



Letters

Clinical and complete remission of asthma among schoolchildren

Factors predicting remission of asthma are often conflicting despite efforts to standardize methods in epidemiologic studies. The discrepancies could be explained by the lack of a standardized definition for remission. The criteria mostly used to define asthma remission are based on the absence of symptoms and medication use,^{1,2} often referred to as clinical remission.³ Complete remission, which requires a combination of normal lung function, absence of bronchial hyperresponsiveness (BHR), and absence of symptoms, has also been used.³ However, whether clinical and complete remissions differ in their associations with childhood, personal, and environmental factors warrants investigation.

A cross-sectional survey of schoolchildren was conducted in Saskatchewan, Canada, in 2013. Participants were then followed up in 2015, when we repeated the survey, completed lung function testing, and BHR testing by exercise challenge testing (ECT). Children from kindergarten to grade 8 (approximately 5–14 years) were eligible. In 2013, the surveys were distributed to students at the school, who then took the surveys home for the parents to complete. In 2015, repeat surveys were mailed to parents for self-completion. Children with active asthma (defined as physician-diagnosed asthma with symptoms of any wheezing, asthma medication use, ≥ 1 asthma episodes, and ≥ 1 health care services in the past 12 months) in 2013 were reassessed in 2015 for the presence of clinical remission (ClinR), complete remission (CompR), or persistent asthma (PersA). ClinR was defined as the absence of active asthma without clinical confirmation (assessed by lung function and BHR tests). CompR remission was defined as the absence of active asthma in addition to a negative BHR test ($<15\%$ decrease in forced expiratory volume in 1 second after ECT) and a normal forced expiratory volume in 1 second ($>80\%$ pre-ECT). PersA was defined as active asthma in 2013 and 2015 regardless of the results of clinical assessments in 2015. This is because children with asthma may demonstrate normal lung function results upon spirometry testing, especially if their asthma condition is stable and well-controlled.⁴

We obtained information on demographics, personal and early-life factors at baseline (2013) and assessed their relationships with ClinR and CompR at follow-up (2015). Covariates of interest included age, sex, parental education levels ($\leq$ high school education vs $>$ high school education), pet ownership (yes vs no), parental history of asthma and allergy (yes vs no), and early-life respiratory infection and allergy (yes vs no). We used multiple logistic regression analysis to assess associations between variables of interest and asthma remission in 2 separate models using PersA as the reference category. The study was approved by the University of Saskatchewan Biomedical Research Ethics Board.

Of the 335 participants who completed the survey in 2015, 79 (23.6%) had active asthma in 2013. The 79 participants were reclassified as having either ClinR vs PersA (30.4% vs 69.6%, respectively) or CompR vs PersA (19.0% vs 81.0%, respectively). The distribution of age, sex, and parental education ($>$ high school) differed by groups as follows: mean age (ClinR vs PersA: 9.48 vs 8.87 years, $P = .29$; CompR vs PersA: 10.50 vs 8.85 years, $P = .03$); female (ClinR vs PersA: 62.5% vs 35.8%, $P = .03$; CompR vs PersA: 45.5% vs 43.8%, $P = .32$); parental education (ClinR vs PersA: 81.8% vs 82.0%, $P = .69$; CompR vs PersA: 83.6% vs 86.8%, $P = .04$). Female sex and pet ownership were positively associated with ClinR (Table 1), whereas age was positively associated with CompR. In addition, low parental education and parental history of asthma reduced the chance of CompR.

Using clinical assessments in comparison with symptoms history alone, we observed that asthma remission was less frequent among children (19.0% vs 30.4%, respectively). The decrease in remission proportion with CompR compared with ClinR suggests that children with clinical asthma might have been originally misclassified as undergoing remission. This further supported the evidence from a study in Canada, which suggested that there may be no permanent relief from asthma in those with the disease because the majority of patients thought to be in remission later relapsed.⁵

Although ClinR and CompR have been reported to differ in factors that predict their occurrences in adults,³ we extend these findings to children and adolescent populations. Female sex and pet ownership were positively associated with ClinR. Age was positively associated with CompR, whereas low parental education and parental history of asthma were inversely associated with CompR. These findings suggest that the lack of standard definition in asthma remission might have explained some of the inconsistencies in factors predicting the long-term outcomes of asthma in previous studies.^{3,5–7} The reason for the inverse association between parental education and CompR is unclear in this study but may reflect limited means to care for a child with asthma because of the relationships between lower educational attainment and socioeconomic factors that can be barriers to care.⁸

One limitation of this study was that we did not assess the effect of asthma medication use because it was used as part of the operational definition of active asthma. However, a study in the United States, in which children with asthma were randomly assigned into inhaled corticosteroid and placebo groups and followed up for 4–6 years found equal percentages of remission and persistence in all treatment groups.⁶ This suggests that although inhaled corticosteroid use may serve as an important controller medication for childhood asthma, the treatment may not necessarily influence the natural outcome of asthma and may not necessarily be a predictor of remitting asthma. The low sample size might have also resulted in biased estimates for remission and

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Table 1
Adjusted^a Associations Between Baseline (2013) Personal, Environmental, and Early-Life Factors and Clinical and Complete Asthma Remission at Follow-Up (2015)

	Model I ^b	Model II ^c
	Clinical remission	Complete remission
Age (y)	1.09 (0.83–1.43)	1.45 (1.01–2.10) ^d
Sex (ref: male)	4.07 (1.10–5.14) ^d	1.82 (0.14–23.19)
Parental education (ref: >high school)	0.69 (0.07–7.19)	0.10 (0.01–0.92) ^d
Pet ownership (ref: no)	5.89 (1.37–5.42) ^d	1.21 (0.15–9.84)
Parental history of asthma (ref: no)	1.21 (0.31–4.77)	0.40 (0.01–0.33) ^d
Parental history of allergy (ref: no)	0.26 (0.05–1.37)	1.35 (0.09–20.44)
Early-life respiratory infection ^{e,f} (ref: no)	0.89 (0.23–3.40)	0.46 (0.05–4.55)
Early-life allergy ^{f,g} (ref: no)	0.63 (0.17–2.38)	0.24 (0.02–2.93)

Abbreviations: BHR, bronchial hyperresponsiveness; ClinR, clinical remission; CompR, complete remission; PersA, persistent asthma.

^aModel adjusted for each variable in the table.^bModel I: The 79 participants with active asthma at baseline (2013) were reclassified as ClinR (n = 24) or PersA (n = 55) at follow-up (2015). Reference category is PersA.^cModel II: Of the 79 subjects with active asthma in 2013, 63 completed lung function testing and BHR tests in 2015 and could only be reclassified as CompR (n = 12) or PersA (n = 51) at follow-up (2015). Reference category is PersA.^dP < .05.^ePhysician-diagnosed bronchitis, pneumonia, whooping cough, or croup.^fCondition diagnosed before the age of 3 years.^gPhysician-diagnosed eczema or hay fever.

persistence when compared with the general population, warranting caution in the interpretation of the results. Finally, the follow-up period was relatively short, 2 years between baseline and follow-up surveys. We acknowledge that a longer follow-up period might have provided a larger window of opportunity for remission. However, the remission proportion seen in this study is similar to that reported in studies that have used longer follow-up periods ranging from 7–36 years.^{9,10}

In summary, we found that the operational definition for asthma remission plays a crucial role with regard to the degree of remission and factors predicting the prognosis of asthma in children. These findings suggest a need for a standard definition of remission in epidemiologic studies of childhood asthma for comparability of results.

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Oluwafemi Oluwale, PhD^{*,†}

Donna C. Rennie, PhD^{†,‡}

Joshua A. Lawson, PhD^{†,§}

^{*}Department of Community Health and Epidemiology
College of Medicine, University of Saskatchewan
Saskatoon, Saskatchewan, Canada

[†]Canadian Centre for Health and Safety in Agriculture
College of Medicine, University of Saskatchewan
Saskatoon, Saskatchewan, Canada

[‡]College of Nursing, University of Saskatchewan
Saskatoon, Saskatchewan, Canada

[§]Department of Medicine
College of Medicine, University of Saskatchewan
Saskatoon, Saskatchewan, Canada
oluwafemi.oluwale@usask.ca

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