

Original Article

Mental Health Services Claims and Adult Onset Asthma in Ontario, Canada

Teresa To, PhD^{a,b,c,d}, Kandace Ryckman, MPH^{a,c}, Jingqin Zhu, MSc^{a,b}, Devon Williams, MSc^a, Laura Y. Feldman, MPH^{a,c}, Kristian Larsen, PhD^a, and Andrea Gershon, PhD^{a,b,d,e} *Toronto, Ontario, Canada*

What is already known about this topic? Living with asthma is associated with a decrease in quality of life, reductions in activities of daily living, and an increase in psychological stress, all of which are known to negatively impact mental health.

What does this article add to our knowledge? There is an increased risk of emergency department visits for mental disorders in the 1 year after being diagnosed with adult onset asthma compared with the 1 year before being diagnosed.

How does this study impact current management guidelines? This finding highlights the need for physicians to assess mental health needs of adults who are newly diagnosed with asthma and provide appropriate care to reduce acute care claims.

BACKGROUND: Living with asthma is associated with a decrease in quality of life due to reductions in activities of daily

living and increased psychological stress, both of which are associated with poor mental health outcomes.

OBJECTIVE: The objective of this study was to quantify the burden of mental disorders on the adult asthma population and compare the risk of mental health services claims (MHSCs) in the 1 year before and 1 year after asthma diagnosis.

METHODS: Ontario residents aged 25 to 65 years with incident physician-diagnosed asthma between April 1, 2005, and March 31, 2012, were included. MHSCs, which consisted of hospitalizations, emergency department (ED), and outpatient physician visits, were identified from universal health administrative data. Poisson regression models with repeated measures were used to estimate the relative risk (RR) of MHSCs for 2 time periods: 1 year after asthma diagnosis compared with the 1 year before and 2 years after compared with 2 years before.

RESULTS: A total of 145,881 adults had incident asthma. In the 1 year after asthma diagnosis, 27% had an MHSC. The risk of ED visits for any mental disorders increased by 13% in the 1 year after asthma diagnosis compared with the 1 year before (adjusted RR [aRR], 1.13; 95% confidence interval [CI], 1.06-1.21). This increased risk of ED visits was not found when comparing 2 years after asthma diagnosis with 2 years before. The risk for outpatient physician visits for substance-related disorders increased by 21% at 1 year (aRR, 1.21; 95% CI, 1.14-1.28) and 37% at 2 years (aRR, 1.37; 95% CI, 1.28-1.46). **CONCLUSIONS:** The significant comorbid burden of mental disorders in adults with newly diagnosed asthma highlights the need for primary care physicians to assess mental health needs and provide appropriate care. © 2017 American Academy of Allergy, Asthma & Immunology (J Allergy Clin Immunol Pract 2017;■:■-■)

Key words: Asthma; Mental health; Mental disorders; Comorbidity; Epidemiology

Previous research suggests an association between asthma and mental disorders including depression,¹⁻¹¹ panic disorders,^{12,13} schizophrenia,^{14,15} substance abuse,^{12,16,17} and suicide.¹⁸

^aChild Health Evaluative Sciences, The Hospital for Sick Children, Toronto, Ontario, Canada

^bChronic Disease and Pharmacotherapy Research Program, Institute for Clinical Evaluative Sciences, Toronto, Ontario, Canada

^cDalla Lana School of Public Health, University of Toronto, Toronto, Ontario, Canada

^dInstitute of Health Policy, Management and Evaluation, University of Toronto, Toronto, Ontario, Canada

^eDivision of Respiratory, Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada

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Corresponding author: Teresa To, PhD, Child Health Evaluative Sciences, The Hospital for Sick Children, 555 University Avenue, Toronto, Ontario, Canada. E-mail: teresa.to@sickkids.ca.

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Abbreviations used

aRR- Adjusted relative risk
CADG- Condensed Aggregated Diagnostic Groups
CI- Confidence interval
ED- Emergency department
GEE- Generalized estimating equations
ICD- International Classification of Diseases
MHSC- Mental health services claims
OASIS- Ontario Asthma Surveillance Information System
OHIP- Ontario Health Insurance Plan
OR- Odds ratio
RR- Relative risk

Those with comorbid asthma and mental disorders have significantly higher rates of mental health service utilization than those with only asthma or only mental disorders.¹⁹ It is estimated that each year 1 in 5 Ontario adults living with asthma has a mental health services encounter with the health care system.²⁰ A systematic review of the literature found that having a mental health disorder increased the rates of asthma hospitalizations, emergency department (ED) visits, and general practitioner visits amongst adults with asthma.²¹ Furthermore, the correlation between poor mental health and asthma is more pronounced amongst women,^{11,22} older people,^{23,24} those of lower socioeconomic status,^{22,23,25} those who are obese,^{2,22} and those who have additional comorbid health conditions.^{22,26} Moreover, living with asthma is associated with a decrease in quality of life^{23,27-29} due to reductions in activities of daily living^{10,19} and an increase in psychological stress,³⁰⁻³² all of which are known to negatively impact mental health.

Although several studies have examined the relationship between asthma and mental health, few have done so using population-based and longitudinal data. This type of analysis will provide insights into the incremental burden of mental health services over people's baseline (ie, before asthma). The purpose of this study was to quantify the burden of mental disorders in the adult asthma population and compare the risk of mental health services claims (MHSCs) before and after the diagnosis of asthma. Two time points (ie, 1 year before compared with 1 year after and 2 years before compared with 2 years after) were used to estimate the risk of MHSCs.

METHODS**Study population**

The Ontario Asthma Surveillance Information System (OASIS, www.lab.research.sickkids.ca/oasis) is a registry of more than 2.1 million Ontario residents with physician-diagnosed asthma. It was created using health administrative data, beginning in 1996.²⁰ Health administrative data in Ontario contain claims within the provincially run universal health care system for the entire population. People were classified as having incident asthma if they had: (1) ≥ 1 asthma hospital admission or (2) ≥ 2 asthma Ontario Health Insurance Plan (OHIP) claims in 2 consecutive years (where the first claim is considered the diagnosis date). This case definition has been validated with 84% sensitivity and 76% specificity in adults.³³

Individuals from the OASIS registry aged 25 to 65 years with incident asthma diagnosed between April 1, 2005, and March 31, 2012, were included in this study. A look-back window of 5 years was used wherein individuals must not have had any claims for asthma to ensure that the subsequent asthma claims represented new

onset of asthma, that is, incidence. Individuals without a valid health card number, age, or Ontario residence postal code were excluded from the study. Also, those with asthma diagnosed before April 1, 2005, and those who died or moved out of province less than 2 years after asthma diagnosis were excluded.

Measures

MHSCs were extracted from health administrative data housed at the Institute for Clinical Evaluative Sciences in Ontario, Canada. Hospital admissions were obtained from the Canadian Institute for Health Information Discharge Abstract Database, and adult inpatient mental health admissions to designated psychiatric beds from the Ontario Mental Health Reporting System. ED visits were obtained from the National Ambulatory Care Reporting System and outpatient physician visits from the OHIP Claims Database. Counts of MHSCs were obtained for 2 time periods (ie, 1 year before compared with 1 year after asthma diagnosis and 2 years before compared with 2 years after). The mental disorders examined in the study included anxiety disorders, mood affective disorders (eg, manic episodes, bipolar affective disorder, depressive episodes), personality disorders, schizophrenia, and substance-related disorder. These disorders were defined using the International Classification of Diseases, 10th Revision (ICD-10), Diagnostic and Statistical Manual of Mental Disorders, 4th Edition, and OHIP diagnostic codes (see [Table E1](#), available in this article's Online Repository at www.jaci-inpractice.org).

Age, sex, and resident postal code were obtained from the Ontario Registered Persons Database. Postal code information was used to discern rurality of residence and categorize individuals based on neighborhood-level income quintile. Comorbidities were defined using the Condensed Aggregated Diagnostic Groups (CADGs) from the Johns Hopkins ACG System Version 10.³⁴ The CADGs categorize ICD-9 and ICD-10 diagnostic codes based on severity and the likelihood of persistence of the respective health condition. The CADGs consist of a series of 12 variables that measure the expected health care utilization of an individual in the 2 years before a time point. The CADGs include conditions in the following categories: acute minor, acute major, likely to recur, chronic medical unstable, chronic medical stable, chronic specialty stable, eye/dental, chronic specialty unstable, prevention, and pregnancy. Two CADGs, "asthma" and "psychosocial," were not considered in the analysis because they overlapped with study population inclusion criteria and outcome measure.

Statistical analysis

Descriptive statistics were used to compare the numbers and proportions of MHSCs in the 1 year after asthma diagnosis. Those with at least one MHSC in the 1 year after asthma diagnosis were compared with those with no MHSCs in the 1 year after asthma diagnosis. An odds ratio (OR) with 95% confidence interval (CI) was calculated for covariates. Refer to [Table E2](#) (available in this article's Online Repository at www.jaci-inpractice.org) for detailed information about the count of MHSCs in the 1 year before and after asthma diagnosis stratified by mental disorder.

A Poisson regression model was used to model the count of MHSCs for mental disorders overall, as well as for each disorder (SAS version 9.3, SAS Institute, Cary, NC). Repeated measures using generalized estimating equations (GEE) were used to assess the risk of MHSCs before asthma diagnosis for each individual compared with their own MHSCs after asthma diagnosis. Two time periods (1 year before compared with 1 year after and 2 years before compared with 2 years after) were examined. This study assumed an independent correlation matrix type for the GEE

models. The models were then adjusted for time-dependent comorbidities as measured by CADGs, as well as fixed covariates including sex, income quintile, age group, and rurality of residence (at the time of asthma diagnosis). Collinearity of covariates was assessed using a variance inflation factor cutoff value of 10. Unadjusted and adjusted relative risks (RR and aRR, respectively) were presented with 95% CI.

The above approach was replicated in an identical fashion as a sensitivity analysis using a cohort of all adults living in Ontario, Canada with physician-diagnosed diabetes, to assess if the effects observed were specific to asthma or similarly relevant to other chronic health conditions (see Table E3, available in this article's Online Repository at www.jaci-inpractice.org).

RESULTS

Characteristics of study population

In Ontario, 145,881 adults (aged 25-65 years) with incident asthma diagnosed between April 1, 2005, and March 31, 2012, were included. There were 39,737 (27%) adults with at least one MHSC in the 1 year after asthma diagnosis. A demographic summary of this population by mental health comorbidity as indicated by having MHSCs in the 1 year after asthma diagnosis is provided in Table 1. Women were more likely than men to have at least one MHSC in the 1 year after asthma diagnosis (OR, 1.37; 95% CI, 1.34-1.40). Compared to individuals aged 60-64, those aged 40-44, 45-49, 50-54 and 55-59 were more likely to have MHSCs in the 1-year after asthma diagnosis. Those in the lowest income quintile were more likely to have at least one MHSC in the 1 year after asthma diagnosis compared with those in the highest income quintile (OR, 1.32; 95% CI, 1.27-1.37). Individuals living in urban areas were more likely to have MHSCs than those living in rural areas (OR, 1.13; 95% CI, 1.08-1.18). Finally, comorbidities increased the odds of MHSCs in the 1 year after asthma diagnosis for all categories except pregnancy.

Mental health services claims by service types

A total of 2,120 hospitalizations, 4,299 ED visits, and 177,059 physician office visits for mental disorders were observed. Hospitalizations for mood affective disorders were most common with 516 (1%) individuals accounting for 773 (36%) admissions in the 1 year after asthma diagnosis. Those with anxiety contributed to most of the ED visits in the 1 year after asthma diagnosis with 1,830 (43%) visits. The 760 participants with substance-related disorders also accounted for a large proportion (ie, 1,380 MHSCs) of the ED visits. Physician visits for anxiety disorders comprised the largest outpatient MHSC burden with 97,148 claims (55%) from 29,344 asthma individuals (74%).

Estimated RR of mental health services uses—multivariable analysis

Figure 1 shows the aRR for hospitalizations for the 1-year and 2-year time periods. Overall, there were no significant increased risks of hospitalizations for mental disorders in the 1 year (aRR, 1.01; 95% CI, 0.92-1.11) or 2 years after asthma diagnosis (aRR, 1.03; 95% CI, 0.96-1.11). However, the risk of hospitalizations for anxiety disorders in the 2 years after asthma diagnosis was 22% higher compared with the 2 years before (aRR, 1.22; 95% CI, 1.07-1.39).

TABLE 1. Descriptive summary of study population in the 1 year after asthma diagnosis (N = 145,881)

	% at least one MHSC (n = 39,737)	% no MHSC (n = 106,144)	OR (95% CI)
Total	27	73	
Sex			
Male	24	76	Ref.
Female	30	70	1.37 (1.34, 1.40)*
Age			
25-29	25	75	0.95 (0.90, 1.00)
30-34	26	74	1.01 (0.96, 1.06)
35-39	26	74	1.03 (0.98, 1.08)
40-44	28	72	1.15 (1.10, 1.20)*
45-49	29	71	1.20 (1.14, 1.25)*
50-54	30	70	1.22 (1.17, 1.28)*
55-59	28	72	1.16 (1.11, 1.22)*
60-64	26	74	Ref.
Income quintile			
Q1 (lowest)	31	69	1.32 (1.27, 1.37)*
Q2	28	72	1.12 (1.08, 1.17)*
Q3	26	74	1.04 (1.00, 1.08)*
Q4	26	74	1.01 (0.97, 1.05)
Q5 (highest)	25	75	Ref.
Location of residence			
Urban	27	73	1.13 (1.08, 1.18)*
Rural	25	75	Ref.
Comorbidity			
Acute minor	29	71	1.68 (1.63, 1.74)*
Acute major	30	70	1.81 (1.76, 1.86)*
Likely to recur	30	70	1.62 (1.57, 1.66)*
Chronic medical unstable	34	66	1.54 (1.50, 1.58)*
Chronic medical stable	31	69	1.49 (1.45, 1.52)*
Chronic specialty stable	33	67	1.37 (1.30, 1.44)*
Eye/dental	37	63	1.58 (1.51, 1.66)*
Chronic specialty unstable	35	65	1.45 (1.39, 1.52)*
Prevention	28	72	1.09 (1.06, 1.11)*
Pregnancy	28	72	1.02 (0.96, 1.07)

CI, Confidence interval; MHSC, mental health service claim; OR, odds ratio; Q, quintile.

*Indicates a statistically significant result ($\alpha = 0.05$).

Figure 2 displays the aRR of ED visits with 95% CI for both time periods. Overall, the risk of ED visits was increased by 13% in the 1 year after asthma diagnosis compared with the 1 year before, after adjusting for covariates (aRR, 1.13; 95% CI, 1.06-1.21). The effect of asthma diagnosis increased the risk of ED visits for all mental disorders, albeit not statistically significant for mood disorders. The largest increased risk of ED visits was observed for schizophrenia (aRR, 1.36; 95% CI, 1.03-1.79). Because of the small number of ED visits for personality disorders (n = 129), it was not possible to estimate the aRR in the 1 year after asthma diagnosis as the Poisson model could not converge. The aRR of ED visits (overall as well as for individual

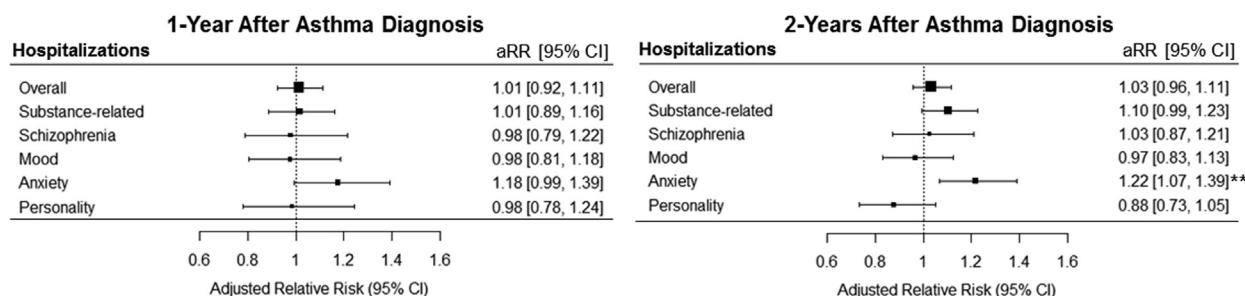


FIGURE 1. Forest plot showing the adjusted relative risk (aRR) of hospitalizations in the 1 year after asthma diagnosis compared with the 1 year before and the 2 years after diagnosis compared with the 2 years before. ** $P < .01$. CI, Confidence interval.

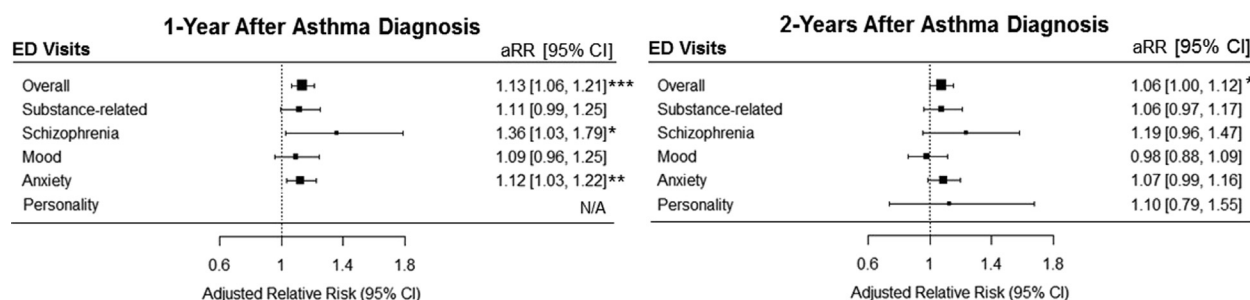


FIGURE 2. Forest plot showing the adjusted relative risk (aRR) of ED visits in the 1 year after asthma diagnosis compared with the 1 year before and the 2 years after diagnosis compared with the 2 years before. * $P < .05$, ** $P < .01$, *** $P < .001$. CI, Confidence interval; ED, emergency department.

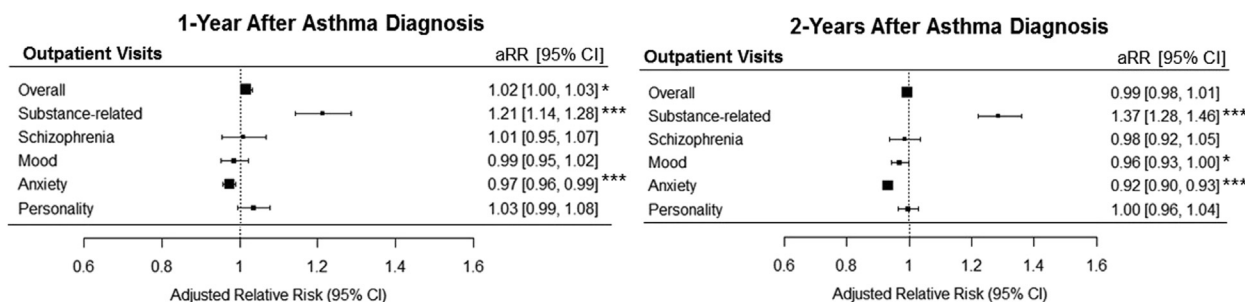


FIGURE 3. Forest plot showing the adjusted relative risk (aRR) of outpatient visits in the 1 year after asthma diagnosis compared with the 1 year before and the 2 years after diagnosis compared with the 2 years before. * $P < .05$, *** $P < .001$. CI, Confidence interval.

mental disorder) was attenuated when comparing the 2 years after asthma diagnosis with the 2 years before.

Figure 3 displays the aRR of outpatient physician visits with 95% CI for both time periods. Overall, there was a slight significant increased risk of outpatient physician visits in the 1 year after asthma diagnosis (aRR, 1.02; 95% CI, 1.00-1.03). After adjusting for comorbidity, the risk for outpatient physician visits for substance-related disorders was increased by 21% (aRR, 1.21; 95% CI, 1.14-1.28) in the 1 year after asthma diagnosis compared with the 1 year before. A similar effect was observed in the 2 years after asthma diagnosis (aRR, 1.37; 95% CI, 1.28-1.46).

The sensitivity analysis using the diabetes cohort did not find the same increased risks of MHSCs. There was no significantly increased risk of MHSCs in the 1 year after diabetes diagnosis compared with the 1 year before for hospitalizations (aRR, 1.04; 95% CI, 0.98-1.09), or ED visits (aRR, 0.96; 95% CI, 0.92-1.02)

for overall mental disorders. A slight decreased risk of outpatient physician visits for overall mental disorders was observed (aRR, 0.94; 95% CI, 0.93-0.95). Details of the results are provided in Table E3 and Figures E1–E3 (available in this article's Online Repository at www.jaci-inpractice.org).

DISCUSSION

We conducted a population-based, real world study of adults with newly diagnosed asthma and found a significant burden and risk of MHSCs. Compared with the 1 year before asthma diagnosis, the risk of ED visits for mental disorders in the 1 year after increased significantly. However, no significant increase was observed for overall hospitalizations or outpatient physician visits. This finding highlights the need to assess and appropriately address mental health needs in this population at the time of

asthma diagnosis to reduce the burden of ED-related claims. It is possible that the increased risk of ED visits, but not outpatient visits, for mental disorders may reflect a lack of appropriate and comprehensive mental health services within the community to provide primary care to those in need.³⁵

These results are consistent with the body of literature suggesting an association between higher acute care utilizations in those with comorbid mental illness and asthma.^{1,11,21,36} This work builds on previous studies by using health administrative data that is free of selection and response bias. Further, these findings are consistent with previous work on the Ontario population that attributed 6% of all hospitalizations, 9% of all ED visits, and 6% of all physician office visits to asthma comorbidities.³⁷

In particular, this study found a 36% increased risk of ED visits for schizophrenia in the 1 year after asthma diagnosis compared with the 1 year before. This finding is consistent with population-based studies from Denmark¹⁵ and Taiwan¹⁴ that found a significant increased risk of schizophrenia in those with asthma. It has also been suggested in the literature that this comorbidity may result from shared immune processes in the pathophysiology of asthma and schizophrenia.^{38,39} Furthermore, another study found that patients with schizophrenia have 3 times greater risk of hospitalizations for ambulatory care sensitive conditions, including asthma, than those without schizophrenia (aRR, 3.26; 95% CI, 3.00-3.54).⁴⁰ As such, patients with schizophrenia who are newly diagnosed with asthma in adulthood pose a particular concern for primary care physicians.

Our study found larger effect estimates when comparing the 1 year after asthma diagnosis with the 1 year before, compared with the 2-year time period, especially when considering acute care claims such as ED visits. This is likely because the 1-year time period is the most appropriate/relevant time frame to study the immediate effects surrounding the time of asthma diagnosis. Our observation was consistent with the findings reported by Chida et al.⁴¹ They reviewed 9 studies and found that two thirds of them showed that atopic disorders (primarily asthma) impaired mental health, with statistically significant OR ranging from 1.90 to 4.50. Although the relationships between atopic diseases and mental health were bidirectional, the authors further note that the effect of asthma on subsequent mental health was stronger than the effect of psychosocial factors (eg, family dysfunction, abuse, life events, etc.) on asthma development and progression. These findings point to the need for greater clinical attention to be paid to mental health outcomes in patients diagnosed with atopic conditions such as asthma.⁴¹ Our 1-year results further suggest that the 1 year after diagnosis of asthma represents an important time window of opportunity for health care practitioners to educate, refer, and/or manage mental health comorbidities.

A slight increased risk of outpatient physician visits for overall mental disorders was also found, due largely to the 21% increased risk of outpatient physician visits for substance-related disorders. This finding is also well supported by the literature that suggests a strong relationship between substance-related disorders and chronic disease morbidity.^{12,16,17} Those with substance-related disorders are also more likely to have poorly controlled asthma and less likely to fill prescriptions for asthma medications.⁴² Similar to the schizophrenia population, physicians should closely monitor patients with newly diagnosed asthma who may have a history of substance-related disorders.

To examine if the impact of the diagnosis of a chronic disease on mental health is unique to the asthma population, we used

the health administrative data to assemble a cohort of incident diabetes cases with a previously validated case definition. We repeated the analysis on this cohort and compared the results with the asthma cohort. Unlike the findings in the asthma cohort, we did not find a significantly increased risk of acute care utilizations for mental health (ie, hospitalizations and ED visits) in the 1 year after diabetes diagnosis compared with the 1 year before. There was a slight decreased risk observed in outpatient physician visits. These results suggest that the increased risk of MHSCs after the diagnosis of asthma may be specific to asthma and it may not be a common phenomenon for or generalizable to other chronic diseases such as diabetes. Although it is unclear what the link/cause might be, there is a growing body of literature that suggests an association between asthma and psychiatric disorders. It has been suggested that atopic diseases such as asthma can have adverse impacts on mental health as a result of chronic and unstable symptoms, consistent unsuccessful treatment, and limitations in activities in daily living.⁴¹ It has also been speculated that atopic disorders and psychosocial factors such as stress may share underlying physiological processes that mediate a close relationship between the central nervous system and atopic disorders such as asthma.⁴¹

This study had strengths and weaknesses. The use of health administrative data allowed for the creation of a large, real world, complete population-based cohort of all newly diagnosed asthma cases in Ontario, Canada. As a result, our study population is free of selection bias relative to patients being recruited in clinical studies with stringent inclusion/exclusion criteria. In addition, the prospective follow-up using health service claims data for mental disorders in this study is not subject to reporting or recall bias. This is especially important due to the stigma associated with mental disorders that may lead to underreporting in clinical studies that rely on self-report. Moreover, our study used the rigorous repeated measure analysis that allows us to quantify the risk of MHSCs after asthma diagnosis, while considering the previous MHSCs, which most cross-sectional studies failed to do.

However, we were limited in our ability to control for health behaviors (eg, medication use, physical activity, diet, smoking, sleep and health seeking behaviors) that are not captured in health administrative data and that could impact the relationship between mental disorders and asthma. It should also be noted that this study measured MHSC as an outcome, not physician diagnosis of mental disorders. This could lead to an overestimation of the true burden of mental disorders in this population, as individuals with a single MHSC may not meet criteria for a physician-diagnosed mental disorder. Moreover, population-based health administrative databases do not routinely or systematically collect information on disease severity (of both asthma and mental disorders), symptom profiles, or patient's adherence to medication, so we are unable to quantify how these factors may impact MHSCs. Finally, the observational nature of this study does not allow for causal inference between asthma diagnosis and MHSCs. However, the results demonstrate a strong association between asthma diagnosis in adults and MHSCs, particularly for ED visits.

CONCLUSIONS

The findings of this study highlight the need for primary care physicians to assess the mental health needs of adult patients with newly diagnosed asthma and take appropriate steps to reduce the

risk of acute care claims. Practitioners should pay special attention to anxiety and substance-related disorders, which were shown to have significant increased risks after asthma diagnosis. Additional research is needed to better understand the relationship between asthma and mental health issues, especially around the time of diagnosis, and to design targeted interventions that can reduce the burden of this comorbidity. Further research, likely with qualitative or mixed methodologies, is needed to better understand what factors are driving MHSCs in this population, including whether those who seek help for mental disorders are doing so because of worsening mental health or in part because of worsening asthma symptoms. Longitudinal research is also needed to better understand the causal mechanisms underlying the association between mental disorders and asthma.

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APPENDIX

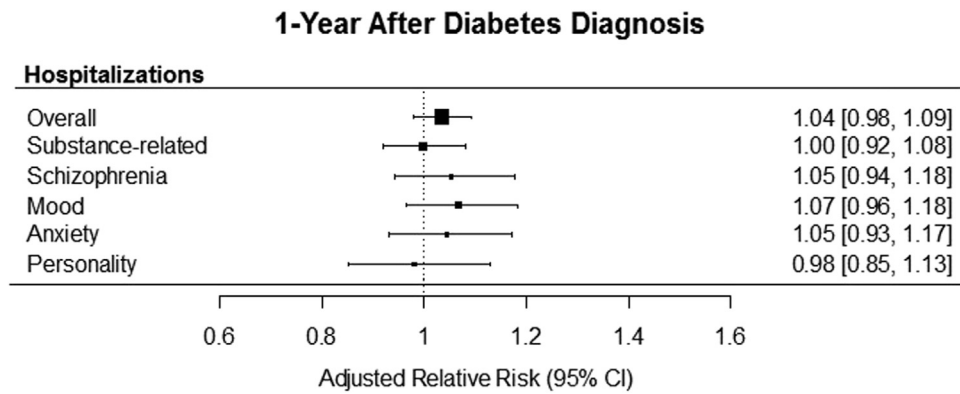


FIGURE E1. Forest plot showing the adjusted relative risk of hospitalizations for mental health service claims in the 1 year after diabetes diagnosis compared with the 1 year before. *CI*, Confidence interval.

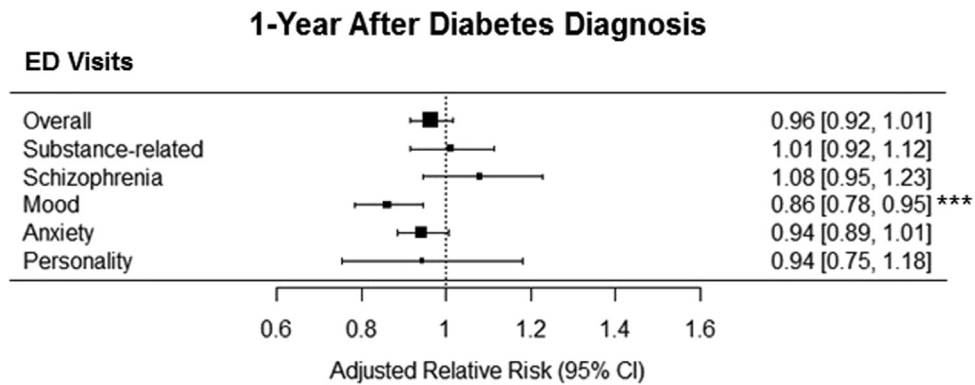


FIGURE E2. Forest plot showing the adjusted relative risk of emergency department (ED) visits for mental health service claims in the 1 year after diabetes diagnosis compared with the 1 year before. *** $P < .001$. *CI*, Confidence interval.

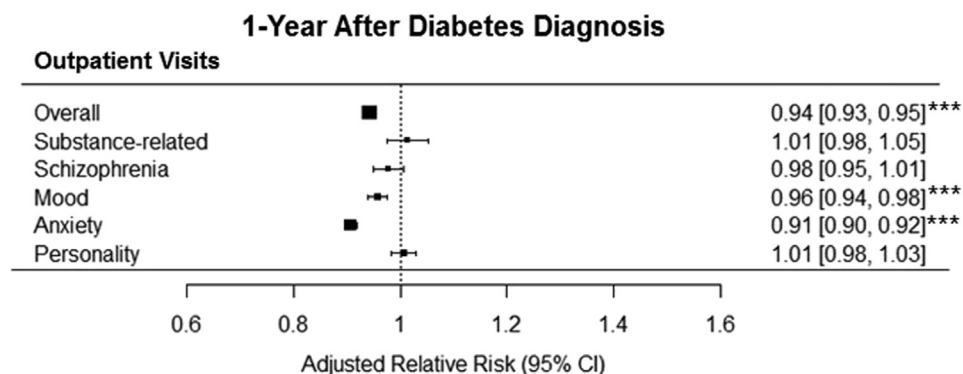


FIGURE E3. Forest plot showing the adjusted relative risk of outpatient physician visits for mental health service claims in the 1 year after diabetes diagnosis compared with the 1 year before. *** $P < .001$. *CI*, Confidence interval.

TABLE E1. Diagnostic codes used in assessing MHSC

Mental disorder	ICD-10	DSM-IV	OHIP
Anxiety	F40, F41, F42, F43, F48.8, F48.9, F93.0	300.(00, 01, 02, 21, 22, 23, 29), 300.3, 308.3, 309.21, 309.81	300
Mood	F30, F31, F32, F33, F34, F39	293.83, 296.0x, 296.2x, 296.3x, 296.4x, 296.5x, 296.6x, 296.7, 296.80, 296.89, 296.90, 300.4, 301.13	296, 311
Personality	F60, F61, F62, F68, F69, F21	301.0, 301.20, 301.22, 301.4, 301.50, 301.6, 301.7, 301.81, 301.82, 301.83, 301.9	301, 306, 307
Schizophrenia (includes delusional and psychotic disorders)	F20 (excluding F20.4), F22, F23, F24, F25, F28, F29	295.(10, 20, 30, 40, 60, 70, 90), 297.1, 297.3, 298.8, 298.9	295, 297, 298
Substance related	F55 (non-dependence-producing substances), F10-F19	291.(0, 1, 2, 3, 5, 81, 89, 9), 292.0, 292.11, 292.12, 292.81, 292.82, 292.83, 292.84, 292.89, 292.9, 303.xx(00, 90), 304.xx(00, 10, 20, 30, 40, 50, 60, 80, 90), 305.xx(00, 10-90)	303, 304, 291

DSM-IV, Diagnostic and Statistical Manual of Mental Disorders, 4th Edition; *ICD-10*, International Classification of Diseases, 10th Revision; *MHSC*, mental health services claim; *OHIP*, Ontario Health Insurance Plan.

TABLE E2. MHSC by mental disorder and service type in the 1 year after asthma diagnosis for those with at least one MHSC (N = 39,737)

	Mental disorder				
	Substance related	Schizophrenia	Mood	Anxiety	Personality
Hospitalizations					
No. of individuals (%)	455 (1.15)	175 (0.44)	516 (1.30)	278 (0.70)	146 (0.37)
Rate (per 1,000 study population)	3.12	1.20	3.54	1.91	1.00
Total no. of claims	586	244	773	326	191
Median no. of claims	1	1	1	1	1
SD of no. of claims	0.69	0.9	1.78	0.52	0.72
ED visits					
No. of individuals (%)	760 (1.91)	156 (0.39)	500 (1.26)	1,404 (3.53)	93 (0.23)
Rate (per 1,000 study population)	5.21	1.07	3.43	9.62	0.64
Total no. of claims	1,380	287	679	1,830	129
Median no. of claims	1	1	1	1	1
SD of no. of claims	3.28	2.07	1.16	1.09	1.21
Outpatient physician visits					
No. of individuals (%)	2,575 (6.48)	1,313 (3.30)	7,169 (18.04)	29,344 (73.85)	7,956 (20.02)
Rate (per 1,000 study population)	17.65	9.00	49.14	201.15	99.79
Total no. of claims	30,599	7,247	27,508	97,148	14,557
Median no. of claims	2	3	2	2	1
SD of no. of claims	20.12	7.95	6.3	5.4	3.41

ED, Emergency department; MHSC, mental health services claim; SD, standard deviation.

TABLE E3. Adjusted relative risk (aRR) of MHSC in the 1 year after diabetes diagnosis compared with 1 year before

	aRR	95% CI		P value
Hospitalization				
Overall	1.04	0.98	1.09	.1904
Substance related	1.00	0.92	1.08	.9432
Schizophrenia	1.05	0.94	1.18	.3634
Mood	1.07	0.96	1.18	.2084
Anxiety	1.05	0.93	1.17	.4472
Personality	0.98	0.85	1.13	.8047
ED visits				
Overall	0.96	0.92	1.02	.1659
Substance related	1.01	0.92	1.12	.8338
Schizophrenia	1.08	0.95	1.23	.2525
Mood	0.86*	0.78	0.95	<.001
Anxiety	0.94	0.89	1.01	.078
Personality	0.94	0.75	1.18	.6124
Outpatient physician visits				
Overall	0.94*	0.93	0.95	<.001
Substance related	1.01	0.98	1.05	.4714
Schizophrenia	0.98	0.95	1.01	.1321
Mood	0.96*	0.94	0.98	<.001
Anxiety	0.91*	0.90	0.92	<.001
Personality	1.01	0.98	1.03	.5721

CI, Confidence interval; ED, emergency department; MHSC, mental health services claim.

*Indicates a statistically significant result ($\alpha = 0.05$).