

ORIGINAL ARTICLE

Maternal psychological distress mediates the relationship between asthma and physician visits in a population-based sample of adolescentsMark A. Ferro, PhD^{1,2,3,4,5}, Michael H. Boyle, PhD^{1,3,4}, Rosa Alati, PhD^{6,7}, James G. Scott, MBBS^{8,9}, and Kaeleen Dingle, PhD¹⁰

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Abstract

Objective: This study examined whether maternal psychological distress mediates the relationship between presence of adolescent asthma and number of physician visits and whether the association between maternal psychological distress and physician visits is moderated by adolescent general health. **Methods:** Data were obtained from the Mater University Study of Pregnancy and included 4025 adolescents. Path analysis was used to examine mediating and moderating effects. **Results:** Maternal psychological distress was found to partially mediate the relationship between adolescent asthma and number of physician visits, accounting for 25% of the effect of adolescent asthma on physician visits ($p=0.046$). There was no evidence to suggest that adolescent general health moderated the association between maternal psychological distress and physician visits ($p=0.093$). **Conclusions:** These findings suggest that maternal psychological distress is associated with increased physician visits, regardless of adolescents' general health. Lowering maternal psychological distress may serve to reduce health care utilization and costs among adolescents with asthma.

Keywords

Health service utilization, mediation, moderation, path analysis, statistical modeling

History

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Introduction

Health service costs among children with asthma are extremely high and appear to be increasing [1–4]. In addition to health system costs, asthma in childhood places considerable burden on individuals and families leading to out-of-pocket expenses, excess school absenteeism and declines in the mental health of caregivers, particularly mothers [5,6].

Compared to mothers of healthy children, mothers of children with asthma are at increased risk for depression and psychological distress [7–9]. The effects of maternal psychological distress are pervasive – child exposure to maternal psychological distress early in life increases their risk for developing asthma and more severe asthma morbidity [10,11] as well as negatively influencing child and adolescent mental health [12]. There is also evidence that maternal psychological

distress may be associated with increased health service use in children and adolescents with asthma [7,13,14].

The attention devoted to maternal psychological distress in the context of child and adolescent asthma care is well-justified. Symptoms of maternal psychological distress, including depression, are associated with poor medical adherence and disease control, as well as increased asthma morbidity [15–17] and in turn, increased direct and indirect health service costs [18,19]. This is particularly problematic given that children and adolescents with poorly controlled asthma account for a disproportionately large amount of health service costs [19]. It is encouraging that health economic research has suggested that treating maternal depression can result in substantially reduced health service costs in the first six months after asthma has been diagnosed in children [20].

Although these studies have alerted us to the potential for maternal psychological distress to increase service use among children with asthma, our knowledge about the role of maternal psychological distress is limited. First, these studies typically focused on populations characterized by increased vulnerability to asthma and higher morbidity from asthma,

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which may limit generalizability of the findings. Second, although the association between poorer child health and increased health service use is well-established [21], the extent to which maternal psychological distress mediates this association or exerts an independent effect is not clear among youth with asthma [7,16]. Third, it is unknown if the association between maternal psychological distress and health service use is similar or different across levels of adolescent health status. Fourth, few studies have included healthy controls [7,10,16] or adequately adjusted for confounding factors known to influence health service use [9,11]. Finally, while much attention has focused on health service outcomes including emergency department visits, hospitalizations and medication use, there is a paucity of research on physician visits.

In the context of these gaps in the literature, we conducted an exploratory analysis of the relationship between maternal psychological distress and physician visits in a population sample of adolescents. We hypothesized that maternal psychological distress would mediate the association between presence of adolescent asthma and physician visits and that adolescent general health would moderate the relationship between maternal psychological distress and physician visits in a population sample of adolescents.

Methods

Data source and participants

The Mater University Study of Pregnancy (MUSP) is a long-term study of mothers and their children that follows their social, psychological and physical development from the prenatal period to early adulthood [22,23]. The MUSP study was designed to collect information about factors that influence maternal and child health and to understand the impact of these factors on healthy development through the life course. The MUSP recruited consecutive women who received public prenatal care from the Mater Misericordiae Hospital in Brisbane, Australia, between 1981 and 1983 [23]. Mothers and their offspring were followed and assessed at 3–5 days, 6 months and approximately 5, 14, 21 and 30 years after the birth. The MUSP cohort consists of $n = 7223$ (85%) live singleton offspring for whom maternal data were available at hospital discharge. Approval to conduct the MUSP was obtained from The University of Queensland's Behavioral and Social Sciences Ethical Review Committee.

The 14-year follow-up of the MUSP was used for this analysis as it included mother- and offspring-reported mental health assessments in early adolescence, an important developmental time-point in the life course. A total of $n = 5171$ (72%) mothers and adolescents completed this phase. As the 14-year follow-up occurred over a single year, the ages of the adolescent varied from 12.8 to 15.4 years. This analysis was restricted to participants for whom maternal reports of asthma were available at the 14-year follow-up ($n = 4025$).

Measures

Asthma

Adolescents were classified as having asthma if their mother replied “yes” to the question, “Has your child had any of

the following...?” [asthma]. Healthy controls were those adolescents whose mothers answered “no” to each of the conditions listed: [acne (pimples); asthma; epileptic fits; diabetes; food allergies; a head injury with loss of consciousness; broken bones or fractures; burns requiring hospitalization; and poisoning requiring hospitalization]. This case ascertainment strategy resulted in $n = 1457$ adolescents classified as having asthma and $n = 2568$ adolescents classified as healthy controls.

Physician visits

Physician visits were assessed by asking mothers, “How many times has your child been to a doctor in the last year?”

Maternal distress

Maternal psychological distress was measured using the anxiety and depression subscales of the self-report Delusions-Symptoms-States Inventory (DSSI) [24]. Each subscale consists of seven items, which assess recent symptoms of anxiety and depression. Items were originally assessed using a five-point scale: 1 = “all of the time”; 2 = “most of the time”; 3 = “some of the time”; 4 = “rarely”; and, 5 = “never”. Responses were then recoded by collapsing the “rarely” and “never” options, and scores were rescaled and reverse-coded as 0–3 to reflect the original DSSI. Total scores can range from 0 to 42, and scores ≥ 8 indicate psychological distress. The DSSI and the anxiety and depression subscales have been shown to be valid and reliable [25]. Internal consistency of the 14-item DSSI was excellent: for mothers of adolescents with asthma, $\alpha = 0.91$ and for mothers of controls, $\alpha = 0.90$.

Adolescent general health

General health was assessed by asking adolescents, “In general, over the last year, do you think your health has been?” Responses were measured using a four-point scale: 1 = “excellent”; 2 = “good”; 3 = “fair”; and, 4 = “poor”. For the statistical analyses, adolescent health was recorded to create two groups: “excellent” or “good” and “fair” or “poor”.

Covariates

Data were also collected on various sociodemographic characteristics including adolescent age and sex and maternal marital and employment status, as well as annual household income. Maternal marital status was dichotomized to “married” (which included common-law relationships) or “not married”. Maternal employment status was dichotomized to “employed” (including full-time, part-time or self-employed) and “not employed”. Household income was measured using seven pre-specified categories ranging from \$0 to $\geq \$36\,350$ (Australian dollars), whereby $\geq \$26\,000$ was considered high income. These sociodemographic characteristics were assessed and included as potential confounding factors in the analyses.

Statistical analysis

Univariate descriptive statistics were used to describe the study sample, and bivariate analyses were used to compare socio-demographic characteristics of mothers and adolescents classified with and without asthma. Factors associated with missing data in the outcome were examined using logistic regression and associated odds ratios (OR) calculated. Multiple imputation based on the expectation-maximization algorithm [26] was used to estimate plausible values for missing data to provide better approximations of unbiased effects.

Within the structural equation modeling framework, path analysis was used to test the hypothesis that maternal psychological distress mediates the association between presence of asthma and number of physician visits. All paths were modeled simultaneously (Figure 1) and controlled for the potential confounding effects of adolescent sex, age and general health, maternal age at childbirth and current marital status and household income. The product of coefficients method was used to calculate the mediated effect [27]. The Sobel test was used to determine whether the magnitude of the mediated effect was statistically significant [28]. To test the hypothesis that adolescent general health has a moderating effect on the association between maternal psychological distress and physician visits, the sample was restricted to adolescents with asthma. Path analysis with a product-term interaction between maternal psychological distress and adolescent general health was used to examine whether adolescent general health had a moderating effect on the association between maternal psychological distress and physician visits. All hypothesis tests were two-sided with $\alpha=0.05$. Multiple imputation was conducted and sample characteristics were analyzed using SAS 9.2 (SAS Institute, Cary, NC). The mediation and moderation analyses were conducted with Mplus 6.11 (Muthen & Muthen, Los Angeles, CA).

Results

The mean age of adolescents was 13.9 (SD: 0.3) years and 50% were male. Adolescents had, on an average, 2.9 (SD: 3.9) visits to a physician in the previous year. Compared to controls, there was a significantly larger proportion of male adolescents in the asthma group, 55% vs. 48%, $\chi^2=19.05$, $p<0.001$ and adolescents with asthma were significantly less

likely to report “excellent” general health during the past year, 15% vs. 25%, $\chi^2=55.14$, $p<0.001$. Adolescents with asthma had significantly more physician visits during the previous year compared to controls, 4.1 vs. 2.2, $p<0.001$. Mothers were mostly married (81%); employed full- or part-time (60%); and reported annual household incomes of at least \$26 000 (67%). Significant between-group differences were found, whereby mothers of adolescents with asthma were younger at childbirth, less likely to be married and have lower household incomes (Table 1). There was also a larger proportion of mothers of adolescents with asthma who met the threshold for psychological distress compared to control mothers as measured by the DSSI, 15% vs. 12%, $\chi^2=7.01$, $p=0.008$. A total of 52 (1%) adolescents had missing physician visit data. Missing data on physician visits was associated with poorer reported adolescent general health, OR = 2.12, $p=0.012$; mothers who were not married, OR = 2.77, $p<0.001$; and lower household incomes, OR = 1.35, $p=0.002$.

Using path analysis of the cross-sectional data, there was evidence to suggest that maternal psychological distress partially mediated the relationship between presence of adolescent asthma and the number of physician visits in the previous year (Figure 1). Controlling for sociodemographic factors, the estimate of the mediated effect, $\alpha\beta=0.05$ was statistically significant, $z=2.00$, $p=0.046$. Maternal psychological distress mediated 25% of the effect of adolescent asthma on the number of physician visits. For completeness, an alternate model that postulates maternal psychological distress impacts asthma symptoms/morbidity [10,15] was examined and model fit was compared with the original model. Using the Bayesian Information Criterion as an index of model fit, there was “strong” evidence [29] to suggest that the original model demonstrated better fit to the data ($\Delta=5.71$) and thus the alternate model was rejected.

Restricting the sample to only those adolescents with asthma, path analysis with a product-term interaction was used to examine whether adolescent general health during the past year moderated the relationship between maternal psychological distress and number of physician visits. Controlling for sociodemographic factors, there was no evidence of a moderating effect of adolescent general health

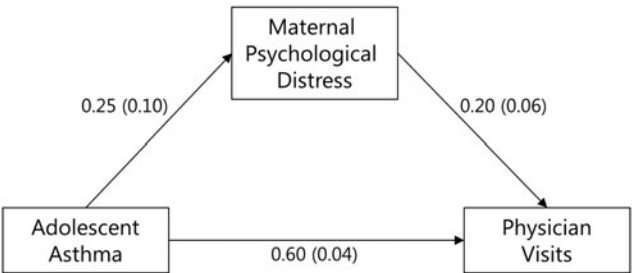


Figure 1. Path analysis of the mediating effect of maternal distress on the relationship between presence of physical illness in adolescents and number of physician visits. Values denote the unstandardized regression estimate (standard error). The model controlled for the potential confounding effects of adolescent sex, age and general health, maternal age at childbirth and current marital status and household income. All estimates $p<0.01$.

Table 1. Characteristics of the study sample.

	Asthma (n = 1457)	Controls (n = 2568)	t/ χ^2 (p Value)
Adolescent			
Age, years	13.9 (0.3)	13.9 (0.3)	0.53 (0.596)
Male, %	55.0	47.8	19.05 (<0.001)
General health, %			
Excellent	14.7	24.6	71.95 (<0.001)
Good	61.8	59.3	
Fair	21.4	15.0	
Poor	2.1	1.2	
Physician visits	4.1 (4.5)	2.2 (3.4)	13.69 (<0.001)
Mother			
Age at birth of child, years	25.5 (4.9)	25.9 (5.1)	2.65 (0.008)
Married, %	78.2	82.1	9.13 (0.003)
Employed, %	58.5	60.4	1.27 (0.260)
Income $\geq$ \$26 000%	64.0	68.7	9.22 (0.002)

Adolescent and mother age is reported as mean (standard deviation).

on the association between maternal psychological distress and number of physician visits, $\beta = -0.26$, $p = 0.093$. In contrast, the main effects of maternal psychological distress, $\beta = 0.27$, $p = 0.041$ and adolescent general health, $\beta = -0.41$, $p < 0.001$ were statistically significant and suggested that maternal psychological distress and lower adolescent general health were associated with an increase in the number of physician visits during the previous year. Results were similar among mothers of controls (data not shown).

Discussion

In this cross-sectional study, we found that maternal psychological distress partially mediated the relationship between presence of asthma and number of physician visits during the past year in a population-based sample of adolescents. The mediated effect was independent of other factors potentially associated with physician visits, including adolescent-reported general health during the past year. No evidence was found to show that adolescent general health moderated the effect of maternal psychological distress on the number of physician visits among adolescents with asthma. This suggested that irrespective of adolescents' general health, presence of maternal psychological distress was associated with more physician visits during the past year.

A greater proportion of mothers of adolescents with asthma had psychological distress compared to control mothers; however, the prevalence was lower than previously reported findings which have suggested that at least a quarter, and up to half of mothers of children with asthma have depression [30,31]. This discrepancy may be attributable to sampling. Previous research has devoted much attention to more vulnerable populations – low income, inner-city and minority mothers of children with asthma [16,30,31] as opposed to the current study which included a population sample of mothers and children.

This study confirmed findings from previous population studies that have consistently reported that adolescents with asthma have higher health service use compared to those without asthma [2]. This effect remained significant after adjusting for a number of sociodemographic factors known to influence health service use, including adolescent general health. Thus, having asthma, irrespective of reported health status, is associated with increased physician visits.

We extend the existing literature in that we found that maternal psychological distress in a large, community, population-based sample partially mediates the relationship between adolescent asthma and physician visits. This is supported by previous studies that have reported a significant association between symptoms of maternal depression and health service use in children with asthma [7,13]. One study examined parental worry and found that such behavior was associated with repeat emergency department visits among children with asthma [14]. Despite difficulty in comparing findings among studies with different sampling and target populations, and outcomes of interest, the literature suggests that symptoms of maternal depression have the potential to increase asthma-related health service use [32].

There may be several explanations as to why psychological distress among mothers of adolescents with asthma is associated with increased physician visits. There is evidence to suggest that the psychological distress following a diagnosis of asthma in their children can result in these mothers functioning at a reduced capacity to effectively cope with her child's asthma. These mothers have reported mild-to-moderate asthma symptoms as difficult to manage [33], indicating a diminished, or underestimated, self-efficacy to provide adequate asthma care or heightened anxiety about the severity of exacerbations. Bartlett et al. [16] suggested that factors associated with psychological distress such as reduced medical adherence and communication with the physician may hinder the caregiving ability of a mother. It has also been proposed that increased physician visits may be an attempt by mothers to signal their own psychological distress [7] and reduce the perceived stigma associated with seeking mental health services [34].

Maternal psychological distress should be considered a key factor related to increased health service use and higher costs. It is notable that the effect of maternal psychological distress was independent of adolescent general health, and that adolescent general health did not moderate the effect of maternal psychological distress on physician visits. Therefore, addressing the problem of maternal psychological distress may reduce health service use and costs among adolescents with asthma. Physicians may naturally be more likely to appreciate the role of maternal psychological distress when adolescent health is poorer, but these findings suggest that psychological distress in mothers plays a key role across the range of adolescent general health. Intervention studies screening for maternal psychological distress and providing brief accessible psychological interventions [35] are needed to determine if this can lower health service use and improve adherence with treatment protocols in children and adolescents with asthma [11,17,36].

Our findings are tempered by a few limitations. First, because this is a cross-sectional study, we cannot untangle the temporal effects of the studied variables. It is plausible that symptoms of psychological distress among mothers occurred after the majority of physician visits had already occurred. Since the evaluation of true mediating effects requires longitudinal data, the results from this study are exploratory. Second, the use of mother-reported asthma diagnosis and physician visits is inherently limited. There may be low agreement between maternal reports and physician records of diagnosis and medical encounters; it is unknown whether physician visits were scheduled visits and/or follow-ups, or if they were mother-initiated; and, it cannot be determined if there is informant bias, between mothers with and without psychological distress, which could either under or overestimate effects. This informant bias may have also impacted maternal reports of adolescent asthma, which were assessed with only a single question and not validated with medical record or administrative data. Third, psychological distress in fathers was not measured. Assessment of the mental health of both parents, when applicable, would better inform the relationship between psychological distress in parents and health service use in children and adolescents with asthma. Finally, congruent with other population-based studies,

attrition in the MUSP is associated with sociodemographic disadvantage. Thus, findings may be impacted by this selection bias.

Conclusions

This study suggested that maternal psychological distress mediates the effect of adolescent asthma on the number of physician visits during the past year and that the influence of maternal psychological distress on physician visits among adolescents with asthma does not vary as function of adolescents' general health. Healthcare professionals should be mindful of the mental health of mothers and adopt family-centered strategies to provide optimal and efficient care for children and adolescents with asthma. Future research is needed to examine these relationships longitudinally with more robust measures of asthma, physician visits, parental mental health and health service use and to determine whether interventions that aim to reduce symptoms of parental psychological distress result in declines in physician visits and general health service use in children and adolescents with asthma.

Declaration of interest

The authors have no conflicts of interest to declare.

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