

TECHNICAL PAPERS ON HEALTH AND BEHAVIOR MEASUREMENT

TECHNICAL PAPER 81

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Reference Citation

Le TT, Bilderback A, Bender B, Wamboldt FS, Turner CF, Rand CS, Bartlett SJ. Do asthma medication beliefs mediate the relationship between minority status and adherence to therapy? *Journal of Asthma*, 45:33-37, 2008.

ORIGINAL ARTICLE

Do Asthma Medication Beliefs Mediate the Relationship Between Minority Status and Adherence to Therapy?

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Minority status has been associated with lower asthma medication adherence. We evaluated whether medication beliefs mediated this association. 86 adults with asthma on inhaled corticosteroid therapy completed surveys regarding selected beliefs about asthma medications. Medication adherence for 1 month was electronically measured. Mean daily adherence was lower in minority patients than in Caucasians ($p < .001$). Multiple negative asthma medication beliefs were associated with lower adherence (p 's $< .05$). Minorities had increased adjusted odds of having a high negative medication beliefs score. Finally, a bootstrapped estimate demonstrated a mediating effect by negative asthma beliefs on the minority status-adherence association ($-.073$ [95% CI: $-.16, -.01$]).

Keywords adherence, asthma, health beliefs, inhaled corticosteroids, minority

INTRODUCTION

More than 20.5 million people suffer from asthma in the United States. The financial burden of asthma exceeds \$16 billion dollars each year in direct and indirect costs (1). Inhaled corticosteroids (ICS) are the treatment of choice for many patients with asthma, and ICS adherence, or the extent to which a patient follows a treatment plan, is critical to successful asthma management. However, adherence to asthma therapy is generally poor among all patient groups (2, 3). Studies have demonstrated that adults and children are about 50% adherent to ICS therapy (4–7).

Low adherence has been associated with poor asthma outcomes. In a 3-month cohort study of children with asthma, those who experienced an exacerbation demonstrated a median ICS adherence of 14%, whereas those whose disease was well controlled had a median adherence of 68% (8). Others have shown that gaps in ICS refills are associated with up to 60% of the asthma-related hospitalizations among adults with asthma (9). Adherence tends to be lower in minority patients and those with low socioeconomic status and may be a factor in explaining why minorities experience twice the asthma morbidity as whites (10, 11).

Recent research has begun to explore relationships between patient beliefs about their asthma medications and adherence to prescribed therapy. In a study of adults with asthma, positive attitudes regarding ICS therapy were associated with greater adherence, whereas concerns about safety and addiction were correlated with nonadherence (11). However, a limited range of beliefs was evaluated. Because asthma

medication beliefs are potentially modifiable, identification of beliefs that facilitate or impair adherence may be an important consideration in enhancing clinical interactions and when designing interventions to improve outcomes. Further, identification of medication beliefs that affect the relationship between race/ethnicity and ICS adherence may lead to improved asthma management in minority populations (11).

In this prospective cohort study of inner-city adult asthma patients, we explored relationships among minority status, medication beliefs, and objectively measured adherence. We hypothesized that minority status would be associated with negative asthma medication beliefs, and that both minority status and negative beliefs would be associated with lower adherence rates. In a combined model, the relationship between minority status and adherence would be partially explained by negative asthma medication beliefs (Figure 1).

METHODS

Study Design

Data were drawn from baseline surveys and 1-month follow-up completed by 86 adults who volunteered to participate in an asthma education study in Baltimore, Maryland. The surveys were administered between August 2002 and December 2003. MDILog electronic monitoring devices (Medtrac Technologies, Lakewood, CO) were used to collect ICS adherence data over the following month. This study was approved by the Johns Hopkins Institutional Review Board.

Participants

Participants were recruited through the asthma outpatient clinics and by use of advertisements. All participants met the following criteria: (1) current diagnosis of asthma and under the care of a health care provider; (2) an active prescription for either a beclomethasone or fluticasone metered dose inhaler

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Funded by: NHLBI 5R01HL064200-03 and 5R01HL064199-03.

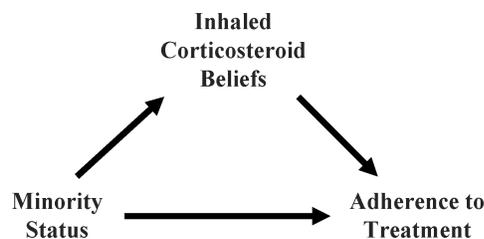


FIGURE 1.—A conceptual diagram modeling potential relationships among minority status, ICS beliefs and adherence to asthma therapy.

(MDI) (which would be compatible with the MDILog devices); (3) age 19 years or older and (4) otherwise in good general health. Participants were excluded if they had a diagnosis of COPD.

Procedures

At the initial visit, the participants provided informed written consent and completed self-administered written questionnaires on demographics, endorsed asthma medication beliefs and confirmed current asthma management practices. General asthma education handouts, including information on ICS medications, were provided. Participants were instructed to bring a full ICS inhaler which was verified by weighing. The inhaler was equipped with an MDILog electronic monitoring device that record the date and time of each MDI usage. The participants were told that the devices would track their medications and were asked to return with the devices in approximately 1 month.

Minority Status

Participants were asked to select a single race or ethnicity that best described themselves from the following choices: “Caucasian,” “African American,” “Hispanic,” “Asian,” “Native American,” “Other.” All participants who selected anything other than “Caucasian” were considered minorities.

ICS Beliefs

Participants completed a brief measure that assessed ICS beliefs and self-management behaviors. The measure includes 5 statements regarding tolerance, side effects, use of inhaled steroids, safety and amount of medication needed to control asthma. The following beliefs were assessed using a 5-point Likert scale (0 = strongly disagree; 4 = strongly agree):

1. “I have not needed to take as much of my inhaled steroid as the doctor prescribed.”
2. “My inhaled steroid is safe to use every day, even when I’m not having problems.”
3. “If I use my inhaled steroid every day, it won’t work as well when I really need it.”
4. “I don’t like the idea of using an inhaled steroid medicine.”
5. “Using an inhaled steroid every single day may cause long-term side effects and problems.”

Adherence to ICS Therapy

Mean daily adherence was calculated as the sum of ICS puffs each day divided by the total number of puffs prescribed

during the study period $\times 100$. Daily use was truncated at the number of prescribed puffs per day to prevent masking of overuse on some days and underuse on others. Possible values range from 0 – 100%. A median split was used to classify adherence relative to the sample as “lower” or “higher.”

Statistical Analysis

Descriptive statistics were calculated for baseline demographics by minority status and adherence. *t*-tests and chi square analyses were used to compare groups. Variables were examined for normality and were transformed for non-normal distributions. Pearson coefficients and Spearman’s rho were used to assess associations between selected variables. Tests of mediation followed recommendations outlined by Baron and Kenny (12).

A series of regression equations to predict low adherence was used to determine whether any association between minority status (independent variable) and adherence (dependent variable) was mediated by ICS beliefs. First, mean daily adherence was regressed on minority status. Next, ICS beliefs were regressed on minority status. Finally, adherence was simultaneously regressed on both the minority status and ICS beliefs (the proposed mediator). Regressions were checked for collinearity. According to the Baron and Kenny model, (12) ICS beliefs are considered a mediator if (1) minority status predicts adherence, (2) minority status predicts ICS beliefs, and (3) ICS beliefs predict adherence after controlling for minority status. We used nonparametric bootstrapping procedures to test the significance of the indirect effect of minority status on adherence through beliefs (12, 13) In comparison to other formal tests of significance, this method makes no assumptions about the shape of the distributions of the variables or the sampling distributions of the statistic. Statistical analyses were conducted with the STATA (version 8.2) and SPSS (version 14). A *p* value of $\leq .05$ was considered statistically significant.

RESULTS

Sample Characteristics

Participants were predominantly female with an average age of 43 years (Table 1). Approximately two-thirds of the

TABLE 1.—Baseline characteristics of participants by minority status (n = 86).

Variable	Caucasians (n = 20)	Minorities* (n = 66)	<i>p</i> value
Age (mean \pm SD)	45.0 \pm 13.5	42.0 \pm 8.4	.34
Female gender (%)	65.0	71.2	.60
Currently smoking (%)	29.4	54.0	.07
Finished high school (%)	85.0	63.6	.07
Work status			.37
Part/full time (%)	40.0	34.9	
Unemployed (%)	30.0	45.4	
Other (%)	30.0	19.7	
Household income \leq \$10,000 (%)	25.0	51.5	.04
No health insurance (%)	35.0	12.1	.02
Asthma characteristics			
One or more asthma flares per week (%)	30.0	22.7	.84
Hospitalized for asthma in the last 3 months (%)	20.0	18.18	.85
Treated in ED for asthma in the last 3 months (%)	20.0	43.9	.05

* African American 92%, Hispanic 2%, Other 6%.

participants finished high school and nearly half were current smokers. Nearly half were unemployed and reported total household income of \$10,000 or less. One-fifth had no health insurance.

Participants also reported significant asthma morbidity. One-quarter of the participants reported one or more asthma flares per week. More than one-third of the participants reported being treated in an Emergency Department (ED) and 20% reported being hospitalized for asthma in the last 3 months.

Sixty-six (76.7%) of the participants were minorities. Of these minority participants, 61 were African-Americans, one was Hispanic and four described themselves as "other." No differences in age, gender, education, smoking or work status were observed between groups, although minority participants were more likely to have household income \leq \$10,000, have health insurance and have been treated in an ED for asthma in the last 3 months.

Adherence to Therapy

Average daily adherence over the 1-month monitoring period was 34% \pm 24%. Median adherence was 29%. Adherence was significantly lower among minority patients (29% vs. 51% for Caucasians, $p < .001$) and women (31% vs. 42% for men, $p = .05$). Adherence to ICS therapy was not associated with household income, education, employment status, health insurance status, or smoking status.

Asthma Medication Beliefs

Three medication beliefs were significantly associated with mean daily adherence to ICS therapy (Table 2). Beliefs that patients did not need as much medication as had been prescribed or that they may develop a tolerance to their medications were weakly to moderately and inversely related to adherence. Conversely, endorsement of the statement that daily ICS therapy was safe was moderately and positively associated with adherence. Adherence was lower among participants who agreed with one or more of the negative beliefs or who disagreed with the positive belief (24% vs. 40% for no problematic beliefs, $p = .002$). There was no cumulative effect for multiple negative beliefs. No relationship was evident between adherence and beliefs related to long-term side effects of ICS or dislike of the idea of using daily ICS therapy.

An index of negative medication beliefs was developed by summing the scores of the three beliefs significantly associated with adherence (total score of 0–12, where higher scores

represent more negative beliefs). Minority status was associated with negative medication beliefs. On average, minority participants had a higher mean composite index scores reflecting more negative ICS beliefs than Caucasians (3.6 \pm 2.7 vs. 2.0 \pm 2.5, respectively, $p = .02$).

The index of negative medication beliefs was moderately and inversely related to adherence ($r = -.46$, $p < .001$). Negative medication beliefs were also significantly associated with younger age ($r = -.28$, $p < .01$), lower family income ($r = -.25$; $p = .02$) and more frequent asthma flares ($r = .27$; $p = .01$). Even with adjustment for these factors, the odds of a high negative beliefs index score (≥ 3) in minority patients was nearly seven times higher (OR 6.7, 95% CI: 1.2, 38.1) as compared to Caucasian participants. No association was observed between negative asthma therapy beliefs and education level, recent ED visits for asthma, recent hospitalizations for asthma, lack of health insurance, gender or being a current smoker.

Finally, in logistic regression models, minority status ($p = .04$) and the index of negative beliefs ($p = .04$) were independent predictors of adherence after adjustment for family income, recent hospitalizations for asthma and lack of health insurance.

Tests of Mediation

To establish whether the conditions necessary for evidence of mediation (i.e., that negative medication beliefs mediated the minority status-adherence relationship), we determined that minority status predicted lower adherence ($B = -.25$, $p = .01$), that minority status was associated with negative medication beliefs ($B = 1.64$, $p = .02$), and finally that negative medication beliefs predicted lower adherence after controlling for minority status ($B = -.046$, $p = .002$). In addition, minority status was no longer significantly associated with lower adherence ($B = -.17$, $p = .08$) after controlling for negative medication beliefs. (All reported B coefficients are unstandardized.) This fulfills Baron and Kenny's criteria for mediation. The bootstrapped estimate of the indirect effect was $-.073$ (95% CI: $-.16$, $-.01$), suggesting that the negative medication beliefs were a statistically significant mediator of the minority status effect on adherence.

DISCUSSION

The main finding of this study was that among adults with asthma who had been prescribed a daily ICS controller, both minority status and negative medication beliefs were associated with lower adherence to therapy. In addition, minority status was associated with negative medication beliefs. Finally, medication beliefs appeared to be a partial mediator of the effect of minority status on adherence to ICS therapy.

We observed that adherence to prescribed ICS therapy was suboptimal in all, but especially problematic among minority participants. Minority patients in our sample used on average 29% of prescribed daily medication over 1 month, whereas Caucasians averaged 51%. Others have also observed that adherence to asthma therapy is lower among minorities (3,11,14). Suboptimal adherence may be an important contributor to poor asthma control among minorities compared to Caucasians (10, 11). It is unclear why adherence is lower among minority patients; however, African

TABLE 2.—Association between asthma medication beliefs and adherence* to ICS therapy over 1 month after enrollment (n = 86).

Medication belief	Rho	p value
I have not needed to take as much ICS as the doctor prescribed	-.42	<.001
My ICS is safe to use every day, even when I'm not having problems	.37	<.001
If I use my ICS every day, it won't work as well when I really need it	-.24	.027
I don't like the idea of using an ICS	-.07	.55
Using ICS every day may cause long-term side effects and problems	<-.01	.99

*Calculated as average daily adherence for 1 month after enrollment as measured by electronic monitoring.

Americans have been noted to have more fear of ICS, higher depression scores, and lower ICS knowledge scores (11). In addition, there are racial and ethnic disparities in regards to healthcare access (15).

Less is known about the relationship between asthma medication beliefs and adherence to therapy. Apter et al. reported that perceptions of past benefit and safety were positively associated with adherence to asthma therapy, while fears related to addiction or side effects were associated with nonadherence (11). Horne and Weinman have argued that medication adherence is related to personal perceptions of the *necessity* of medication, *concerns* about adverse effects and the manner by which patients reconcile perceived benefits (*necessity*) with perceived risks (*concerns*) (16).

They found that while asthma patients generally believed use of medications was necessary to control their disease, they also had significantly stronger concerns about taking their medication than other selected chronic illness patient groups. Medication beliefs (necessity—concern differential) were stronger predictors of reported adherence than clinical and sociodemographic factors, accounting for 19% of the variance in self-reported adherence (16). Similar findings have been observed in children with asthma where caregiver beliefs, especially medication concerns (17–19), were also associated with lower adherence.

In the current study, we evaluated a specific set of beliefs about asthma medications and their association with subsequent adherence. The belief that the patient did not require as much asthma medicine as had been prescribed by the physician was a predictor of lower adherence. In a survey of adults with asthma in a large managed care organization, more than half said they used less medication than had been prescribed because they felt better (20). In addition, negative beliefs about asthma therapy have been associated with a lack of concordance between caregivers of children with asthma and their physicians regarding report of controller medication prescription (21).

In our study, concerns about the safety of daily ICS therapy and the development of tolerance with regular use were predictive of lower adherence. Bender and Bender reviewed 32 qualitative studies examining patient beliefs related to use of asthma medications and reached similar conclusions (22). Among adults, frequently cited factors for nonadherence included fear of adverse medication effects, belief that the asthma medication does not help or is not necessary, and the sense of only an intermittent need for medications.

In our study, minority patients had a nearly 7-fold higher adjusted odds of endorsing negative beliefs about their asthma medications. In a qualitative study of urban African American adults with asthma, George et al. noted that beliefs regarding the patient's own ability to assess asthma control as being better than that of the health provider and concerns about ICS side effects were reported barriers to ICS use (23). We also demonstrated that negative beliefs mediated the relationship between minority status and suboptimal adherence. Though negative beliefs about asthma medications have been suspected of playing a role in suboptimal adherence in minorities, evidence had been lacking (11).

Both social-cognitive and self-regulatory theories posit that health behavior is influenced by patient beliefs, which

in turn influence their interpretation of information. Increased understanding of patient beliefs about their asthma and treatment is important as beliefs may affect the quality of patient-physician communications (21) and influence patient adherence to medications and other self-management behaviors. Beliefs are potentially modifiable. Providing appropriate asthma self-management education and improving communications may correct misperceptions and address negative beliefs, resulting in improved adherence and clinical outcomes (24).

Therefore, our findings have implications for the design and development of interventions that seek to improve asthma treatment adherence by modifying relevant health beliefs, especially among minorities. Further research is needed to increase understanding of how asthma patients develop beliefs about their medication and whether these beliefs change over the course of treatment.

Our study has several limitations. The sample was relatively small and composed largely of inner-city women using selected daily ICS therapies. Our study included a limited range of controller medications as there were no reliable electronic monitors for other MDIs or dry-powder inhalers. Thus the findings may not be generalizable to other asthma populations or medications. We also explored a limited set of asthma therapy beliefs. Additional studies are needed to replicate these findings and explore a broader range of medication-related beliefs in asthma patients.

In summary, we found that negative beliefs about asthma therapy were more prevalent among minority patients and partially mediated the relationship between minority status and adherence to therapy. Results from this study reinforce the need for clinicians to actively explore patients' beliefs about their medications on a regular basis and to address misperceptions or concerns directly as these may be important barriers to adherence. This is particularly true for poor, inner-city, minority patients who are more likely to have negative medication beliefs and lower rates of adherence and are at higher risk for asthma morbidity and mortality. Research is needed to determine whether interventions that specifically target negative medication beliefs can improve adherence to therapy and ultimately health outcomes in patients with asthma.

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