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Mental health, long-term medication adherence, and the control of asthma symptoms among persons exposed to the WTC 9/11 disaster

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Abstract

Objective: A positive association between mental health conditions and poor asthma control has been documented in the World Trade Center-exposed population. Whether factors such as medication adherence mediate this association is unknown.

Methods: The study population was drawn from adult participants of the World Trade Center Health Registry Cohort who self-reported as asthmatic after the disaster and who were currently prescribed a long-term control medication (LTCM). Multivariable linear regression was used to estimate the associations between mental health condition (PTSD, depression, or anxiety) and continuous adherence and Asthma Control Test (ACT) scores.

Results: In the study sample of 1,293, 49% were not adherent to their LTCM and two thirds reported poorly or very poorly controlled asthma. Presence of any mental health condition was associated with a 2-point decline in ACT and half a point decrease in adherence scores. However, in the multivariable model, better adherence was statistically significantly associated with slightly worse control.

Conclusions: The total effect of mental health on asthma control was opposite in sign from the product of the paths between mental health and adherence and adherence and asthma control; we therefore found no evidence to support the hypothesis that adherence mediated the negative association between poor mental health and adequate asthma control. More research is needed to understand the complex causal mechanisms that underlie the association between mental and respiratory health.

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Declaration of interest

The authors report no conflicts of interest. The article contents are solely the responsibility of the authors and do not necessarily represent the official views of the NIOSH, CDC, or the Department of Health and Human Services.

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Keywords

Control/management; epidemiology; phenotypes; treatment

Introduction

The destruction of the World Trade Center Towers on 9/11/2001 resulted in a massive release of dust and fumes affecting both rescue and recovery workers (RRW) and community members (area workers, local residents, and passers-by). New-onset lower respiratory symptoms (LRS) consistent with asthma have been well described among persons who were exposed to dust during the course of the disaster and subsequent recovery and clean-up efforts (1–6). Asthma and LRS have persisted in all exposure groups for more than a decade after 9/11 (6–12). In RRW, the cumulative incidence of self-reported physician diagnoses of asthma nine years after 9/11 was 30% (8), and the cumulative incidence of post-911 onset of self-reported clinician diagnoses of asthma among WTCHR enrollees, who had varying degrees of exposure to the disaster and subsequent clean-up, was 15.4% as of 2016 (13).

Since 2006, RRW and community members have been offered treatment for asthma and other 9/11-related conditions through the World Trade Center Health Program under the Centers for Disease Control and Prevention (14,15). Even before 2006, WTC clinical centers generally followed the National Asthma Education and Prevention Program (NAEPP) Guidelines for persistent asthma with the use of long-term control medication (LTCM), including inhaled corticosteroids (ICS) (16). However, asthma control has been reported as poor or very poor in both RRW workers (71%) and community members (64%) (11,17). This may be due to a variety of factors, such as asthma severity in this cohort or non-response to typical medication regimens for WTC-related asthma. Another possibility includes low medication adherence.

Failure to adhere to prescribed medication regimens is associated with uncontrolled asthma in the majority of studies (18–20), though a few studies that used a proxy for control, such as hospitalizations, found an inverse relationship (21,22). Adherence to asthma treatments in adults is generally poor (50% for ICS) (23). Similarly, the only study to date of adherence in WTC RRW with asthma reported 44% (95% CI: 38–50%) overall adherence to asthma control medicines (24).

Co-morbid psychiatric diseases (such as posttraumatic stress disorder [PTSD], depression and anxiety disorders) are prevalent among those exposed to the 9/11 attacks (25–27) and have also been shown to increase the risk for incident (30) and persistent asthma and poor asthma control (11,17, 28, 29). Moreover, each of these disorders has been shown to be negatively associated with medication adherence (31–33), and adherence may therefore be on the causal pathway between mental illness and poor asthma control.

Little is known about the factors which influence the relationship between adherence and level of asthma control in this population of asthmatics. We hypothesized that poor adherence to LTCM regimens is associated with poor asthma control, and that adherence

mediates the association between mental health comorbidities and poor asthma symptom control.

Methods

The WTC Health Registry has been described in detail (34). Briefly, the Registry is a closed, longitudinal cohort of RRW and community members who met criteria for exposure to the disaster on or after September 11, 2001 (34). A total of 68,046 adults aged ≥18 years on September 11, 2001, responded to the first Registry survey (Wave 1, 2003–2004). To date, three additional surveys have been completed in the following years: 2006–2007, 2011–2012, and 2015–2016. These surveys asked about demographics, exposure to the disaster, physical and mental health status, history of diagnosed conditions, social status, and quality of life. The third survey (Wave 3) included a module devoted to asthma symptoms and control. Individuals who reported that they had been diagnosed with asthma onset soon after 9/11/2001 on the Wave 1, 2 or 3 surveys and who completed the asthma symptoms and control module in Wave three were the subject of a prior Registry study of asthma control [11]. In 2016, these individuals were mailed another survey, which asked about asthma morbidity, control, adherence to prescribed medication regimen, and asthma triggers. These respondents comprise the cohort for this study (Figure 1).

The Institutional Review Boards of the New York City Department of Health and Mental Hygiene and the Centers for Disease Control and Prevention approved the Registry protocols.

Study sample

Asthmatics who reported taking a prescribed LTCM (ICS, long-acting $\beta 2$ agonists [LABA], long-acting muscarinic antagonists [LAMA], leukotriene modifiers, or IgE antibody) formed the analytic study sample (n = 1,293). This analysis focused on long-term medication use. Of the 5,151 adult participants who reported physician-diagnosed asthma after 9/11 and before 2012, 3,584 completed the Wave four asthma survey. Of these, 1,016 reported that they were not currently prescribed LTCM. Finally, those with missing covariate data were excluded.

Study outcomes

Asthma control was measured with the Asthma Control Test (ACT), a self-administered, validated quantitative questionnaire consisting of five questions related to symptom severity within the previous four weeks, including episodes of breathlessness, nocturnal awakenings, limitations of daily activities, need of rescue medication, and patient self-rating of asthma control. Asthma control was examined as a continuous variable (with scores ranging from 5 to 25), and also categorized into controlled (ACT ≥20), poorly controlled (ACT between 16 and 20), or very poorly controlled (ACT ≤15) (35).

Exposure variables

Probable PTSD was determined by a score of ≥44 on the PTSD Checklist, Stressor-Specific Version (36,37). Probable depression was determined using the Patient Health Questionnaire

(PHQ8) with a score ≥10 (38). Anxiety was self-reported as ever been told by a doctor or health professional (yes/no). A binary mental health measure was then created that recorded whether an enrollee had any of these conditions. Medication adherence was measured in the asthma survey using the eight item Morisky Medical Adherence Scale (MMAS) where a score of <6 indicates poor adherence (39). A checklist of LTCM (generic and brand names) was provided along with an option to write in a LTCM (see appendix). Write-in medications were reviewed individually for validity. Dosage was not recorded.

In order to establish temporal sequencing, recorded mental health conditions were all recorded in Wave 3. Adherence and asthma control data were collected approximately four years later. Although adherence and asthma control were measured at the same time, asthma control questions related to the last 30 days, while respondents were asked about adherence farther back in time.

Analysis variables

Demographic variables included age on September 11, 2001, gender, racial/ethnic group, educational level, and household income. Additional covariates included weight status (calculated via self-reported height and weight and classified as BMI <25, BMI ≥25 and less than 30, and BMI ≥30); and whether an enrollee worked as a rescue, recovery, clean-up or volunteer worker (RRW) at the WTC site. Social support was assessed based on the number of close friends, contacting a friend at least twice a month, attending religious services twice a month, and being actively involved in a group, and categorized as low (zero or one positive answers), medium (two positive answers), and high (three or four positive answers). Smoking history and ever been told by a doctor of a gastroesophageal reflux disease (GERD) diagnosis or a diagnosis of obstructive sleep apnea (OSA) were assessed via self-report. Respondents were also asked whether they had had an inpatient hospital stay or emergency department visit due to asthma in the 12 months prior to the asthma survey. Enrollee response regarding ever having had a pulmonary function test was also included in the final model as a proxy for disease severity. All covariates were collected at Wave three with the exception of age, gender, race, and education (all collected at baseline), and ever had a pulmonary function test and hospitalization due to asthma (both collected on the asthma survey). We chose covariates that we hypothesized to be a common cause of both mental health and asthma control.

Statistical analysis

Two bivariate analyses were conducted. Enrollee characteristics were first assessed stratified by adherence status and then separately by categories of asthma control (controlled or poorly or very poorly controlled), either by a chi-squared or Fisher’s exact test.

Before conducting a mediation analysis, a fully adjusted multivariable linear regression model was used to estimate the associations between mental health and continuous adherence and ACT scores. Specifically, in order to determine the direction of both the direct and indirect paths, we estimated the following relationships: (a) between mental health and adherence score, (b) between adherence and ACT score, and (c) between mental health and ACT score. We defined the total, direct, and indirect effects as follows:

$c = c' + ab$

c = total effect

c' = direct effect

ab = indirect effects

We then assessed the sign for the total effect (c) and the indirect path (the product of a and b).

In a subsequent sensitivity analysis, the characteristics and asthma control of the analytical study sample were compared to those who were not currently advised by a physician to take any LTCM asthma medication via chi-squared and Fisher's exact test. Finally, as an additional measure of asthma severity, the mean ACT score was graphed in relation to the number of prescribed LTCMs, stratified by adherence. All *p* values at 0.05 or lower were considered statistically significant. SAS 9.4 (SAS, Cary, NC) was used for all analyses.

Results

The sample was predominantly non-Latino White and male. The median age on September 11, 2001, was 43 years [range 18–75]. The analytic sample had high rates of physical and mental health comorbidities. For example, 84% were overweight or obese, 40% had probable PTSD, and 37% had probable depression.

The sample characteristics are described and stratified by asthma control in Table 1. This cohort had scores consistent with poor control with more than two thirds classified as poorly or very poorly controlled. There was an inverse relationship between adherence and asthma symptom control level based on the ACT: adherence was less likely (44.2%) in the controlled than in the poorly (48.7%) or very poorly (58.8%) controlled asthmatics. Higher educational level, household income, and social support were associated with greater level of control, while greater emergency room use and hospitalization and presence of PTSD or depression had an inverse relationship with control. Both GERD and OSA were associated with poorer control (Table 1). There was no correlation between age or BMI and level of control.

In Table 2, we explored the characteristics associated with adherence. Half of enrollees reported being non-adherent to their LTCM regimen. With the exceptions of sex and education, there were no differences in adherence status by socioeconomic characteristics, such as age, race, and social support, BMI, asthma exacerbations (as measured by emergency room visits or hospitalizations), or mental health (including anxiety, PTSD and depression).

In bivariate analysis (Table 1), there was an inverse relationship between adherence and asthma control level based on the ACT: the prevalence of controlled asthma was slightly higher in the non-adherent group compared with the adherent group.

In multivariable models, greater LTCM adherence remained associated with worse asthma symptom control (Figure 2). After adjusting for demographic and other characteristics, the beta for adherence score decreased further but remained significantly negative (adjusted beta: −0.32 [−0.43, −0.21]). The overall indirect effect via adherence was therefore positive and statistically significant, contrary to our original hypothesis. The association between any mental health condition, however, was as expected, statistically significantly inversely associated with ACT score (−1.83, 95% CI −2.37, −1.29). Finally, in a fully adjusted model, the adjustment of adherence did not diminish the association between mental health and asthma control, and in fact strengthened it (−2.0, 95% CI −2.51, −1.44). Therefore, the possibility that adherence mediated the relationship between mental health problems and asthma control, as originally hypothesized, was not supported (Figure 2) because the direct and indirect paths were opposite in sign, a phenomenon known as inconsistent mediation (40). In the case of inconsistent mediation, the mediator (here adherence) has a suppressor effect on the total effect (here the association between mental health and poor asthma control). Because this is both contrary to our original hypothesis and highly biologically implausible, we decided that a full mediation analysis was inappropriate.

Although our analyses focused on asthmatics who reported prescribed LTCM, we also performed a subanalysis (Appendix 1) of those asthmatics who did not report LTCM prescription, to determine whether enrollee characteristics were different in both groups. Those prescribed LTCM were significantly less likely to be controlled, and more likely to be male, older, or obese, to have lower educational attainment and annual household income, to have probable PTSD or depression, GERD, OSA, and hospitalization or ER visits in the last 12 months. Finally, we wanted to determine whether those with poor control were being prescribed more LTCM, and whether those on more LTCM had better adherence. We found a higher number of prescribed LTCMs was associated both with poorer control and better adherence (Figure 3).

Discussion

Our findings demonstrate that half the enrollees who were prescribed a LTCM were incompletely adherent with their asthma regimen, and that a majority of enrollees had poorly or very poorly controlled asthma as measured by the ACT. Poor adherence is well described in the general asthma literature (23,41–43), as well as a previous report of WTC RRW (24). Similarly, poor asthma control in the WTC disaster population has been noted previously (11,17).

This study produced two novel and unexpected findings. First, our data suggest that those who were adherent had poorer asthma control. The inverse relationship between adherence and asthma control attenuated but persisted in a multivariable model. This is the first study to our knowledge to report this finding. Rojano et al., however, found no association between adherence and self-reported wheezing, fatigue or emotional concerns due to asthma, and did not present data on a relationship between adherence and asthma control level (24).

Secondly, the relationship between mental health conditions, such as PTSD, anxiety, and depression, and asthma control was not mediated by medication adherence as we hypothesized, and in fact the mediational effects appeared to be reversed.

There are multiple potential explanations for the first finding. One may be that patients with poor control are more adherent to their medication regimen because they are symptomatic and take the medicine regularly in an attempt to reduce symptoms. This explanation is supported by our finding that the more poorly controlled, and therefore symptomatic, patients are those with the greater number of LTCMs (Figure 3). It is also possible that the lack of a positive association between adherence and control is a consequence of our cross-sectional rather than longitudinal study design, given that adherence is likely to be fluid over time. Early on, the association between adherence and control may have been positive but may have inverted over time as patients more responsive to treatment improved, and no longer required LTCM. It would thus not be surprising that treatment of the cohort now under study, up to 12 years after asthma onset, is more difficult.

The persistence of symptoms in those who were adherent to asthma medications raises a question about the physiology of WTC-related asthma: is corticosteroid-based therapy incompletely effective in this cohort? This may be due in part to the presence of inflammatory pathways that are insensitive to corticosteroids. Asthma is heterogeneous and can be due to a variety of inflammatory pathways. High type 2 (T2) asthma is characterized by eosinophils and atopy, which may be responsive to current LTCM. In contrast, the inflammatory mechanisms involved in low T2 asthma are less-well characterized, but may involve epithelial cell damage and activation of neutrophils, Th1 and Th17 cells, which may be less responsive to inhaled corticosteroids (44,45). This explanation would be consistent with irritant-induced asthma and is suggested by the low exhaled NO levels identified in persistently symptomatic community members (46), and the substantial proportion of nonatopic responders (17,47). It is thus possible that symptom persistence in LTCM-treated and -adherent WTC-exposed populations may be mediated by relatively steroid-insensitive pathways, or led to airway remodeling, and that alternative treatment approaches are needed.

Finally, it is possible that some of these enrollees are being treated for but do not have asthma. Symptoms of asthma are nonspecific, and asthma is often misdiagnosed (48–50). Indeed, WTC exposed individuals have been described to have disorders such as chronic bronchitis, bronchiolitis, vocal cord dysfunction, chronic obstructive pulmonary disease (51,52), and sarcoidosis (53) that share symptoms with asthma but that may not respond to recommended asthma treatment.

Our second finding that medication adherence does not mediate the association between mental health disorders and asthma control in the direction hypothesized, suggests that other factors may drive this relationship. For example, it is possible that self-management behaviors beyond medication adherence, such as lack of trigger avoidance behaviors or patients' illness and medication beliefs (24), may have affected control in this population. An alternative explanation may be that mental health disorder such as PTSD, anxiety, and depression may increase the risk of factors such as obesity and smoking behaviors, poor sleep, low physical activity, or daily stressors that may in turn lead to poor control (54–56).

The study population of patients currently prescribed LTCM includes a relatively large proportion of asthmatics with physical and mental health comorbidities which are likely to make their asthma more difficult to treat and control (5,52,57). Evidence for the latter explanation can also be found in Appendix 1, which demonstrates that those not on LTCM at the time of survey had better asthma control and lower rates of GERD, OSA, depression, anxiety, probable PTSD, and overweight/obesity. Finally, there is evidence WTC enrollees with mental health conditions are more likely to experience barriers to care, such as difficulties with cost or access (58).

This study had limitations that should be noted. It relied solely on self-reported data and lacked clinical confirmation of asthma diagnosis and severity such as independently verified pulmonary function test results. Although we utilized well-validated adherence (39) and control (35) measures, it is unknown whether their reliability is the same for all disease outcomes. For example, at least one study found no association between Morisky scores and asthma control as measured by the ACT (59). Adherence may have been overreported due to social desirability bias, and asthma control may have been underreported among enrollees concerned that reporting symptom improvement would lead to diminished clinical services or financial compensation. For example, a study of children found no relationship between adherence and control in self-report data but a positive relationship in objective measures (60). On the other hand, the validity of the ACT is supported by our findings that poor asthma control was associated with more severe illness (measured by self-reported emergency department visits and inpatient hospital stays) (Appendix 1), with a higher prevalence of asthma action plan use (data not shown), and with combined ICS, LABA and LAMA therapy versus ICS alone (Figure 3).

This analysis had several strengths. This large cohort is relatively sociodemographically diverse compared to other WTC cohorts and includes both community members and RRW. The instruments used to determine adherence and asthma control have been well validated in several different groups (35,39). Although the association between adherence and asthma control was not in the expected direction, poor control was associated with indicators of severe disease. Poor control was also positively associated with covariates such as physical comorbidities, smoking, and lower socioeconomic status, consistent with prior studies, and indicate that our data accurately detailed control status and factors relevant to control.

Conclusions

Poorly controlled asthma persists in RRW and community members, and non-adherence to prescribed LTCM is high in this WTC-exposed cohort. Although mental health diagnoses are associated with poor asthma control, adherence to LTCM does not mediate that association. Additional data such as pharmacy refill records for adherence, and assessment of asthma type and level of control using pulmonary function testing with bronchial hyperreactivity or methacholine challenge, exhaled nitrous oxide, and peripheral eosinophil counts would be useful in further exploring this finding.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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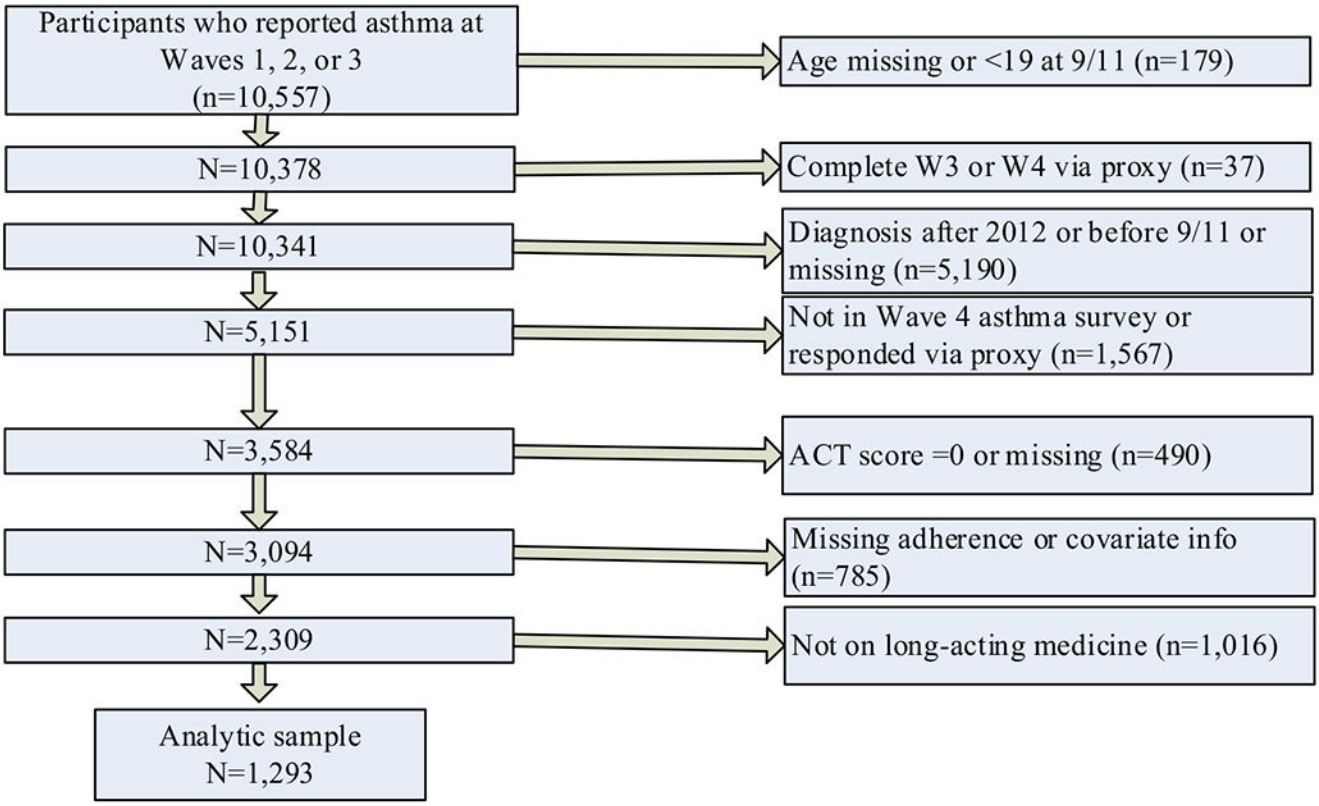

Figure 1.
Sample selection from World Trade Center Health Registry cohort.

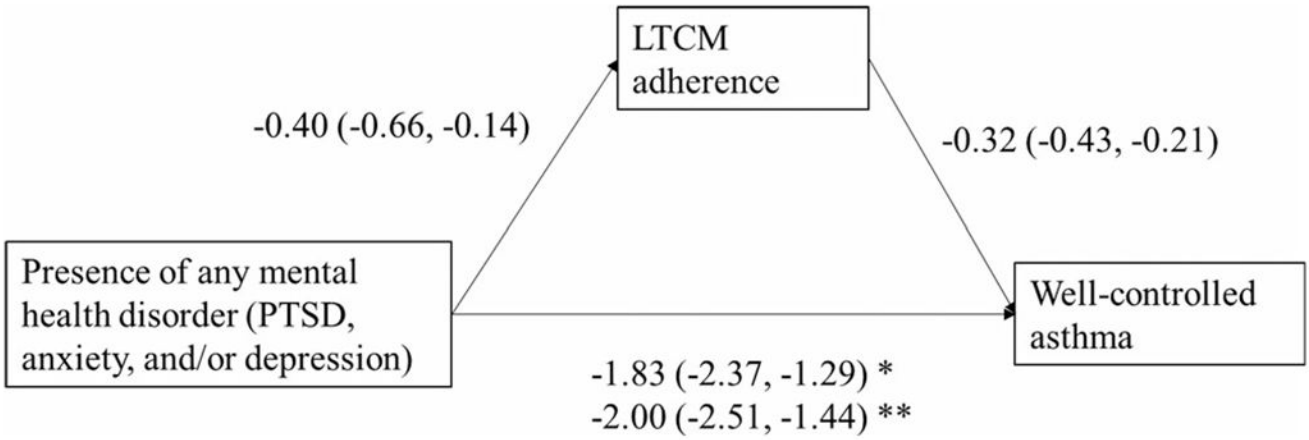

Figure 2.

Multivariable linear regression coefficients and 95% confidence intervals for the relationships between mental health, LTCM adherence, and asthma control.

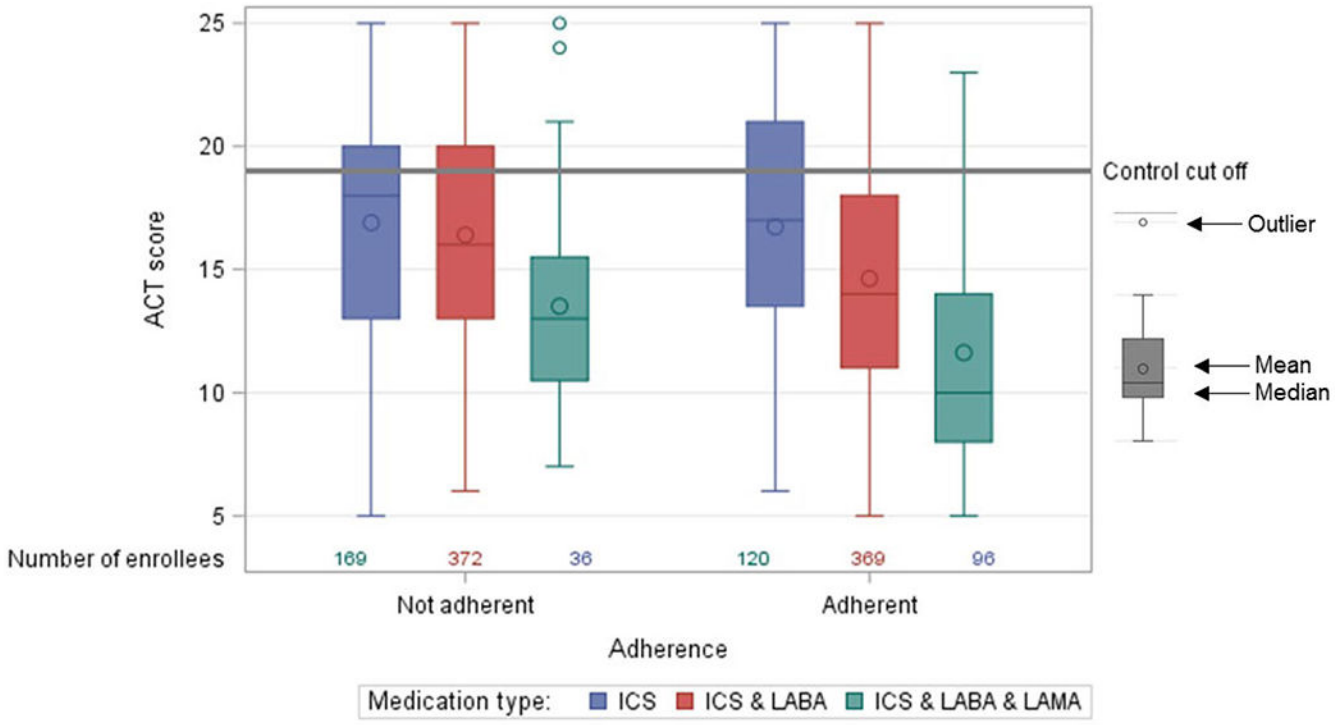

Figure 3.

Asthma control decreases with increasing numbers of medications in both adherent and non-adherent enrollees.

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Table 1.

Risk factors overall and stratified by asthma control in the WTCHR cohort.

	Overall	Controlled: ACT ≥20 (*n* = 457) *N* (%)	Poorly controlled: ACT 16-20 (*n* = 341) *N* (%)	Very poorly controlled: ACT ≥15 (*n* = 495) *N* (%)	*p* value
Adherent	659 (51.0)	202 (44.2)	166 (48.7)	291 (58.8)	<0.001 *
Age on 9/11					n.s.
18–24	20 (1.6)	11 (2.4)	5 (1.5)	4 (0.8)	
25–44	716 (55.4)	257 (56.2)	196 (57.5)	263 (53.1)	
45–64	548 (42.4)	185 (40.5)	136 (39.9)	227 (45.9)	
65+	9 (0.7)	4 (0.9)	4 (1.2)	1 (0.2)	
Gender					0.018 *
Males	847 (65.5)	278 (60.8)	225 (66.0)	344 (69.5)	
Females	446 (34.5)	179 (39.2)	116 (34.0)	151 (30.5)	
Race					n.s.
Non-Latino White	885 (68.5)	334 (73.1)	228 (66.9)	323 (65.3)	
Non-Latino Black	124 (9.6)	43 (9.4)	35 (10.3)	46 (9.3)	
Latino, any race	199 (15.4)	54 (11.8)	53 (15.5)	92 (18.6)	
Non-Latino Asian	44 (3.4)	17 (3.7)	13 (3.8)	14 (2.8)	
Other/multiracial	41 (3.2)	9 (2.0)	12 (3.5)	20 (4.0)	
PTSD	523 (40.5)	78 (17.1)	144 (42.2)	301 (60.8)	<0.001 *
Depression	479 (37.1)	77 (16.9)	115 (33.8)	287 (58.0)	<0.001 *
Anxiety	472 (36.5)	105 (23.0)	128 (37.5)	239 (48.2)	<0.001 *
Education					<0.001 *
High school or less	334 (25.9)	87 (19.0)	95 (27.9)	152 (30.7)	
Some college	444 (34.3)	145 (31.7)	109 (32.0)	190 (38.4)	
College grad or greater	515 (39.8)	225 (49.2)	137 (40.2)	153 (30.9)	
Household income					<0.001 *
Less than $25,000	163 (12.6)	27 (5.9)	46 (13.5)	90 (18.2)	
$25,001–$50,000	211 (16.3)	59 (12.9)	53 (15.5)	99 (20.0)	
$50,001–$75,000	254 (19.6)	68 (14.9)	73 (21.4)	113 (22.8)	
$75,001–$150,000	503 (38.9)	208 (45.5)	136 (39.9)	159 (32.1)	

	Overall	Controlled: ACT ≥20 (*n* = 457) *N* (%)	Poorly controlled: ACT 16-20 (*n* = 341) *N* (%)	Very poorly controlled: ACT ≥15 (*n* = 495) *N* (%)	*p* value
More than $150,000	162 (12.5)	95 (20.8)	33 (9.7)	34 (6.9)	
Weight status					n.s
Healthy/underweight	207 (16.0)	83 (18.2)	52 (15.3)	72 (14.6)	
Overweight	491 (38.0)	177 (38.7)	119 (34.9)	195 (39.4)	
Obese	595 (46.0)	197 (43.1)	170 (49.9)	228 (46.1)	
OSA[a]	458 (35.4)	107 (23.4)	110 (32.2)	241 (48.7)	<0.001*
GERD[b]	698 (54.0)	191 (41.8)	196 (57.5)	311 (62.8)	<0.001*
Social support					<0.001*
Low	272 (21.0)	67 (14.7)	64 (18.8)	141 (28.5)	
Medium	473 (36.6)	171 (37.4)	128 (37.5)	174 (35.2)	
High	548 (42.4)	219 (47.9)	149 (43.7)	180 (36.4)	
Hospitalized last 12 months	52 (4.0)	6 (1.3)	8 (2.4)	38 (7.7)	<0.001*
ER visit last 12 months	263 (20.3)	55 (12.0)	63 (18.5)	145 (29.3)	<0.001*
Ever had pulmonary function test	1,256 (97.1)	438 (95.8)	334 (98.0)	484 (97.8)	n.s.

*Significant at the 0.05 level.

[a]39 enrollees missing OSA data.

[b]59 enrollees missing GERD data.

Table 2.

Risk factors stratified by adherence status as measured by the scale in the WTCHR cohort.

	Non-adherent (*n* = 634) *N* (%)	Adherent (*n* = 659) *N* (%)	*p* value
Controlled asthma	174 (27.4)	148 (22.5)	0.04*
Age on 9/11			
18–24	11 (1.7)	9 (1.4)	n.s.
25–44	370 (58.4)	346 (52.5)	
45–64	247 (39.0)	301 (45.7)	
65+	6 (1.0)	3 (0.5)	
Gender			0.009*
Males	393 (62.0)	454 (68.9)	
Females	241 (38.0)	205 (31.1)	
Race			n.s.
Non-Latino White	421 (66.4)	464 (70.4)	
Non-Latino Black	71 (11.2)	53 (8.0)	
Latino, any race	102 (16.1)	97 (14.7)	
Non-Latino Asian	24 (3.8)	20 (3.0)	
Other/multiracial	16 (2.5)	25 (3.8)	
PTSD	264 (41.6)	259 (39.3)	n.s.
Depression	248 (39.1)	231 (35.1)	n.s.
Anxiety	243 (38.3)	229 (34.8)	n.s.
Education			0.05*
High school or less	165 (26.0)	169 (25.6)	
Some college	198 (31.2)	246 (37.3)	
College grad or greater	271 (42.7)	244 (37.0)	
Household income			n.s.
Less than $25,000	82 (12.9)	81 (12.3)	
$25,001–$50,000	93 (14.7)	118 (17.9)	
$50,001–$75,000	126 (19.9)	128 (19.4)	
$75,001–$150,000	242 (38.2)	261 (39.6)	
More than $150,000	91 (14.4)	71 (10.8)	

	Non-adherent (n = 634) N (%)	Adherent (n = 659) N (%)	p value
Weight status			n.s.
Healthy/underweight	95 (15.0)	112 (17.0)	
Overweight	231 (36.4)	260 (39.5)	
Obese	308 (45.6)	287 (43.6)	
Social support			n.s.
Low	141 (22.2)	131 (19.9)	
Medium	226 (35.7)	247 (37.5)	
High	267 (42.1)	281 (42.6)	
Hospitalized last 12 months	18 (2.8)	34 (5.2)	n.s.
ER visit last 12 months	117 (18.5)	146 (22.2)	n.s.
Ever had pulmonary function test	617 (97.3)	639 (97.0)	n.s.

*Significant at the 0.05 level.