

ORIGINAL ARTICLE

Who Remembers Whether They Had Asthma as Children?

JOHN A. BURGESS,^{1,*} E. HAYDN WALTERS,² GRAHAM B. BYRNES,¹ CATHRYN WHARTON,¹ MARK A. JENKINS,¹
MICHAEL J. ABRAMSON,³ JOHN L. HOPPER,¹ AND SHYAMALI C. DHARMAGE¹

¹Centre for Molecular, Environmental, Genetic and Analytical Epidemiology, The University of Melbourne, Australia

²Respiratory Research Group, University of Tasmania, Hobart, Australia

³Department of Epidemiology and Preventive Medicine, Monash University, Melbourne, Australia

Purpose: To assess misclassification in adults reporting childhood asthma. **Methods:** The Tasmanian Asthma Survey commenced in 1968 when 8,583 7-year-old children attending school in Tasmania (participants) were studied. In 1991–1993, a stratified sample of 1,494 participants was studied. Their recall of childhood asthma was compared to their parents' prospectively gathered report. **Results:** Where participants had childhood asthma, those with current asthma, severe eczema, or hay fever were less likely to misclassify while females were more likely to misclassify. Where participants had no childhood asthma, misclassification was associated with current asthma, hay fever, or allergies. **Conclusions:** Retrospective self-assessment of childhood asthma is unreliable.

Keywords asthma, chronic disease, cross-sectional study, recall error

INTRODUCTION

While there is considerable published work on misclassification in epidemiologic studies, such as the recall of dietary details in retrospective studies of cancer (1) and of occupational exposure in asthma (2), there is little published on misclassification among adults who are asked to recall their childhood asthma status. Brogger et al. (3) followed a cohort that was asthma free at enrollment and prospectively estimated asthma incidence by year of birth. At last follow-up, asthma incidence by year of birth was estimated retrospectively using recalled age of onset of asthma. A separate cross-sectional study from the same community over the same time period was then performed and asthma incidence was estimated using recalled age of onset of asthma. The results suggested that retrospectively gathered evidence for an increasing trend in asthma incidence should be treated with scepticism. A limitation of this study lay in the fact that the comparison of asthma incidence in the cohort and cross-sectional studies used different individuals.

Strachan et al. (4) reported a population-based longitudinal study of adult lung function following earlier onset asthma. The study noted that 41% of subjects who were known prospectively to have a history of asthma by 16 years of age denied ever having asthma when asked at 33 years of age. A further 28% reported a later age at onset of asthma than recorded prospectively. Had the participants been recalling their asthma status by age 16 years to estimate asthma incidence, 69% would have misclassified their early life asthma status.

In cross-sectional studies, misclassification of childhood asthma status by adult participants is a potential source of

measurement error as the risk factors for continuing and incident asthma may be different. Furthermore, recall error by adults who actually had early life asthma will lead to an underestimation of childhood incidence rates and an overestimation of adult incidence rates. Accurate estimation of asthma incidence is clearly important in helping determine whether an increase in prevalence, such as reported over the last three or four decades, is due to a rising incidence rather than a decrease in remission. The 1991–1993 survey of a sample of the Tasmanian Asthma Survey (TAS) cohort provided an opportunity to examine the extent of misclassification of their childhood asthma status by the then adult participants after an interval of 25 years.

METHODS

Study Design

The TAS began in 1968 with the enrollment of 8,583 children born in 1961 who were attending school in Tasmania. Their parents provided details of each child's medical history including the response to the question "Has your child ever in his/her life suffered from asthma or wheezy breathing?" In 1991–1993, a sample of 1,494 participants from the birth cohort, stratified by their asthma status by 7 years of age (asthma "yes," $n = 741$; 49.6%), were surveyed by a mailed respiratory questionnaire that required the participants to nominate their lifetime asthma status by answering the question "Have you ever in your life suffered from asthma or wheezy breathing?" Those who answered in the affirmative were asked to nominate their age at onset of asthma. The responses of the participants in 1991–1993 were compared with their parents' reports in 1968 concerning asthma status by age 7 years.

Definitions

Childhood asthma was defined by an affirmative response in 1968 to the "asthma or wheezy breathing ever" question.

*Corresponding author: Dr. John Burgess, Centre for Molecular, Environmental, Genetic and Analytical Epidemiology, The University of Melbourne, Level 2, 723 Swanston Street, Carlton, VIC. 3053, Australia; E-mail: j.burgess@pgrad.unimelb.edu.au

Current asthma in 1991–1993 was defined by the participant's affirmative answer to the "lifetime asthma or wheezy breathing ever" question and the report of an attack within the previous twelve months. No current asthma in 1991–1993 was defined by the participant having no asthma attack within the last 12 months. The participant's perception in 1991–1993 as to asthma status by 7 years of age was recorded as "no" if the participant stated that he/she had either never had asthma or had asthma that began after the age of 7 yrs.

Participant misclassification was defined by discordance between the participant's recall in 1991–1993 of asthma status by age 7 yrs and the parent's report in 1968. Possible predictors of misclassification were the participant's gender, smoking, current asthma status in 1991–1993, history of hay fever or allergy to food or medicine, history of eczema or hives, a family history of asthma, socioeconomic status, and years of secondary education. These data were collected from the 1991–1993 survey. Eczema when present was graded as "mild" (once or twice a year), "moderate" (more than twice a year) or "severe" (nearly all the time). An adult participant's socioeconomic status was derived from the Socio-Economic Indexes for Areas (SEIFA) 1991 (5) where the areas were defined by postcode. Each of the five Indexes was divided into quartiles. The 1st quartile represented the lowest level of socio-economic status.

Analysis

Sensitivity and specificity were computed for the participant's response in 1991–1993 against the parent's report in 1968. Possible predictors of misclassification were first tested using univariate logistic regression. Multivariable logistic regression (6) was then used to identify the independent predictors. Inclusion in the final multivariable models was determined by a two sided p value ≤ 0.05 . The analysis was done using Stata 9.1 statistical software (7).

RESULTS

The participants' recall in 1991–1993 compared with their parents' report in 1968 is shown in Table 1.

Table 2 shows the agreement between participants' recall in 1991–1993 and their parents' report in 1968.

The sensitivity and specificity of the participant's response in 1991–1993 as a predictor of the parent's report in 1968 were 34% (95% CI 32% to 37%) and 97% (95% CI 96% to 98%), respectively. Of the 1,494 participants, 511 (34%) disagreed with their parents. Of these, 332 (65%) gave a false-negative response, 24 (5%) gave a false-positive response, and 155 (30%) reported a later age at onset of asthma than was reported by their parents.

TABLE 1.—Comparison between the participant's asthma status by age 7 reported by the parent in 1968 and the perceived age at onset of asthma reported by the adult participants in 1991–1993.

Asthma status in 1968 reported by parents	Age (yrs) at onset of asthma reported by participants when 32 years of age					Total
	Never	<7	7–14	15–21	>21	
No asthma	627	24	29	15	58	753
Asthma	332	254	58	35	62	741
Total	959	278	87	50	120	1,494

TABLE 2.—Agreement between participants in 1991–1993 and parents in 1968 as to participant's asthma status at age 7 in 1968.

Participant's recall in 1991–1993 of age of onset of asthma	Parent's statement in 1968		
	Asthma—yes	Asthma—no	Total
Asthma before 7—"yes"	254 (34%)	24 (3%)	278
Asthma before 7—"no"	487 (66%)	729 (97%)	1,216
	741	753	1,494

Table 3 shows the associations between the univariate predictors and participant/parent disagreement.

Among the participants who had asthma by 7 years of age, females were significantly more likely to misclassify than males. Those reporting current asthma, eczema, or hay fever were less likely to misclassify than those without such a history. All five SEIFA indexes were tested as univariate predictors of misclassification and none showed any association. Only the results for the Index of Relative Socio-Economic Disadvantage are presented. Among those with no history of asthma by 7 years of age, misclassification was more likely if the participant had 3 years or less of secondary schooling, had current asthma, eczema, hay fever, or had an allergy to food or medicine.

Table 4 summarizes the results for the multivariable analysis.

For those participants with childhood asthma, being female remained an independent predictor of misclassification, while current asthma, hay fever, and severe eczema were independent predictors of a lesser risk of misclassification.

For those participants without childhood asthma, having current asthma, hay fever, or an allergy to medicine or food all independently predicted misclassification. In the univariate model, there was evidence of some effect modification between gender and current asthma status among those who did not have childhood asthma. The odds ratio for females misclassifying childhood asthma was six times greater than that for males and the interaction term was of borderline statistical significance ($p = 0.08$). When the interaction term was included in the multivariable model it became clearly non-significant. In the univariate model, 3 years or less of secondary schooling was a significant predictor of misclassification among those who had no parent-defined childhood asthma. In the multivariable model, 3 years or less of secondary schooling was no longer significant (OR 2.45; $p = 0.08$) due to confounding by current asthma.

DISCUSSION

Most of the data concerning misclassification of childhood disease by adults have dealt with the accuracy of recall of others, usually parents, about the disease status of children a few years later (8, 9). We examined the degree of misclassification by adults of their own childhood disease status, in this case "asthma,"—after an interval of 25 years.

Just over one third of the young adults who participated in this study misclassified their childhood asthma status. More misclassification occurred among those with than without childhood asthma. Of the participants with childhood asthma, nearly one half misclassified their childhood asthma status by giving a false-negative response, one fifth exhibited

TABLE 3.—Univariate predictors of disagreement.

Variable	Asthma by age 7		No asthma by age 7	
	OR (95% CI)	<i>p</i> value	OR (95% CI)	<i>p</i> value
Female gender	1.41 (1.03 to 1.93)	0.03	0.79 (0.35 to 1.79)	0.57
Family history asthma				
Both parents had asthma	0.41 (0.11 to 1.55)	0.19	6.9 (0.76 to 62.5)	0.09
One parent asthma	0.92 (0.65 to 1.31)	0.65	1.44 (0.52 to 4.00)	0.49
Current asthma	0.26 (0.18 to 0.36)	<0.001	5.48 (2.31 to 12.96)	<0.001
Stratified by gender				
Female	0.28 (0.16 to 0.48)	<0.001	12.9 (3.64 to 45.9)	<0.001
Male	0.22 (0.14 to 0.35)	<0.001	2.19 (0.46 to 10.38)	0.32
Interaction term		0.51	Interaction term	0.08
Current smoker	1.28 (0.91 to 1.81)	0.16	0.63 (0.25 to 1.58)	0.32
Former smoker	1.19 (0.11 to 13.2)	0.89	2.86 (0.33 to 4.84)	0.34
3 yrs or less secondary schooling	1.20 (0.80 to 1.80)	0.39	3.08 (1.24 to 7.64)	0.02
Allergy to food or medicines	0.75 (0.53 to 1.05)	0.09	3.41 (1.46 to 7.94)	0.004
Eczema				
Mild	0.49 (0.30 to 0.82)	0.01	1.34 (0.30 to 5.90)	0.70
Moderate	0.62 (0.25 to 1.57)	0.32	4.26 (0.91 to 19.9)	0.07
Severe	0.29 (0.14 to 0.57)	<0.001	3.41 (0.42 to 28.0)	0.25
Hay fever	0.39 (0.29 to 0.54)	<0.001	4.01 (1.64 to 9.78)	0.002
SEIFA Disadvantage Index				
Quartile 1	1.00		1.00	
Quartile 2	1.01 (0.66 to 1.55)	0.96	1.07 (0.31 to 3.78)	0.91
Quartile 3	1.21 (0.78 to 1.90)	0.39	1.48 (0.48 to 1.61)	0.50
Quartile 4	0.89 (0.58 to 1.37)	0.60	1.18 (0.35 to 3.34)	0.79
<i>p</i> for trend		0.80	<i>p</i> for trend	0.67

telescoping bias (10, 11) by indicating a later age at onset of asthma than documented by their parents, and only one third correctly classified their childhood asthma status. Among those who had childhood asthma, females were twice as likely as males to misclassify while adults with current asthma, eczema, or hay fever were half to a third as likely to misclassify. Among those who did not have childhood asthma, adults with current asthma, hay fever, or allergy to food or medicine were two to three times more likely to misclassify.

The factors that may have led women with childhood asthma to misclassify were not clear. However, it is known that as many as 33% to 46% of women have asthma that is more troublesome in the peri-menstrual phase (12–14). Perhaps women so affected may have assumed that their asthma began about the time of menarche rather than earlier. Why being free of current asthma in adulthood should be associated with misclassification where the adult participant actually had childhood asthma is not obvious. Possible explanations may include the capacity of people to forget early life health issues when these were distressing (15), did not continue into adult life (16), or were not of sufficient severity in childhood to be recalled later. As well, early memory may have been “re-configured” as participants became older (17). Among adults

who had childhood asthma, those with severe eczema or with hay fever were less likely to misclassify than those without these disorders. Perhaps these other allergic disorders were potent reminders of the presence of childhood asthma and reinforced accurate recall in adult life. The association between current asthma in adult life and misclassification when the adult participant actually did not have childhood asthma may simply be related to them assuming that they must have had the disease lifelong.

Participant recall was less sensitive for identifying parent-reported asthma, but the specificity of participant recall was high; that is, the ability of the participant to accurately identify childhood asthma was poor when that disease was truly present. However, the high specificity indicated good ability of the participant to identify the absence of childhood asthma when that disease was truly absent.

However assessed, the amount of misclassification in our study was substantial. Much has been written about the increase in asthma prevalence in recent decades, and much of the data on incidence has depended on recall of the age at onset of asthma in cross-sectional studies (18–20). Our study, which used the prospectively gathered parent report as the “gold standard” showed substantial misclassification when adult recall of childhood asthma status was measured against that standard.

Our study also showed that women who truly had childhood asthma were more likely to incorrectly classify themselves as having been asthma free as children than were men, an important observation in light of the reported higher prevalence of asthma in post-pubertal females.

The strength of our study lay in the prospective gathering of parental observation against which misclassification could be measured, together with sufficient numbers in the study to allow a valid estimate of misclassification. One possible limitation is the fact that the parents in our study may have overestimated the prevalence of asthma in their children.

TABLE 4.—Independent predictors of disagreement.

Variable	OR (95% CI)	<i>p</i> value
Asthma by age 7		
Severe eczema	0.31 (0.15 to 0.66)	0.002
Current asthma	0.30 (0.21 to 0.44)	<0.0001
Hay fever	0.53 (0.37 to 0.75)	<0.0001
Female gender	1.90 (1.33 to 2.72)	<0.0001
No asthma by age 7		
Allergy to food or medicines	2.68 (1.12 to 6.40)	0.026
Current asthma	3.53 (1.41 to 1.81)	0.007
Hay fever	3.35 (1.25 to 8.98)	0.016

However, others have found that a definition of asthma such as we used does not suffer by comparison with one that includes measures such as bronchial hyper-responsiveness (21, 22). Furthermore, the evidence that a definition such as used in our study will underestimate any associations (23) suggests that the associations identified in our study are unlikely to be related to its validity. Another possible limitation lay with non-response in the 1991–1993 survey. Out of 2,000 participants from the original cohort who were selected to participate in this survey, only 1,494 (75%) participated. It is possible that the non-participants differed systematically from those who participated. This would bias the estimates of misclassification if the non-participants were more or less prone to recall error than the participants.

Our study dealt specifically with misclassification in a study of asthma. We do not suggest that similar misclassification would necessarily occur in studies of other chronic diseases. Asthma has clinical peculiarities in that it may develop in early life and then persist, remit, remit and recur or it may develop for the first time in adult life. These features may lead adult asthma patients to misclassify more than those with diseases that do not have these characteristics. The availability of a “gold standard” for measuring childhood asthma status will allow determination of the accuracy of an adult participant’s recall and the correction of any error. Ideally such a standard would be collected prospectively, as was the case in our study, or gathered retrospectively from an independent source such as a medical record. Such matters have implications for study design.

In conclusion, our study supports the view that misclassification of their childhood asthma status by adult participants in cross-sectional studies is common and that correction of recall bias is necessary for the accurate estimation of age-specific asthma incidence in retrospective studies. Alternatively, adjustment should be made in the analysis for factors that are known to be associated with recall bias in cross-sectional studies (24).

ACKNOWLEDGMENTS

The Tasmanian Asthma Study is supported by grants from the National Health and Medical Research Council of Australia, the Victorian and Tasmanian Asthma Foundations, the Clifford Craig Medical Research Trust, and the Royal Hobart Hospital Research Foundation. Dr. John Burgess is supported by a Research Scholarship from the University of Melbourne.

REFERENCES

- Michels KB. The role of nutrition in cancer development and prevention. *Int J Cancer* 2005; 114(2):163–165.
- Bakke PS, Hanao R, Gulsvik A. Relation of occupational exposure to respiratory symptoms and asthma in a general population sample: self-reported versus interview-based exposure data. *Am J Epidemiol* 2001; 154(5):477–483.
- Brogger J, Eagan T, Eide GE, Bakke P, Gulsvik A. Bias in retrospective studies of trends in asthma incidence. *Eur Respir J* 2004; 23:281–286.
- Strachan DP, Griffiths JM, Johnston ID, Anderson HR. Ventilatory function in British adults after asthma or wheezing illness at ages 0–35. *Am J Respir Crit Care Med* 1996; 154(6 Pt. 1):1629–1635.
- Socio-Economic Indexes for Areas. Census. Belconnen ACT 2617: Australian Bureau of Statistics; 1991.
- Kirkwood B, Sterne J. *Essential Medical Statistics*. 2nd ed. Malden, MA: Blackwell Science Ltd., 2003.
- StataCorp. *Stata Statistical Software: Release 9*. College Station, TX: Stata Corporation.
- Cummings P, Rivara FP, Thompson RS, Reid RJ. Ability of parents to recall the injuries of their young children. *Inj Prev* 2005; 11:43–47.
- Suarez L, Simpson DM, Smith DR. Errors and correlates in parental recall of child immunizations: effects on vaccination coverage estimates. *Pediatrics* 1997; 99:E3.
- Petridou E, Dessypris N, Frangakis CE, Belehri M, Mavrou A, Trichopoulos D. Estimating the population burden of injuries: a comparison of household surveys and emergency department surveillance. *Epidemiology* 2004; 15:428–432.
- Raphael KG, Marbach JJ. When did your pain start?: reliability of self-reported age of onset of facial pain. *Clin J Pain* 1997; 13:352–359.
- Eliasson O, Scherzer HH, DeGraff AC, Jr. Morbidity in asthma in relation to the menstrual cycle. *J Allergy Clin Immunol* 1986; 77(1 Pt. 1): 87–94.
- Troisi RJ, Speizer FE, Willett WC, Trichopoulos D, Rosner B. Menopause, postmenopausal estrogen preparations, and the risk of adult-onset asthma. A prospective cohort study. *Am J Respir Crit Care Med* 1995; 152(4 Pt. 1): 1183–1188.
- Skobeloff EM, Spivey WH, Silverman R, Eskin BA, Harchelroad F, Alessi TV. The effect of the menstrual cycle on asthma presentations in the emergency department. *Arch Intern Med* 1996; 156:1837–1840.
- Della Femina D, Yeager CA, Lewis DO. Child abuse: adolescent records vs. adult recall. *Child Abuse Negl* 1990; 14:227–231.
- Mannuzza S, Klein RG, Klein DF, Bessler A, ShROUT P. Accuracy of adult recall of childhood attention deficit hyperactivity disorder. *Am J Psychiatry* 2002; 159:1882–1888.
- Ahlberg SW, Sharps MJ. Bartlett revisited: reconfiguration of long-term memory in young and older adults. *J Genet Psychol* 2002; 163:211–218.
- Sunyer J, Anto JM, Tobias A, Burney P. Generational increase of self-reported first attack of asthma in fifteen industrialized countries. European Community Respiratory Health Study (ECRHS). *Eur Respir J* 1999; 14:885–891.
- de Marco R, Locatelli F, Sunyer J, Burney P. Differences in incidence of reported asthma related to age in men and women. A retrospective analysis of the data of the European Respiratory Health Survey. *Am J Respir Crit Care Med* 2000; 162:68–74.
- De Marco R, Locatelli F, Cerveri I, Bugiani M, Marinoni A, Giammanco G. Incidence and remission of asthma: a retrospective study on the natural history of asthma in Italy. *J Allergy Clin Immunol* 2002; 110:228–235.
- Jenkins MA, Clarke JR, Carlin JB, Robertson CF, Hopper JL, Dalton MF, Holst DP, Choi K, Giles GG. Validation of questionnaire and bronchial hyperresponsiveness against respiratory physician assessment in the diagnosis of asthma. *Int J Epidemiol* 1996; 25:609–616.
- Remes ST, Pekkanen J, Remes K, Salonen RO, Korppi M. In search of childhood asthma: questionnaire, tests of bronchial hyperresponsiveness, and clinical evaluation. *Thorax* 2002; 57:120–126.
- Camargo CA Jr., Weiss ST, Zhang S, Willett WC, Speizer FE. Prospective study of body mass index, weight change, and risk of adult-onset asthma in women. *Arch Intern Med* 1999; 159:2582–2588.
- Stewart W, Brookmyer R, Van Natta M. Estimating age incidence from survey data with adjustments for recall errors. *J Clin Epidemiol* 1989; 42:869–875.