

Association between allergies, asthma, and breast cancer risk among women in Ontario, Canada

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Abstract

Purpose To investigate the association between allergies, asthma, and breast cancer risk in a large, population-based case–control study.

Methods Breast cancer cases ($n = 3,101$) were identified using the Ontario Cancer Registry and population controls ($n = 3,471$) through random digit dialing. Self-reported histories of allergies, hay fever, and asthma were collected by questionnaire. Logistic regression was used to assess associations between breast cancer risk and history of allergy/hay fever and asthma, with 16 possible confounders examined. Analyses were stratified by menopausal status.

Results A history of allergies or hay fever was associated with a small reduction in breast cancer risk [age-adjusted odds ratio (AOR) = 0.86, 95 % confidence interval (CI) 0.77–0.96] and did not differ by menopausal status. Asthma was not associated with breast cancer risk overall; however, among premenopausal women, asthma was associated with a reduced risk of breast cancer (AOR = 0.72, 95 % CI 0.54–0.97).

Conclusions A history of allergies may be associated with a modest reduction in breast cancer risk. Asthma does not appear to be associated with breast cancer risk overall; however, asthma may be associated with reduced breast cancer risk among premenopausal women.

Keywords Breast cancer · Allergy · Asthma · Case–control

Introduction

Numerous studies have reported associations between atopic disease, most commonly allergies, and decreased risk of some cancers, including glioma [1], pancreatic cancer [2–4], and hematologic cancers [5, 6]. The few studies to evaluate the association between allergies and breast cancer risk have reported inconsistent findings [e.g., 7–10]. One meta-analysis has been published and reported no statistically significant association between allergies or asthma and breast cancer risk [11]; however, the numbers of breast cancer cases in most studies were small ($n < 500$ in 10 of 14 studies), and studies were included that assessed breast cancer mortality, rather than incidence. In order to further elucidate whether there is a relationship between allergies, asthma, and breast cancer risk, we investigated this association using a large, population-based case–control study among women in Ontario, Canada.

Methods

Data were from women participating in the Ontario Women's Diet and Health Study, a population-based case–control study which has previously been described [12–14]. Pathologically confirmed breast cancer cases diagnosed in women aged 25–74 years during 2002–2003 were identified through the Ontario Cancer Registry. Controls were women identified through random digit dialing of households in Ontario and were 1:1 frequency matched to cases on 5-year age group. Ethics approval for this study was

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Approximately 75 % of cases (3,101/4,109) and 80 % of eligible controls (3,471/4,352) completed a personal history questionnaire by mail. The questionnaire asked the following questions pertaining to allergy and asthma history: “Before two years ago, did you ever have allergies or hay fever lasting more than one year?” and “Before two years ago, were you ever diagnosed with asthma?” Cases and controls were categorized as yes or no to (1) ever having had allergies/hay fever and (2) ever being diagnosed with asthma. The questionnaire also collected information about reproductive history, family and personal medical history, and many other breast cancer risk factors.

Logistic regression was used to estimate age-adjusted odds ratios (AOR) and 95 % confidence intervals (CI) for the associations between case–control status and allergy/asthma variables. Potential confounding by breast cancer risk factors that may also be associated with allergies and/or asthma (body mass index, smoking, physical activity, education, income, country of birth, and ethnicity) was assessed by adding each variable to the regression model and observing whether the change in the AOR was >10 %. To be cautious, we also tested for confounding by other established breast cancer risk factors (breast cancer in a first degree relative; ages at menarche, last menstrual period, and first live birth; parity; oral contraceptives; hormone replacement therapy; benign breast disease; and alcohol intake). A variable was considered to be a confounder if the AOR changed by >10 % [15]; none of the variables assessed met the definition.

Analyses were stratified by menopausal status, and the statistical significance of interactions between allergies or asthma and menopausal status was assessed using the likelihood ratio test to compare models with and without the product term.

Results

Characteristics of this study population have been previously described, and established breast cancer risk factors (including older age at menopause, lower parity, and family history of breast cancer) were associated with breast cancer risk in this data set [12, 13].

Table 1 shows that a history of allergies or hay fever was associated with a small, statistically significant reduction in breast cancer risk (AOR = 0.86, 95 % CI 0.77–0.96), and there was no association between an asthma diagnosis and breast cancer risk (AOR = 0.99, 95 % CI 0.85–1.17).

In stratified analyses (Table 2), allergies/hay fever was associated with similar reductions in both premenopausal

Table 1 Distribution of breast cancer cases and controls and AOR for the association between breast cancer risk and allergies/hay fever and asthma

Variable	Cases (<i>n</i> = 3,101)	Controls (<i>n</i> = 3,471)	AOR ^a (95 % CI)
Ever had allergies/hay fever lasting more than 1 year			
Yes	720 (23.5)	911 (26.7)	0.86 (0.77–0.96)
No	2,339 (76.5)	2,502 (73.3)	1.00
Ever diagnosed with asthma			
Yes	318 (10.5)	358 (10.6)	0.99 (0.85–1.17)
No	2,711 (89.5)	3,007 (89.4)	1.00

^a None of the 16 variables evaluated as potential confounders were identified as confounders

(AOR = 0.86, 95 % CI 0.71–1.05) and postmenopausal breast cancer risks (AOR = 0.84, 95 % CI 0.73–0.97); however, the association did not reach statistical significance among premenopausal women; the interaction was not significant ($P_{\text{interaction}} = 0.84$).

There was a statistically significant interaction between asthma diagnosis, menopausal status, and breast cancer risk ($P_{\text{interaction}} < 0.01$). Among premenopausal women, a diagnosis of asthma was associated with a reduced risk of breast cancer (AOR = 0.72, 95 % CI 0.54–0.97), while there was no association among postmenopausal women (AOR = 1.14, 95 % CI 0.94–1.38).

Discussion

The findings of this study suggest that a history of allergies or hay fever may be associated with a small reduction in breast cancer risk. To our knowledge, this is the largest study in which this association has been evaluated to date. A large study conducted several decades ago found no association between breast cancer risk and hay fever, but the risk of breast cancer was moderately, and significantly, reduced among women who reported a history of “hives” or “other allergies” [10]. Similar to our findings, a case–control study of young American women found that, among women aged 35–45 years, a history of allergies was associated with a reduced risk of breast cancer [7]. Recently, contact allergy has also been associated with reduced breast cancer risk in a linkage study conducted in Denmark [16]. Other previous studies of allergies and breast cancer risk found no association, but may not have had sufficient power to assess this association adequately [e.g., 8, 9, 17].

A diagnosis of asthma was not associated with breast cancer risk in this study overall; however, among

Table 2 Distribution of breast cancer cases and controls and AOR for the association between breast cancer risk and allergies/hay fever and asthma, stratified by menopausal status

Variable	Premenopausal			Postmenopausal		
	Cases (<i>n</i> = 957)	Controls (<i>n</i> = 1,237)	AOR (95 % CI)	Cases (<i>n</i> = 2,140)	Controls (<i>n</i> = 2,228)	AOR (95 % CI)
Ever had allergies/hay fever lasting more than 1 year						
Yes	234 (24.7)	331 (27.3)	0.86 (0.71–1.05)	485 (23.0)	580 (26.4)	0.84 (0.73–0.97)
No	714 (75.3)	881 (72.7)	1.00	1,622 (77.0)	1,617 (73.6)	1.00
Ever diagnosed with asthma						
Yes	81 (8.7)	139 (11.7)	0.72 (0.54–0.97)	235 (11.2)	219 (10.1)	1.14 (0.94–1.38)
No	848 (91.3)	1,047 (88.3)	1.00	1,861 (88.8)	1,956 (89.9)	1.00

premenopausal women only, a statistically significant reduction in breast cancer risk was observed. A recent meta-analysis reported that asthma was not associated with breast cancer risk, which is consistent with our overall findings; the meta-analysis did not explore the association stratified by menopausal status [11]. It is possible that the differing asthma–breast cancer associations observed for pre- and postmenopausal women are due to differences in the predominant types of asthma (allergic or non-allergic) that had occurred in the two groups; unfortunately, information on asthma type was not available. It has been documented that age at onset of allergic asthma is earlier than that of non-allergic asthma [18, 19], and women who develop asthma in adulthood, including “menopausal asthma” [20–22], most frequently develop non-allergic asthma [23].

Allergies are immunoglobulin E (IgE)-mediated immune reactions to innocuous environmental exposures, such as plant pollens or pet dander. A growing body of evidence suggests that IgE may play a role in the recognition of tumor antigens [24]. It has been suggested that since allergic persons typically have elevated levels of IgE, it is plausible that individuals with allergies exhibit enhanced tumor immune surveillance [25], whereby the immune system is primed to identify and eliminate cancerous or precancerous cells [26].

Strengths of this study include a large sample size, population-based selection of controls and incident breast cancer cases, and assessment of confounding by all established breast cancer risk factors. Limitations of this study include the somewhat crude self-reported history of “allergies or hay fever,” and the possible poor validity of this measure, since intolerances (for example, to certain foods or chemicals) may be mistakenly reported as allergies. However, given that such misclassification errors are likely similar for both cases and controls, we expect this would bias associations toward the null. Other limitations include the lack of information on age at allergy/asthma onset, as well as the use of allergy medications, which could be possible confounders if, for example,

antihistamines were associated with breast cancer risk—which has not been shown to date [27, 28].

In summary, this study found that self-reported history of hay fever or allergies may be associated with a small reduction in breast cancer risk and asthma may be associated with reduced risk of breast cancer in premenopausal, but not postmenopausal, women. Future studies are needed to replicate these findings and would benefit from more detailed information regarding allergy and asthma history, such as age at onset, specific type of allergy, skin prick test results, and medication use.

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Conflict of interest The authors declare that they have no conflict of interest.

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