STRENUOUS PHYSICAL ACTIVITY AND BREAST CANCER RISK IN AFRICAN-AMERICAN WOMEN

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Objectives: Some studies of white women suggest that exercise reduces the incidence of breast cancer. There are no data on black women. We assessed the relationship between strenuous physical activity and prevalent breast cancer among participants in the Black Women's Health Study.

Methods: Data on strenuous recreational physical activity at various ages and other factors were collected in 1995 by mail questionnaire from 64,524 United States black women aged 21 to 69 years. The 704 women who reported breast cancer (cases) were matched on age and on menopausal status at the time of the breast cancer diagnosis with 1408 women who did not report breast cancer (controls). Odds ratios for levels of physical activity at various ages were derived from conditional logistic regression with control for potential confounding factors.

Results: Odds ratios for ≥7 h per week relative to <1 were significantly reduced for strenuous activity at age 21 for breast cancer overall and premenopausal breast cancer, at age 30 for breast cancer overall, and at age 40 for postmenopausal breast cancer. There was no evidence of a reduction associated with exercise in high school.

Conclusions: The findings of the present study suggest that strenuous physical activity in early adulthood is associated with a reduced risk of breast cancer in African-American women. (*J Natl Med Assoc.* 2001;93:267–275.)

Key words: physical activity ♦ breast cancer ♦ African Americans

Bernstein et al.[1] proposed that increased physical activity might represent a means for the primary prevention of breast cancer, through alterations in menstrual characteristics (e.g., increased anovulatory cycles). Other potential mechanisms include reductions in weight and favorable effects on immune function.[2,3] The evidence supporting an inverse relationship between physical activity and breast cancer is inconsistent.[2,3] Some studies have reported a significant reduction in the risk of breast cancer[1,4] but others have reported no effect.[5–9] The epidemiologic studies of breast cancer and physical activity have varied in design and methods utilized for measuring intensity and duration of activity and the time period in life when activity was assessed. Furthermore, it is not clear if there is a selected group of women that benefit from risk reduction,

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e.g., premenopausal women. The studies to date have assessed virtually all white populations.

The present study is designed to assess the relationship between strenuous physical activity during young adulthood and breast cancer risk, based on information reported at baseline in 1995 by the 64,524 participants in the Black Women's Health Study (BWHS).

METHODS

Study Population

In 1995, 64,524 United States black women aged 21 to 69 yr were enrolled through postal questionnaires in a follow-up study of African-American women, the Black Women's Health Study. The questionnaires were sent to subscribers of *Essence* magazine (whose readership consists almost entirely of black women), members of selected black women's professional organizations, and the friends and relatives of early respondents. The women were from all parts of the United States, with the largest numbers residing in California, Georgia, Illinois, Indiana, Louisiana, Maryland, Massachusetts, Michigan, New Jersey, New York, South Carolina, Virginia, and the District of Columbia. The median age of participants was 38 years.

In the BWHS, 97% of the women completed high school or a higher level of education. National data indicate that 83% of U.S. black women of the same ages as in the BWHS have completed high school or a higher level.[10] Thus, the BWHS results may not be applicable to women who have not completed high school.

Cases

There were 716 potential cases, who were women who responded "yes" to breast cancer and gave an age at diagnosis (<30, 30–39, 40–49, ≥50) on the 1995 questionnaire. Twelve women who reported having a cancer of some other type before the diagnosis of breast cancer were excluded, leaving 704 cases. Based on data on the age at diagnosis (<30, 30–39, 40–49, ≥50), menopausal status and age at menopause (<35, 35–39, 40–44, 45–49, 50–54, ≥55), 336 cases were classified as premenopausal at the time of diagnosis (i.e., premenopausal at the time of data collection in 1995 or whose age at menopause was greater than the age at diagnosis), 182 cases were classified as postmenopausal, the menopausal status could not be determined for 186 cases.

A single request for consent to obtain medical records was sent to all women who reported breast cancer. Consent was received from 262, and records were obtained for 218. All of the latter had breast cancer, of which 42 were in situ breast cancers. The assumption was made that cases for whom records were not obtained were breast cancer.

Controls

For each case, two controls in the same 5-yr age group and who had the same current menopausal status (and age at menopause if postmenopausal) were selected at random from those who did not report breast cancer. This was the equivalent to matching each case with controls who had the same menopausal status as the case at the time of diagnosis.

Survey Instrument

The BWHS questionnaire comprised 54 items including demographics, menstrual and reproductive history, medication history, medical history, cigarette smoking, and alcohol use.

The exercise data assessed were the responses to questions on the 1995 questionnaire about hours per week of participation in strenuous activity (such as basketball, swimming, running, aerobics) during high school, at around age 21, at around age 30, and at around age 40, where the response categories were none, <1, 1, 2, 3–4, 5–6, 7–9, 10+.[11]

Statistical Analysis

Odds ratios for breast cancer for various categories of hours of exercise per week relative to <1 h per week were estimated from conditional logistic regressions with terms for years of education, age at menarche, body mass index (wt(kg)/ht^2(m) at age 18, age at birth of first child, and history of breast cancer in a mother or sister. In tests for trend, we used 0.5 for less than 1 h, 10 for 10 or more h, and the midpoint of the intervals (e.g., 3.5 for 3–4 h per week). Only physical activity that preceded the diagnosis was considered for each case and her matched controls. In situ cases were included in all analyses. The point estimates, after the removal of the in situ cases, were similar to the overall analyses.

RESULTS

The descriptive characteristics of the study sample are presented in Table 1. Approximately 70% of

Table 1. Distribution of 704 Cases and 1408 Matched Controls by Selected Characteristics*

Characteristic	Cases		Controls	
	n	(%)	*n*	(%)
Age at diagnosis				
<30	30	(4.3)		
30–39	161	(22.9)		
40–49	302	(42.9)		
≥50	211	(30.0)		
Current age (yr)				
21–39	66	(9.4)	132	(9.4)
40–49	232	(33.0)	464	(33.0)
50–59	262	(37.2)	524	(37.2)
60–69	144	(20.5)	268	(20.5)
Region				
Northeast	178	(25.3)	367	(26.1)
South	192	(27.3)	379	(26.9)
Midwest	140	(27.0)	365	(25.9)
West	144	(20.5)	297	(21.1)
Education (yr)				
≤12	143	(20.3)	305	(21.7)
13–15	209	(29.7)	472	(33.5)
16+	326	(46.3)	576	(40.9)
Age at menarche (yr)				
<12	368	(52.3)	686	(48.7)
12	164	(23.3)	348	(24.7)
13+	133	(18.9)	296	(21.0)
Age at first birth (yr)				
<20	197	(28.0)	395	(28.1)
20–24	189	(26.8)	438	(31.1)
25+	162	(23.0)	307	(21.8)
Nulliparous	135	(19.2)	212	(15.1)
Parity				
0	135	(19.2)	212	(15.1)
1–2	317	(45.0)	677	(48.1)
3+	237	(33.7)	485	(34.4)
Breast cancer in mother or sister	107	(15.2)	134	(9.5)
Body mass index at age 18†				
<20	347	(49.3)	654	(46.4)
20–24	273	(38.8)	563	(40.0)
25+	54	(7.7)	143	(10.2)

*Women with unknown values are excluded.
†Weight (kg)/height^2 (m).

the breast cancers were diagnosed before the age of 50 yr. The breast cancer cases were distributed equally across the geographic areas. The cases were better educated than the controls and had earlier age at menarche, later age at first birth, lower parity, lower body mass index at age 18, and a higher prevalence of family history of breast cancer.

Table 2 gives the hours per week of strenuous exercise in high school among all cases and controls, overall and by menopausal status. None of the odds ratios (OR) was statistically significant and there were no trends.

The hours per week of strenuous exercise at age 21 among cases aged 30 to 69 yr at diagnosis and age matched controls are shown in Table 3. The OR was significantly reduced for 7+ h per week of exercise

Table 2. Hours Per Week of Strenuous Exercise in High School Among All Cases and Controls, Overall, and By Menopausal Status*

	Hours per week						
	<1 *n* (%)	1–2 *n* (%)	3–4 *n* (%)	5–6 *n* (%)	7+ *n* (%)	Unknown *n* (%)	Total
Overall							
Cases	100 (14.2)	151 (21.4)	117 (16.6)	105 (14.9)	143 (20.3)	88 (12.5)	704
Controls	207 (14.7)	320 (22.7)	204 (14.5)	208 (14.8)	278 (19.7)	191 (13.6)	1408
Odds ratio	ref.	1.0	1.2	1.0	1.0	0.9	
95% CI		0.7–1.3	0.8–1.7	0.7–1.5	0.7–1.4	0.7–1.3	
(p trend = 0.88)							
Menopausal status							
Premenopausal							
Cases	40 (11.9)	73 (21.7)	58 (17.3)	54 (16.1)	64 (19.0)	47 (14.0)	336
Controls	92 (13.7)	153 (22.8)	97 (14.4)	106 (15.8)	140 (20.8)	84 (12.5)	672
Odds ratio	ref.	1.1	1.3	1.1	1.0	1.2	
95% CI		0.7–1.7	0.8–2.2	0.7–1.9	0.6–1.6	0.7–2.1	
(p trend = 0.59)							
Postmenopausal							
Cases	30 (16.5)	41 (22.5)	29 (15.9)	29 (15.9)	36 (19.8)	17 (9.3)	182
Controls	58 (16.0)	87 (23.9)	57 (15.7)	47 (12.9)	60 (16.5)	55 (15.1)	364
Odds ratio	ref.	0.9	1.1	1.2	1.1	0.6	
95% CI		0.5–1.8	0.6–2.2	0.6–2.5	0.6–2.1	0.3–1.2	
(p trend = 0.76)							
Unknown							
Cases	30 (16.1)	37 (19.9)	30 (16.1)	22 (11.8)	43 (23.1)	24 (12.9)	186
Controls	57 (15.3)	80 (21.5)	50 (13.4)	55 (14.8)	78 (21.0)	52 (14.0)	372
Odds ratio	ref.	0.9	1.2	0.8	1.1	1.0	
95% CI		0.5–1.6	0.6–2.3	0.4–1.5	0.6–2.0	0.5–2.0	
(p trend = 0.83)							

*Status at the time of the case's diagnosis.
Covariates: education, age at menarche, body mass index at age 18, age at first birth and history of breast cancer.

at age 21 in the overall group and in premenopausal women as well compared to those who exercised less than 1 h per week. The trends were significant trends ($p < 0.01$) for the OR to decline with increasing exercise in both groups. Among postmenopausal women, and women whose menopausal status was unknown, the OR for 7+ h per week were 0.6 and 0.7, respectively, but these were not significant, nor was there a significant trend.

Table 4 shows exercise at age 30 among cases who were 40 to 69 yr at the time of diagnosis and their age-matched controls. The OR for 7+ h per week of strenuous exercise at age 30 was 0.5, overall. In each menopausal group, the OR for 7+ h per week was reduced, but not statistically significant. The p for trend overall and premenopausal women were 0.01 and 0.03, respectively.

Strenuous exercise at age 40 among cases who were 50 to 69 yr of age at diagnosis and their age matched controls are shown in Table 5. The ORs for 7+ h of exercise per week was 0.3 in postmenopausal women and 0.6 in women whose menopausal status was unknown, and the former value is statistically significant. Because there were only 20 cases who were premenopausal at the time of diagnosis, the data were insufficient for separate analysis.

DISCUSSION

In previous studies of physical activity and breast cancer, results on recreational activity and occupational activity have been inconsistent. Thune et al.[4] found both occupational and recreational physical activity to be associated with reduced risk, with a

Table 3. Hours Per Week of Strenuous Exercise at Age 21 Among Cases Diagnosed at Age 30 or Older and Their Matched Controls, Overall and By Menopausal Status*

	Hours per week						
	<1 n (%)	1–2 n (%)	3–4 n (%)	5–6 n (%)	7+ n (%)	Unknown n (%)	Total
Overall							
Cases	175 (26.0)	171 (25.4)	108 (6.0)	79 (11.7)	63 (9.3)	78 (11.6)	674
Controls	346 (25.7)	29 (21.8)	201 (14.9)	157 (11.6)	207 (15.4)	143 (10.6)	1348
Odds ratio	ref.	1.1	1.0	1.0	0.6	1.1	
95% CI		0.9–1.5	0.8–1.4	0.7–1.3	0.4–0.8	0.8–1.5	
(*p* trend = <0.01)							
Menopausal status							
Premenopausal							
Cases	74 (24.1)	85 (27.7)	47 (15.3)	43 (14.0)	22 (7.2)	36 (11.7)	307
Controls	158 (25.7)	135 (22.0)	96 (15.6)	73 (11.9)	97 (15.8)	55 (9.0)	614
Odds ratio	ref.	1.3	1.0	1.2	0.5	1.3	
95% CI		0.9–1.9	0.6–1.5	0.7–1.9	0.3–0.8	0.8–2.2	
(*p* trend = 0.01)							
Postmenopausal							
Cases	50 (27.5)	38 (20.9)	33 (18.1)	23 (12.6)	18 (9.9)	20 (11.0)	182
Controls	90 (24.7)	87 (23.9)	49 (13.5)	38 (10.4)	50 (13.7)	50 (13.7)	364
Odds ratio	ref.	0.8	1.2	1.0	0.6	1.0	
95% CI		0.5–1.4	0.7–2.2	0.5–2.0	0.3–1.2	0.6–1.8	
(*p* trend = 0.28)							
Unknown							
Cases	51 (27.6)	48 (25.9)	28 (15.1)	13 (7.0)	23 (12.4)	22 (11.9)	185
Controls	98 (20.9)	72 (15.3)	56 (11.9)	46 (9.8)	60 (12.8)	138 (29.4)	470
Odds ratio	ref.	1.3	0.9	0.6	0.7	1.2	
95% CI		0.7–2.1	0.5–1.7	0.3–1.2	0.3–1.2	0.6–2.3	
(*p* trend = 0.11)							

*Status at the time of the case's diagnosis.
Covariates: education, age at menarche, body mass index at age 18, age at first birth and history of breast cancer.

stronger association in premenopausal women. Bernstein[1] also showed a strong inverse association among women aged 40 yr and younger. The odds ratio was 0.42 for an average lifetime exercise level of at least 3.8 h per week. Gammon[3] found no relationship between physical activity and risk of breast cancer using measures similar to those of Bernstein.[1] In the Nurses Health Study II, Rookhill et al.[12] observed no relationship between risk of breast cancer and exercise in high school and at age 18 to 21, but their highest category was only 2 + hours per week. In a recent study in the Netherlands, Verloop[13] observed a 30% reduction in breast cancer for women who had ever engaged in recreational physical activity compared with inactive women. Verloop could not identify a specific period in life in which the decrease in risk associated with physical activity was most pronounced.

The present study of African-American women suggests that high levels of strenuous physical activity during young adulthood are associated with reduced risk of breast cancer. In particular, the odds ratio for ≥7 h per week of strenuous exercise relative to <1 h was significantly reduced for exercise at age 21 for breast cancer overall and premenopausal breast cancer, for exercise at age 30 for breast cancer overall, and for exercise at age 40 for postmenopausal breast cancer. The results were more often statistically significant for premenopausal women, the largest group, but the odds ratios for ≥7 h of physical activity were similar across the categories of menopausal status. There was no evidence of a re-

Table 4. Hours Per Week of Strenuous Exercise at Age 30 Among Cases Diagnosed at Age 40 or Older and Their Matched Controls, Overall and by Menopausal Status*

	Hours per week						
	<1 n (%)	1-2 n (%)	3-4 n (%)	5-6 n (%)	7+ n (%)	Unknown n (%)	Total
Overall							
Cases	150 (29.2)	138 (26.9)	76 (14.8)	39 (7.6)	34 (6.6)	76 (14.8)	513
Controls	251 (24.4)	261 (25.4)	158 (15.4)	90 (8.8)	97 (9.5)	169 (16.5)	1026
Odds ratio	ref.	0.9	0.8	0.7	0.6	0.8	
95% CI		0.7–1.2	0.5–1.1	0.5–1.1	0.3–0.9	0.5–1.1	
(p trend = <0.01)							
Menopausal status							
Premenopausal							
Cases	53 (28.5)	57 (30.6)	25 (13.4)	12 (6.5)	13 (7.0)	26 (14.0)	186
Controls	81 (22.5)	96 (26.7)	55 (15.3)	40 (11.1)	35 (9.7)	53 (14.7)	360
Odds ratio	ref.	0.8	0.7	0.5	0.5	0.7	
95% CI		0.5 – 1.4	0.4 – 1.2	0.2–1.0	0.2–1.1	0.4 – 1.4	
(p trend = 0.03)							
Postmenopausal							
Cases	47 (28.7)	39 (23.8)	33 (20.1)	14 (8.5)	8 (4.8)	23 (14.0)	164
Controls	81 (24.7)	84 (25.6)	43 (13.1)	26 (7.9)	28 (8.5)	66 (20.1)	328
Odds ratio	ref.	0.8	1.3	1.0	0.5	0.6	
95% CI		0.4 – 1.4	0.7 – 2.5	0.4–2.1	0.2–1.2	0.3 – 1.1	
(p trend = 0.23)							
Unknown							
Cases	50 (29.6)	48 (28.4)	18 (10.7)	13 (7.7)	13 (7.7)	27 (16.0)	169
Controls	89 (26.3)	81 (24.0)	60 (17.8)	24 (7.1)	34 (10.1)	50 (14.8)	338
Odds ratio	ref.	1.1	0.5	1.1	0.6	1.0	
95% CI		0.6–1.7	0.3–1.0	0.5–2.4	0.3–1.3	0.5–1.9	
(p trend = 0.22)							

*Status at the time of the case's diagnosis.
Covariates: education, age at menarche, body mass index at age 18, age at first birth and history of breast cancer.

duction associated with exercise in high school. In previous studies with data on exercise during the teen years, while some have shown a reduction [1,13–15] most have shown little or no reduction.[6,8,16–18] The lack of statistical significance among postmenopausal women may have been attributed to less statistical power due to the fewer cases.

Although the test for trend for exercise at age 21 was statistically significant overall and in premenopausal women, the data did not show any evidence of a dose response relationship. This was also the case for exercise at age 40, although the test for trend was not significant. Nevertheless, the point estimates for exercise at age 30, as well as the test for trend suggest that reduced risk begins with fewer hours of exercise and increases as exercise time increases. It is evident that the lack of a dose-response relationship may be attributed to recall bias as well as psychometric properties of the survey instrument.

Physical activity assessment is very difficult. Differences in the ways physical activity was assessed may have contributed to the inconsistent study findings. Data on both leisure time and occupational activities have been collected in relatively few studies.[4,9,18–21] Only Dorgan et al.,[9] in a follow up study, assessed physical activity from all sources including activities of daily living. The majority of studies collected physical activity data for a restricted time period. Only Bernstein[1] has reported on lifetime recreational activity. Failure to include all sources of physical activity may result in misclassification. In the present study, we measured only strenuous recreational activity. Differential misclassification could explain the inverse associations if cases had underre-

Table 5. Hours Per Week of Strenuous Exercise at Age 40 Among Cases Diagnosed at Age 50 or Older and Their Matched Controls, overall and by Menopausal Status*

	Hours per week						
	<1 *n* (%)	1–2 *n* (%)	3–4 *n* (%)	5–6 *n* (%)	7+ *n* (%)	Unknown *n* (%)	Total
Overall							
Cases	68 (32.2)	55 (26.1)	35 (16.6)	13 (6.2)	13 (6.2)	27 (12.8)	211
Controls	140 (33.2)	103 (24.4)	62 (14.7)	23 (5.5)	41 (9.7)	53 (12.6)	422
Odds ratio	ref.	1.1	1.1	1.1	0.5	1.0	
95% CI		0.7–1.8	0.6–1.8	0.5–2.4	0.3–1.1	0.6–1.8	
(*p* trend = .15)							
Menopausal status							
Premenopausal							
Cases	4 (20.0)	5 (25.0)	2 (10.0)	1 (5.0)	2 (10.0)	6 (30.0)	20
Controls	14 (35.0)	8 (20.0)	6 (15.0)	4 (10.0)	3 (7.5)	5 (12.5)	40
Postmenopausal							
Cases	38 (34.5)	31 (28.2)	18 (16.4)	7 (6.4)	5 (4.5)	11 (10.0)	110
Controls	71 (32.3)	57 (25.9)	27 (12.3)	11 (5.0)	23 (10.5)	31 (14.1)	220
Odds ratio	ref.	1.0	1.3	1.2	0.3	0.5	
95% CI		0.5 – 1.9	0.6–2.8	0.4–3.6	0.1–0.9	0.2–1.3	
(*p* trend = 0.13)							
Unknown							
Cases	26 (32.1)	19 (23.5)	15 (18.5)	5 (6.2)	6 (7.4)	10 (12.3)	81
Controls	55 (24.8)	38 (17.1)	29 (13.1)	8 (3.6)	15 (6.8)	77 (34.7)	222
Odds ratio	ref.	1.3	0.9	1.4	0.6	2.2	
95%CI		0.6 – 2.8	0.4–2.2	0.3–5.4	0.2–1.9	0.7–6.3	
(*p* trend = 0.37)							

*Status at the time of the case's diagnosis.
Covariates: education, age at menarche, body mass index at age 18, age at first birth, and history of breast cancer.

ported their physical activity more often than controls. We believe this was unlikely because cases tend to be more aware of their health habits than controls. Although cases may be more aware of health habits than controls, it is possible that cases may underestimate their good health habits because of their disease whereas controls may overestimate exercise.

Psychometric properties of the survey instrument may be a factor in differential misclassification. There exists the possibility that various parameters such as test-retest reliability could differ between cases and controls. Also, it is not known if the definition of strenuous exercise varies between cases and controls.

African-American women have been consistently reported to have a higher prevalence of sedentary behavior and a lower level of total habitual activity compared to white women.[11,22–32] Nondifferential misclassification, resulting from overreporting of physical activity considered as strenuous by inactive/sedentary women, may have potentially resulted in bias to the null. To accurately quantify misclassification would require validation of strenuous physical activity during the different time periods, which is impossible.

Prevalent cases of breast cancer were assessed in the present study. Because the timing of some exposures was not known with respect to the occurrence of the breast cancer (e.g., alcohol consumption), these factors could not be controlled in the analysis. Selection bias was also a possibility (i.e., cases with certain characteristics might have been more likely to enroll in the study than cases without those characteristics). Against this, however, is the fact that early menarche, low parity, late age at birth of first child, body mass index at age 18, and family history of breast cancer were associated in the expected manner with breast cancer in these data. Another type of selection bias might have been present. If physical activity prolongs survival from

breast cancer, there would have been an overrepresentation of strenuous activity in the case group which would have biased the odds ratio toward 1.0.

An effect of physical activity on breast cancer risk, particularly of premenopausal cancer, would be of particular importance to African-American women, who have the highest incidence of breast cancer under the age of 50 yr among U.S. women.[33] Furthermore, if physical activity protects against the development of breast cancer, it may also be related to increased survival among African-American women. In the future, the Black Women's Health Study will be better able to provide data on the relationship of physical activity to incident breast cancer in both premenopausal and postmenopausal women. With incident cases, it will be possible to assess whether physical activity reduces the occurrence of breast cancer unconfounded by an association of activity with survival.

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