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Original Paper

Occupational and Leisure Time Physical Activity and the Risk of Breast Cancer

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The relationship between occupational and leisure-time activity and the risk of breast cancer was analysed using data from a case–control study conducted in the Swiss Canton of Vaud between 1993 and 1998 on 246 incidents, histologically confirmed breast cancer cases and 374 controls below the age of 75 years, admitted to the same network of hospitals for acute, non neoplastic non hormone-related conditions. For occupational physical activity, the multivariate odds ratios (OR) for the highest versus the lowest level of physical activity were 0.6 (95% confidence interval, CI = 0.35–1.04) when aged 15 to 19 years, 0.5 (95% CI = 0.26–0.98) when aged 30 to 39 years, and 0.68 (95% CI = 0.36–1.28) when aged 50 to 59. For leisure time physical activity, the ORs were 0.4 (95% CI = 0.26–0.69), 0.5 (95% CI = 0.30–0.81), and 0.4 (95% CI = 0.22–0.80) for the highest versus the lowest level, respectively, in the three age groups, and an inverse trend in risk was significant in all groups. This study, based on one of the few European datasets on the issue, further suggests that physical activity is a favourable indicator of breast cancer risk.

Key words: breast cancer, case–control study, physical activity, risk, Switzerland, women
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INTRODUCTION

STRENUOUS PHYSICAL activity in adolescence and young adult life has been inversely related to subsequent breast cancer risk, possibly by delaying menarche and the onset of regular ovulatory activity [1, 2]. Physical activity may also modify body fat composition and decrease fat stores, and hence reduce breast cancer risk in post-menopause, since oestrogen levels and availability are related to conversion of androgens to oestrogens in the adipose tissue [3].

Epidemiological data on physical activity and breast cancer risk at various ages are, however, still open to debate. In a comprehensive review of studies published up to 1997 [4], seven out of nine studies on occupational activity showed some reduction for risk among more active women, at least in some subgroups; 11 out of 16 studies on recreational activity showed also some reduction in risk. However, the strength of the association varied across studies, and the protection tended to be more consistently reported in case–control than in cohort studies. With reference to more recent studies, no association was observed for recreational physical activity in a population-based case–control study including 1668 cases under the age of 45 years in three areas of the US [5], as well as in a report from the Nurses' Health Study II, based on 372 breast cancer cases in young women [6]. However, a significant inverse trend in risk emerged for postmenopausal women among the 109 cases from the College Alumni Health Study [7].

Sociodemographic, reproductive and hormonal correlates of breast cancer [8], which were only partly allowed for in most studies, could explain part of the inverse association between physical activity and breast cancer risk, but this cannot totally account for the different results of various studies. It is also unclear whether the relevant measure of physical activity is some overall measure of lifelong activity, or whether selected periods of life are of specific relevance [9, 10]. For instance, a 60% reduced risk in the highest exercise level was reported from a case–control study of women under the age of 40 years in California [11], and was interpreted in terms of influence of physical activity on luteal

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phase hormones [12]. Definition and assessment of physical activity in epidemiological studies is also complex, and this may explain some of the apparent discrepancies [13].

In order to provide further information on the issue, we considered data from a case–control study of breast cancer conducted in the Swiss Canton of Vaud [14], including detailed information on potentially relevant covariates, such as anthropometric, hormonal and reproductive factors and diet.

PATIENTS AND METHODS

A case–control study on breast cancer was conducted between January 1993 and August 1998 in the Swiss Canton of Vaud [14]. Cases were women with incident, histologically confirmed breast cancer, admitted to the University Hospital of Lausanne. A total of 246 women aged between 29–74 years (median age 56) were included in the present analysis. Controls were 374 patients aged between 27–74 years (median age, 58) admitted to the hospitals in the same catchment area as cases for acute, non-neoplastic, non-gynaecological, non-hormone-related conditions. The major diagnostic categories were traumas, mostly fractures and sprains (26%); other orthopaedic disorders, such as low back pain and disc disorders (18%); acute surgical conditions (29%); eye diseases (5%); and other miscellaneous diseases, such as ear, nose, throat, and skin (22%). Fifteen per cent of cases and 12% of controls approached for interview refused to participate.

The interviews were conducted by trained interviewers, using a structured questionnaire, including information on sociodemographic characteristics such as education, occupation and socio-economic indicators; lifelong smoking habits; physical activity at various ages; anthropometric measures; alcohol and coffee consumption; a validated food-frequency consumption section [15]; a problem-oriented personal medical history; family history of selected cancers in first-degree relatives; gynaecological and reproductive history; and history of use of oral contraceptives, hormone replacement treatment, and hormones for other indications.

The section on physical activity included questions on self-reported intensity of activity at work and in leisure-time separately. Both types of activity were elicited for three periods of life; from 15–19, from 30–39 and from 50–59 years. For occupational physical activity, the scores ranged between 1 and 3, corresponding to 'very tiring or tiring', 'standing', and 'mainly sitting'; housewives being classified according to their personal report. Physical activity in leisure-time was defined according to number of hours per week of sport and leisure time activity such as walking, gardening and cycling. The cutoffs were defined as <2, 2–4, and ≥ 5 h per week [16].

Odds ratios (ORs), and the corresponding 95% confidence intervals (CIs) for various levels of occupational and leisure-time physical activity at various ages were derived using unconditional multiple logistic regression, fitted by the method of maximum likelihood [16]. The regression equations included (1) terms for age and education, and (2) also terms for age at menarche, age at first birth, number of births, menopausal status, age at menopause, family history of breast cancer, history of benign breast disease, and total calorie intake.

RESULTS

Table 1 gives the distribution of breast cancer cases and the comparison group according to age and selected characteristics. Cases reported later first birth (OR = 1.5, 95% CI 1.1–2.2, for ≥ 25 versus <25 years) more frequent history of breast cancer in first-degree relatives (OR = 4.1, 95% CI 2.1–7.8), personal history of benign breast disease (OR = 2.4, 95% CI 1.2–4.8), and higher calorie intake (OR = 1.8, 95% CI 1.3–2.5).

Table 2 details occupational and leisure-time physical activity. The multivariate ORs for the highest versus the lowest level of occupational physical activity were 0.61 when aged 15 to 19 years, 0.51 when aged 30 to 39 years, and 0.68 when aged 50 to 59 years. The inverse association was significant for ages 15 to 19 years. The ORs for the highest versus the lowest level of leisure time physical activity were

Table 1. *Distribution of* 246 *cases of breast cancer and of* 374 *controls according to selected characteristics. Vaud, Switzerland,* 1993–1998

Characteristic	Cases *n* (%)	Controls *n* (%)	Odds ratio (95% CI)
Age group (years)			
<35	5 (2)	16 (4)	
35–44	37 (15)	54 (14)	
45–54	61 (25)	81 (22)	
55–64	63 (26)	97 (26)	
65–74	80 (33)	126 (34)	
Education (years)			
<11	150 (61)	247 (66)	1*
≥11	96 (39)	127 (34)	1.2 (0.8–1.6)
Age at menarche (years)			
<13	130 (53)	191 (51)	1*
≥13	116 (47)	183 (49)	0.6 (0.4–0.9)
Parity			
Nulliparae	56 (23)	85 (23)	1*
1–2	146 (59)	224 (60)	1.0 (0.7–1.5)
≥3	44 (18)	65 (17)	1.0 (0.6–1.7)
Age at birth of first child			
Nulliparae	56 (23)	85 (23)	
<25	87 (35)	167 (45)	1*
≥25	103 (42)	122 (33)	1.5 (1.1–2.2)
Menopausal status			
Pre- or in-menopause	75 (30)	129 (34)	1*
Post	171 (70)	245 (66)	1.7 (0.9–3.0)
Age at menopause (years)			
<50	85 (35)	100 (27)	1*
≥50	86 (35)	145 (39)	0.8 (0.5–1.2)
Body mass index (kg/m^2)			
<25	132 (54)	204 (55)	1*
≥25	114 (46)	170 (45)	1.0 (0.7–1.4)
History of breast cancer in first-degree relatives			
No	212 (86)	360 (96)	1*
Yes	34 (14)	14 (4)	4.1 (2.1–7.8)
History of benign breast disease			
No	224 (91)	360 (96)	1*
Yes	22 (9)	14 (4)	2.4 (1.2–4.8)
Total calorie intake (Kcal/day)			
<1640	86 (35)	187 (50)	1*
≥1640	160 (65)	187 (50)	1.8 (1.3–2.5)

CI, confidence interval; odds ratios were adjusted for age. *Reference category.

between 0.42 and 0.50 in various age groups, and the inverse trends in risk were significant. The ORs adjusted for age and education only (OR1 in Table 2) were similar to those of the multivariate analysis.

The relationship between occupation and leisure time activity and breast cancer risk was also examined in separate strata of age, menopausal status, education, body mass index and total calorie intake. In particular, the ORs for the intermediate level of occupational physical activity were 0.87 (95% CI 0.44–1.71) in pre-menopausal and 0.69 (95% CI 0.44–1.08) in post-menopausal women, and those for the high level, 0.42 (95% CI 0.18–0.99) and 0.40 (95% CI 0.23–0.70), respectively. No other systematic effect modification nor appreciable interaction was observed, most ORs being below unity in the highest levels of physical activity.

DISCUSSION

The present data, based on one of the few available European datasets, further suggest that physical activity is a favourable indicator of breast cancer risk. An inverse association between both occupational and leisure-time physical activity was observed in adolescence and younger age, this being in agreement with the observation that strenuous physical activity in adolescence may delay menarche, decrease the number of regular menstrual cycles, and consequently be inversely related to subsequent breast cancer risk [1, 2]. However, mean age at menarche was 13.4 years both in women reporting low leisure-time physical activity and in those reporting high leisure-time physical activity between the ages of 15 and 19 years.

Although a detailed discussion of possible biological mechanisms goes beyond the scope of the present report, effects of physical activity on energy balance, anthropometry and body mass composition [8, 18–21], immune mechanisms and oxydative stress can be mentioned [22, 23].

We were unable to explain completely the inverse association between physical activity and breast cancer risk through allowance for a large number of potential confounding factors, including menstrual, reproductive, anthropometric factors, and total calorie intake. A potentially relevant modifying

Table 2. Odds ratios and 95% confidence intervals (CIs) of breast cancer according to different levels of occupational or leisure physical activity (Vaud, Switzerland, 1993–1998)

Type of physical activity	No. cases	No. controls	OR (95% CI)*	
			OR1	OR2
Occupational physical activity				
When aged 15–19 years				
1 (low)	152	193	1†	1†
2 (intermediate)	55	112	0.62 (0.42–0.91)	0.60 (0.40–0.91)
3 (high)	39	69	0.73 (0.46–1.17)	0.61 (0.35–1.04)
X^2_1 (trend)			3.88 ($P=0.05$)	5.84 ($P=0.02$)
When aged 30–39 years				
1 (low)	29	23	1†	1†
2 (intermediate)	69	114	0.50 (0.27–0.94)	0.45 (0.21–0.88)
3 (high)	147	234	0.53 (0.29–0.96)	0.51 (0.26–0.98)
X^2_1 (trend)			1.99 ($P=0.16$)	1.87 ($P=0.17$)
When aged 50–59 years				
1 (low)	31	30	1†	1†
2 (intermediate)	73	116	0.64 (0.36–1.14)	0.54 (0.29–1.02)
3 (high)	77	113	0.69 (0.38–1.24)	0.68 (0.36–1.28)
Undefined	–	1		
X^2_1 (trend)			0.65 ($P=0.42$)	0.40 ($P=0.53$)
Leisure-time physical activity				
When aged 15–19 years				
1 (low)	78	107	1†	1†
2 (intermediate)	128	126	1.39 (0.94–2.05)	1.53 (1.01–2.32)
3 (high)	40	141	0.39 (0.25–0.63)	0.42 (0.26–0.69)
X^2_1 (trend)			16.64 ($P=0.001$)	10.83 ($P=0.001$)
When aged 30–39 years				
1 (low)	107	121	1†	1†
2 (intermediate)	102	148	0.75 (0.52–1.08)	0.87 (0.59–1.29)
3 (high)	36	102	0.41 (0.25–0.65)	0.50 (0.30–0.81)
X^2_1 (trend)			13.91 ($P=0.001$)	6.83 ($P=0.01$)
When aged 50–59 years				
1 (low)	111	105	1†	1†
2 (intermediate)	52	110	0.43 (0.28–0.67)	0.44 (0.28–0.70)
3 (high)	18	44	0.39 (0.21–0.72)	0.42 (0.22–0.80)
Undefined	–	1		
X^2_1 (trend)			15.13 ($P=0.001$)	12.28 ($P=0.001$)

*Estimates were derived from multiple logistic regression equations including for OR1 terms for age and education; for OR2 terms for age, education, age at menarche, age at first birth, number of births, menopausal status, age at menopause, calorie intake, previous benign breast disease, and history of breast cancer in first-degree relatives. †Reference category. OR, odds ratio; CI, confidence interval.

factor was education, which is correlated to occupational—as well as to leisure-time—physical activity and may, therefore, represent for several aspects an overadjustment. Residual confounding could in principle be a problem, but this is unlikely to be of practical relevance, since the multivariate ORs were similar to those adjusted for age and education only.

With reference to other possible sources of bias, cases and controls came from comparable catchment areas, participation was satisfactory, and the results were consistent when separate comparison was made with major diagnostic categories of the controls. In particular, when orthopaedic controls were excluded, the inverse relation with leisure-time physical activity became, if anything, somewhat stronger. The physical activity section of the questionnaire was not validated [13, 24], but differential recall or information bias is unlikely, given the lack of public attention on the issue, and the hospital setting which should have assured a similar attitude towards the interview in cases and controls [17].

An Italian study estimated that over 10% of breast cancer cases could be avoided by increasing physical activity [25]. This figure is in broad agreement with the estimate of the present study, assuming a shift of one level in physical activity of all our cases. If real, this would be of major public health relevance, given that physical activity would be one of the few modifiable risk factors for breast cancer.

The present study, therefore, provides a useful contribution to a still open issue. However, the role of physical activity on breast carcinogenesis, if any, requires further definition and more precise quantification across various populations and study designs, before focusing any potential intervention at a preventive and public health level [26].

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