02 (0.20–2.09) 1.13 (0.40–2.43) 1.26 (0.42–2.82)	BMI, height, weight independently entered into model as categorical data; adjusted for age, age at menopause, family history of BC, parity
Phipps et al. (2008) USA Study 1: 1997–1999 Study 2: 2000–2004	1233 with ductal cancer, aged 65–79 yr at diagnosis (study 1), and 55–74 yr at diagnosis (study 2) 1447 Population; from Health Care Financing Administration records, frequency-matched to cases by age	Weight (lb)	Luminal: < 121 121–139 140–162 > 162 [<i>P</i> _{trend}] HER2-overexpressing: < 121 121–139 140–162 > 162 [<i>P</i> _{trend}] Triple-negative: < 121 121–139 140–162 > 162 [<i>P</i> _{trend}]	200/366 285/380 250/346 273/355 8/366 11/380 7/346 13/355 9/366 26/380 19/346 23/355	1.0 1.3 (1.1–1.7) 1.3 (1.0–1.6) 1.3 (1.1–1.7) [0.04] 1.0 1.3 (0.5–3.2) 0.9 (0.3–2.4) 1.5 (0.6–3.7) [0.50] 1.0 2.5 (1.2–5.4) 1.9 (0.9–4.4) 2.1 (1.0–4.7) [0.20]	

Table 2.2.9e Case-control studies of weight and cancer of the breast in postmenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
Nemesure et al. (2009) Barbados 2002–2006	Women of African descent, aged ≥ 21 yr 222 454 Population; Barbados Statistical Services; frequency-matched by 5-yr age group	Current weight (lb)	< 132 132–192 ≥ 192	Aged ≥ 50 yr 40/56 78/173 24/58	1.00 0.57 (0.31–1.06) 0.59 (0.28–1.25)	Current age, HRT use, parity, family history of BC, history of benign breast disease, age at first pregnancy, age at menarche, physical activity, other body size variable
Shin et al. (2009) China 1996–1998 (1st phase) 2002–2005 (2nd phase)	3452 aged 20–64 yr (1st phase), 20–70 yr (2nd phase) 3474 Population; frequency-matched by age	Current weight (kg)	≤ 52.4 52.5–57.9 58.0–63.9 ≥ 64.0 [<i>P</i> _{trend}]	1372/1512 248/356 261/330 375/398 485/427	1.0 1.2 (0.9–1.5) 1.5 (1.2–1.8) 1.8 (1.4–2.2) [< 0.001]	
Ogundiran et al. (2010) Nigeria 1998–2009	Aged ≥ 18 yr 1233 1101 Population; community register of Ibadan	Weight (kg)	< 55 55–64 65–74 ≥ 75 [<i>P</i> _{trend}]	127/68 145/73 106/70 127/67	1.00 0.98 (0.63–1.52) 0.72 (0.46–1.14) 0.90 (0.57–1.44) [0.48]	Age at diagnosis or interview, ethnicity, education level, age at menarche, number of live births, age at first live birth, duration of breastfeeding, menopausal status, age at menopause, family history of BC, benign breast disease, OC use, alcohol consumption, height

Table 2.2.9e Case-control studies of weight and cancer of the breast in postmenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
Kawai et al. (2013) Japan 1997–2009	1017 2902 Hospital; female non-cancer patients with benign tumours, cardiovascular diseases, digestive tract diseases, respiratory tract disease, urological–gynaecological disease	Weight (kg)	ER+PR+:	277		Age, smoking, alcohol consumption, family history of BC, occupation, age at menarche, age at first birth, parity, use of exogenous female hormones or OC, year of recruitment, area, referral basis (screening, other), height, time spent exercising
			< 49.0	43/514	1.00	
			49.0–54.0	51/400	1.38 (0.88–2.17)	
			54.0–60.0	74/424	2.19 (1.42–3.36)	
			≥ 60.0	418/109	3.47 (2.27–5.30)	
			[<i>P</i> _{trend}]		[< 0.0001]	
			ER–PR–:	142		
			< 49.0	37/514	1.00	
49.0–54.0	33/400	1.00 (0.60–1.67)				
54.0–60.0	33/424	0.87 (0.52–1.46)				
≥ 60.0	39/418	1.05 (0.62–1.76)				
[<i>P</i> _{trend}]		[0.99]				
Singh & Jangra (2013) India August 2009–July 2010	128 aged 20–80 yr 128 Hospital; enrolled from the general surgical ward, without history of any type of cancer, matched by age within 2 yr	Weight (kg)	< 50	19/16	1.018	<i>P</i> _{heterogeneity} < 0.0001
			50–60	28/24	1.0	
			60–70	16/10	1.371	
			> 70	16/04	3.429	
			[<i>P</i> _{trend}]		[0.202]	
Troisi et al. (2013) USA, Washington State 1974–2009	22 646 aged < 85 yr, with primary in situ or invasive cancer 224 721 Population; frequency-matched by parity, age, calendar year of delivery, race/ethnicity	Pre-pregnancy weight (lb), after 1992	Aged ≥ 50 yr at diagnosis			Age at delivery, race/ethnicity, parity at index birth, year of index birth
			< 125	33/354	0.74 (0.46–1.20)	
			125– < 140	48/402	1.00	
			140– < 160	48/409	0.95 (0.62–1.46)	
			≥ 160	30/399	0.64 (0.40–1.04)	

BC, breast cancer; BMI, body mass index (in kg/m²); CI, confidence interval; ER, estrogen receptor; HER2, human epidermal growth factor receptor 2; HRT, hormone replacement therapy; MET, metabolic equivalent; OC, oral contraceptive; PR, progesterone receptor; yr, year or years

^a In this table, the study population describes the population of the entire study, and the numbers of cases and controls refer to the number of women in the study, not necessarily the number of premenopausal women.

Table 2.2.9f Case-control studies of weight and cancer of the breast in premenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates	
Hirose et al. (2001) Japan 1988–1997	1584 15 331 Hospital; first-visit outpatients (screening) without any previous diagnosis of cancer	Current weight (kg)	Without family history of BC:				Age, age at menarche, menstrual regularity in the 20s, age at first birth, parity
			≤ 47	188/2280	1.00		
			48–51	190/2254	0.98 (0.79–1.20)		
			52–56	252/2778	1.01 (0.83–1.30)		
			≥ 57	233/2317	1.07 (0.87–1.30)		
			[<i>P</i> _{trend}]		[0.48]		
		With family history of BC:					
		≤ 47	13/99	1.00			
		48–51	18/79	1.56 (0.68–3.50)			
		52–56	20/130	0.92 (0.42–2.00)			
		≥ 57	14/105	0.75 (0.32–1.80)			
		[<i>P</i> _{trend}]		[0.27]			
2032 17 848 Hospital; first-visit outpatients (screening) without any previous diagnosis of cancer	2032 17 848 Hospital; first-visit outpatients (screening) without any previous diagnosis of cancer	Current weight (kg)	Parous:				Age, first-visit year, age at menarche, menstrual regularity in the 20s, family history of BC
			< 47	147/1681	1.00		
			47–57	559/5754	1.02 (0.84–1.23)		
			≥ 57	297/2546	1.11 (0.90–1.37)		
			[<i>P</i> _{trend}]		[0.27]		
		Nulligravid:					
		< 47	29/315	1.00			
		47–57	72/670	1.07 (0.68–1.70)			
		≥ 57	24/214	0.94 (0.52–1.70)			
		[<i>P</i> _{trend}]		[0.88]			

Table 2.2.9f Case-control studies of weight and cancer of the breast in premenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
Shu et al. (2001) China August 1996–March 1998	1459 aged 25–64 yr enrolled from Shanghai Cancer Registry 1556 Population; randomly selected from female residents of Shanghai (Shanghai Resident Registry), matched by age, 5-yr interval	Weight (kg) at diagnosis	< 52	208/239	1.0	Age, education level, family history of BC, ever had fibroadenoma, age at menarche, age at first live birth, exercise
			52–56.9	210/239	1.0 (0.7–1.3)	
			57–63.9	289/285	1.1 (0.8–1.4)	
			≥ 64	242/226	1.0 (0.8–1.4)	
			[<i>P</i> _{trend}]		[0.52]	
		Weight (kg) at age 20 yr	952/990 (%)			
			< 45	19.8/21.9	1.0	
			45–48.9	27.1/26.3	1.1 (0.8–1.5)	
			49–52.9	25.7/26.0	1.0 (0.8–1.4)	
			≥ 53	37.4/25.8	1.1 (0.8–1.5)	
[<i>P</i> _{trend}]			[0.67]			
Yoo et al. (2001) Japan 1988–1992	1154 aged ≥ 25 yr, no previous history of cancer 21 714 Hospital	Weight	per 5 kg			Age at interview, occupation, family history of BC, age at menarche, age at menopause, age at first full-term pregnancy, number of full-term pregnancies, months of breastfeeding, alcohol consumption, cigarette smoking, BMI, height
			All		1.03 (0.96–1.10)	
			ER+		1.13 (0.99–1.01)	
			ER–		1.06 (0.89–1.12)	
			PR+		1.05 (0.91–1.22)	
			PR–		1.17 (1.01–1.36)	
Friedenreich et al. (2002) Canada 1995–1997	1233 1241 Population, using Waksberg method; frequency-matched by age, 5-yr intervals, and place of residence (urban/rural)	Weight (kg)	< 61.2	129/116	1.00	Current age, total energy intake, total lifetime physical activity, education level, ever use of HRT, ever diagnosed with benign breast disease, first-degree family history of BC, ever alcohol consumption, current smoking
			≥ 61.2– < 68.3	113/121	0.86 (0.59–1.26)	
			≥ 68.3– < 78.4	114/119	0.97 (0.66–1.42)	
			≥ 78.4	106/119	0.81 (0.55–1.19)	
			[<i>P</i> _{trend}]		[0.4]	
		Weight (kg) at age 20 yr	< 49.9	86/94	1.00	
			≥ 49.9– < 54.9	112/114	1.11 (0.73–1.67)	
			≥ 54.9– < 59.0	142/123	1.35 (0.91–2.02)	
			≥ 59.0	122/144	1.02 (0.68–1.52)	
			[<i>P</i> _{trend}]		[0.76]	

Table 2.2.9f Case-control studies of weight and cancer of the breast in premenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
Wenten et al. (2002) USA 1992–1994	712 (332 Hispanic, 380 non-Hispanic White) aged 30–70 yr diagnosed with invasive or in situ BC 1039 (511 Hispanic, 528 non-Hispanic White) Population	Weight (kg) at age 18 yr	Hispanic: < 49 49–53 54–57 > 57 [<i>P</i> _{trend}] Non-Hispanic White: < 49 49–53 54–57 > 57 [<i>P</i> _{trend}]		1.00 1.53 (0.75–3.13) 1.77 (0.73–4.28) 1.35 (0.64–2.87) [0.47] 1.00 0.60 (0.25–1.45) 1.15 (0.48–2.76) 0.59 (0.25–1.37) [0.70]	Age, family history of BC in first-degree relative, total METs, parity, OC use, months of breastfeeding, age at first full-term birth
Okobia et al. (2006) Nigeria September 2002– April 2004	250 250 Hospital; patients recruited from the same hospitals as cases, treated for non-malignant and non-hormonal surgical disorders	Weight (kg)	Mean (± SD): Cases: 66.63 (± 12.58) Controls: 66.94 (± 12.24)	142	1.00 (0.98–1.02)	Age
Kruk (2007) Poland 2003–2007	858 1085 Hospital; frequency-matched by 5-yr age group and place of residence (urban/rural)	Current weight (kg)	< 62 62–70 > 70 [<i>P</i> _{trend}]	310/475 121/197 108/144 81/134	1.00 1.29 (0.92–1.80) 1.03 (0.71–1.47) [0.04]	Age, recreational activity, breastfeeding, stress, passive smoking

Table 2.2.9f Case-control studies of weight and cancer of the breast in premenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
Wu et al. (2007) USA 1995–2001	Asian American women aged 25–74 yr at diagnosis 1277 (450 Chinese, 352 Japanese, 475 Filipinos) 1160 (486 Chinese, 311 Japanese, 363 Filipinos) Population (neighbourhood); frequency-matched by specific ethnicity, 5-yr age group	Weight (kg) at age 18 yr	≤ 43.1 > 43.1–47.0 > 47.0–51.3 > 51.3 [<i>P</i> _{trend}]	130/111 163/171 134/150 133/172	1.00 0.92 (0.64–1.32) 0.99 (0.67–1.47) 0.78 (0.52–1.17) [0.30]	Age, ethnicity, duration of residence in the USA, education level, age at menarche, number of live births, menopausal status, age at menopause, intake of tea and soy during adolescence and adult life, years of physical activity, height
		Recent weight (kg)	≤ 49.9 > 49.9–55.4 > 55.4–61.3 > 61.3 [<i>P</i> _{trend}]	157/161 156/157 146/167 113/128	1.00 1.06 (0.75–1.50) 0.85 (0.59–1.21) 0.75 (0.50–1.12) [0.099]	
Nemesure et al. (2009) Barbados 2002–2006	Women of African descent, aged ≥ 21 yr 222 454 Population; Barbados Statistical Services; frequency-matched by 5-yr age group	Current weight (lb)	< 132 132–192 ≥ 192	Aged < 50 yr 16/17 48/108 13/40	1.00 0.75 (0.28–1.96) 0.38 (0.12–1.22)	Current age, HRT use, parity, family history of BC, history of benign breast disease, age at first pregnancy, age at menarche, physical activity, other body size variable
Shin et al. (2009) China 1996–1998 (1st phase) 2002–2005 (2nd phase)	3452 aged 20–64 yr (1st phase), 20–70 yr (2nd phase) 3474 Population; frequency-matched by age	Current weight (kg)	≤ 52.4 52.5–57.9 58.0–63.9 ≥ 64.0 [<i>P</i> _{trend}]	2080/1962 464/501 478/493 550/492 584/473	1.0 1.0 (0.9–1.3) 1.2 (1.0–1.4) 1.2 (1.0–1.5) [0.006]	
Ogundiran et al. (2010) Nigeria 1998–2009	Aged ≥ 18 yr 1233 1101 Population; community register of Ibadan	Weight (kg)	< 55 55–64 65–74 ≥ 75 [<i>P</i> _{trend}]	159/253 196/257 156/158 172/151	1.00 0.81 (0.59–1.11) 0.89 (0.63–1.26) 0.78 (0.55–1.12) [0.27]	Age at diagnosis or interview, ethnicity, education level, age at menarche, number of live births, age at first live birth, duration of breastfeeding, family history of BC, benign breast disease, OC use, alcohol consumption, height

Table 2.2.9f Case-control studies of weight and cancer of the breast in premenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
John et al. (2011) USA Hispanic: 1995–2002 African American: 1995–1999 Non-Hispanic White: 1995–1999	702 of 2258 (1119 Hispanic, 543 African American, 596 non-Hispanic White) 846 of 2706 (1462 Hispanic, 598 African American, 646 non-Hispanic White) Population; randomly selected and frequency-matched by race/ethnicity and the expected 5-yr age distribution of cases	Current weight (kg)		672/808		Age, race/ethnicity, place of birth, education level, family history of BC, history of benign breast disease, age at menarche, number of full-term pregnancies, months of breastfeeding, lifetime physical activity, alcohol consumption, daily total energy intake, current height Age, place of birth, education level, family history of BC, history of benign breast disease, age at menarche, number of full-term pregnancies, months of breastfeeding, lifetime physical activity, alcohol consumption, daily total energy intake, current height
			≤ 61.2	227/229	1.00	
			61.3–68.0	148/182	0.76 (0.56–1.04)	
			68.1–81.6	181/214	0.70 (0.52–0.95)	
			> 81.6	116/183	0.51 (0.36–0.72)	
			[<i>P</i> _{trend}]		[< 0.01]	
			Hispanic:	375/483		
			≤ 61.2	134/125	1.00	
			61.3–68.0	86/121	0.61 (0.40–0.93)	
			68.1–81.6	102/146	0.48 (0.32–0.73)	
			> 81.6	53/91	0.43 (0.26–0.69)	
			[<i>P</i> _{trend}]		[< 0.01]	
			African American:	154/160		
			≤ 61.2	31/27	1.00	
			61.3–68.0	35/34	0.70 (0.31–1.56)	
			68.1–81.6	41/37	0.75 (0.35–1.62)	
> 81.6	47/62	1.62 (0.26–1.14)				
[<i>P</i> _{trend}]		[0.13]				
Non-Hispanic White:	143/165					
≤ 61.2	62/77	1.00				
61.3–68.0	27/27	1.25 (0.60–2.60)				
68.1–81.6	38/31	1.86 (0.94–3.70)				
> 81.6	16/30	0.55 (0.23–1.34)				
[<i>P</i> _{trend}]		[0.96]				

Table 2.2.9f Case-control studies of weight and cancer of the breast in premenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
Kawai et al. (2013) Japan 1997–2009	1017 2902 Hospital; female non-cancer patients with benign tumours, cardiovascular diseases, digestive tract diseases, respiratory tract disease, urological–gynaecological disease	Weight (kg)	ER+PR+:	250		Age, smoking, alcohol consumption, family history of BC, occupation, age at menarche, age at first birth, parity, use of exogenous female hormones or OC, year of recruitment, area, referral basis (screening, other), height, time spent exercising <i>P</i> _{heterogeneity} = 0.79
			< 49.0	47/223	1.00	
			49.0–54.0	56/218	1.00 (0.62–1.62)	
			54.0–60.0	82/261	1.34 (0.85–2.11)	
			≥ 60.0	65/337	0.79 (0.49–1.27)	
			[<i>P</i> _{trend}]		[0.45]	
			ER–PR–:	95		
			< 49.0	22/223	1.00	
49.0–54.0	15/218	0.55 (0.27–1.14)				
54.0–60.0	29/261	0.83 (0.44–1.57)				
≥ 60.0	29/337	0.65 (0.34–1.24)				
[<i>P</i> _{trend}]		[0.41]				
Singh & Jangra (2013) India August 2009–July 2010	128 aged 20–80 yr 128 Hospital; enrolled from the general surgical ward, without history of any type of cancer, matched by age within 2 yr	Weight (kg)	< 50	6/19	0.496	
			50–60	21/33	1.0	
			60–70	12/15	1.257	
			> 70	10/7	2.245	
			[<i>P</i> _{trend}]		[0.143]	
Troisi et al. (2013) USA 1974–2009	22 646 aged < 85 yr, with primary in situ or invasive cancer 224 721 Population; frequency-matched by parity, age, calendar year of delivery, and race/ethnicity	Pre-pregnancy weight (lb), after 1992	Aged < 50 yr at diagnosis	1770/18 000		
			< 125	411/4408	0.80 (0.69–0.92)	
			125– < 140	522/4571	1.00	
			140– < 160	415/4263	0.86 (0.75–0.99)	
			≥ 160	422/4758	0.78 (0.68–0.90)	

BC, breast cancer; BMI, body mass index (in kg/m²); CI, confidence interval; ER, estrogen receptor; HRT, hormone replacement therapy; MET, metabolic equivalent; OC, oral contraceptive; PR, progesterone receptor; yr, year or years

^a In this table, the study population describes the population of the entire study, and the numbers of cases and controls refer to the number of women in the study, not necessarily the number of premenopausal women.

Table 2.2.9h Case-control studies of body mass index and cancer of the breast in premenopausal women, by hormone receptor status

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
Enger et al. (2000) USA 1983–1988	424 premenopausal 714 premenopausal Population; matched by age, race (Hispanic/non-Hispanic), parity, and residential neighbourhood	BMI at reference age	ER+PR+:			
			< 21.7	88/319	1.00	Age at reference year, SES, age at menarche, age at first full-term pregnancy, number of full-term pregnancies, months of breastfeeding, family history of BC, physical activity
			21.7–23.6	54/162	1.28 (0.86–1.89)	
			23.7–27.0	33/115	1.03 (0.65–1.64)	
			≥ 27.1	34/118	1.11 (0.70–1.77)	
			[<i>P</i> _{trend}]		[0.68]	
			ER+PR–:			
			< 21.7	17/319	1.00	
			21.7–23.6	17/162	2.19 (1.09–4.39)	
			23.7–27.0	11/115	1.72 (0.77–3.85)	
			≥ 27.1	6/118	0.92 (0.34–2.47)	
			[<i>P</i> _{trend}]		[0.72]	
			ER–PR–:			
			< 21.7	62/319	1.00	
			21.7–23.6	35/162	1.11 (0.71–1.77)	
			23.7–27.0	23/115	0.95 (0.58–1.70)	
≥ 27.1	25/118	1.07 (0.56–1.68)				
[<i>P</i> _{trend}]		[0.91]				
ER unknown/PR unknown						
< 21.7	140/319	1.00				
21.7–23.6	64/162	0.89 (0.63–1.28)				
23.7–27.0	47/115	0.80 (0.54–1.21)				
≥ 27.1	45/118	0.80 (0.53–1.20)				
[<i>P</i> _{trend}]		[0.20]				

Table 2.2.9h Case-control studies of body mass index and cancer of the breast in premenopausal women, by hormone receptor status

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
Huang et al. (2000) USA 1993–1996	862 790 Population	BMI	ER+PR+:	168/354	1.0	Age at selection, race, age at menarche, nulliparity/age at first full-term pregnancy, breastfeeding, abortion or miscarriage, WHR, OC use, HRT use, first-degree family history of BC, medical radiation to the chest, cigarette smoking, alcohol consumption, education level, and the offset term
			< 23		0.7 (0.4–1.1)	
			23–31		0.6 (0.3–1.2)	
			> 31			
			ER–PR–:	151/354	1.0	
			< 23		0.9 (0.6–1.6)	
23–31		0.6 (0.3–1.2)				
> 31						
Yoo et al. (2001) Japan 1988–1992	1154 aged ≥ 25 yr, no previous history of cancer 21 714 Hospital	BMI	per 1 kg/m ²		1.05 (0.99–1.12)	Age at interview, occupation, family history of BC, age at menarche, age at menopause, age at first full-term pregnancy, number of full-term pregnancies, months of breastfeeding, alcohol consumption, cigarette smoking, weight, height
			ER+		1.02 (0.94–1.11)	
			ER–		1.02 (0.95–1.10)	
			PR+		1.06 (0.99–1.14)	
			PR–			
Britton et al. (2002) USA 1990–1992 Women’s Interview Study of Health	1556 1397 Population; frequency-matched by age and geographical region	BMI	ER+PR+:			Age, race, education level, WHR, parity, age at first birth, lactation, OC use, cigarette smoking, alcohol consumption, recreational exercises at age 12–13 yr and 1 yr before interview, age at menarche, family history of BC, menopausal status
			≤ 24.6	351/642		
			> 24.6	249/660		
			ER+PR–:			
			≤ 24.6	58/642	1.00	
			> 24.6	56/660	1.04 (0.68–1.60)	
			ER–PR+:			
			≤ 24.6	50/642	1.00	
			> 24.6	61/660	1.01 (0.66–1.56)	
			ER–PR–:			
			≤ 24.6	168/642	1.00	
			> 24.6	176/660	0.91 (0.70–1.19)	

Table 2.2.9h Case-control studies of body mass index and cancer of the breast in premenopausal women, by hormone receptor status

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
Britton et al. (2002) (cont.)			ER/PR status not available			
			≤ 24.6	183/642	1.00	
			> 24.6	153/660	0.90 (0.69–1.18)	
Cotterchio et al. (2003) Canada ECSS study: April 1995–March 1996 WHS study: July 1996–September 1998	3748 3691 Population; frequency-matched by study: April 5-yr age group 3276 with ER/PR status 480 missing ER/PR status	BMI	ER+PR+:			<i>P</i> _{heterogeneity} = 0.03
			≤ 25	295/721	1.00	
			25.1–27	68/165	1.14 (0.76–1.72)	
			> 27	126/335	0.71 (0.50–1.00)	
			ER–PR–:			
			≤ 25	155/721	1.00	
25.1–27	38/165	1.36 (0.80–2.31)				
> 27	72/335	1.35 (0.89–2.05)				
McCredie et al. (2003) Australia 1992–1999	Aged < 40 yr 765 564 Population (electoral roll)	BMI	ER+PR+:	323/564		Study centre, study period, reference age, highest completed education level, country of birth, marital status, affected first- degree relative, height, age at menarche, number of live births, ever use of OC
			< 23		1.0	
			≥ 23	43%/46%	0.9 (0.7–1.2)	
			ER+PR–:	34/564		
			< 23		1.0	
			≥ 23	50%/46%	1.2 (0.6–2.3)	
			ER–PR+:	80/564		
			< 23		1.0	
			≥ 23	46%/46%	1.0 (0.6–1.6)	
			ER–PR–:	181/564		
			< 23		1.0	
			≥ 23	50%/46%	1.1 (0.8–1.5)	
ER or PR unknown:	147/564					
< 23		1.0				
≥ 23	51%/46%	1.3 (0.9–1.3)				

Table 2.2.9h Case-control studies of body mass index and cancer of the breast in premenopausal women, by hormone receptor status

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates	
Nichols et al. (2005) Viet Nam, China 1993–1999	Cases were simultaneously participants in randomized clinical trial on oophorectomy and tamoxifen 682 649 Population; visitors of non-cancer patients in the participating hospitals; matched to cases by single year of age	BMI	ER+:				Age, parity, age at first birth, alcohol consumption, spouse's education level
			13.2–18.5	78/159	1.00		
			18.6–20.0	64/160	0.84 (0.56–1.26)		
			20.1–21.6	61/155	0.81 (0.53–1.23)		
			21.7–40.8	68/156	0.89 (0.59–1.35)		
			[<i>P</i> _{trend}]		[0.3]		
			ER-:				
			13.2–18.5	48/159	1.00		
			18.6–20.0	39/160	0.78 (0.48–1.28)		
			20.1–21.6	37/155	0.71 (0.43–1.18)		
			21.7–40.8	44/156	0.88 (0.54–1.42)		
			[<i>P</i> _{trend}]		[0.4]		
			HER2/neu+:				
			13.2–18.5	48/159	1.00		
			18.6–20.0	40/160	0.79 (0.49–1.28)		
			20.1–21.6	32/155	0.62 (0.37–1.04)		
21.7–40.8	32/156	0.64 (0.38–1.07)					
[<i>P</i> _{trend}]		[0.2]					
HER2/neu-:							
13.2–18.5	74/159	1.00					
18.6–20.0	64/160	0.89 (0.59–1.36)					
20.1–21.6	65/155	0.92 (0.60–1.40)					
21.7–40.8	76/156	1.08 (0.71–1.62)					
[<i>P</i> _{trend}]		[0.6]					

Table 2.2.9h Case-control studies of body mass index and cancer of the breast in premenopausal women, by hormone receptor status

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
Tsakountakis et al. (2005) Greece 1996–2002	384 women with primary invasive BC 566 Hospital; women referred for breast screening and who did not develop cancer	BMI	BMI > 29 HER2/neu+ HER2/neu- Ratio HER2/neu+ to HER2/neu-		NS 6.89 (2.23–21.25) NS	Age, residence, menopausal status, menopausal age, use of OC, use of HRT, first-degree family history of BC, age at first full-term pregnancy, parity, abortion, lactation, medication to suppress lactation, radiation to the chest, BMI, benign breast disease
Ma et al. (2006) USA White including Hispanic: 1998–2003 African American: 2000–2003	Aged 20–49 yr 1794 (1585 White including Hispanic, 209 African American) 444 (409 White including Hispanic, 35 African American) Population; neighbourhood walk algorithm	BMI 1 yr before reference date	ER+PR+: < 25 25–29 30–34 ≥ 35 [P _{trend}] ER-PR-: < 25 25–29 30–34 ≥ 35 [P _{trend}]	854/440 495/257 209/95 94/51 56/37 385/440 183/440 101/95 61/51 40/37	1.00 1.11 (0.82–1.50) 0.88 (0.59–1.30) 0.69 (0.43–1.11) [0.20] 1.00 1.41 (0.99–2.02) 1.43 (0.91–2.23) 1.18 (0.70–2.01) [0.16]	Race, age, education level, first-degree family history of BC, age at menarche, gravidity, number of full-term pregnancies, combined OC use, average number of alcoholic drinks per week in recent 5 yr
Millikan et al. (2008) USA Phase 1: 1993–1996 (invasive cancers) Phase 2: 1996–2001 (all cases of CIS, including DCIS)	1424 2022 Population Phase 1: 1803 (787 African American, 1016 White) 1564 (718 African American, 846 White) Phase 2: 508 (107 African American, 401 White) 458 (70 African American, 388 White)	BMI	Luminal A: < 25 25–29 ≥ 30 [P _{trend}] Basal-like: < 25 25–29 ≥ 30 [P _{trend}]	138/292 75/233 105/318 34/292 35/233 50/318	1.0 0.7 (0.5–1.0) 0.7 (0.5–1.0) [0.08] 1.0 1.1 (0.7–1.9) 1.0 (0.6–1.8) [0.96]	Offsets, age, race, menopausal status (overall), family history of BC, alcohol consumption, smoking duration, OC use, age at menarche, parity, breastfeeding

Table 2.2.9h Case-control studies of body mass index and cancer of the breast in premenopausal women, by hormone receptor status

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
Dey et al. (2009) South India 2002–2005	900 1208 Population; visitors of non-BC patients, matched to cases by age (5-yr groups) and residence type (urban/rural)	BMI	ER+ER-:	153/316	1.00	Age, religion, education level, SES, BMI, age at menarche, parity, age at marriage, total duration of breastfeeding, physical activity per day
			≤ 21.4	0.72 (0.44–1.20)		
			21.4–25.1	0.54 (0.32–0.92)		
			> 25.1	[0.24]		
			[<i>P</i> _{trend}]			
			ER+:	153/811	1.00	
			≤ 21.4	1.04 (0.66–1.62)		
			21.4–25.1	1.29 (0.80–2.08)		
			> 25.1	[0.30]		
[<i>P</i> _{trend}]						
ER-:	316/811	1.00				
≤ 21.4	1.53 (1.08–2.16)					
21.4–25.1	2.21 (1.54–3.16)					
> 25.1	[< 0.0001]					
[<i>P</i> _{trend}]						
Dolle et al. (2009) USA 1983–1992	Aged ≤ 45 yr 897 (187 triple-negative) 1569 Population; matched by age	BMI	All:	897/1569		Age, family history of BC, breastfeeding, duration of OC use
			< 18.5	35/87	0.7 (0.4–1.2)	
			18.5–24.9	578/977	1.0	
			25.0–29.9	151/269	1.0 (0.7–1.3)	
			≥ 30.0	117/209	0.9 (0.7–1.3)	
			[<i>P</i> _{trend}]		[0.99]	
			Triple-negative:	187/1569		
			< 18.5	6/87	0.5 (0.2–1.7)	
			18.5–24.9	121/977	1.0	
			25.0–29.9	33/269	1.1 (0.6–1.8)	
≥ 30.0	26/209	1.3 (0.8–2.2)				
[<i>P</i> _{trend}]		[0.18]				

Table 2.2.9h Case-control studies of body mass index and cancer of the breast in premenopausal women, by hormone receptor status

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
Dolle et al. (2009) (cont.)			Non-triple-negative: < 18.5 18.5–24.9 25.0–29.9 ≥ 30.0 [<i>P</i> _{trend}]	710/1569 29/87 457/977 118/269 91/209	0.8 (0.4–1.4) 1.0 0.9 (0.7–1.3) 0.8 (0.6–1.2) [0.54]	
Trivers et al. (2009) USA 1990–1992	Aged 20–54 yr 476 (116 Black, 360 White) 913 Population	BMI	Triple-negative: < 25 25–29.9 ≥ 30 ER/PR– HER2+: < 25 25–29.9 ≥ 30 ER/PR+ HER2+: < 25 25–29.9 ≥ 30 ER/PR+ HER–: < 25 25–29.9 ≥ 30	135/913 54/408 39/248 41/227 33/913 15/408 11/248 7/227 36/913 23/408 7/248 6/227 272/913 171/408 57/248 43/227	1.00 1.11 (0.78–1.59) 1.25 (0.87–1.79) 1.00 1.12 (0.60–2.07) 0.72 (0.35–1.47) 1.00 0.45 (0.23–0.90) 0.45 (0.22–0.94) 1.00 0.58 (0.44–0.77) 0.58 (0.43–0.78)	Race, age

Table 2.2.9h Case-control studies of body mass index and cancer of the breast in premenopausal women, by hormone receptor status

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates	
Bao et al. (2011) China Phase I: 1996–1998 Phase II: 2002–2005	3443 3474 Population; randomly selected, Shanghai Resident Registry; frequency-matched by 5-yr age group 1409 ER+PR+ 712 ER-PR- 301 ER+PR- 254 ER-PR+	BMI	ER+PR+:				
			< 21.00	212/586	1.00		
			21.00–23.02	219/537	0.96 (0.76–1.21)		
			23.03–25.15	233/455	1.09 (0.86–1.39)		
			≥ 25.16	218/378	1.07 (0.82–1.39)		
			[<i>P</i> _{trend}]		[0.45]		
			ER-PR-:				
			< 21.00	113/586	1.00		
			21.00–23.02	116/537	0.98 (0.73–1.31)		
			23.03–25.15	90/455	0.81 (0.59–1.11)		
≥ 25.16	90/378	0.84 (0.59–1.19)					
[<i>P</i> _{trend}]		[0.19]					
Gaudet et al. (2011) USA; SEER and CASH study 1980–1982	Aged ≤ 56 yr 890 3432 Population; frequency-matched	BMI Treated as ordinal variable, and included underweight BMI < 18.5, normal weight 18.5 to < 25.0, overweight 15.0 to < 30.0, and obese ≥ 30.0	Luminal A (<i>n</i> = 455)	198/1271	1.11 (0.84–1.48)	<i>P</i> values calculated based on comparison of each tumour subtype with luminal A; adjusted for age at diagnosis, age at menarche, nulliparity, age at first birth per 5 yr, months of breastfeeding per 6 months, BMI, ever OC use, benign breast disease, family history of BC	
			Luminal B (<i>n</i> = 72)	38/1271	1.73 (1.07–2.77)		0.088
			HER2/neu+ (<i>n</i> = 117)	47/1271	0.67 (0.32–1.41)		0.22
			Triple-negative (<i>n</i> = 246)	109/1271	1.67 (1.22–2.28)		0.026
			Perimenopausal women:				
			Luminal A (<i>n</i> = 455)	91/658	0.81 (0.56–1.17)		
			Luminal B (<i>n</i> = 72)	13/658	1.27 (0.63–2.56)		0.19
			HER2/neu+ (<i>n</i> = 117)	12/658	0.55 (0.23–1.33)		0.46
			Triple-negative (<i>n</i> = 246)	35/658	0.92 (0.56–1.50)		0.41

Table 2.2.9h Case-control studies of body mass index and cancer of the breast in premenopausal women, by hormone receptor status

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
John et al. (2011) USA Hispanic: 1995–2002 African American: 1995–1999 Non-Hispanic White: 1995–1999	702 of 2258 (1119 Hispanic, 543 African American, 596 non-Hispanic White) 846 of 2706 (1462 Hispanic, 598 African American, 646 non-Hispanic White) Population; randomly selected and frequency-matched by race/ethnicity and the expected 5-yr age distribution of cases	Current BMI	ER+PR+:	305		Age, race/ethnicity, place of birth, education level, family history of BC, history of benign breast disease, age at menarche, number of full-term pregnancies, months of breastfeeding, lifetime physical activity, alcohol consumption, daily total energy intake, current height
			< 25.0	158/262	1.00	
			25.0–29.9	80/274	0.50 (0.35–0.71)	
			≥ 30	67/272	0.42 (0.29–0.61)	
			[<i>P</i> _{trend}]		[< 0.01]	
			ER–PR–:	163		
< 25.0	56/262	1.00				
25.0–29.9	49/274	0.91 (0.58–1.42)				
≥ 30	58/272	1.05 (0.67–1.64)				
[<i>P</i> _{trend}]		[0.81]				
Bandera et al. (2013a) USA	Women of African ancestry 978 958 Population; random-digit dialling	Current BMI	ER+PR+:			Age, ethnicity, country of origin, education level, family history of BC, history of benign breast disease, age at menarche, parity, breastfeeding, age at first birth, HRT use, OC use
			< 25	42/103	1.00	
			25–29.99	58/142	1.15 (0.67–1.96)	
			≥ 30	95/237	1.34 (0.68–2.68)	
			[<i>P</i> _{trend}]		[0.40]	
			ER–PR–:			
< 25	20/103	1.00				
25–29.99	31/142	1.17 (0.59–2.34)				
≥ 30	51/237	1.26 (0.53–3.00)				
[<i>P</i> _{trend}]		[0.65]				
Kawai et al. (2013) Japan 1997–2009	1017 2902 Hospital; female non-cancer patients with benign tumours, cardiovascular diseases, digestive tract diseases, respiratory tract disease, urological–gynaecological disease	BMI	ER+PR+:	250		Age, smoking, alcohol consumption, family history of BC, occupation, age at menarche, age at first birth, parity, use of exogenous female hormones or OC, year of recruitment, area, referral basis (screening, other), height, time spent exercising
			< 18.5	18/68	1.00	
			18.5–22.1	97/385	0.89 (0.49–1.64)	
			22.1–25.0	77/318	0.83 (0.44–1.55)	
			25.0–30.0	48/208	0.90 (0.46–1.74)	
			≥ 30.0	10/60	0.55 (0.22–1.34)	
[<i>P</i> _{trend}]		[0.34]				

Table 2.2.9h Case-control studies of body mass index and cancer of the breast in premenopausal women, by hormone receptor status

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
Kawai et al. (2013) (cont.)			ER-PR-:	95		
			< 18.5	7/68	1.00	
			18.5–22.1	35/385	0.73 (0.30–1.76)	
			22.1–25.0	26/318	0.57 (0.23–1.44)	
			25.0–30.0	22/208	0.82 (0.32–2.12)	
			≥ 30.0	5/60	0.65 (0.19–2.28)	
			[<i>P</i> _{trend}]		[0.79]	<i>P</i> _{heterogeneity} = 0.75
Kawai et al. (2014) USA 2004–2010	1021 939 Population	BMI at age 18 yr	Triple-negative:	182/940		Age at reference, reference year, race/ethnicity, age at first birth <i>P</i> _{homogeneity} triple-negative vs ER+, 0.28
			< 18.8	56/238	1.0	
			18.8– < 20.4	47/233	0.7 (0.4–1.2)	
			20.4– < 22.2	37/224	0.7 (0.4–1.2)	
			≥ 22.2	41/232	0.7 (0.4–1.2)	
			[<i>P</i> _{trend}]		[0.17]	
			ER-HER2+:	60/940		
			< 18.8	15/238	1.0	
			18.8– < 20.4	15/233	1.0 (0.5–2.3)	
			20.4– < 22.2	16/224	1.0 (0.4–2.3)	
			≥ 22.2	14/232	1.0 (0.4–2.3)	
			[<i>P</i> _{trend}]		[0.93]	
			ER+:	779/940		
			< 18.8	228/238	1.0	
			18.8– < 20.4	195/233	0.9 (0.7–1.3)	
			20.4– < 22.2	184/224	1.0 (0.8–1.4)	
			≥ 22.2	166/232	0.9 (0.6–1.2)	
			[<i>P</i> _{trend}]		[0.65]	

Table 2.2.9h Case-control studies of body mass index and cancer of the breast in premenopausal women, by hormone receptor status

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
Kawai et al. (2014) (cont.)		BMI at reference	Triple-negative:	182/940		<i>P</i> _{homogeneity} triple-negative vs ER+, 0.38
			< 21.7	47/235	1.0	
			21.7– < 24.2	37/231	0.9 (0.5–1.5)	
			24.2– < 28.8	42/241	0.8 (0.5–1.4)	
			≥ 28.3	56/232	1.2 (0.7–2.0)	
			[<i>P</i> _{trend}]		[0.62]	
			ER–HER2+:	60/940		
			< 21.7	13/235	1.0	
			21.7– < 24.2	20/231	1.4 (0.6–3.1)	
			24.2– < 28.8	9/241	0.8 (0.3–1.9)	
			≥ 28.3	18/232	1.2 (0.5–2.8)	
			[<i>P</i> _{trend}]		[1.00]	
			ER+:	779/940		
			< 21.7	235/235	1.0	
21.7– < 24.2	178/231	0.8 (0.6–1.2)				
24.2– < 28.8	202/241	1.0 (0.7–1.3)				
≥ 28.3	164/232	0.8 (0.6–1.2)				
[<i>P</i> _{trend}]		[0.5]				
		BMI at reference; WHO cut-off	Triple-negative:	182/940		Age at reference, reference year, race/ethnicity, age at first birth <i>P</i> _{homogeneity} triple-negative vs ER+, 0.54
			< 25	99/526	1.0	
			25– < 30	43/241	1.0 (0.6–1.5)	
			≥ 30	40/172	1.2 (0.7–2.0)	
			[<i>P</i> _{trend}]		[0.5]	
			ER–HER2+:	60/940		
			< 25	37/526	1.0	
			25– < 30	9/241	0.6 (0.3–1.3)	
			≥ 30	14/172	1.1 (0.5–2.3)	
			[<i>P</i> _{trend}]		[0.88]	

Table 2.2.9h Case-control studies of body mass index and cancer of the breast in premenopausal women, by hormone receptor status

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
Kawai et al. (2014) (cont.)			ER+:	779/940		
			< 25	464/526	1.0	
			25– < 30	191/241	1.0 (0.8–1.4)	
			≥ 30	124/172	1.0 (0.7–1.4)	
			[<i>P</i> _{trend}]		[0.94]	

BC, breast cancer; BMI, body mass index (in kg/m²); CI, confidence interval; CIS, carcinoma in situ; DCIS, ductal carcinoma in situ; ER, estrogen receptor; HER2, human epidermal growth factor receptor 2; HRT, hormone replacement therapy; NS, not significant; OC, oral contraceptive; PR, progesterone receptor; SES, socioeconomic status; WHR, waist-to-hip ratio; yr, year or years

^a In this table, the study population describes the population of the entire study, and the numbers of cases and controls refer to the number of women in the study, not necessarily the number of premenopausal women.

Table 2.2.9j Case-control studies of body mass index and cancer of the breast in premenopausal women, by ethnicity

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
Wenten et al. (2002) USA 1992–1994	712 (332 Hispanic, 380 non-Hispanic White) aged 30–70 yr diagnosed with invasive or in situ BC 1039 (511 Hispanic, 528 non-Hispanic White) Population	BMI, usual	Hispanic:			Age, family history of BC in first-degree relatives, total METs, parity, OC use, months of breastfeeding, age at first full-term birth, HRT use, menopausal status, weight at age 18 yr Results also reported for BMI at age 18 yr
			< 22		1.00	
			22– < 25		1.72 (0.83–3.59)	
			25– < 30		1.51 (0.67–3.41)	
			≥ 30		1.64 (0.52–5.11)	
			[<i>P</i> _{trend}]		[0.54]	
			Non-Hispanic White:			
			< 22		1.00	
			22– < 25		0.86 (0.44–1.70)	
			25– < 30		0.70 (0.27–1.80)	
			≥ 30		0.71 (0.19–2.63)	
			[<i>P</i> _{trend}]		[0.42]	
Ziv et al. (2006) USA 1997–1999	Hispanic/Latina women 324 421 Population; matched by ethnicity and 5-yr age group	BMI	All Latinas:			Age, case-control status, grandparents' place of birth, age at migration, education level, place of birth (USA vs foreign) Age, case-control status, grandparents' place of birth, education level Age, case-control status, grandparents' place of birth, age at migration, education level
			25–29.9 vs < 25	71/121	1.93 (1.38–2.69)	
			≥ 30 vs < 25	115/161	1.51 (1.12–2.04)	
			Latinas born in USA:			
			25–29.9 vs < 25		1.25 (0.79–1.96)	
			≥ 30 vs < 25		1.26 (0.83–1.92)	
Foreign-born Latinas:						
25–29.9 vs < 25		3.44 (1.97–5.99)				
≥ 30 vs < 25		1.95 (1.24–3.06)				

Table 2.2.9j Case-control studies of body mass index and cancer of the breast in premenopausal women, by ethnicity

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates	
Slattery et al. (2007) USA 1999–2004	Hispanic women living in non-reservations and non-Hispanic White women 2325 (1527 non-Hispanic White, 798 Hispanic) 2525 (1601 non-Hispanic White, 924 Hispanic) Population; matched by ethnicity, age in 5-yr classes, random selection	BMI in reference year	Non-Hispanic White:				Age, height, physical activity, energy intake, parity, alcohol consumption, age at first pregnancy, age at menopause, centre Results also reported for BMI at age 15 yr
			< 25	269/311	1.00		
			25–29.9	129/128	0.85 (0.63–1.16)		
			≥ 30	93/92	0.82 (0.58–1.17)		
			[<i>P</i> _{trend}]		[0.21]		
			Hispanic:				
< 25	118/129	1.00					
25–29.9	107/102	0.99 (0.66–1.48)					
≥ 30	104/96	0.96 (0.63–1.46)					
[<i>P</i> _{trend}]		[0.86]					
Berstad et al. (2010) USA, 5 sites 1994–1998	4575 (2953 Caucasian, 1622 African American) 4682 (3021 Caucasian, 1661 African American) Population	BMI at age 18 yr	Caucasian:	1365/1347		Age, race, education level, study site, first-degree family history of BC, parity, age at menopause, HRT use, BMI at the other time point	
		< 20	721/710	1.00			
		20–24	562/544	1.02 (0.87–1.19)			
		≥ 25	82/93	0.84 (0.61–1.15)			
		[<i>P</i> _{trend}]		[0.58]			
		African American:	733/688				
		< 20	337/298	1.00			
		20–24	320/295	0.94 (0.75–1.18)			
		≥ 25	76/95	0.67 (0.47–0.96)			
		[<i>P</i> _{trend}]		[0.06]			
		BMI 5 yr before reference date	Caucasian:				
		< 25	993/942	1.00			
25–29	240/258	0.87 (0.71–1.06)					
30–34	82/92	0.80 (0.59–1.10)					
≥ 35	50/55	0.86 (0.57–1.29)					
[<i>P</i> _{trend}]		[0.09]					

Table 2.2.9j Case-control studies of body mass index and cancer of the breast in premenopausal women, by ethnicity

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
Berstad et al. (2010) (cont.)			African American: < 25 25–29 30–34 ≥ 35 [<i>P</i> _{trend}]	349/324 332/208 86/83 66/73	1.00 1.02 (0.79–1.30) 0.94 (0.66–1.33) 0.81 (0.56–1.19) [0.34]	
John et al. (2011) USA Hispanic: 1995–2002 African American: 1995–1999 Non-Hispanic White: 1995–1999	702 of 2258 (1119 Hispanic, 543 African American, 596 non-Hispanic White) 846 of 2706 (1462 Hispanic, 598 African American, 646 non-Hispanic White) Population; controls randomly selected and frequency- matched by race/ethnicity and the expected 5-yr age distribution of cases	Current BMI	Hispanic: < 25.0 25.0–29.9 ≥ 30 [<i>P</i> _{trend}] African American: < 25.0 25.0–29.9 ≥ 30 [<i>P</i> _{trend}] Non-Hispanic White: < 25.0 25.0–29.9 ≥ 30 [<i>P</i> _{trend}]	375/483 146/118 125/190 104/175 154/160 59/46 40/50 55/64 143/165 93/98 30/34 20/33	1.00 0.56 (0.38–0.81) 0.52 (0.35–0.77) [< 0.01] 1.00 0.54 (0.29–1.03) 0.65 (0.35–1.23) [0.20] 1.00 1.02 (0.54–1.93) 0.60 (0.28–1.30) [0.28]	Age, place of birth, education level, family history of BC, history of benign breast disease, age at menarche, number of FTPs, months of breastfeeding, lifetime physical activity, alcohol consumption, daily total energy intake, current height
Bandera et al. (2013b) USA New York City: 2002–2008 New Jersey: 2006–2012	Women of African and Caucasian ancestry 1751 (979 African American, 772 European American) 1673 (958 African American, 715 European American) Population	BMI at age 20 yr	African American: < 25 25–29.9 ≥ 30 [<i>P</i> _{trend}]	347/340 64/75 23/47	1.00 1.02 (0.67–1.56) 0.77 (0.42–1.40) [0.52]	Age, ethnicity (Hispanic/non- Hispanic), country of origin, family history of BC, history of benign breast disease, age at menarche, parity, breastfeeding status, age at first birth, HRT use, OC use, height and weight at menarche

Table 2.2.9j Case-control studies of body mass index and cancer of the breast in premenopausal women, by ethnicity

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
Bandera et al. (2013b) (cont.)		BMI at age 20 yr	European American: < 25 25–29.9 ≥ 30 [<i>P</i> _{trend}]	357/343 27/28 5/15	1.00 0.98 (0.53–1.82) 0.29 (0.09–0.86) [0.07]	
Robinson et al. (2014) USA 1993–2001	1783 (788 Black, 995 White) aged 20–74 yr 1536 (718 Black, 818 White) Population; frequency- matched by 5-yr age group	BMI, measured	Black: < 25 25–30 30–35 ≥ 35 [<i>P</i> _{trend}] White: < 25 25–30 30–35 ≥ 35 [<i>P</i> _{trend}]	58/53 92/100 84/85 101/83 270/174 130/95 57/49 50/42	1.00 0.85 (0.51–1.41) 0.89 (0.53–1.51) 1.02 (0.61–1.73) [0.75] 1.00 0.87 (0.62–1.23) 0.73 (0.47–1.14) 0.67 (0.41–1.08) [0.05]	Age, age squared, family history of BC, alcohol consumption, menarche, parity, age at first FTP composite, lactation, education level, smoking Results also reported for BMI at age 18 yr, at age 35 yr, and 1 yr before interview
John et al. (2015) USA 2 population-based case-control studies San Francisco Bay Area study: 1995–2002 4-Corners Breast Cancer Study: 1999– 2004	945 1418 Population	Current BMI	ER+PR+ Hispanic ER+PR+: per 5 kg/m ² Non-Hispanic White ER+PR+: per 5 kg/m ²	575/1418 285/765 290/653	 0.81 (0.71–0.92) 0.92 (0.82–1.05)	Age, study, ethnicity/English language acculturation (for Hispanic women), family history of BC, age at menarche, number of FTPs, age at first FTP, lifetime number of months of breastfeeding, OC use Results also reported for young adult BMI, by hormone receptor status and by ethnicity

Table 2.2.9j Case-control studies of body mass index and cancer of the breast in premenopausal women, by ethnicity

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
John et al. (2015) (cont.)		Current BMI	ER-PR-	247/1418	0.83 (0.71-0.98)	Age, study, ethnicity, English language acculturation, average alcohol consumption
			Hispanic ER-PR-: per 5 kg/m ²	142/765		
			Non-Hispanic White ER-PR-: per 5 kg/m ²	105/653		
Sanderson et al. (2015) USA 2001-2011	2614 aged 25-75 yr, with primary DCIS or invasive BC 2306 Population; matched by 5-yr age group, race, and county of residence	BMI	Black:	214/143	1.0 1.2 (0.6-2.3) 2.2 (1.1-4.6) 1.6 (0.8-3.2) [0.17] 1.0 1.4 (1.1-1.8) 1.0 (0.7-1.4) 1.1 (0.7-1.6) [0.87]	Age, education level, history of BC in first-degree relatives, OC use, age at menarche
			< 25.0	37/28		
			25.0-29.9	65/49		
			30.0-34.9	56/28		
			≥ 35	56/37		
			[<i>P</i> _{trend}]			
			White:	672/720		
			< 25.0	325/404		
			25.0-29.9	199/164		
			30.0-34.9	83/86		
≥ 35	65/65					
[<i>P</i> _{trend}]						

BC, breast cancer; BMI, body mass index (in kg/m²); CI, confidence interval; DCIS, ductal carcinoma in situ; ER, estrogen receptor; FTP, full-term pregnancy; HRT, hormone replacement therapy; MET, metabolic equivalent; OC, oral contraceptive; PR, progesterone receptor; yr, year or years

^a In this table, the study population describes the population of the entire study, and the numbers of cases and controls refer to the number of women in the study, not necessarily the number of premenopausal women.

Table 2.2.9I Case-control studies of waist circumference and cancer of the breast in premenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
Friedenreich et al. (2002) Canada 1995–1997	1233 1241 Population, using Waksberg method; frequency-matched by age, 5-yr intervals, and place of residence (urban/rural)	WC (cm)	< 71.5 ≥ 71.5– < 78.5 ≥ 78.5– < 86.8 ≥ 86.8 [<i>P</i> _{trend}]	937 133/117 108/117 105/120 113/118	1.00 0.84 (0.58–1.22) 0.79 (0.54–1.16) 0.89 (0.61–1.31) [0.64]	Age, total energy intake, total lifetime physical activity, education level, ever use of HRT, ever diagnosed with benign breast disease, first-degree family history of BC, ever alcohol consumption, current smoking
Okobia et al. (2006) Nigeria September 2002–April 2004	250 250 Hospital; patients recruited from the same hospitals as cases, treated for non- malignant and non- hormonal surgical disorders	WC (cm)	Mean (± SD): Cases: 88.08 (± 11.10) Controls: 87.37 (± 11.06)	142	1.31 (0.83–1.08)	Age
Slattery et al. (2007) USA 1999–2004	Hispanic women living in non-reservations and non-Hispanic White women 2325 (1527 non- Hispanic White, 798 Hispanic) 2525 (1601 non- Hispanic White, 924 Hispanic) Population; random selection, matched by ethnicity and age in 5-yr classes	WC (in), by ethnicity	Non-Hispanic White: < 35 35–40 > 40 [<i>P</i> _{trend}]	327/361 97/102 56/65	1.00 1.00 (0.72–1.38) 0.98 (0.65–1.47) [0.93]	Age, height, physical activity, energy intake, parity, alcohol consumption, age at first pregnancy, age at menopause, centre

Table 2.2.9I Case-control studies of waist circumference and cancer of the breast in premenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
Slattery et al. (2007) (cont.)			Hispanic: < 35 35–40 > 40 [<i>P</i> _{trend}]	170/174 97/90 62/59	1.00 1.02 (0.69–1.51) 1.04 (0.66–1.62) [0.87]	
Tian et al. (2007) Taiwan, China 2004–2005	244 aged 22–87 yr 244 Hospital; recruited from health examination clinics at the same hospital and time, free of cancer history, matched by menopausal status, date of enrolment, and duration of fasting	WC (cm)	≤ 77.50 > 77.50	104/107 37/34	1.00 1.10 (0.63–1.94)	Age at enrolment, fasting status, levels of adiponectin
Mathew et al. (2008) India 2002–2005	1866 1873 Population; accompanying persons to cancer cases; matched by age ± 5 yr and residence status (urban/rural)	WC (cm)	≤ 85 > 85 Unknown	898/1182 631/918 250/254 17/10	1.00 1.24 (0.96–1.62) 1.19 (0.37–3.90)	Age, centre, religion, marital status, education level, SES, residence status, parity, age at first childbirth, duration of breastfeeding, physical activity
Nemesure et al. (2009) Barbados 2002–2006	Women of African descent, aged ≥ 21 yr 222 454 Population; Barbados Statistical Services; frequency-matched by 5-yr age group	WC (cm)	< 80 80–101 ≥ 101	Aged < 50 yr 27/34 41/104 8/27	1.00 0.70 (0.27–1.80) 0.45 (0.10–2.12)	Age, HRT use, parity, family history of BC, history of benign breast disease, age at first pregnancy, age at menarche, physical activity, other body size variable

Table 2.2.9I Case-control studies of waist circumference and cancer of the breast in premenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates	
John et al. (2011) USA Hispanic: 1995–2002 African American: 1995–1999 Non-Hispanic White: 1995–1999	702 of 2258 (1119 Hispanic, 543 African American, 596 non- Hispanic White) 846 of 2706 (1462 Hispanic, 598 African American, 646 non- Hispanic White) Population; randomly selected and frequency- matched by race/ethnicity and the expected 5-yr age distribution of cases	WC (cm)	All:	672/808		Age, race/ethnicity, place of birth, education level, family history of BC, history of benign breast disease, age at menarche, number of FTPs, months of breastfeeding, lifetime physical activity, alcohol consumption, daily total energy intake, current height	
			≤ 78.7	192/197	1.00		
			78.8–87.0	132/190	0.77 (0.56–1.07)		
			87.1–98.0	155/193	0.87 (0.63–1.21)		
			> 98.0	154/191	0.80 (0.57–1.12)		
			[<i>P</i> _{trend}]		[0.30]		
			WC (cm), by ethnicity	Hispanic:	375/483		
				≤ 78.7	103/95		1.00
		78.8–87.0		76/131	0.59 (0.38–0.91)		
		87.1–98.0		93/135	0.71 (0.46–1.10)		
		> 98.0		91/110	0.74 (0.47–1.17)		
		[<i>P</i> _{trend}]			[0.35]		
		African American:		154/160			
		≤ 78.7		17/23	1.00		
		78.8–87.0	31/31	1.60 (0.65–3.93)			
		87.1–98.0	42/30	1.89 (0.79–4.50)			
> 98.0	47/60	1.09 (0.47–2.52)					
[<i>P</i> _{trend}]		[0.87]					
Non-Hispanic White:	143/165						
≤ 78.7	72/79	1.00					
78.8–87.0	25/28	0.96 (0.46–1.98)					
87.1–98.0	20/28	0.75 (0.35–1.65)					
> 98.0	16/21	0.90 (0.37–2.17)					
[<i>P</i> _{trend}]		[0.59]					

Table 2.2.9I Case-control studies of waist circumference and cancer of the breast in premenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
John et al. (2011) (cont.)		WC (cm), by hormone receptor status	ER+PR+:	305		
			≤ 78.7	104/197	1.00	
			78.8–87.0	63/190	0.70 (0.47–1.05)	
			87.1–98.0	56/193	0.63 (0.41–0.96)	
			> 98.0	65/191	0.65 (0.43–0.99)	
			[<i>P</i> _{trend}]		[0.04]	
			ER–PR–:	163		
			≤ 78.7	34/197	1.00	
			78.8–87.0	32/190	1.00 (0.58–1.73)	
			87.1–98.0	39/193	1.19 (0.69–2.05)	
> 98.0	47/191	1.33 (0.78–2.30)				
[<i>P</i> _{trend}]		[0.24]				
Bandera et al. (2013a) USA	Women of African ancestry 978 958 Population; random- digit dialling	WC (cm)	ER+PR+:			
			≤ 87.88	137/143	1.00	
			87.89–97.75	124/119	1.26 (0.85–1.88)	
			97.76–110.25	107/116	1.47 (0.88–2.44)	
			> 110.25	92/100	2.25 (1.07–4.74)	
			[<i>P</i> _{trend}]		[0.04]	
			ER+PR+:			
			≤ 87.88	57/143	1.00	
			87.89–97.75	52/119	1.28 (0.76–2.17)	
			97.76–110.25	47/116	1.57 (0.80–3.08)	
			> 110.25	36/100	2.05 (0.79–5.35)	
			[<i>P</i> _{trend}]		[0.13]	
			ER–PR–:			
			≤ 87.88	20/143	1.00	
87.89–97.75	24/119	1.07 (0.55–2.10)				
97.76–110.25	25/116	1.52 (0.67–3.47)				
> 110.25	23/100	1.91 (0.59–6.13)				
[<i>P</i> _{trend}]		[0.25]				

BMI, age, ethnicity, country of origin, education level, family history of BC, history of benign breast disease, age at menarche, parity, breastfeeding, age at first birth, HRT use, OC use

Table 2.2.9I Case-control studies of waist circumference and cancer of the breast in premenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
Sangrajrang et al. (2013) Thailand May 2002–March 2004; August 2005–August 2006	1126 1135 Population; female visitors of hospital patients admitted for conditions other than breast or ovarian cancer	WC (cm)	< 80 ≥ 80	363/472 265/268	1.00 0.99 (0.75–1.30)	
Bandera et al. (2013a) USA	Women of African ancestry 978 958 Population; random- digit dialling	WC (cm)	≤ 87.88 87.89–97.75 97.76–110.25 > 110.25 [<i>P</i> _{trend}] ER+/PR+: ≤ 87.88 87.89–97.75 97.76–110.25 > 110.25 [<i>P</i> _{trend}] ER–PR–: ≤ 87.88 87.89–97.75 97.76–110.25 > 110.25 [<i>P</i> _{trend}]	137/143 124/119 107/116 92/100 57/143 52/119 47/116 36/100 20/143 24/119 25/116 23/100	1.00 1.26 (0.85–1.88) 1.47 (0.88–2.44) 2.25 (1.07–4.74) [0.04] 1.00 1.28 (0.76–2.17) 1.57 (0.80–3.08) 2.05 (0.79–5.35) [0.13] 1.00 1.07 (0.55–2.10) 1.52 (0.67–3.47) 1.91 (0.59–6.13) [0.25]	BMI, age, ethnicity, country of origin, education level, family history of BC, history of benign breast disease, age at menarche, parity, breastfeeding, age at first birth, HRT use, OC use
Amadou et al. (2014) Mexico 2004–2007	1000 1074 Population	WC (cm)	< 93 93–103 ≥ 103 [<i>P</i> _{trend}]	214/173 122/165 79/138	1.00 0.60 (0.43–0.85) 0.42 (0.29–0.61) [< 0.001]	Age, health care system, region, SES, breastfeeding, family history of BC, alcohol consumption, physical activity, total energy intake, height, current BMI

Table 2.2.9I Case-control studies of waist circumference and cancer of the breast in premenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
Robinson et al. (2014) USA 1993–2001	Aged 20–74 yr 1783 (788 Black, 995 White) 1536 (718 Black, 818 White) Population; frequency- matched by 5-yr age group	WC (cm), by ethnicity	Black: ≤ 88 > 88 [<i>P</i> _{trend}] White: ≤ 88 > 88 [<i>P</i> _{trend}]	117/140 224/185 369/254 137/111	1.00 1.74 (1.12–2.71) [0.01] 1.00 1.43 (0.88–2.32) [0.15]	Age, age squared, family history of BC, alcohol consumption, menarche, parity, age at first FTP composite, lactation, education level, smoking, reference BMI

BC, breast cancer; BMI, body mass index (in kg/m²); CI, confidence interval; ER, estrogen receptor; FTP, full-term pregnancy; HRT, hormone replacement therapy; OC, oral contraceptive; PR, progesterone receptor; SES, socioeconomic status; WC, waist circumference; yr, year or years

^a In this table, the study population describes the population of the entire study, and the numbers of cases and controls refer to the number of women in the study, not necessarily the number of premenopausal women.

Table 2.2.9n Case-control studies of change in body mass index or weight and cancer of the breast in premenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
<i>BMI change</i>						
Hirose et al. (2001) Japan 1988–1997	1584 15 331 Hospital; first-visit outpatients (screening) without any previous diagnosis of cancer	BMI change	Without family history of BC: < 0 0–1.24 1.25–2.99 ≥ 3 [P _{trend}] With family history of BC: < 0 0–1.24 1.25–2.99 ≥ 3 [P _{trend}]	177/2460 232/2568 247/2401 201/2164 19/97 13/116 12/102 21/97	0.81 (0.66–0.99) 1.00 1.05 (0.87–1.30) 0.89 (0.73–1.10) [0.35] 1.90 (0.87–4.20) 1.00 0.91 (0.38–2.20) 1.45 (0.65–3.20) [0.49]	Age, age at menarche, menstrual regularity in the 20s, age at first birth, parity
Verla-Tebit & Chang- Claude (2005) Germany 1992–1995	558 women with no previous cancer, aged ≤ 51 yr, with in situ or invasive BC 1116 Population; women with no previous history of BC; matched by age and study region	BMI change, age 20 yr to current BMI change, age 30 yr to current	< –1.0 –1.0 to 1.0 1.1–3.0 3.1–5.0 ≥ 5.0 [P _{trend}] < –1.0 –1.0 to 1.0 1.1–3.0 3.1–5.0 ≥ 5.0 [P _{trend}]	50/112 71/177 101/342 73/220 74/249 27/91 127/312 118/380 43/156 39/107	1.16 (0.74–1.80) 1.00 0.75 (0.52–1.08) 0.87 (0.59–1.29) 0.79 (0.53–1.18) [0.28] 0.67 (0.52–1.32) 1.00 0.74 (0.58–1.08) 0.68 (0.55–1.21) 0.96 (0.53–1.30) [0.17]	Age at menarche, parity, OC use, first-degree family history of BC, total months of breastfeeding, mean daily alcohol consumption

Table 2.2.9n Case-control studies of change in body mass index or weight and cancer of the breast in premenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates		
Verla-Tebit & Chang- Claude (2005) (cont.)		BMI change, age 40 yr to current	< -1.0	23/41	0.67 (0.92–2.77)			
			-1.0 to 1.0	158/470	1.00			
			1.1–3.0	40/191	0.64 (0.42–0.98)			
			3.1–5.0	14/42	1.08 (0.44–1.76)			
			≥ 5.0	10/12	2.41 (0.71–3.81)			
			Difference, highest – lowest BMI	< 2.5	130/277		1.00	
2.5–4.0	145/273	1.03 (0.68–1.58)						
		4.1–6.1	115/269	0.81 (0.52–1.26)				
		> 6.1	153/265	1.22 (0.81–1.83)				
Kawai et al. (2014) USA 2004–2010	1021 939 Population	BMI change from age 18 yr to reference year	Aged 20–44 yr:	1021/940	0.9 (0.6–1.4) 1.0 0.9 (0.7–1.1) 1.1 (0.8–1.5) [0.90]	Age at reference, reference year, race/ethnicity, age at first birth		
			< 0	91/89				
			0– < 5.0	535/456				
			5.0– < 10	251/259				
			≥ 10	137/123				
Robinson et al. (2014) USA 1993–2001	1783 (788 Black, 995 White) aged 20–74 yr 1536 (718 Black, 818 White) Population; frequency- matched by 5-yr age group	BMI change from age 18 yr to age 35 yr	Black:	54/51 81/96 152/144 [P _{trend}]	1.00 0.87 (0.52–1.47) 0.98 (0.58–1.65) [0.96]	Age, age squared, family history of BC, alcohol consumption, age at menarche, parity, age at first FTP composite, lactation, education level, smoking, reference BMI		
			< 1.77					
			1.77–4.44					
			≥ 4.44					
			White:					
			< 1.77				181/119	1.00
			1.77–4.44				147/110	0.84 (0.59–1.19)
≥ 4.44	129/106	0.68 (0.44–1.03)						
		[P _{trend}]	[0.07]					

Table 2.2.9n Case-control studies of change in body mass index or weight and cancer of the breast in premenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
<i>Weight change</i>						
Shu et al. (2001) China August 1996–March 1998	1459 aged 25–64 yr enrolled from Shanghai Cancer Registry 1556 of 1724 Population; randomly selected from female residents of Shanghai (Shanghai Resident Registry), matched to cases by age, 5-yr interval	Weight gain (kg) since age 20 yr	< 1.15	952/990 (%) 22.2/23.4	1.0	Age, education level, family history of BC, ever had fibroadenoma, age at menarche, age at first live birth, exercise
			1.15–3.41	23.1/20.8	1.1 (0.8–1.5)	
			3.42–5.64	26.9/23.7	1.1 (0.8–1.4)	
			≥ 5.65	27.8/32.1	1.0 (0.8–1.3)	
			[<i>P</i> _{trend}]		[0.80]	
		Weight gain (kg) during past 10 yr	< 1.15	952/990 (%) 28.5/30.4	1.0	
			1.15–3.41	15.4/15.4	1.1 (0.8–1.5)	
			3.42–5.64	17.6/15.7	1.2 (0.9–1.6)	
≥ 5.65	38.5/38.5		1.1 (0.9–1.4)			
	[<i>P</i> _{trend}]		[0.42]			
de Vasconcelos et al. (2001) Brazil May 1995–February 1996	177 377 Population; visitors at hospital	Weight change (kg) since age 18 yr	> 22.3	7/21	1.00	Age, parity, age at menarche, family history of BC
			13.11–22.3	9/21	1.73 (0.43–6.93)	
			0–13.10	16/24	2.93 (0.85–10.02)	
			Weight loss	4/3	16.65 (1.75–157.80)	
			[<i>P</i> _{trend}]		[0.01]	
		Weight change (kg) from age 18 yr to age 30 yr	> 10	8/22	1.00	
			5.1–10	8/17	1.63 (0.37–7.22)	
			0–5	12/36	1.20 (0.34–4.23)	
			Weight loss	5/3	29.02 (2.39–351.19)	
			[<i>P</i> _{trend}]		[0.16]	
Weight change (kg) since age 30 yr	> 16.2	7/14	1.00	Also adjusted for weight and height at age 30 yr		
	9.1–16.2	19/5	0.48 (0.10–2.29)			
	0–9	18/19	1.48 (0.37–5.81)			
	Weight loss	4/14	0.72 (0.14–3.66)			
	[<i>P</i> _{trend}]		[0.71]			

Table 2.2.9n Case-control studies of change in body mass index or weight and cancer of the breast in premenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
Friedenreich et al. (2002) Canada 1995–1997	1233 1241 Population, using Waksberg method; frequency-matched by age, 5-yr intervals, and place of residence (urban/rural)	Weight gain (kg) since age 20 yr	< 7.72	937	1.00	Current age, total energy intake, total lifetime physical activity, education level, ever use of HRT, ever diagnosed with benign breast disease, first-degree family history of BC, ever alcohol consumption, current smoking
			≥ 7.72– < 13.8	143/118	0.69 (0.47–1.01)	
			≥ 13.8– < 22.0	92/119	0.84 (0.58–1.21)	
			≥ 22.0	113/119	0.79 (0.54–1.15)	
		Difference (kg), maximum – minimum weights over adult lifetime	< 6.81	114/119	[0.24]	
			≥ 6.81– < 12.3	120/113	1.00	
			≥ 12.3– < 20.0	111/122	0.90 (0.62–1.32)	
			≥ 20.0	115/120	0.95 (0.65–1.40)	
Wenten et al. (2002) USA 1992–1994	712 (332 Hispanic, 380 non-Hispanic White) aged 30–70 yr diagnosed with invasive or in situ breast BC 1039 (511 Hispanic, 528 non-Hispanic White) Population	Weight change (kg) (usual weight – weight at age 18 yr)	Hispanic:			Age, family history of BC in first-degree relative, total METs, parity, OC use, months of breastfeeding, age at first full-term birth, weight at age 18 yr
			< 4		1.00	
			4–7		1.65 (0.72–3.81)	
			8–14		1.28 (0.54–3.05)	
			> 14		1.87 (0.82–4.24)	
			[P _{trend}]		[0.27]	
		Non-Hispanic White:				
		< 4		1.00		
		4–7		0.85 (0.43–1.60)		
		8–14		1.17 (0.56–2.43)		
		> 14		0.71 (0.32–1.60)		
		[P _{trend}]		[0.72]		
Weight change (%)	Hispanic:					
	≤ 5.9		1.00			
	> 5.9–14.3		1.65 (0.71–3.83)			
	> 14.3–26.1		1.20 (0.49–2.95)			
	> 26.1		1.97 (0.83–4.67)			
[P _{trend}]		[0.33]				

Table 2.2.9n Case-control studies of change in body mass index or weight and cancer of the breast in premenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
Wenten et al. (2002) (cont.)			Non-Hispanic White: ≤ 5.9 > 5.9–14.3 > 14.3–26.1 > 26.1 [<i>P</i> _{trend}]		1.00 0.52 (0.26–1.05) 1.00 (0.48–2.08) 0.54 (0.22–1.35) [0.67]	
Verla-Tebit & Chang- Claude (2005) Germany 1992–1995	558 aged ≤ 51 yr, with no previous cancer, with in situ or invasive BC 1116 Population; women with no previous history of BC; matched by age and study region	Weight gain (kg)	Overall: < 5 5–8 9–14 > 14 [<i>P</i> _{trend}] Aged ≤ 21 yr: < 5 5–8 9–14 > 14 [<i>P</i> _{trend}] Aged > 21 yr: < 5 5–8 9–14 > 14 [<i>P</i> _{trend}]	123/295 80/266 85/272 80/259 39/122 43/135 53/145 48/159 84/173 37/131 32/127 32/100	1.00 0.75 (0.53–1.05) 0.76 (0.54–1.06) 0.74 (0.53–1.06) [0.10] 1.00 1.10 (0.65–1.86) 1.19 (0.72–1.98) 1.06 (0.62–1.80) [0.78] 1.00 0.52 (0.32–0.83) 0.50 (0.30–0.81) 0.56 (0.34–0.94) [0.007]	Age at menarche, OC use, parity, first-degree family history of BC, total months of breastfeeding, mean daily alcohol consumption

Table 2.2.9n Case-control studies of change in body mass index or weight and cancer of the breast in premenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
Verla-Tebit & Chang- Claude (2005) (cont.)		Weight loss (kg)	Overall:			
			No weight loss	179/610	1.00	
			Weight loss	191/483	1.30 (1.02–1.67)	
			Aged ≤ 40 yr:			
			No weight loss	78/245	1.00	
			Weight loss	149/386	1.29 (0.91–1.81)	
Aged > 40 yr:						
No weight loss	101/365	1.00				
Weight loss	42/99	1.69 (1.07–2.69)				
Slattery et al. (2007) USA 1999–2004	Hispanic women living in non-reservations and non-Hispanic White women 2325 (1527 non- Hispanic White, 798 Hispanic) 2525 (1601 non- Hispanic White, 924 Hispanic) Population; matched by ethnicity, age in 5-yr classes, random selection	Total weight gain (kg) between age 15 yr and reference year	Non-Hispanic White:			Age, height, physical activity, energy intake, parity, alcohol consumption, age at first pregnancy, age at menopause, centre
			≤ 5.0	85/99	1.00	
			5.1–15.0	174/165	0.76 (0.52–1.10)	
			15.1–25.0	122/141	0.98 (0.66–1.46)	
			> 25.0	100/116	0.90 (0.59–1.37)	
			[<i>P</i> _{trend}]		[0.85]	
			Hispanic:			
			≤ 5.0	41/34	1.00	
			5.1–15.0	87/98	1.59 (0.89–2.84)	
			15.1–25.0	98/94	1.29 (0.72–2.33)	
> 25.0	96/89	1.38 (0.76–2.52)				
[<i>P</i> _{trend}]		[0.76]				

Table 2.2.9n Case-control studies of change in body mass index or weight and cancer of the breast in premenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
Wu et al. (2007) USA 1995–2001	Asian American women aged 25–74 yr at diagnosis 1277 (450 Chinese, 352 Japanese, 475 Filipinos) 1160 (486 Chinese, 311 Japanese, 363 Filipinos) Population (neighbourhood); frequency-matched by specific ethnicity, 5-yr age group	Weight gain (kg) since age 18 yr (recent weight – weight at age 18 yr)	≤ 10	358/401	1.00	Age, ethnicity, duration of residence in the USA, education level, age at menarche, number of live births, menopausal status, age at menopause, intake of tea and soy during adolescence and adult life, years of physical activity, height
			> 10– ≤ 15	106/93	1.05 (0.74–1.48)	
		Weight gain (kg) since age 30 yr (recent weight – weight at age 30 yr)	> 15– ≤ 20	46/60	0.64 (0.41–1.05)	
			> 20	51/47	0.87 (0.54–1.40)	
			[<i>P</i> _{trend}]		[0.24]	
			≤ 10	494/544	1.00	
			> 10– ≤ 15	41/44	0.68 (0.41–1.12)	
			> 15– ≤ 20	17/13	0.96 (0.43–2.16)	
			> 20	11/7	1.48 (0.52–4.25)	
			[<i>P</i> _{trend}]		[0.88]	
Shin et al. (2009) China 1996–1998 (1st phase) 2002–2005 (2nd phase)	3452 aged 20–64 yr (1st phase), 20–70 yr (2nd phase) 3474 Population; frequency-matched by age	Weight change (kg) since age 20 yr	≤ 0	2080/1962	1.0	
			0.1–9.4	264/313	1.2 (1.0–1.5)	
			9.5–14.9	731/701	1.2 (1.0–1.5)	
			≥ 15	510/476	1.4 (1.1–1.7)	
			[<i>P</i> _{trend}]	536/435	[0.011]	
Berstad et al. (2010) USA, 5 sites 1994–1998	4575 (2953 Caucasian, 1622 African American) 4682 (3021 Caucasian, 1661 African American) Population	Weight change (kg), age 18 yr until recent	≤ 5	2097/2035	1.00	Age, race, education level, study site, first-degree family history of BC, parity, age at menopause, HRT use, BMI at age 18 yr
			5.1–15.0	686/672	0.96 (0.82–1.11)	
			15.1–25.0	802/782	0.91 (0.76–1.11)	
			≥ 25.1	359/363	1.11 (0.89–1.39)	
			[<i>P</i> _{trend}]	250/218	[0.75]	

Table 2.2.9n Case-control studies of change in body mass index or weight and cancer of the breast in premenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
Cribb et al. (2011) Canada 1999–2002	207 621 Population; women presenting for routine mammography screening; matched by age, menopausal status, and family history of BC	Weight gain	> 10 kg since age 25 yr	39%/39%	2.90 (1.58–5.30)	
John et al. (2011) USA Hispanic: 1995–2002 African American: 1995–1999 Non-Hispanic White: 1995–1999	702 of 2258 (1119 Hispanic, 543 African American, 596 non-Hispanic White) 846 of 2706 (1462 Hispanics, 598 African American, 646 non-Hispanic White) Population; controls randomly selected and frequency-matched by race/ethnicity and the expected 5-yr age distribution of cases	Weight change (kg)	Hispanic: Loss > 3.0 None/stable Gain 3.1–10.0 Gain 10.1–20.0 Gain > 20.0 [<i>P</i> _{trend}] African American: Loss > 3.0 None/stable Gain 3.1–10.0 Gain 10.1–20.0 Gain > 20.0 [<i>P</i> _{trend}] Non-Hispanic White: Loss > 3.0 None/stable Gain 3.1–10.0 Gain 10.1–20.0 Gain > 20.0 [<i>P</i> _{trend}]	375/483 13/17 82/57 119/142 94/138 62/104 154/160 7/6 23/17 45/48 34/33 44/54 143/165 4/10 41/41 53/50 27/34 16/29	0.57 (0.24–1.36) 1.00 0.60 (0.38–0.95) 0.40 (0.25–0.65) 0.35 (0.21–0.59) [<i><</i> 0.01] 1.17 (0.28–4.91) 1.00 0.61 (0.27–1.39) 0.68 (0.28–1.62) 0.52 (0.22–1.22) [0.32] 0.35 (0.09–1.38) 1.00 1.35 (0.69–2.65) 0.87 (0.40–1.90) 0.57 (0.22–1.45) [0.23]	Age, place of birth, education level, family history of BC, history of benign breast disease, age at menarche, number of FTPs, months of breastfeeding, lifetime physical activity, alcohol consumption, daily total energy intake, current height

Table 2.2.9n Case-control studies of change in body mass index or weight and cancer of the breast in premenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates	
Sangaramoorthy et al. (2011) USA 1998–2002	Hispanic women aged 35–79 yr 650 766 Population; frequency- matched by race and age in 5-yr groups, without history of BC	Relative weight vs peers at 10 yr	All:	210/265		Age, country of birth, education level, first-degree family history of BC, prior biopsy history of benign breast disease, number of FTPs, age at first FTP, lifetime breastfeeding, OC use, adult height, alcohol consumption, average energy intake, BMI	
			Lighter	109/100	1.00		
			Same	68/106	0.58 (0.37–0.94)		
		Relative weight vs peers at age 15 yr	Heavier	31/46	0.63 (0.33–1.20)		[0.05]
			All:				
			Lighter	91/69	1.00		
		Relative weight vs peers at age 20 yr	Same	89/129	0.53 (0.32–0.86)		
			Heavier	29/61	0.31 (0.16–0.61)		[< 0.01]
			All:				
		Relative weight vs peers at age 10 yr	Lighter	80/67	1.00		
			Same	95/120	0.82 (0.50–1.35)		
			Heavier	34/73	0.44 (0.24–0.84)		[0.02]
Relative weight vs peers at age 15 yr	Current BMI < 25:	74/60					
	Lighter	48/30	1.00				
	Same	26/30	0.51 (0.16–1.62)				
Relative weight vs peers at age 15 yr	Heavier	0	–	[0.26]			
	Current BMI < 25:						
	Lighter	41/27	1.00				
Relative weight vs peers at age 15 yr	Same	33/32	0.89 (0.30–2.62)				
	Heavier	0	–	[0.83]			
	[P _{trend}]						

Table 2.2.9n Case-control studies of change in body mass index or weight and cancer of the breast in premenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates	
Sangaramoorthy et al. (2011) (cont.)		Relative weight vs peers at age 20 yr	Current BMI < 25:				Age, country of birth, education level, first-degree family history of BC, prior biopsy history of benign breast disease, number of FTPs, age at first FTP, lifetime breastfeeding, OC use, adult height, alcohol consumption, average energy intake
			Lighter	24/28	1.00		
			Same	32/32	0.99 (0.34–2.86)		
			Heavier	0	–		
			[<i>P</i> _{trend}]	[0.98]			
		Relative weight vs peers at age 10 yr	Current BMI ≥ 25:				
			Lighter	61/70	1.00		
			Same	49/79	0.73 (0.41–1.29)		
			Heavier	24/43	0.61 (0.30–1.24)		
			[<i>P</i> _{trend}]	[0.14]			
		Relative weight vs peers at age 15 yr	Current BMI ≥ 25:				
			Lighter	50/42	1.00		
			Same	63/104	0.47 (0.26–0.86)		
			Heavier	22/54	0.26 (0.12–0.56)		
			[<i>P</i> _{trend}]	[< 0.01]			
		Relative weight vs peers at age 20 yr	Current BMI ≥ 25:				
Lighter	38/39		1.00				
Same	70/92		0.92 (0.49–1.73)				
Heavier	27/69		0.42 (0.21–0.87)				
	[<i>P</i> _{trend}]	[0.02]					

Table 2.2.9n Case-control studies of change in body mass index or weight and cancer of the breast in premenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
Bandera et al. (2013b) USA New York City: 2002–2008 New Jersey: 2006–2012	Women of African American and Caucasian ancestry 1751 (979 African American, 772 European American 1673(958 African American, 715 European American) Population	Weight gain (kg) since age 20 yr	African American: Q1: ≤ 13.82 Q2: 13.83–23.72 Q3: 23.73–34.56 Q4: > 34.56 [<i>P</i> _{trend}]	114/130 118/111 93/102 82/91	1.00 1.27 (0.86–1.89) 1.15 (0.73–1.82) 1.49 (0.81–2.73) [0.27]	Age, ethnicity (Hispanic/non- Hispanic), country of origin, family history of BC, history of benign breast disease, age at menarche, parity, breastfeeding status, age at first birth, HRT use, OC use, current BMI
		Weight gain (kg) since age 20 yr	European American: Q1: ≤ 7.57 Q2: 7.58–14.57 Q3: 14.58–24.52 Q4: > 24.52 [<i>P</i> _{trend}]	93/86 85/87 75/76 63/71	1.00 0.88 (0.55–1.40) 0.64 (0.36–1.13) 0.51 (0.23–1.16) [0.10]	
Troisi et al. (2013) USA 1974–2009	22 646 aged < 85 yr, with primary in situ or invasive cancer 224 721 Population; frequency- matched by parity, age, calendar year of delivery, and race/ethnicity	Weight gain (lb) after 1989	< 25 25– < 31 31– < 40 ≥ 40	Aged < 50 yr at diagnosis 534/5788 691/7148 681/6348 695/6984	1.00 1.04 (0.92–1.18) 1.14 (1.01–1.29) 1.06 (0.94–1.20)	Age at delivery, race/ethnicity, parity at index birth, year of index birth
Robinson et al. (2014) USA 1993–2001	Aged 20–74 yr 1783 (788 Black, 995 White) 1536 (718 Black, 818 White) Population; frequency- matched by 5-yr age group	Adult weight gain (lb)	Black: ≤ 25 26–54 ≥ 55 [<i>P</i> _{trend}]	100/81 110/116 126/129	1.00 0.84 (0.54–1.31) 0.68 (0.39–1.19) [0.18]	Age, age squared, family history of BC, alcohol consumption, menarche, parity, age at first FTP composite, lactation, education level, smoking, reference BMI

Table 2.2.9n Case-control studies of change in body mass index or weight and cancer of the breast in premenopausal women

Reference Study location Period	Study population ^a Total number of cases Total number of controls Source of controls	Exposure assessment	Exposure categories	Exposed cases (cases/controls)	Relative risk (95% CI)	Covariates
Robinson et al. (2014) (cont.)			White: ≤ 25 26–54 ≥ 55 [<i>P</i> _{trend}]	153/182 158/92 101/85	1.00 1.24 (0.86–1.80) 0.90 (0.49–1.65) [0.88]	
Sanderson et al. (2015) USA 2001–2011	2614 aged 25–75 yr, primary ductal carcinoma in situ or invasive BC 2306 Population; matched by 5-yr age group, race, and county of residence	Weight change (lb) since age 18 yr	Black: ≤ 0 1–22 23–45 > 46 [<i>P</i> _{trend}] White: ≤ 0 1–22 23–45 > 46 [<i>P</i> _{trend}]	14/9 27/23 52/46 119/62 65/91 215/231 205/208 186/189	1.0 0.7 (0.2–2.0) 0.6 (0.2–1.7) 1.0 (0.4–2.8) [0.27] 1.0 1.3 (0.9–2.0) 1.3 (0.9–1.9) 1.2 (0.8–1.8) [0.68]	Age, education level, history of BC in first-degree relatives, OC use, age at menarche, weight at age 18 yr <i>P</i> _{interaction} = 0.91

BC, breast cancer; BMI, body mass index (in kg/m²); CI, confidence interval; ER, estrogen receptor; FTP, full-term pregnancy; HRT, hormone replacement therapy; MET, metabolic equivalent; OC, oral contraceptive; PR, progesterone receptor; yr, year or years

^a In this table, the study population describes the population of the entire study, and the numbers of cases and controls refer to the number of women in the study, not necessarily the number of premenopausal women.

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