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Enhancing Asthma Self-Management in Rural School-Aged Children: A Randomized Controlled Trial

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Abstract

Purpose—To test the effects of 2 modes of delivering an asthma educational intervention on health outcomes and asthma self-management in school-aged children who live in rural areas.

Methods—Longitudinal design with data collected 4 times over 12 months. The target sample was composed of children in grades 2–5 who had a provider diagnosis of asthma. Elementary schools were stratified into high or low socioeconomic status based on student enrollment in the free or reduced-cost lunch program. Schools were then randomly assigned to 1 of 3 treatment arms: in-school asthma class, asthma day camp, or the attention-control group.

Findings—Sample retention was good (87.7%) and equally distributed by study arm. Improvements in emergency department visits and office visits were related to attending either the asthma class or asthma day camp. Asthma severity significantly decreased in both asthma treatment groups. Other factors such as hospitalizations, parent asthma management, and child asthma management improved for all groups.

Conclusions—Both asthma class and asthma day camp yielded significant reductions in asthma severity. There were reductions in the emergency department and office visits for the 2 asthma arms, and hospitalizations declined significantly for all groups. Asthma self-management also improved in all groups, while it was somewhat higher in the asthma arms. This may be due to the attention being drawn to asthma management by study participation and the action of completing questionnaires about asthma management, asthma symptoms, and health outcomes.

Keywords

asthma; child health; health promotion; rural children

Asthma affects 9.5% of children in the United States with the highest prevalence rate of 11% reported among school-aged (6–12 years) children.[,] It is a leading cause of functional limitations in school-aged children despite the fact that asthma is largely a controllable condition when guidelines for care are followed by practitioners and patients.[,] The majority of studies of childhood asthma focus on urban inner-city children while few studies focus on

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children who live in rural areas. Rural populations are faced with substantial barriers to asthma care, including having lower socioeconomic status (SES), more uninsured residents, and fewer health care providers. Health care services are often widely dispersed in rural areas, or not available at all, thereby resulting in greater distances and longer travel times to reach health care services. In the case of asthma exacerbations, timeliness in responding to symptoms is paramount to reverse the airway constriction and hypoxemia that results. Families are in essence the first responders and they need effective interventions to support their work to manage asthma.

Literature Review

Asthma in Rural America

Agriculture remains the primary source of employment in rural settings, and the use of pesticides and increased airborne fine particulate matter present health hazards to children.[–] Many jobs do not provide health care benefits and there is a lack of health care services available in rural areas that together contribute to delays in seeking health care.[–] Texas has a large rural and racial/ethnic minority population, and it leads the nation in uninsured residents with 28.8% of Texans being uninsured and 38% of Hispanic Texans being underinsured.[,]

Typically, epidemiological research studies report higher rates of asthma among children in urban settings (9.5%) when compared to rural settings (8.8%). However, recent research comparing rural and urban populations found that rural children experience levels of asthma equal to or greater than that experienced by their urban peers.[,] Ownby’s critical review of studies conducted in the US found evidence that asthma may in fact be under-diagnosed in rural areas of the country due in part to lower access to health care.

Childhood Asthma Self-Management Intervention Studies

Asthma self-management educational interventions have been shown to reduce acute care visits to emergency departments (ED) and physicians’ offices. A meta-analysis of asthma educational interventions showed that more educational sessions (greater dosage) and use of more interactive learning strategies resulted in greater improvements in asthma management and reductions in acute care visits. Few asthma self-management interventions have been tested with rural populations. Two randomized controlled asthma self-management intervention trials have been conducted in rural areas, both focusing on elementary school-aged children with asthma. One study was conducted in rural Maryland counties with 221 children ages 6 – 12 years, who had physician-diagnosed asthma, and their parents. The parents received 1 hour of small group instruction and the children received 4 hours of instruction during 2 after-school sessions on asthma self-management. The comparison group received a quarterly newsletter with information about asthma and asthma management. The children were followed for 10 months. Asthma knowledge was significantly increased in parents and the youngest children (grades 1–2) but not in the older children (grades 3–5). There were no significant changes in health care utilization (ED visits, hospitalizations, office visits) for asthma or quality of life after the intervention.

However, parents' ratings of asthma symptom frequency were significantly lower in the treatment group at the end of the study.

We conducted a study in rural school districts in Texas with 183 children in grades 2 – 5 who had a diagnosis of asthma on their school medical record. The children received 4 hours of asthma self-management education divided into 16 sessions delivered during their lunch breaks over 5 weeks. The control group received an attention-control intervention of general health promotion topics delivered in the same format as the treatment intervention. Both interventions were delivered by trained lay health educators who followed scripted instruction manuals. The children were followed for 12 months. The treatment group children's asthma self-management, self-efficacy, and inhaler skill significantly improved in comparison to the control group. Parents in the treatment group reported significant reductions in asthma symptom frequency.

These 2 studies showed that delivering educational interventions in school settings can improve asthma self-management. However, access to schools is becoming increasingly restricted due to security concerns and limitations placed on the use of instructional time for non-academic purposes. Therefore, it is important to develop and test alternative mechanisms for providing asthma self-management education that do not rely on the traditional school setting. The purpose of the current study was to test the delivery of an asthma self-management educational intervention in 2 different settings—the school setting and the community setting.

Methods

A 12-month randomized control trial conducted with school-aged children compared 2 modes of delivering an asthma self-management intervention (in-school asthma class or asthma day camp) to each other and to an attention-control intervention. The aim was to see if asthma education delivered in a single asthma day camp would be as effective in improving asthma-related health outcomes as education delivered in school-based asthma education classes.

Thirty-three elementary schools in 5 rural Texas school districts participated in the study. The school districts met the US Census Bureau classification of rural since they served residents who lived in small towns with fewer than 1,500 residents and sparsely populated unincorporated areas (census density < 295 people per square mile). The schools were stratified into low or high SES based on the percentage of students enrolled in the free or reduced-cost lunch program. The high SES schools (n=6) were randomized first, followed by the low SES schools (n=27) into 1 of the 3 study arms to ensure equal distribution of high and low SES schools across groups. The hypotheses (H) addressed in this study were:

- **H1** Children in the 2 asthma intervention groups will have greater improvements than the attention-control group in their health outcomes (office visits, ED visits, hospital stays for asthma), asthma severity and airway inflammation.

H2 Children in the 2 asthma intervention groups will have greater improvements in their asthma self-management and medication adherence to inhaled corticosteroid (ICS) medicines than the attention-control group.

H3 Parents in the 2 asthma intervention groups will have greater improvements in their asthma management than the attention-control group parents.

Sampling Procedures

Sample Pool—Children in grades 2 – 5 with a diagnosis of asthma and who attended rural schools were the sample pool. Inclusion criteria were: (a) have a diagnosis of asthma made by a medical provider listed on the school health record; (b) have current asthma symptoms in the past 12 months; (c) speak either English or Spanish; and (d) do not have significant co-morbidity that would preclude participation in classes (eg, severe cerebral palsy, oxygen dependent conditions). This last criterion was determined by asking the parent if the co-morbidity limited the child's participation in regular school activities. Based on our earlier studies, with power set at .80 to detect a moderate effect size at the .05 significance level, and estimating 16% attrition over 12 months, we required a sample enrollment of 283 children to yield a final sample of at least 238 participants with complete data to answer the research questions.,

Ethics Review, Sample Recruitment—Sample recruitment began after the study was approved by the University's Institutional Review Board. A 1-page letter printed in Spanish and English and signed by the school nurse invited families to participate in the study. The invitation letter and a stamped, return-addressed postcard were mailed to parents of children who had a diagnosis of asthma on their school's medical records in early fall of the school year. Follow-up telephone calls to non-responders were made by school nurse office staff.

Study Enrollment—The bilingual project coordinator contacted families (who had granted permission) to explain the study and schedule a home visit. At this first home visit (Time 1), research assistants (RA) who were blind to treatment group obtained the parent's consent and then obtained the child's assent.

Intervention

Bruhn's theoretical model of asthma self-management guided this study. This model indicates that background factors (eg, asthma severity, asthma knowledge, SES, health insurance) can complicate the family's work to manage asthma. The effectiveness of asthma self-management in turn contributes to the child's health outcomes (eg, health care utilization, quality of life). Interventions that are designed to increase knowledge and improve asthma self-management behaviors should lead to improvements in health-related outcomes.

Asthma Intervention—The Asthma Plan for Kids was developed specifically to address situations experienced by families in rural areas. It is a 7-step curriculum for children to use when responding to asthma symptoms. Learning exercises that use common school-child and rural-based scenarios are incorporated into the curriculum content. Skills practice with a placebo metered-dose inhaler and peak expiratory flow meter score interpretation are threaded throughout the curriculum. The Asthma Plan for Kids curriculum meets the national guidelines for patient education in asthma self-management. Topics included (a) identifying lung function, asthma warning signs, symptoms, and triggers; (b) learning skills to manage symptoms, including peak expiratory flow score interpretation, communication with adults, medication use and inhaler technique; (c) evaluating asthma symptoms and the effectiveness of management; and (d) discussing how to safely keep active during physical activity and sports.

The Asthma Plan for Kids curriculum was provided to both the in-school asthma class and asthma day camp groups. The in-school classes were provided in 15-minute segments over the lunch break in 16 sessions that were completed in 5 weeks. The single asthma day camp format was developed and tested in a feasibility study with 8 children. We found that children became restless when too much didactic content was presented at one time and that their interest was retained when games and hands-on activities were interspersed between brief (eg, 5 minutes) didactic presentations over the course of the day. Both formats had 4 hours of content and activities. The in-school asthma intervention relied heavily on handouts and vignettes that were designed to improve children's problem-solving skills and reinforce good asthma management decisions. While the asthma day camp intervention used many of the same handouts, it relied more heavily on group work and was augmented with game-like activities as children moved from one learning station to the next. The asthma day camps were held on Saturdays in the school district's alternative schools, in local church community halls, and in regional rural health clinics' education rooms or community meeting rooms.

Attention-Control Intervention—The attention-control intervention format mirrored the in-school asthma classes and was delivered in 15-minute segments over the lunch break, 3 days a week for 5.3 weeks. The content consisted of topics identified by school nurses as useful for this age group and focused on general health information and included: (a) infection control (eg, tissue use and disposal, hand washing, avoiding crowds during cold season); (b) a skills session on hand washing, using special lotion and black lights to detect unwashed areas on the hands; (c) nutrition with fun handouts and a bingo game; (d) a supervised session with children brushing their teeth; and (e) exercising safely (eg, stretching exercises, warm-up exercises). Children in the attention-control group were offered the asthma intervention after the final data collection.

Data Collection

Data were collected 4 times over the 12-month study during home visits, scheduled at times convenient to the families, by RAs who were blind to group assignment. After obtaining consent and assent, baseline data were collected (Time 1). Demographic data were only collected at Time 1, while all other data were collected at each of the 4 data collection times. Post-intervention follow-up data were collected at 5 (Time 2), 8 (Time 3, end of school year), and 12 months (Time 4).

Measures

The parents and children both completed questionnaire booklets written in English and Spanish. The RAs read the children's items out loud to ensure that the child understood the items and the response scales.

Background Factors—The parents provided information about asthma risk factors (ie, gender, age, grade, race, ethnicity), asthma history (eg, asthma triggers, onset of asthma), SES, and asthma severity. The family SES was calculated using the parents' education levels and occupations with the Hollingshead Four Factor Index calculation that yielded a continuous variable (possible range of 8 – 66). The 3-item Severity of Chronic Asthma scale asks how often the child had daytime asthma symptoms, nighttime asthma symptoms, and days with limited activity over the past month using a 4-point ordinal response scale that ranges from "0 – 2 times a week" to "daily." The Severity of Chronic Asthma scale corresponds to the national clinical guidelines and higher scores mean more severe asthma.

Family Asthma Management—Parents completed the 16-item Home Management survey by rating "how often" they performed each behavior, with 0 for "never" to 4 for "always." Children answered the 13-item Asthma Inventory for Children scale by rating how often they performed each behavior on a 5-point scale ranging from 0 for "never" to 4 for "always."

Health Outcomes—Health outcomes (ie, school absenteeism, office visits, ED visits, hospitalizations for asthma) and asthma control (ie, airway inflammation, medication adherence to ICS) were collected at each time point. At Time 1, parents reported the number of office visits, ED visits, and hospitalizations for asthma for the previous 12 months and since the last data collection visit at Times 2, 3, and 4.

Asthma Control—Medication adherence to ICS was operationalized as the number of inhaler actuations/prescribed dose over a 2-week time period. Exhaled nitric oxide, collected using the single-use RTube™ collection device (Respiratory Research, Inc., Austin, Texas), was the biomarker of airway inflammation in this study. The child was directed to breathe normally into the RTube™ mouthpiece for 6 minutes and this yielded sufficient volume of condensate. The RTube™ was capped and placed in a cold chest with an ice block for transport back to the research office were it was stored in a freezer. Frozen condensate was thawed, collected via sterile pipette, placed in Eppendorf tubes, and shipped in batches to the laboratory where chemiluminescence assays were performed to measure eNO.

Data Analysis

The data for each group were analyzed using latent growth curve modeling in SAS 9.3 (SAS Institute Inc., Cary, North Carolina). Growth curve analysis expands traditional regression techniques and takes into account both group-level effects (ie, asthma class, asthma day camp, attention-control) as well as the individual differences between participants and develops a model to represent change over the 4 time points., Parameter estimates were assessed by comparing a series of unconditional models and conditional models. For the intercept latent construct, loadings were set to 1.0 and the slope loadings ranged from 0 to 3.

The covariance between the intercept and slope was assessed. Both residual and random effects were also modeled and estimated. Typical latent growth curve parameter estimates, such as the intercept, slope and covariance between these 2 estimates, as well as residual and random effects, were modeled and assessed. Preliminary analysis indicated that some trajectories appeared to be nonlinear. For this reason, nonlinear models were estimated for those cases in which a quadratic trajectory was apparent and seemed like a more appropriate model.

Results

A total of 292 children were enrolled and 257 completed the 12-month study (87.7% retention). There were no significant baseline differences in age, gender, race/ethnicity, SES, language spoken by parents, or asthma severity between the children who completed the study and those who dropped out (see Table 1). There was a significant difference between the treatment groups in that there were more boys in the attention-control group than in either asthma group, and this variable was controlled for in the analyses. None of the other variables were significantly different between the groups at baseline (see Table 1). Table 2 presents the means and standard deviations for each time point by group.

Asthma-Related Health Outcomes

Office Visits—When group assignment was added as a covariate, the resultant conditional model found a significant effect for the asthma class, $F(1,504) = 3.94$, $P = .048$. Examination of the covariance parameter estimates and random parameter estimates lends further support. The random intercepts (6.33, $P < .001$) and the random slope (−1.48, $P < .0001$) for this model indicated that office visits varied significantly across participants at baseline. Overall, the findings indicate that across the 4 time points, the number of times a child was taken to a doctor's office or clinic for asthma symptoms declined from baseline to Time 4. When group status was considered, children who attended the asthma class ($B = -.29$, $t(504) = 1.98$, $P = .048$) reported fewer doctor's office visits across time than either the asthma day camp or attention control group participants.

Emergency Department Visits—When considering the effect of group assignment, there was a significant decrease in ED visits for children who attended the asthma day camp, $F(1,509) = 3.99$, $P = .046$. Random effects estimates indicated that the intercept varied across participants ($b = 1.12$, $P < .0001$, as did the slope $B = -25$, $P < .001$), with day camp participants seeing the most significant decline in emergency department visits.

Hospitalizations—The trend in hospitalizations did not vary significantly by group. However, an assessment of the estimates shows that the trend in hospitalizations were in the expected direction. In other words, hospitalizations decreased from baseline to Time 4, $F(1, 266) = 15.65$, $P < .0001$. Children who attended an asthma class, $F(1, 509) = 3.68$, $P < .10$, and in the asthma day camp, $F(1,509) = 2.30$, $P = .13$, were less likely to have hospitalizations compared to those in the attention control group. However, this effect was not statistically significant.

Asthma Severity—After controlling for group status, asthma severity decreased significantly over time, $F(1, 266) = 43.05$, $P < .0001$. A group effect was found for asthma class, $F(1,510) = 8.28$, $P = .004$. Overall asthma severity decreased, with those in the asthma class experiencing lower levels of asthma severity across the study period. An assessment of key parameter estimates supported the decrease in asthma severity across time. The random intercept (estimate = .90, $P < .0002$) was significant and the covariance between the intercept and slope (estimate = −.13, $P = .07$), though greater than $P > .05$, supports the decrease in asthma severity across time.

Asthma Control—Asthma control included airway inflammation and adherence to prescribed ICS medication. There were no significant linear changes over time or group effects found for either airway inflammation or ICS medication adherence. However, a seasonal effect was found wherein airway inflammation was elevated during the winter and spring data collection cycles. This coincides with the peak pollen seasons in central Texas.

Asthma Management: Parent & Child

Parent asthma management was assessed at baseline and after the intervention, so for this particular outcome, a pre-post analysis of covariance was conducted to determine the change in parent asthma management and any potential group or group by time interactions. Initial results indicated that parents in the asthma day camp group had significant improvement in their asthma management, $F(1,249) = 5.09$, $P = .025$. However, additional models to account for time by group interactions showed that there was no significant group by time interaction after controlling for group status. Although statistical significance was not retained, there was overall improvement in parent asthma management from Time 1 to Time 4, with the asthma day camp parents reporting the highest parent asthma management scores.

Child asthma management improved significantly over time, $F(1, 263) = 12.49$, $P < .0005$, but there was no group effect. However, the covariance parameters suggest that child asthma management at baseline varied significantly among participants (estimate = 56.80, $P < .0001$) and that the slope varied among participants as well (estimate = 5.13, $P < .001$). Overall, child asthma management improved over time though no group effects were found.

Additional Analyses

Whenever behavioral interventions for chronic illness self-management are designed and tested, questions about cost arise. While a full cost-effectiveness analysis was beyond the scope of this study, a post-hoc cost estimate compared the 3 interventions (see Table 3 for cost comparison). The costs of delivering the in-school asthma class and attention control class were similar. The asthma day camp costs were higher due to the need to have a registered nurse present at the day camp and the additional costs of food for the participants.

Discussion

In this sample of rural school-aged children, an overall reduction in office visits and hospitalizations for asthma were found. When examined by treatment group, significant effects were found for the asthma class and a positive trend for the asthma day camp. That is, the number of occasions on which children went to the doctor or were hospitalized for asthma-related symptoms declined over time and the greatest effect was among those attending the asthma class. Similarly, there was an overall reduction in the number of visits to the ED over time. Although the reduction was significant for children who attended the asthma day camp, a non-significant trend was found for those in the asthma class. The more important point may be that the number of visits to the ED and hospital stays decreased by nearly half. Furthermore, controlling for group status, asthma severity decreased significantly for those in the asthma class and those in the asthma day camp over time.

The findings supported the first hypothesis that children in the 2 intervention groups would have greater improvements than the attention-control group in selected health outcomes such as visits to the doctor for asthma symptoms, ED visits, and severity of asthma. This finding is similar to the meta-analysis findings of Coffman and associates, in that asthma self-management education can lead to behavior changes that can decrease costly urgent health care utilization.

There were no significant linear changes over time or by groups for airway inflammation or ICS medication adherence. Thus these findings did not support the second hypothesis, that children in the 2 asthma intervention groups would have greater improvements than the attention control group in self-management and medication adherence to inhaled corticosteroid medicines. Other factors may be contributing to these outcomes such as the influence of the timing of data collection on airway inflammation (eg, seasonal effects) or missing medication doses due to unfilled prescriptions.

Parent asthma management did not reflect a linear pattern; rather, similar to Butz and colleagues' study, parent asthma management improved over time for all groups. Thus, the third hypothesis that parents in the 2 intervention groups would have greater improvements in their asthma management than parents in the control group was not supported. Similarly, child asthma self-management behaviors improved significantly over time for all the children in the study. Other studies have also reported improvements in behavioral outcomes and suggest that the act of responding to survey questions about asthma may raise the participants' awareness of asthma triggers, and perhaps sensitize them to pay closer attention to asthma management.

Limitations

The sample was drawn from one region of the country and this limits generalizability. A further limitation is the use of parent self-report of health care utilization data that may be subject to recall error. It was not possible to confirm the health care utilization data as there were no hospitals or urgent care clinics located in the rural areas for this study.

Noting the improvements in asthma self-management and hospitalizations across all groups, one must also consider the effect of the attention-control intervention on the children's self-management skills. Because the attention-control intervention provided instruction on increasing health promotion behaviors (eg, exercise warm-up, hygiene, hand washing), it is possible that the learning strategies enabled children to pay better attention to "other" areas of self-management, including asthma self-management. Despite these limitations and the lack of support for 2 of the hypotheses, findings from this study provide valuable information about the use of educational interventions, regardless of delivery format, on reducing the toll that asthma takes on the health of rural school-aged children.

Conclusions

The asthma intervention delivered in either in-school asthma classes or day asthma camps led to significant reductions in the frequency of asthma symptoms and thereby significant reduction in asthma severity. The overall improvement in parent and child asthma self-management, reduction in hospitalizations, and reduction in asthma severity do support the need to provide asthma education to families who live in rural areas. Such education may help them make better management decisions to control asthma symptoms and prevent adverse sequelae.

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Table 1

Comparing Demographics for Sample Total vs. Completers, and by Group

	Comparing Sample			Comparing Intervention Groups			
	Total	Completers	***P***	Asthma Class	Asthma Day Camp	Attention Control	***P***
Variable							
N	292	257		84	89	84	
Age (M, SD)	8.82 (1.3)	8.79 (1.3)	ns	8.83 (1.3)	8.82 (1.2)	8.73 (1.2)	ns
SES (M, SD)	30.7 (13.9)	30.7 (14)	ns	31.2 (15.7)	31.4 (13.2)	29.5 (13.3)	ns
Asthma							
Severity (M,SD)	4.15 (1.4)	4.14 (1.4)	ns	4.02 (1.3)	4.12 (1.2)	4.27 (1.5)	ns
Male (%)	63.7%	62.3%	ns	55.2%	61.5%	74%	.02
Female (%)	36.3%	37.7%	ns	44.6%	38.5%	26%	
							$X^2 = 7.79$
White (%)	18.8%	19.5%	ns	22.9%	23.9%	11.3%	ns
Hispanic (%)	57.5%	57.2%	ns	55.2%	60.9%	60.8%	ns
African-American (%)	21.2%	21.4%	ns	21.9%	15.2%	27.8%	ns
Spanish-Speaker (%)	25%	26.8%	ns	30.2%	18.8%	26%	ns

Table 2

Mean and Standard Deviation for Outcome Variables by Group and Time (T)

Outcome variable (n=sample by group at baseline)	**Control (n = 100)**	**Asthma class (n = 96)**	**Day camp (n = 96)**
Office visit (T1)	3.40 (2.41)	3.13 (3.53)	3.16 (2.80)
Office visit (T2)	1.40 (1.58)	1.05 (1.39)	1.12 (1.47)
Office visit (T3)	1.20 (1.96)	0.63 (1.07)	0.90 (1.68)
Office visit (T4)	0.69 (1.30)	0.49 (1.02)	0.44 (0.67)
Hospitalization (T1)	0.26 (0.84)	0.32 (1.53)	0.15 (0.67)
Hospitalization (T2)	0.20 (1.13)	0.01 (0.11)	0.05 (0.43)
Hospitalization (T3)	0.02 (0.22)	0.01 (0.11)	0.03 (0.24)
Hospitalization (T4)	0.02 (0.22)	0.01 (0.11)	0.00 (0.00)
ED visit (T1)	0.76 (1.42)	0.42 (0.97)	0.49 (1.13)
ED visit (T2)	0.16 (0.50)	0.08 (0.38)	0.37 (1.25)
ED visit (T3)	0.09 (0.37)	0.10 (0.68)	0.18 (0.61)
ED visit (T4)	0.04 (0.19)	0.04 (0.19)	0.04 (0.30)
Asthma severity (T1)	4.25 (1.54)	4.07 (1.32)	4.13 (1.15)
Asthma severity (T2)	4.00 (1.57)	3.81 (1.29)	4.00 (1.32)
Asthma severity (T3)	4.06 (1.51)	3.59 (0.80)	3.91 (1.16)
Asthma severity (T4)	3.79 (1.34)	3.38 (0.69)	3.36 (0.63)
Asthma Control: Airway inflammation (T1)	2.03 (3.63)	1.69 (2.11)	2.19 (2.50)
Asthma Control: Airway inflammation (T2)	2.11 (2.56)	1.91 (2.25)	2.51 (3.20)
Asthma Control: Airway inflammation (T3)	2.61 (3.77)	1.83 (3.04)	2.50 (3.32)
Asthma Control: Airway inflammation (T4)	1.97 (3.06)	1.93 (3.86)	2.05 (4.53)
Asthma Control: Medication adherence (T1)	1.58 (1.24)	1.22 (1.51)	1.49 (1.26)
Asthma Control: Medication adherence (T2)	1.75 (1.59)	0.95 (0.95)	1.26 (1.45)
Asthma Control: Medication adherence (T3)	1.25 (0.99)	1.15 (1.15)	1.44 (1.05)
Asthma Control: Medication adherence (T4)	1.98 (1.22)	1.01 (1.10)	1.23 (1.15)
Asthma management: Parents (T1)	55.45 (9.14)	53.64 (11.02)	53.16 (10.20)
Asthma management: Parents (T2)	64.57 (18.06)	61.08 (21.38)	61.51 (11.64)
Asthma management: Parents (T3)	64.16 (11.50)	60.66 (12.55)	64.42 (10.79)
Asthma management: Parents (T4)	62.78 (12.75)	60.98 (13.09)	64.83 (13.57)
Asthma management: Child (T1)	50.51 (9.34)	48.89 (9.57)	48.00 (9.00)
Asthma management: Child (T2)	51.66 (9.30)	50.31 (10.50)	50.82 (9.31)
Asthma management: Child (T3)	52.54 (10.02)	51.24 (10.59)	52.10 (9.18)
Asthma management: Child (T4)	51.15 (10.29)	51.59 (10.28)	51.67 (9.15)

Table 3

Comparison of Cost Estimates for Each Participant by Group

Item	Asthma Class	Asthma Day Camp	Attention Control
Workbooks	$10	$10	$10
Class supplies	$6	$6	$10
Peak flow meter	$5	$5	-
Asthma action plan	$2	$2	-
Camp food	-	$8.25	-
Class teachers	$107.50	-	$107.50
Camp staff	-	$111.50	-
Total	$130.50	$142.75	$128.50