

Supplementary material for Lahart I. M. et al. Physical activity, risk of death and recurrence in breast cancer survivors: A systematic review and meta-analysis of epidemiological studies, Acta Oncologica, 2015;54: 635–54.

Supplementary 1. Search strategy.

PubMed Search Strategy with search results

1	activity, physical[MeSH Terms]	195139
2	physical activit*[Title/Abstract]	61434
3	physically active[Title/Abstract]	5111
4	exercise[MeSH Terms]	119579
5	exercis*[Title/Abstract]	206138
6	sport*[Title/Abstract]	44645
7	fitness[Title/Abstract]	42416
8	aerobic[Title/Abstract]	57136
9	cardiovascular[Title/Abstract]	286523
10	(cardiorespiratory[Title/Abstract]) OR cardiopulmonary[Title/Abstract]	61478
11	walk*[Title/Abstract]	74796
12	resistance training[MeSH Terms]	3325
13	strength training[Title/Abstract]	2992
14	weight training[Title/Abstract]	778
15	(weight lifting[Title/Abstract]) OR weightlifting[Title/Abstract]	934
16	(#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15)	830618
17	breast cancer[MeSH Terms]	217675
18	breast cancer[Title/Abstract]	177589
19	breast neoplasm*[Title/Abstract]	929
20	breast tumour*[Title/Abstract]	2858
21	breast tumor*[Title/Abstract]	13911
22	breast carcinom*[Title/Abstract]	25200
23	breast malignan*[Title/Abstract]	786
24	breast[Title/Abstract]	297605
25	(#17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24)	334840
26	(#16 AND #25)	7104
27	mortality[Title/Abstract]	482957
28	survival[Title/Abstract]	611456
29	survivor*[Title/Abstract]	66062
30	recurrence*[Title/Abstract]	210724
31	death*[Title/Abstract]	557252
32	prognosis[Title/Abstract]	243821
33	progression[Title/Abstract]	311997
34	relapse*[Title/Abstract]	110263
35	disease-free[Title/Abstract]	40796
36	cancer outcome*[Title/Abstract]	1790
37	(#27 OR #28 OR #29 OR #30 OR #31 OR #32 OR #33 OR #34 OR #35 OR #36)	1982886
38	(#26 AND #37)	2442

EMBASE Search Strategy with search results

1	'physical activity'.ti,sh,ab.	110915
2	'physically active'.ti,sh,ab.	6022
3	'physical activities'.ti,sh,ab.	5167
4	exercise.ti,sh,ab.	293439
5	"exercis*".ti,sh,ab.	338439
6	sport.ti,sh,ab.	50427
7	"sport*".ti,sh,ab.	98754

Supplementary 1. Search strategy. (Continued)

8	fitness.ti,sh,ab.	57780	
9	aerobic.ti,sh,ab.	66891	
10	'resistance training'.ti,sh,ab.	8423	
11	'strength training'.ti,sh,ab.	3571	
12	'weight lifting'.ti,sh,ab.	4116	
13	weightlifting.ti,sh,ab.	381	
14	'weight training'.ti,sh,ab.	891	
15	'breast cancer'.ti,sh,ab.	308690	
16	"breast neoplasm*".ti,sh,ab.	2580	
17	"breast tumour*".ti,sh,ab.	3609	
18	'breast tumor'.ti,sh,ab.	83235	
19	"breast malignan*".ti,sh,ab.	1164	
20	"breast carcinom*".ti,sh,ab.	66388	
21	breast.ti,sh,ab.	399408	
22	15 or 16 or 17 or 18 or 19 or 20 or 21	476289	
23	cardiovascular.ti,sh,ab.	387541	
24	cardiorespiratory.ti,sh,ab.	13555	
25	cardiopulmonary.ti,sh,ab.	64533	
26	"walk*".ti,sh,ab.	107595	
27	mortality.ti,sh,ab.	834912	
28	survival.ti,sh,ab.	833811	
29	recurrence.ti,sh,ab.	255224	
30	"survivor*".ti,sh,ab.	87507	
31	death.ti,sh,ab.	658303	
32	"relapse*".ti,sh,ab.	171430	
33	"recurrence*".ti,sh,ab.	300477	
34	prognosis.ti,sh,ab.	572320	
35	disease-free.ti,sh,ab.	54093	
36	progression.ti,sh,ab.	419710	
37	27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36	2873272	
38	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 23 or 24 or 25 or 26	1065658	
39	22 and 38	12517	
40	37 and 39	4593	
41	limit 40 to human	4185	
42	limit 41 to english language	3870	

CENTRAL Search Strategy with search results

1	MeSH descriptor: [Breast Neoplasms] explode all trees	8760
2	breast near cancer*	16824
3	breast near neoplasm*	9119
4	breast near carcinoma*	1594
5	breast near tumour*	376
6	breast near tumor*	777
7	Masectom*	1
8	Axillary near dissection*	526
9	#1 or #2 or #3 or #4 or #5 or #6 or #7 or #8	18329
10	MeSH descriptor: [Exercise] explode all trees	14005
11	Exercis*	46264
12	MeSH descriptor: [Motor Activity] explode all trees	16219
13	MeSH descriptor: [Sports] explode all trees	10079
14	Sport*	12414
15	MeSH descriptor: [Resistance Training] explode all trees	1211
16	strength training	5783

Supplementary 1. Search strategy. (Continued)

17	weight training	5838	
18	weight lifting	1289	
19	weightlifting	45	
20	training	38090	
21	fitness	4883	
22	Physical near activit*	9096	
23	aerobic	5230	
24	cardiovascular	39868	
25	cardiorespiratory	1477	
26	cardiopulmonary	7045	
27	walk*	14428	
28	#10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 or #21 or #22 or #23 or #24 or #25 or #26 or #27		125583
29	#9 and #28	1762	
30	mortality	48172	
31	survival	44949	
32	survivor*	4511	
33	recurrence	26215	
34	relapse*	15196	
35	recurrence*	26223	
36	prognosis	17540	
37	disease-free	7823	
38	progression	20311	
39	#30 or #31 or #32 or #33 or #34 or #35 or #36 or #37 or #38		115919
40	#29 and #39	937	

Supplementary 2. Adjustment for potential confounding variables across studies.

Supplementary Table 1. Adjustment for potential confounding variables for analyses across included studies.

Study	Adjusted variables
Rohan, 1995	Estimates adjusted for stage and multiple breast cancer risk factors, including BMI and energy intake, but not treatment
Borugian, 2004	Estimates adjusted for age and stage at diagnosis, treatment, oestrogen receptor status, WHR, and family history of breast cancer
Enger, 2004	Estimates adjusted for age, stage at diagnosis and BMI
Holmes, 2005	Estimates adjusted for age (months); interval between diagnosis and physical activity assessment (28-33, 34-40, ≥ 41 mo); smoking status (never, current, past); body mass index (≤ 21 , 21-22.9, 23-24.9, 25-28.9, ≥ 29), menopausal status and hormone therapy use (premenopausal, postmenopausal, and never use; postmenopausal and current use; postmenopausal and past use; uncertain menopausal status; missing); age at first birth and parity (nulliparous, < 25 y and 1-2 births, < 25 y and ≥ 3 births, ≥ 25 y and 1-2 births, ≥ 25 y and ≥ 3 births); oral contraceptive use (never, ever, missing); energy intake (quintiles); energy-adjusted protein intake (quintiles); disease stage (I, II, III); radiation treatment (yes or no); chemotherapy (yes or no); and tamoxifen treatment (yes or no)
Abrahamson, 2006	Estimates for physical activity adjusted for stage and income
Dal Maso, 2008	Estimates were adjusted for region of residence, age and year at breast cancer diagnosis, and for major tumour characteristics (i.e., TNM stage and ER/PR status)
Holick, 2008	Estimates adjusted for age at diagnosis, stage of disease at diagnosis, state of residence at diagnosis, and interval between diagnosis and physical activity assessment. Additionally adjusted for post-diagnosis BMI, post-diagnosis menopausal status, post-diagnosis hormone therapy use, total energy intake year before enrollment, education level at diagnosis, family history of breast cancer at diagnosis, and initial treatment modality (radiation, chemotherapy, tamoxifen)
Irwin, 2008	Adjusted for age, race, disease stage, treatment, tamoxifen use at the baseline or 3-year interview, body mass index at the 3-year follow-up interview, fruit/vegetable servings per day at the 3-year follow-up interview, and prediagnosis physical activity for analysis of change in physical activity. Other covariates considered were study site, education, parity, age at first full-term pregnancy, family history of breast cancer, estrogen receptor (ER) status, menopausal status, history of smoking, history of oral contraceptive use and diet.
Friedenreich, 2009	Recurrences: Estimates for total physical activity were adjusted for age, tumour stage, treatment (chemotherapy, hormone therapy and radiation therapy), SBR grade, BMI and other comorbidity conditions. Estimates for recreational activity, occupational activity and household activity were adjusted for other types of physical activity, age, tumour stage, treatment (chemotherapy, hormone therapy and radiation therapy), SBR grade, BMI and other comorbidity conditions Breast cancer-related mortality: Estimates for total physical activity were adjusted for age, tumour stage, treatment (chemotherapy, hormone therapy and radiation therapy), SBR grade, PR status, WHR and HRT use. Estimates for recreational activity, occupational activity and household activity were adjusted for other types of physical activity, age, tumour stage, treatment (chemotherapy, hormone therapy and radiation therapy), SBR grade, PR status, WHR and HRT use
Study	Adjusted variables All-cause mortality: Estimates for total physical activity were adjusted for age, tumour stage, treatment (chemotherapy, hormone therapy and radiation therapy), SBR grade, WHR, HRT use, oral contraceptive use, weight gain since age 20 and total pack-years of smoking for current and former smokers. Estimates for recreational activity, occupational activity and household activity were adjusted for other types of physical activity types, age, tumour stage, treatment (chemotherapy, hormone therapy and radiation therapy), SBR grade, WHR, HRT use, oral contraceptive use, weight gain since age 20 and total pack-years of smoking for current and former smokers. Multivariable model is adjusted for recreational physical activity, occupational physical activity, age, tumour stage, treatment (chemotherapy, hormone therapy and radiation therapy), SBR grade, WHR, HRT use, oral contraceptive use, weight gain since age 20 and total pack-years of smoking for current and former smokers
Sternfield, 2009	Recurrence and breast cancer-related death: adjusted for age, number of positive nodes, stage, weight at 18 y, type of treatment (chemotherapy/radiation) and type of surgery (mastectomy or conserving) All-cause death: adjusted for age, number of positive nodes, stage, weight at 18 y, education level and smoking status
West-Wright, 2009	Estimates adjusted for age (in years) and adjusted for race, BMI, total caloric intake, oestrogen receptor status, number of comorbid conditions, stage and physical activity summary variable
Emaus, 2010	Estimates adjusted for age at diagnosis, pre-diagnostic observation time, tumor stage, region of residence (strata), year at diagnosis before and after 1995 (strata), and BMI or leisure time physical activity, respectively
Hellmann, 2010	Estimates adjusted for age, disease stage, adjuvant treatment, menopausal status, parity, alcohol intake, smoking, body mass index and hormone replacement therapy
Keegan, 2010	Estimates adjusted for study center (Ontario, Northern California, Australia), age of diagnosis (continuous), race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, non-Hispanic Asian, other, missing), number of affected nodes (0, 1-3, 4+, missing), BMI (< 25.0 , 25.0-29.9, ≥ 30.0 , missing), time since last full term pregnancy (nulliparous, < 2 yrs, 2-4 yrs, ≥ 5 yrs, missing), ER status (negative, positive, missing), PR status (negative, positive, missing), tumor grade (1,2,3, missing), tumor size (≤ 20 , > 20 , missing), and tumor type (invasive ductal, invasive lobular, other, missing)

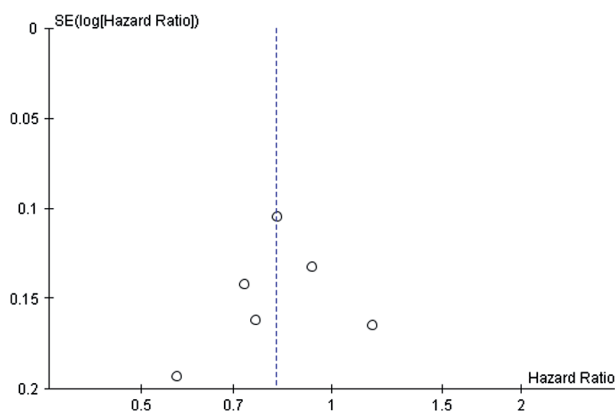
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Supplementary Table 1. (Continued)

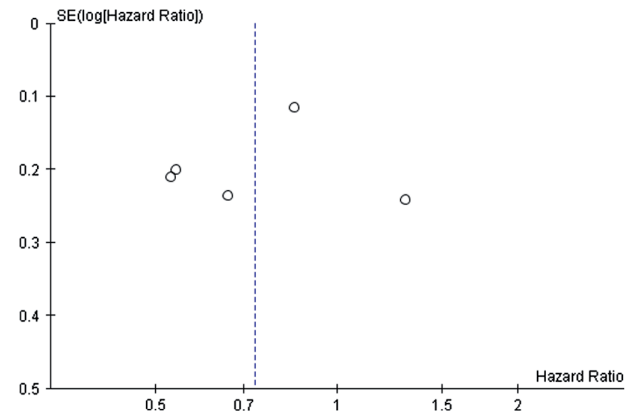
Study	Adjusted variables
Bertram, 2011	All analyses adjusted for age at randomization, race, fruit and vegetable consumption, BMI at randomization, menopausal status, tumour type, tumour grade, tumour stage, anti-oestrogen use, clinical site, time from diagnosis to randomization, hot flashes, and study group
Chen, 2011	Estimates adjusted for date of birth, BMI at baseline, waist-to-hip ratio at baseline, menopausal status, income, education, QOL, cruciferous vegetable intake, soy protein intake, tea consumption, chemotherapy, radiotherapy, tamoxifen use, TNM status, and ER/PR status. Exercise was treated as a time-dependent variable
Irwin, 2011	Pre-diagnosis physical activity: Adjusted for age, ethnicity, WHI study arm, previous hormone therapy use, BMI, diabetes, alcohol, smoke, total calories, percentage calories from fat, and servings of fruit and vegetables Post-diagnosis physical activity: Adjusted for age, stage, ER, PR, grade, HER2, ethnicity, WHI study arm, previous hormone therapy use, time from diagnosis to physical activity assessment, BMI, diabetes, alcohol, smoke, total calories, and % calories from fat, and servings of fruit and vegetables
Study	Adjusted variables
Cleveland, 2012	Estimates adjusted for age at diagnosis, BMI and menopausal status
Schmidt, 2013	All models were adjusted for tumor size, nodal status, tumor grading, ER/PR status, radiotherapy, screening-detected tumor, HRT use at diagnosis, age at diagnosis, BMI pre-diagnosis, smoking status and pack years and pre-existing angina pectoris. In addition, models for overall mortality and for other deaths were adjusted for pre-existing hypertension, previous stroke and use of insulin
Williams, 2013	Adjusted for follow-up age, race, menopause, and oral contraceptive and oestrogen or oestrogen/progesterone use. Additional adjustment for BMI as indicated.
Bradshaw, 2014	All proportional hazards models adjusted for age, pre-diagnosis BMI, chemotherapy treatment, and tumor size Model 1 includes models for covariates with missing data: PA, chemotherapy, and tumor size, which assumes that the missing data mechanism for PA is ignorable
Williams, 2014	Age, race, family history of breast cancer, menopause and duration of breastfeeding and oral contraceptive use, BMI.

Key: WHR = waist-hip ratio, TNM stage = Tumor Node Metastases stage, HT = hormone treatment, HR = hormone receptor, HRT = Hormone Replacement Therapy, ER = oestrogen receptor, PR = progesterone receptor, SBR grade = Scarff-Bloom-Richardson grading, PA = physical activity,

Supplementary 3. Funnel plots from epidemiological studies meta-analysis

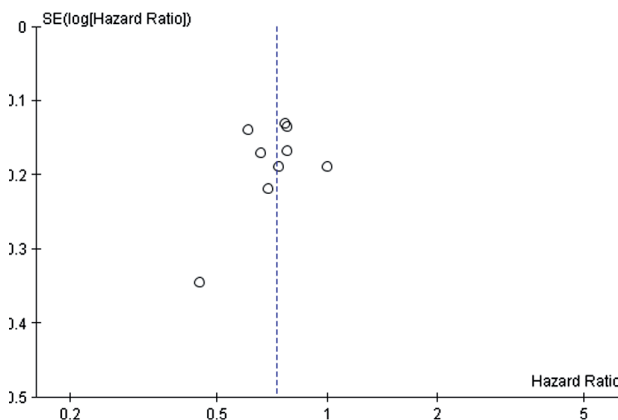


Supplementary Figure 3.1. Lifetime pre-diagnosis recreational physical activity and all-cause death funnel plot.

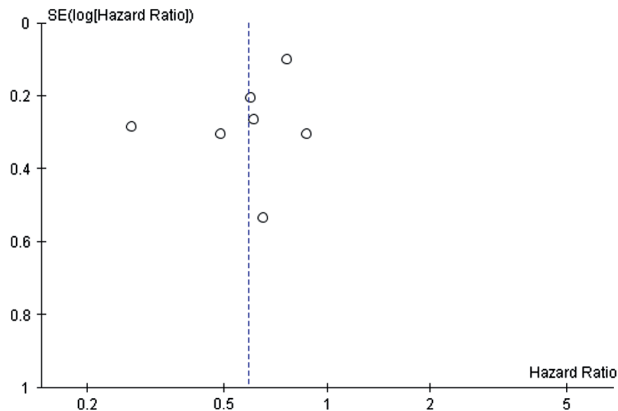


Supplementary Figure 3.2. Lifetime pre-diagnosis recreational physical activity and breast cancer-related death funnel plot.

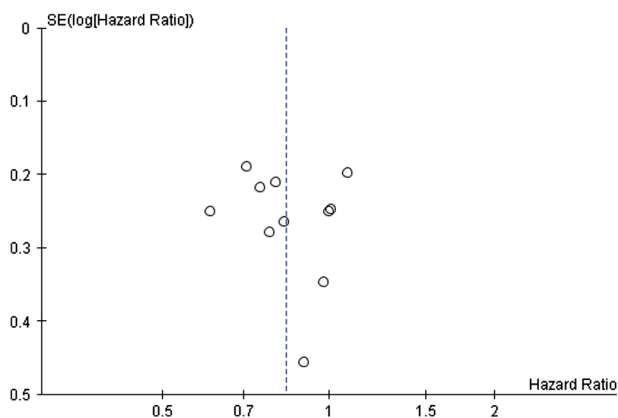
Supplementary 3. Funnel plots from epidemiological studies meta-analysis



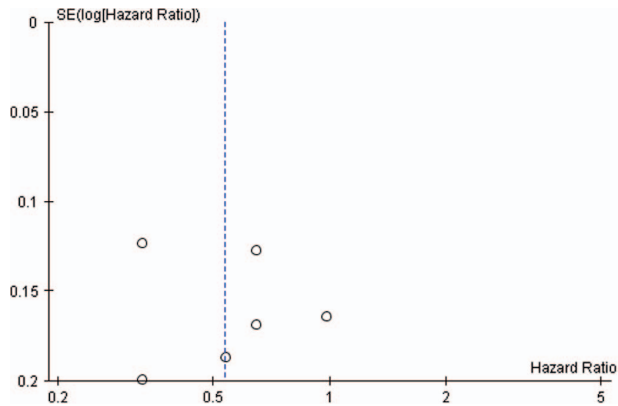
Supplementary Figure 3.3. More recent pre-diagnosis recreational physical activity and all-cause death funnel plot.



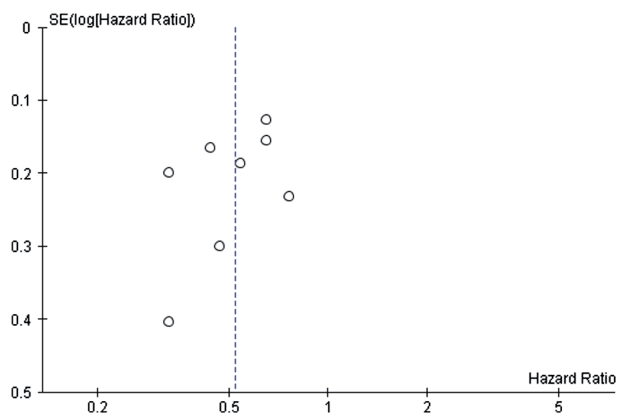
Supplementary Figure 3.6. Post-diagnosis recreational physical activity and breast cancer-related death funnel plot.



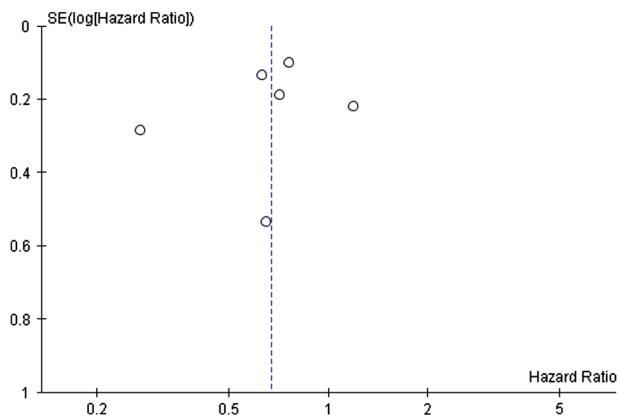
Supplementary Figure 3.4. More recent pre-diagnosis recreational physical activity and breast cancer-related death funnel plot.



Supplementary Figure 3.7. Meeting recommended physical activity guidelines post-diagnosis and all-cause death funnel plot.



Supplementary Figure 3.5 Post-diagnosis recreational physical activity and all-cause death funnel plot.



Supplementary Figure 3.8. Meeting recommended physical activity guidelines post-diagnosis and breast cancer-related death funnel plot.

Supplementary 4. Results from analysis of physical activity and breast cancer outcome in epidemiological studies.

Supplementary Table 2. Physical activity and all-cause and breast cancer death and recurrence risk; results from epidemiological studies[†].

Trial	Comparisons	Hazard ratios (95% CI)	Subgroup analysis
Studies including pre-diagnosis lifetime recreational PA analysis only:			
Friedenreich (2009)	Pre-diagnosis recreational PA (MET-h·wk ⁻¹ ·y ⁻¹) • ≥ 5 vs. > 19	All-cause death: HR = 0.73 (0.53-1.00) BC-related death: HR = 0.54 (0.36-0.79) Recurrence*: HR = 0.76 (0.55-1.03)	None reported
Dal Maso (2008) (PACE)	Pre-diagnosis lifetime recreational PA (h·wk ⁻¹) • < 2 vs. ≥ 2	All-cause death: HR = 0.82 (0.67-1.01) BC death: HR = 0.85 (0.68-1.07)	None reported
Studies including both lifetime and recent recreational PA analysis:			
Cleveland (2012) (LIBCSP)	Pre-diagnosis lifetime recreational PA (Met-h·wk ⁻¹): • 0 vs. ≥ 9	All-cause death: HR = 0.57 (0.39-0.83) BC-related death: HR = 0.66 (0.42-1.06)	BMI < 25: PA (0 vs. ≥ 9 Met-h·wk ⁻¹) and all-cause death, HR = 0.45 (0.25-0.80), and BC-related death, HR = 0.67 (0.32-1.40) BMI ≥ 25: PA (0 vs. ≥ 9 Met-h·wk ⁻¹) and all-cause death, HR = 0.62 (0.38-1.02), and BC-related death, HR = 0.59 (0.32-1.08) Stronger effects on all-cause death for recreational PA after menopause.
Keegan (2010) (BCFR)	Pre-diagnosis lifetime recreational PA (Met-h·wk ⁻¹): • ≤ 6.7 vs. 26.2-46.0 Pre-diagnosis recent recreational PA (Met-h·wk ⁻¹) (3y pre-diagnosis) • 0 vs. > 38.2	All-cause death: HR = 0.93 (0.72-1.21) All-cause death: HR = 0.77 (0.60-1.00)	BMI < 25: Recent PA (0 vs. ≥ 0 Met-h·wk ⁻¹) and all-cause death, HR = 1.46 (1.10-1.94) BMI 25-29.9: Recent PA (0 vs. ≥ 0 Met-h·wk ⁻¹) and all-cause death, HR = 1.46 (1.10-1.93) BMI > 30: Recent PA (0 vs. ≥ 0 Met-h·wk ⁻¹) and all-cause death, HR = 1.26 (1.04-1.52) ER+: Recent PA (0 vs. ≥ 38.2 Met-h·wk ⁻¹) and all-cause death, HR = 0.67 (0.48-0.94) ER-: Recent PA (0 vs. ≥ 0 Met-h·wk ⁻¹) and all-cause death, HR = 1.05 (0.66-1.68) No difference in effects by race or ethnicity.
Trial	Comparisons	Hazard ratios (95% CI)	Subanalysis
West-Wright (2009) (CTS)	Pre-diagnosis lifetime recreational PA (h·wk ⁻¹ ·y ⁻¹): • Low PA (> 0.5) vs. High PA (≥ 1 of moderate or strenuous activity > 3) Pre-diagnosis recent recreational PA (h·wk ⁻¹ ·y ⁻¹) • Low PA (> 0.5) vs. High PA (≥ 1 of moderate or strenuous activity > 3)	All-cause death: HR = 0.73 (0.55-0.96) BC-related death: HR = 0.53 (0.35-0.80) All-cause death: HR = 0.78 (0.60-1.02) BC-related death: HR = 1.08 (0.73-1.58)	BMI < 25: Lifetime PA (low vs. high) and all-cause death, HR = HR = 0.83 (0.55-1.25) and BC-related death, HR = 1.15 (0.58-2.29) BMI ≥ 25: Lifetime PA (low vs. high) and all-cause death, HR = 0.70 (0.46-1.08), and BC-related death, HR = 0.41 (0.23-0.74) ER+: Lifetime PA (low vs. high) and all-cause death, HR = 0.78 (0.56-1.11), and BC-related death, HR = 0.46 (0.26-0.80) ER-: Lifetime PA (low vs. high) and all-cause death, HR = 0.33 (0.15-0.74), and BC-related death, HR = 0.33 (0.13-0.83) ER+: Recent PA (low vs. high) and all-cause death, HR = 0.89 (0.64-1.23), and BC-related death, HR = 1.06 (0.62-1.81) ER-: Recent PA (low vs. high) and all-cause death, HR = 0.71 (0.35-1.46), and BC-related death, HR = 1.18 (0.51-2.74)

(Continued)

Supplementary Table 2. (Continued)

Trial	Comparisons	Hazard ratios (95% CI)	Subanalysis
			Localised: Lifetime PA (low vs. high) and all-cause death, HR = 0.75 (0.51-1.09), and BC-related death, HR = 0.35 (0.17-0.73) Regional: Lifetime PA (low vs. high) and all-cause death, HR = 0.66 (0.42-1.05), and BC-related death, HR = 0.57 (0.34-0.96) Localised: Recent PA (low vs. high) and all-cause death, HR = 0.75 (0.53-1.08), and BC-related death, HR = 0.94 (0.48-1.83) Regional: Recent PA (low vs. high) and all-cause death, HR = 0.84 (0.55-1.29), and BC-related death, HR = 1.09 (0.67-1.79)
Abrahamson (2006)	Average recreational PA (lifetime) age 13y, age 20y and year before diagnosis (relative units): • 1.6-16.6 vs. 43.1-98.0	All-cause death: HR = 1.16 (0.84-1.60)	BMI < 25: Recent PA (< median vs. ≥ median) and all-cause death, HR = 1.08 (0.77-1.52) BMI ≥ 25: Recent PA (< median vs. ≥ median) and all-cause death, HR = 0.70 (0.49-0.99)
Abrahamson (2006) continued...	Average recent recreational PA (1 year) pre-diagnosis quartiles (relative units): • 1.6-3.4 vs. 35.1-98.0	All-cause death: HR = 0.78 (0.56-1.08)	
Enger (2004)	Lifetime pre-diagnosis recreational PA per week from first menses to 1-y prior to diagnosis (h·wk ⁻¹): • 0 vs. 3.8 Average hours of recent pre-diagnosis recreational PA per week during year before 1-y prior to diagnosis (h·wk ⁻¹): • 0 vs. ≥ 5	BC-related death: HR = 1.30 (0.81-2.09) BC-related death: HR = 0.78 (0.45-1.34)	None reported
Studies including recent recreational pre-diagnosis physical activity analysis only:			
Schmidt (2013) (MARIE)	Pre-diagnosis recreational PA since age 50 y (Met·h·wk ⁻¹): • 0 vs. ≥ 42	All-cause death: HR = 0.66 (0.47-0.92) BC-related death: HR = 0.80 (0.53-1.21) Recurrence: HR = 0.65 (0.44-0.97)	BMI < 25: PA (0 vs. ≥ 0 Met·h·wk ⁻¹) and all-cause death, HR = 1.63 (1.23-2.17), and BC-related death, HR = 1.38 (0.97-1.95) BMI ≥ 25: PA (0 vs. ≥ 0 Met·h·wk ⁻¹) and all-cause death, HR = 1.04 (0.67-1.61), and BC-related death, HR = 0.90 (0.51-1.62)
Williams (2013) (NWRHS)	Pre-diagnosis (5 y pre-diagnosis) walking and running exercise combined (Met·h·wk ⁻¹): • < 7.5 vs. ≥ 7.5	BC-related death: HR = 0.61 (0.38-1.01)	None reported
Emaus (2010)	Pre-diagnosis recent recreational (mean 11.5y pre-diagnosis) PA: • Sedentary vs. Regular exercise (≥ 4 h·wk ⁻¹)	All-cause death: HR = 0.74 (0.51-1.08) BC-related death: HR = 0.75 (0.49-1.15)	Premenopause (< 55y): PA (Sedentary vs. regular exercise (≥ 4 h·wk ⁻¹) and all-cause death, HR = 0.96 (0.54-1.72), and BC-related death: HR = 0.96 (0.52-1.80) Postmenopause (< 55y): PA (Sedentary vs. regular exercise (≥ 4 h·wk ⁻¹) and all-cause death, HR = 0.60 (0.36-0.99) and BC-related death: HR = 0.57 (0.31-1.04)

(Continued)

Supplementary Table 2. (Continued)

Trial	Comparisons	Hazard ratios (95% CI)	Subanalysis
Hellmann (2010) (CHCS)	Pre-diagnosis recent recreational PA categories: Inactive vs. High PA of > 4 h·wk ⁻¹	All-cause death: HR = 1.00 (0.69-1.45) BC-related death: HR = 1.01 (0.62-1.63)	Premenopause: PA (Inactive vs. High PA of > 4 h·wk ⁻¹) and all-cause death, HR = 0.29 (0.03-2.80) Postmenopause: PA (Inactive vs. High PA of > 4 h·wk ⁻¹) and all-cause death, HR = 1.02 (0.69-1.51)
Hellmann (2010) (CHCS) continued...			Local disease: PA (Inactive vs. High PA of > 4 h·wk ⁻¹) and all-cause death, HR = 0.63 (0.37-1.07) Regional disease: PA (Inactive vs. High PA of > 4 h·wk ⁻¹) and all-cause death, HR = 0.81 (0.40-1.62)
Borugian (2004)	Pre-diagnosis exercise (days·wk ⁻¹): None vs. more than once a week	BC-related death: HR = 1.0 (0.6-1.6)	Premenopausal: Exercise (None vs. ≥ 1 day·wk ⁻¹) and BC-related death, HR = 1.4 (0.6-3.0) Postmenopausal: Exercise (None vs. ≥ 1 day·wk ⁻¹) and BC-related death, HR = 0.8 (0.4-1.5)
Rohan (1995)	Total recent pre-diagnosis recreational PA (1-y pre-diagnosis) categories (kcal·min ⁻¹): • 0 vs. > 4,000	BC-related death: HR = 0.98 (0.5-1.94)	Premenopausal: PA (0 vs. > 4000 kcal·min ⁻¹) and BC-related death, HR = 1.38 (0.45-4.26) Postmenopausal: PA (0 vs. > 4000 kcal·min ⁻¹) and BC-related death, HR = 0.72 (0.29-1.81)
Studies that assessed both recent pre-diagnosis and post-diagnosis recreational physical activity:			
Irwin (2008) (HEAL)	Pre-diagnosis (1y pre-diagnosis) recreational PA (Met-h·wk ⁻¹): • 0 vs. ≥ 9 Post-diagnosis (1y preceding interview at 2.5y post-diagnosis) recreational PA (Met-h·wk ⁻¹): • 0 vs. ≥ 9	All-cause death: HR = 0.69 (0.45-1.06) BC-related death: HR = 0.83 (0.45-1.38) All-cause death: HR = 0.33 (0.15-0.73) BC-related death: HR = 0.65 (0.23-1.87)	Age at diagnosis < 55y: Post-diagnosis PA (0 vs. > 0 Met-h·wk ⁻¹) and A-C death, HR = 0.18 (0.05-0.60) Age at diagnosis < 55y: Post-diagnosis PA (0 vs. > 0 Met-h·wk ⁻¹) and A-C death, HR = 0.29 (0.14-0.60) BMI < 25: Post-diagnosis PA (0 vs. ≥ 0 Met-h·wk ⁻¹) and all-cause death, HR = 0.31 (0.13-0.74) BMI ≥ 25: Post-diagnosis PA (0 vs. ≥ 0 Met-h·wk ⁻¹) and all-cause death, HR = 0.43 (0.24-0.76) ER+: Post-diagnosis PA (0 vs. ≥ 0 Met-h·wk ⁻¹) and all-cause death, HR = 1.26 (0.15 to 11.00) ER-: Post-diagnosis PA (0 vs. ≥ 0 Met-h·wk ⁻¹) and all-cause death, HR = 0.20 (0.09 to 0.46) Stage I PA (0 vs. ≥ 0 Met-h·wk ⁻¹) and all-cause death, HR = 0.53 (0.23 to 1.20) Stage II-IIIa: PA (0 vs. ≥ 0 Met-h·wk ⁻¹) and all-cause death, HR = 0.65 (0.42-0.99)
Irwin (2011) (WHI)	Pre-diagnosis (ave 4.1y pre-diagnosis) moderate-vigorous intensity recreational PA (Met-h·wk ⁻¹): • 0 vs. ≥ 9 Post-diagnosis moderate-vigorous intensity recreational PA (Met-h·wk ⁻¹): • 0 vs. ≥ 9	All-cause death: HR = 0.61 (0.47-0.81) BC-related death: HR = 0.71 (0.49-1.03) All-cause death: HR = 0.54 (0.38-0.79) BC-related death: HR = 0.61 (0.5-0.99)	BMI < 25: Post-diagnosis PA (0 vs. ≥ 0 Met-h·wk ⁻¹) and all-cause death, HR = 0.49 (0.27-0.91) BMI 25-29.9: Post-diagnosis PA (0 vs. ≥ 0 Met-h·wk ⁻¹) and all-cause death, HR = 0.43 (0.24-0.76) BMI > 30: post-diagnosis PA (0 vs. ≥ 0 Met-h·wk ⁻¹) and all-cause death, HR = 0.80 (0.45-1.41) ER+: Post-diagnosis PA (0 vs. ≥ 0 Met-h·wk ⁻¹) and all-cause death, HR = 0.78 (0.35-1.73)

(Continued)

Supplementary Table 2. (Continued)

Trial	Comparisons	Hazard ratios (95% CI)	Subanalysis
			ER-: Post-diagnosis PA (0 vs. ≥ 0 Met-h-wk⁻¹) and all-cause death, HR = 0.50 (0.34–0.74) Stage I PA (0 vs. ≥ 0 Met-h-wk⁻¹) and all-cause death, HR = 0.65 (0.42–0.99) Stage II-IIIa: PA (0 vs. ≥ 0 Met-h-wk⁻¹) and all-cause death, HR = 0.46 (0.27–0.78) Significant effect for HER2-negative but not HER2-positive
Studies including post-diagnosis recreational physical activity analysis only:			
Bradshaw (LIBCSP) 2014	Post-diagnosis recreational PA (Met-h-wk ⁻¹): • 0 vs. ≥ 9	All-cause death: HR = 0.33 (0.22–0.48) BC-related death: HR = 0.27 (0.15–0.46)	BMI < 25: PA (0 vs. ≥ 9 Met-h-wk⁻¹) and all-cause death, HR = 0.24 (0.13–0.42), and BC-related death, HR = 0.18 (0.08–0.42) BMI ≥ 25: PA (0 vs. ≥ 9 Met-h-wk⁻¹) and all-cause death, HR = 0.18 (0.08–0.42), and BC-related death, HR = 0.33 (0.16–0.65) ER+/PR+: PA (0 vs. ≥ 9 Met-h-wk⁻¹) and all-cause death, HR = 0.25 (0.14, 0.42), and BC-related death, HR = 0.18 (0.08, 0.36) ER-/PR-: PA (0 vs. ≥ 9 Met-h-wk⁻¹) and all-cause death, HR = 0.46 (0.29, 0.70), and BC-related death, HR = 0.38 (0.19, 0.72) Both 0–2 y and > 2 y both associated with reduced risk of all-cause and BC-related death.
Williams (2014) (NRWHS)	Post-diagnosis (5 y post-diagnosis) walking and running exercise combined (Met-h-day ⁻¹): • 0 vs. ≥ 1	BC-related death: HR = 0.76 (0.62–0.92)	None reported
Bertram (2011) (WHEL)	Post-diagnosis recreational PA (Met-h-wk ⁻¹): • 0–2.5 vs. 24.7–107 Meeting PA (Met-h-wk ⁻¹): No (< 10) vs. Yes (≥ 10)	All-cause death: HR = 0.47 (0.26–0.84) Recurrence*: HR = 0.74 (0.50–1.10) All-cause death: HR = 0.65 (0.47–0.91) Recurrence: HR = 0.89 (0.70–1.14)	None reported
Chen (2011) (SBCSS)	36 mo Post-diagnosis exercise energy expenditure (Met-h-wk ⁻¹): • No exercise vs. ≥ 8.3	All-cause death: HR = 0.65 (0.51–0.84) BC outcome‡: HR = 0.59 (0.45–0.76)	Premenopausal: PA (0 vs. ≥ 8.3 Met-h-wk⁻¹) and all-cause death, HR = 0.86 (0.58–1.26) and BC outcome, HR = 0.69 (0.47–0.1.00) Postmenopausal: PA (0 vs. ≥ 8.3 Met-h-wk⁻¹) and all-cause death, HR = 0.55 (0.40–0.77) and BC outcome, HR = 0.52 (0.36–0.74) BMI < 25: PA (0 vs. ≥ 8.3 Met-h-wk⁻¹) and all-cause death, HR = 0.62 (0.45–0.85), and BC outcome, HR = 0.66 (0.47–0.94) BMI ≥ 25: PA (0 vs. ≥ 8.3 Met-h-wk⁻¹) and all-cause death, HR = 0.70 (0.46–1.05), and BC outcome, HR = 0.50 (0.38–0.74) ER+ PR+ (positive): PA (0 vs. ≥ 8.3 Met-h-wk⁻¹) and all-cause death, HR = 1.32 (0.83–2.12) and BC outcome, HR = 0.79 (0.53–1.19)

(Continued)

Supplementary Table 2. (Continued)

Trial	Comparisons	Hazard ratios (95% CI)	Subanalysis
Chen (2011) (SBCSS) continued...			ER-PR- (negative): PA (0 vs. ≥ 8.3 Met-h-wk ⁻¹) and all-cause death, HR = 0.40 (0.29-0.59) and BC outcome, HR = 0.36 (0.24-0.56)
			ER+ PR-/ER-PR+ (mixed): PA (0 vs. ≥ 8.3 Met-h-wk ⁻¹) and all-cause death, HR = 0.67 (0.36-1.22) and BC outcome, HR = 0.51 (0.27-1.00)
			Stage I-IIa: PA (0 vs. ≥ 8.3 Met-h-wk ⁻¹) and all-cause death, HR = 0.89 (0.59-1.36) and BC outcome, HR = 0.62 (0.41-0.92)
Sternfield (2009) (LACE)	Post-diagnosis recreational PA (Met-h-wk ⁻¹): • < 29 vs. ≥ 62 NHS activity score (Met-h-wk ⁻¹): • < 9 vs. ≥ 9	All-cause death: HR = 0.76 (0.48-1.19) BC-related death: HR = 0.87 (0.48-1.59) Recurrence: HR = 0.91 (0.61-1.36) All-cause death: HR = 0.98 (0.71-1.35) BC-related death: HR = 1.19 (0.78-1.84) Recurrence: HR = 1.16 (0.87-1.55)	Stage IIb-III: PA (0 vs. ≥ 8.3 Met-h-wk ⁻¹) and all-cause death, HR = 0.52 (0.37-0.72) and BC outcome, HR = 0.45 (0.32-0.64)
			No effect modification by comorbidity and quality of life.
			BMI < 25: Post-diagnosis moderate PA (0 vs. ≥ 1 h-wk ⁻¹) and all-cause death, HR = 0.38 (0.17-0.85) BMI 25-29.9: Post-diagnosis moderate PA (0 vs. ≥ 1 h-wk ⁻¹) and all-cause death, HR = 0.95 (0.47-1.94) BMI > 30: post-diagnosis moderate PA (0 vs. ≥ 1 h-wk ⁻¹) and all-cause death, HR = 0.90 (0.38-2.16)
Holick (2008) (CWLS)	Post-diagnosis recreational PA (Met-h-wk ⁻¹): • < 2.7 vs. ≥ 21.0	All-cause death: HR = 0.44 (0.32-0.60) BC-related death: HR = 0.51 (0.29-0.89)	ER+ PR+ (positive): PA (0 vs. ≥ 8.3 Met-h-wk ⁻¹) and all-cause death, HR = 0.59 (0.34-1.04)
			ER- and/or PR- (negative): PA (0 vs. ≥ 8.3 Met-h-wk ⁻¹) and all-cause death, HR = 0.75 (0.36-1.59)
			Age at diagnosis < 59y: PA (< 8 vs. ≥ 8 Met-h-wk ⁻¹) and BC-related death, HR = 0.53 (0.31-0.89) Age at diagnosis < 59y: PA (< 8 vs. ≥ 8 Met-h-wk ⁻¹) and BC-related death, HR = 0.85 (0.47-1.54) BMI < 25: PA (0 vs. ≥ 8 Met-h-wk ⁻¹) and BC-related death, HR = 0.63 (0.39-1.02) BMI ≥ 25 : PA (0 vs. ≥ 8 Met-h-wk ⁻¹) and BC-related death, HR = 0.33 (0.16-0.65) Local stage: PA (< 8 vs. ≥ 8 Met-h-wk ⁻¹) and BC-related death, HR = 0.81 (0.44-1.51) Regional stage: PA (< 8 vs. ≥ 8 Met-h-wk ⁻¹) and BC-related death, HR = 0.56 (0.34-0.94)
Holmes et al. (2005) (NHS)	Post-diagnosis recreational PA (Met-h-wk ⁻¹): • < 3 vs. ≥ 24	All-cause death: HR = 0.65 (0.48-0.88) BC-related death: HR = 0.60 (0.40-0.89) Recurrence: HR = 0.74 (0.53-1.04)	No effect modification by time since diagnosis.
			Premenopausal: PA (< 9 vs. ≥ 9 Met-h-wk ⁻¹) and BC-related death, HR = 0.58 (0.32-1.04)
			Postmenopausal: PA (< 9 vs. ≥ 9 Met-h-wk ⁻¹) and BC-related death, HR = 0.72 (0.54-0.98)

(Continued)

Supplementary Table 2. (Continued)

Trial	Comparisons	Hazard ratios (95% CI)	Subanalysis
Holmes et al. (2005) (NHS) continued...	Post-diagnosis recreational PA (Met-h·wk ⁻¹): • <9 vs. ≥9	BC-related death: HR = 0.63 (0.48-0.81)	BMI < 25: PA (<9 vs. ≥9 Met-h·wk ⁻¹) and BC-related death, HR = 0.61 (0.37-0.99) BMI ≥ 25: PA (<9 vs. ≥9 Met-h·wk ⁻¹) and BC-related death, HR = 0.52 (0.25-1.06) ER+ PR+ (positive): PA (<9 vs. ≥9 Met-h·wk ⁻¹) and BC-related death, HR = 0.50 (0.34-0.74) ER-PR- (negative): PA (<9 vs. ≥9 Met-h·wk ⁻¹) and BC-related death, HR = 0.91 (0.43-1.96) Stage I: PA (<9 vs. ≥9 Met-h·wk ⁻¹) and BC-related death, HR = 0.67 (0.41-1.09) Stage II: PA (<9 vs. ≥9 Met-h·wk ⁻¹) and BC-related death, HR = 0.62 (0.43-0.90) Stage III: PA (<9 vs. ≥9 Met-h·wk ⁻¹) and BC-related death, HR = 0.36 (0.19-0.71)

[†]Only results from multivariate adjusted comparisons are reported. Full multivariate analysis details can be found in Table S1.

^{*}Breast cancer recurrence and breast cancer progression and new breast cancer primaries combined

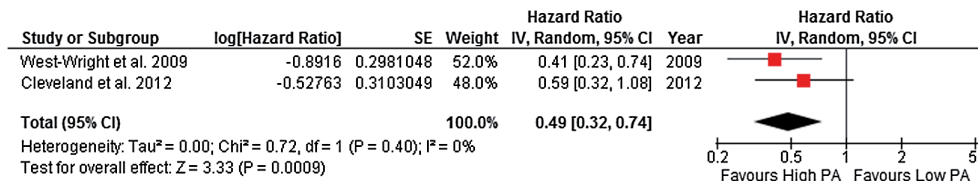
^{**}Breast cancer recurrence and new breast cancer primaries combined

[‡]Breast cancer-related deaths and recurrence combined

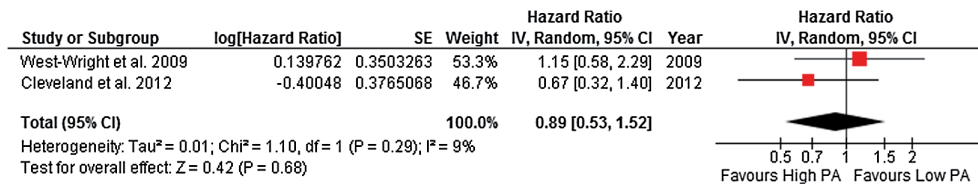
Supplementary 5. Forest plots from subgroup and sensitivity analyses.

BMI subanalyses:

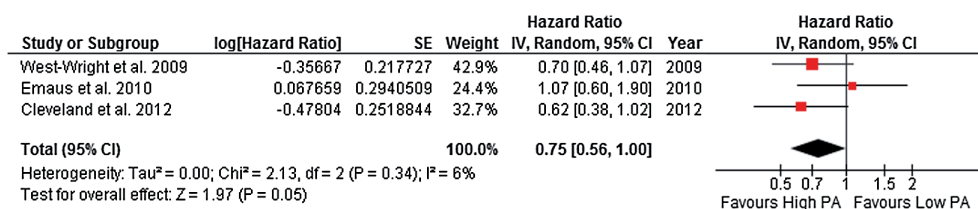
Lifetime pre-diagnosis PA:



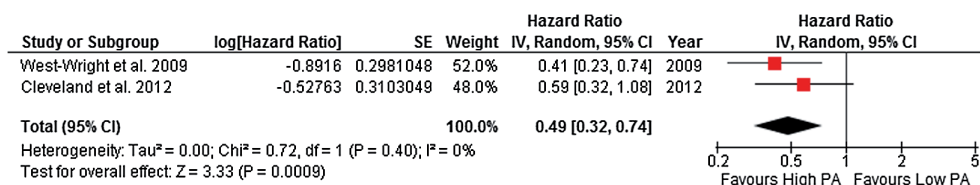
Supplementary Figure 5.1. Lifetime pre-diagnosis PA (high vs. low): <25 BMI and all-cause death.



Supplementary Figure 5.2. Lifetime pre-diagnosis PA (high vs. low): <25 BMI and BC-related death.

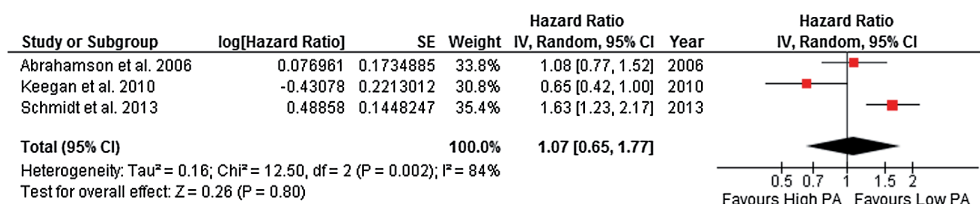


Supplementary Figure 5.3. Lifetime pre-diagnosis PA (high vs. low): BMI ≥ 25 and all-cause death.

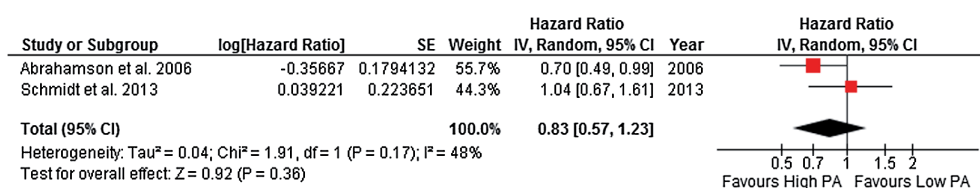


Supplementary Figure 5.4. Lifetime pre-diagnosis PA (high vs. low): BMI < 25 and BC-related death.

More recent pre-diagnosis PA:

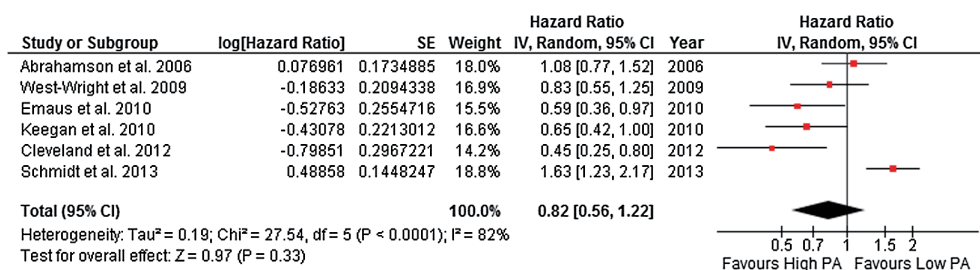


Supplementary Figure 5.5. More recent pre-diagnosis PA (high vs. low): BMI < 25 and all-cause death.

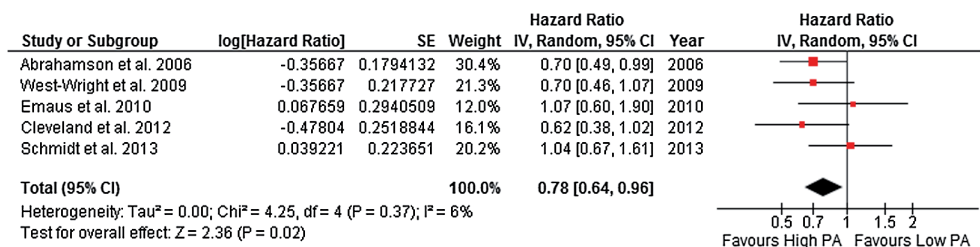


Supplementary Figure 5.6. More recent pre-diagnosis PA (high vs. low): BMI ≥ 25 and all-cause death.

Lifetime and more recent pre-diagnosis PA combined:

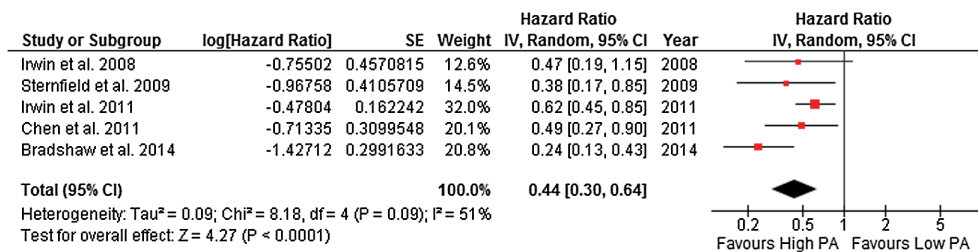


Supplementary Figure 5.7. Lifetime and more recent pre-diagnosis PA (high vs. low) combined: < 25 BMI and all-cause death.

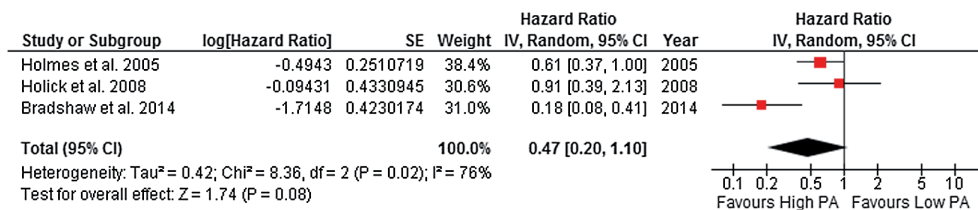


Supplementary Figure 5.8. Lifetime and more recent pre-diagnosis PA (high vs. low) combined: ≥ 25 BMI and all-cause death.

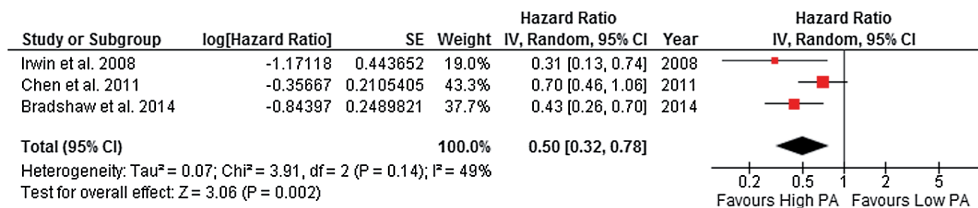
Post-diagnosis PA:



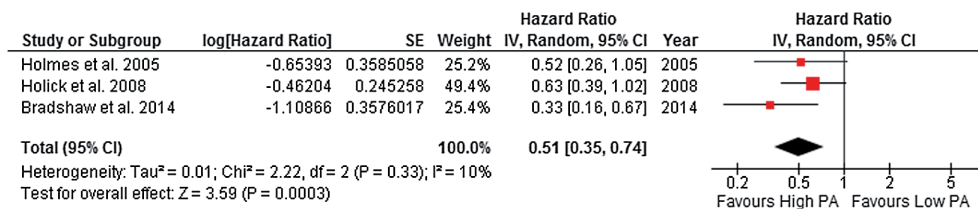
Supplementary Figure 5.9. Post-diagnosis PA (high vs. low): BMI < 25 and all-cause death.



Supplementary Figure 5.10. Post-diagnosis PA (high vs. low): BMI < 25 and BC-related death.



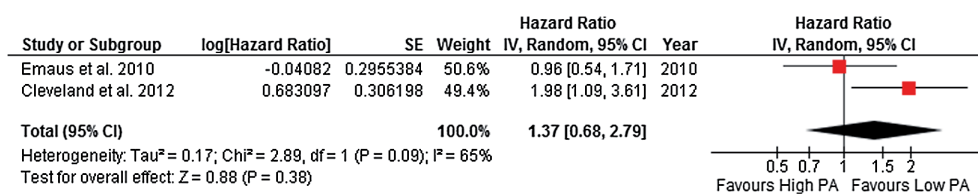
Supplementary Figure 5.11. Post-diagnosis PA (high vs. low): BMI ≥ 25 and all-cause death.



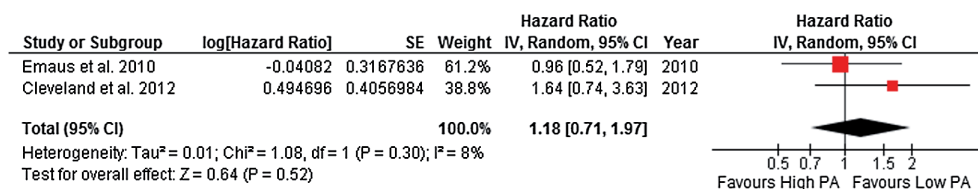
Supplementary Figure 5.12. Post-diagnosis PA (high vs. low): BMI ≥ 25 and BC-related death.

Menopausal status subanalyses:

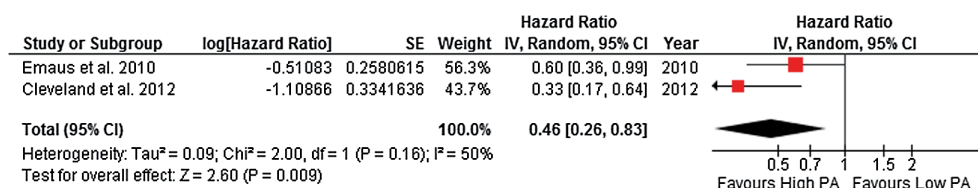
Lifetime pre-diagnosis PA:



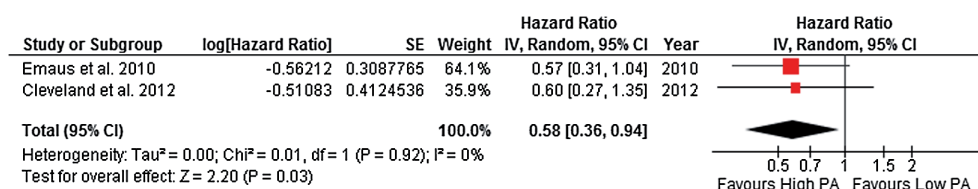
Supplementary Figure 5.13. Lifetime pre-diagnosis PA (high vs. low): premenopause and all-cause death.



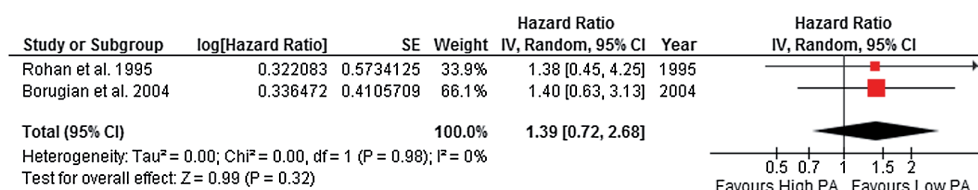
Supplementary Figure 5.14. Lifetime pre-diagnosis PA (high vs. low): premenopause and BC-related death.



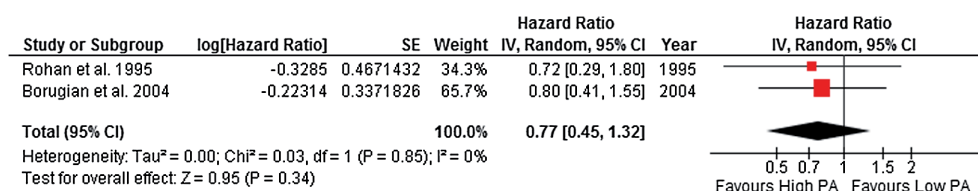
Supplementary Figure 5.15. Lifetime pre-diagnosis PA (high vs. low): postmenopause and all-cause death.



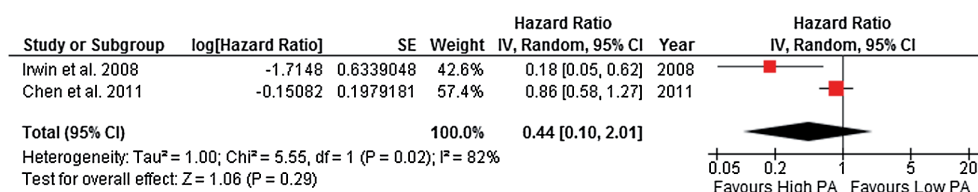
Supplementary Figure 5.16. Lifetime pre-diagnosis PA (high vs. low): postmenopause and BC-related death.

More recent pre-diagnosis PA:

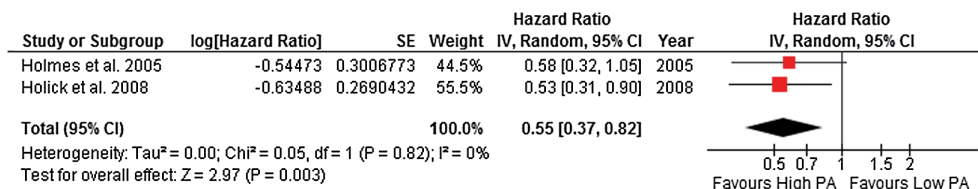
Supplementary Figure 5.17. More recent pre-diagnosis PA (high vs. low): premenopause and BC-related death.



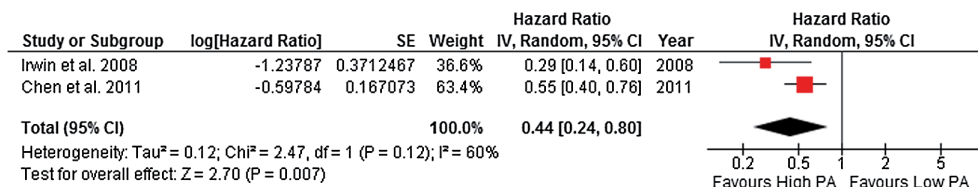
Supplementary Figure 5.18. More recent pre-diagnosis PA (high vs. low): postmenopause and BC-related death.

Post-diagnosis PA:

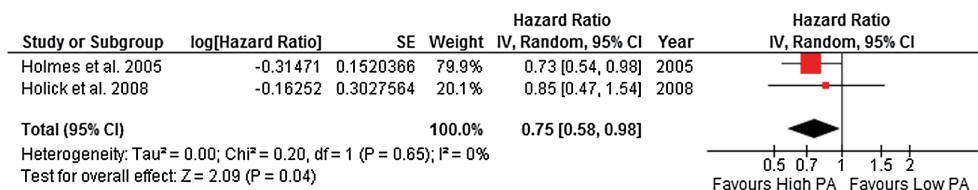
Supplementary Figure 5.19. Post-diagnosis PA (high vs. low): premenopause and all-cause death.



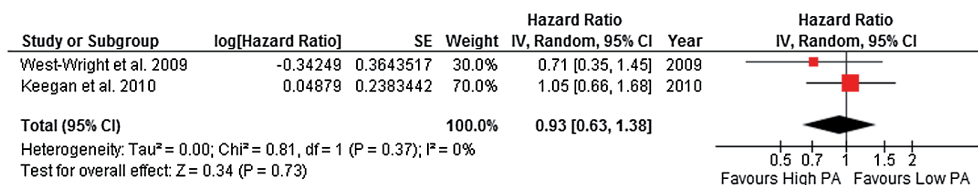
Supplementary Figure 5.20. Post-diagnosis PA (high vs. low): premenopause and BC-related death.



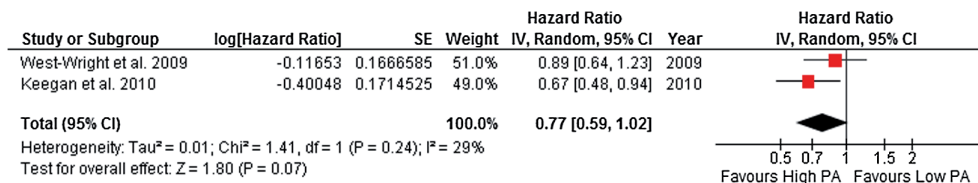
Supplementary Figure 5.21. Post-diagnosis PA (high vs. low): postmenopause and all-cause death.



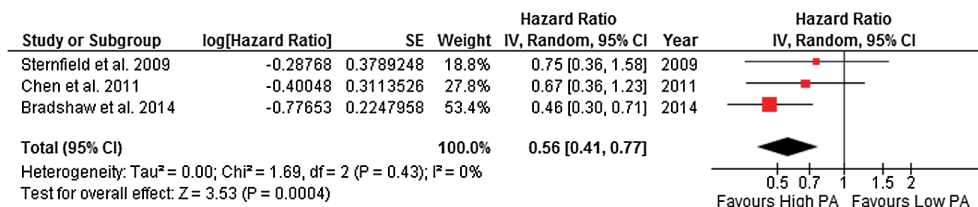
Supplementary Figure 5.22. Post-diagnosis PA (high vs. low): postmenopause and BC-related death.

HR status subanalyses:*More recent Pre-diagnosis PA:*

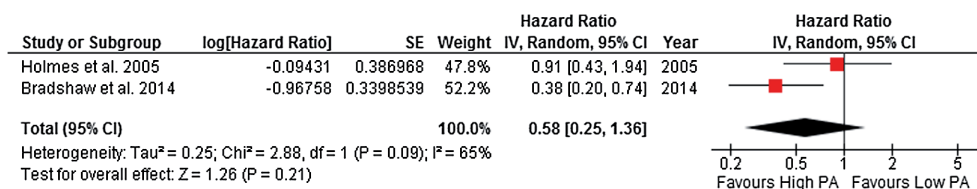
Supplementary Figure 5.23. More recent pre-diagnosis PA (high vs. low): ER- and all-cause death.



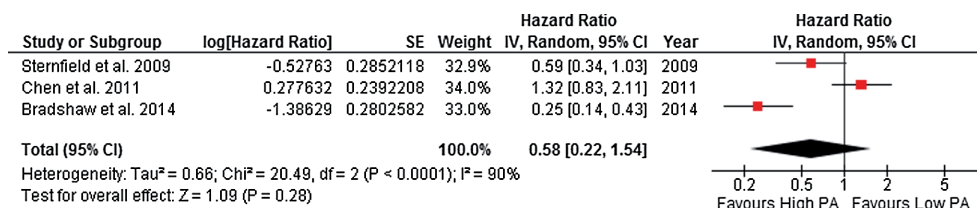
Supplementary Figure 5.24. More recent pre-diagnosis PA (high vs. low): ER1 and all-cause death. Post-diagnosis PA:

Post-diagnosis PA:

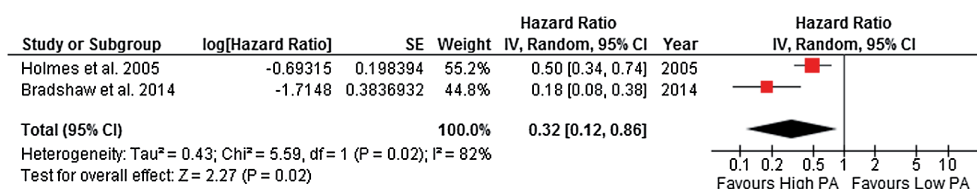
Supplementary Figure 5.25. Post-diagnosis PA (high vs. low): ER-/PR- and all-cause death.



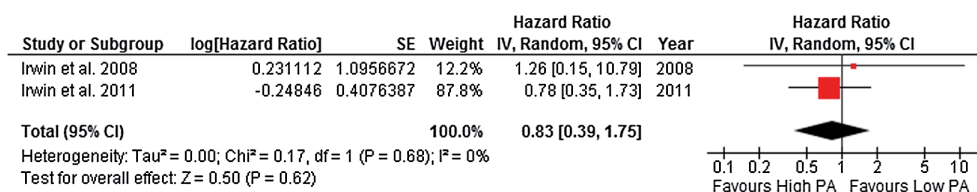
Supplementary Figure 5.26. Post-diagnosis PA (high vs. low): ER-/PR- and BC-related death.



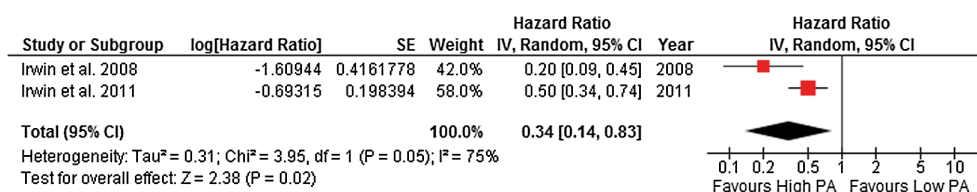
Supplementary Figure 5.27. Post-diagnosis PA (high vs. low): ER+/PR+ and all-cause death.



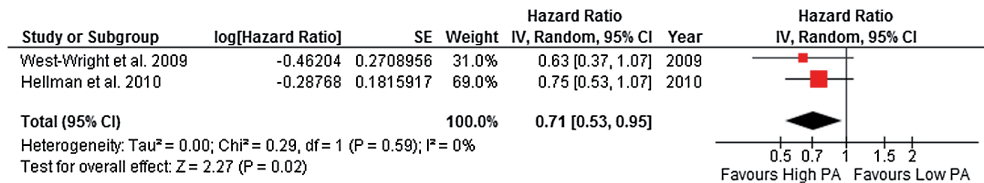
Supplementary Figure 5.28. Post-diagnosis PA (high vs. low): ER+/PR+ and BC-related death.



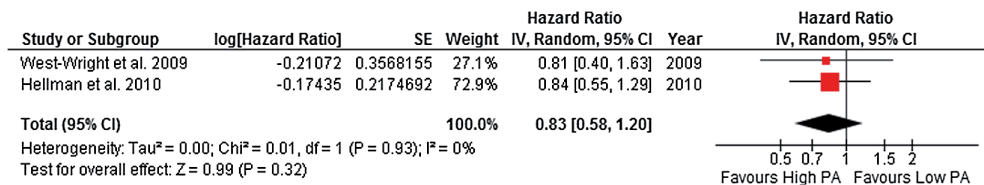
Supplementary Figure 5.29. Post-diagnosis PA (high vs. low): ER- and all-cause death.



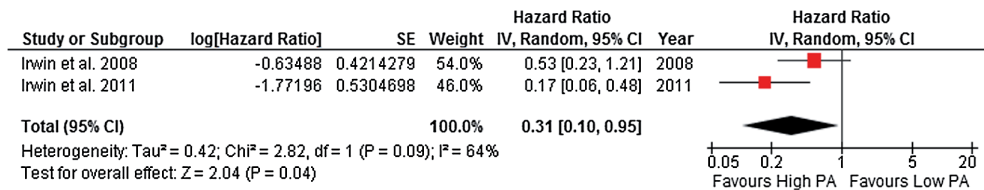
Supplementary Figure 5.30. Post-diagnosis PA (high vs. low): ER+ and all-cause death.

Breast cancer stage subanalyses:*More recent pre-diagnosis PA:*

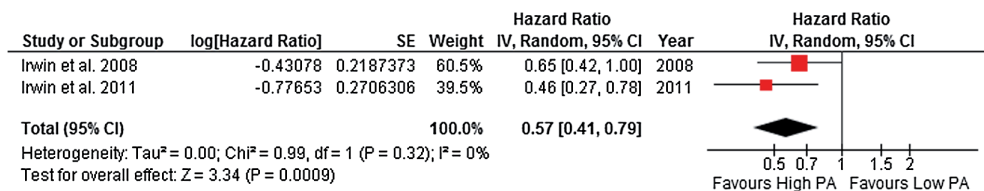
Supplementary Figure 5.31. More recent pre-diagnosis PA (high vs. low): local disease and all-cause death.



Supplementary Figure 5.32. Recent pre-diagnosis PA (high vs. low): regional disease and all-cause death.

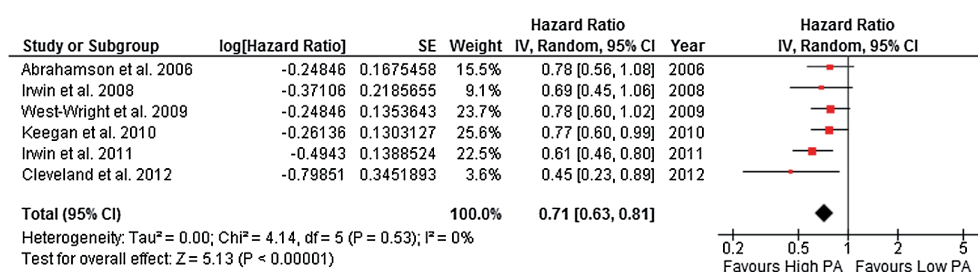
Post-diagnosis PA:

Supplementary Figure 5.33. Post-diagnosis PA (high vs. low): Stage I and all-cause death.

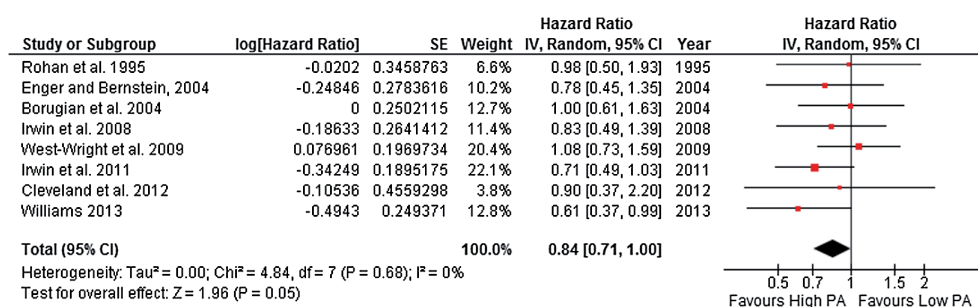


Supplementary Figure 5.34. Post-diagnosis PA (high vs. low): Stage II-III and all-cause death.

Sensitivity analysis:



Supplementary Figure 5.35. PA in the 5 years pre-diagnosis (high vs. low) and all-cause death.



Supplementary Figure 5.36. PA in the 5 years pre-diagnosis (high vs. low) and breast cancer-related death.