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Archives of Pediatrics

Morphew T and Galant SP. Arch Pediatr 3: JPED-151.

Research Article

DOI: 10.29011/2575-825X.100051

Reducing Morbidity in Inner-City Obese and Morbidly Obese Asthmatic Children

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Citation: Morphew T, Galant SP (2018) Reducing Morbidity in Inner-City Obese and Morbidly Obese Asthmatic Children. Arch Pediatr 3: 151. DOI: 10.29011/2575-825X.100051

Received Date: 08 June, 2018; **Accepted Date:** 07 July, 2018; **Published Date:** 16 July, 2018

Abstract

Background: Obesity is thought to be associated with poor asthma control, increased health resource utilization, and reduced responsiveness to inhaled corticosteroids. Based on previous experience our hypothesis was that by improved access to comprehensive guideline care that outcomes in normal weight would be comparable in obese asthmatic children.

Study Design: This was a retrospective cohort study of predominately Hispanic children (3-18 years of age), in underserved areas of Orange County, CA, who enrolled in the Breath Mobile Program from 2003 -2012, and returned for follow-up care. Outcomes were examined using Cox regression and generalized estimating equations analyses, adjusted for potential confounding factors.

Results: Clinical outcomes in over 1200 children followed for a mean of 6 visits (SD=2.2) across 403 days (SD=112) were improved, on average, regardless of BMI. Reductions in average number of asthma-related ED visits (>70%), hospitalizations (>50%), school days missed from ten to one day were achieved in normal weight, overweight, obese, and morbidly obese children with moderate-severe asthma (pre vs. post year, p<.001). In these more severe patients, 45-57% probability of exercise limitations at baseline was reduced to less than 10% by last visit and achieved across all BMI groups with similar mean step of therapy (p<.001).

Conclusion: Access to effective community-based care where trust, education, and continuity of care consistent with NAEPP guidelines is possible, as demonstrated by the Breath Mobile Program, can provide an opportunity for asthmatic children in all BMI categories to achieve well controlled disease.

Keywords: Asthma; Morbidity; Obesity; Pediatrics

Introduction

Obesity and asthma are currently the most common chronic conditions in children living in economically developed regions [1-3]. Nearly 8.6% of children in the United States have asthma [4]. Obesity prevalence is at 17.2% and highest among Hispanic-American youth where approximately 1 in 5 children are obese (21.9%) [5]. Obesity estimates are even higher in children with asthma at 28.0% [6]. An indirect benefit of proper disease managed care in the asthmatic child is the potential to increase their ability to actively participate in physical activities, supporting an aspect of healthy life choices related to decreased risk of obesity [7]. Common comorbidities may complicate and perpetuate the interaction between asthma and obesity such as gastrointestinal reflex and sleep disturbance [7]. Common genetic determinates have also been suggested including the beta -2 adrenergic receptor, gene encoding for TNFA, the glucocorticoid receptor beta and the leptin gene [8,9], although this was not confirmed in a recent systematic genome-wide associated study [10].

Obesity reportedly is associated with a 1.5-fold increased risk of developing asthma and twice the odds of an asthma exacerbation [11]. Several studies found obese asthmatic children disproportionately experience greater severity, morbidity, increased exacerbations [12], decreased quality of life [13] and reduced responsiveness to inhaled corticosteroids [14]. However, these outcomes may be influenced by gender, age, atopy, and race [15]. Distinguishing asthma and obesity related outcomes

is also an important consideration [16]. Further, the provision of guideline based care [17] in the asthmatic child may help mitigate obesity differentials in asthma outcomes [12-14], such as exercise limitations commonly attributed to obesity. The Body Mass Index (BMI) is currently recommended by the World Health Organization as a measure of obesity, but may not effectively distinguish lean from fat mass which could be relevant in the growing child [18].

The relationship between obesity and lung function in the asthmatic child is not definitive. Obesity has been shown to correspond to reduced improvement in FEV1/FVC% after initiation of controller therapy [14] and to lower average baseline values [19]. Yet, another study reported no significant differences in lung function between obese and normal weight asthmatic children [20].

We have provided comprehensive care for inner city, primarily Mexican-American children since 2003 utilizing a community based mobile asthma clinic, the Breath Mobile ™ (BM), a model of care originating in Los Angeles in 1995 [21]. It had been observed that asthma related morbidity disproportionally affected African American and Hispanic children [22] often associated with living in poverty with poor access to quality medical care [23]. The BM model of healthcare delivery has attempted to identify and reduce the barriers to care in this population by providing access to care, cultural compatibility, eliminating economic concerns, and providing care by the same provider and staff at each visit which engenders trust and improved outcomes [21,24]. In a recent BM multi-site study which included over 8000 patients, nearly a third of asthmatic children in this large cohort had co-morbid condition of obesity [25], nearly double the national average for all children and 1.5 times higher than the national average for Hispanic children [5].

Our hypothesis is that by improved access to comprehensive guideline [17] based care that outcomes reflecting the goals of therapy in normal weight patients are achievable in obese asthmatic children, a population thought to be more difficult to control [12] and less responsive to inhaled corticosteroids [14]. The purpose of this study therefore, was to examine efficacy of our program in obese (obese and morbidly obese) compared to normal weight children. Our focus was on high risk patients presenting with moderate to severe persistent asthma at baseline.

Material and Methods

Study Population and Design

This is a retrospective analyses of clinical and demographic data from 1204 children, ages 3 to 18 years, with physician diagnosis of asthma confirmed upon enrollment in Children's Hospital of Orange County (CHOC) Children's Breathmobile™ Program [21]. located in Orange County, California. Patients in the program predominately represent underserved children as majority of students at participating schools were eligible for free or reduced price meals. Study participants were children enrolled in the CHOC Children's Breathmobile™ program during the ten-year period 2003-2012 who engaged in care for at least six months. The study observation period encompassed all visits from baseline through possible 1½ year follow-up.

Data were collected at each visit and entered into a standardized electronic medical record system, AsmaTrax (created by Loran Clement, MD, Los Angeles, CA). The baseline study data include age, gender, height, weight, ethnicity, allergen specific skin tests, spirometry, severity, prior year asthma-related school absenteeism, and lifetime asthma-related ED visits and hospitalizations converted to annual average based on duration of disease. Visit level data include medication prescribed, adherence (report of controller medication use as directed >=5 d/wk), impairment/risk factors defining the patient's asthma control, and morbidity events in the visit interval (ED visits, hospitalizations, and school days missed) which were annualized based on cumulative sum relative to exposure time through last visit during study period. The provider utilized National Asthma Education and Prevention Program (NAEPP) criteria to define baseline disease severity and asthma control at follow-up visits [17]. Moderate-severe disease at baseline was classified when any of the following criteria were met: daily symptoms, night awakenings >1/week, daily SABA use for symptom control (not prevention of Exercise Induced Bronchospasm (EIB)), limitations with normal activities (some or extreme), repeated exacerbations requiring Oral Cortico Steroids (OCS), and lung function impairment (FEV_1 <80% predicted or FEV_1/FVC <80%, depending on age and ability to perform test). Well controlled asthma at follow-up was defined by day symptoms (<2 d/wk), night symptoms (<1x/month), no interference with normal activities, SABA use for symptom control not prevention of EIB (<2 d/wk), OCS use <1/yr, and age and performance dependent additional criteria of FEV_1 >80% predicted and FEV_1/FVC >80%. Age- and gender- specific BMI percentiles abstracted from 2000 CDC growth charts were used to qualify a patient as Normal Weight (NW, <85th percentile), Over Weight (OW, 85th-94th percentile), Obese (OB, 95th-98th percentile), or Morbidly Obese (MOB, 99-100th percentile). This study of retrospective data was approved by the Children's Hospital of Orange County Institutional Review Board.

Analysis

Patient characteristics in our study population were described in terms of valid percent with defined trait for categorical factors and mean (SD) for continuous factors. Distributional differences between BMI percentile groups were assessed for significance using the Chi-square test statistic and ANOVA, respectively. Analyses were then performed to examine BMI group differentials in relation to the following outcomes: 1) Time to achieve well

controlled asthma in patients who entered the program with persistent disease, 2) improvement in lung function from baseline to last visit, 3) morbidity reductions post vs. pre year, and 4) reduced probability of exercise limitations from baseline to last visit. Results presented were based on multivariate analyses with adjustment for the following factors: Age, gender, atopic (positive to one or more of nine allergens tested: cat, dog, feather, cockroach, mites, molds, weeds, trees, and grass), baseline severity (intermittent, mild, moderate-severe), and specific to each analyses: Time to control analyses included term for visit interval length (<90 d or >=90 days) and adherence with controller therapy in the visit interval (use as prescribed >=5 d/wk); lung function analyses forced into each model interaction effects for time period by severity and time period by BMI group; morbidity and exercise limitation analyses included term for days in program thru last visit. In the adjusted models, two-way interaction effects (dependencies) between each adjustment factor and BMI group were assessed and retained in final model when significant at the .05 level. Assessment of time to achieve well controlled asthma utilized Cox regression analyses with specification of the TIES=EXACT approach. Generalized estimating equations analyses assessed improvement in average lung function parameters (normal distribution with identity link specified), reductions in expected number of ED visits and school days missed (Poisson distribution with log link specified, negative binomial distribution used for hospitalizations) and reductions in probability of exercise limitation (binomial distribution with logit link specified). Cox regression analyses were performed using SAS V9.2 while all remaining analyses were performed using SPSS V18.0.

Results

Patient Demographics

1204 predominately Hispanic children (90.3%) with a mean age of 7.7 years (SD=3.5) met study criteria (Table 1). More than half of children enrolling in the program during the 10 year's period had BMI in excess of normal range: 22.1% OW, 22.4% OB, and 8.3% MOB. A significantly greater percentage of OB and MOB patients had moderate to severe disease compared to NW and OW patients (39.5% vs. 33.2%), p=.036. Nearly 80% of patients entering the program had persistent disease, yet the majority were not on controller therapy prior to their initial visit (68.3%). Average step of therapy prescribed at baseline was 2.7 (SD=1.2). Prescribing patterns were severity dependent (p<.001), but consistent across BMI risk groups at baseline and follow-up (p>.05) Adherence with controller therapy prescribed for patients with persistent disease was relatively high at 81%. In characterizing change in BMI we found minimal transition in classification with 73.5% remaining unchanged and 15.5% increasing BMI risk classification by their last visit. Patients had an average of 6 visits (SD=2.2), and the median visit interval length was 77 days (IQR=56-108 d).

Valid % or mean (SD)	**Overall**	**Normal BMI**	**Overweight**	**Obese**	**Morbidly Obese**
Demographics	N=1204	N=568, 47.2%	N=266, 22.1%	N=270, 22.4%	N=100, 8.3%
Age, mean (SD) †	7.7 (3.5)	7.5 (3.5)	7.4 (3.4)	8.4 (3.4)	7.1 (3.4)
Male, %	62.2%	63.4%	57.1%	64.4%	63.0%
Hispanic, % †	90.3%	88.0%	90.5%	92.8%	95.9%
Asthma-related Morbidity (prior year)					
ED visits (any), %	34.6%	37.1%	30.8%	33.0%	35.0%
ED visits (>=2), %	13.6%	14.1%	12.4%	12.6%	17.0%
Hospitalizations (any), % †	12.0%	14.4%	9.0%	8.5%	15.0%
School missed (>=5 d), %	32.9%	32.0%	28.2%	38.1%	36.0%
Baseline Disease Severity					
Intermittent	20.1%	18.3%	22.2%	20.4%	24.0%
Mild Persistent	44.8%	47.9%	45.9%	41.1%	34.0%
Moderate	25.2	23.1%	24.1%	29.6%	29.0%
Severe	9.9	10.7%	7.9%	8.9%	13.0%
Atopic	73.3%	75.9%	68.5%	74.6%	67.3%

Controller Naïve at Baseline	72.4%	70.2%	77.0%	73.8%	68.7%
Step of therapy[a] adjusted for baseline severity, mean (SD)					
Baseline	2.7 (1.2)	2.7 (1.0)	2.5 (1.0)	2.7 (1.0)	2.8 (1.0)
Interval prior to last visit	2.6 (1.5)	2.6 (1.2)	2.5 (1.2)	2.7 (1.2)	2.8 (1.2)
Across all visits	2.7 (1.1)	2.7 (1.1)	2.6 (0.9)	2.7 (0.9)	2.7 (0.9)
Lung Function (subset): [b]	(N=720)	(N=322)	(N=157)	(N=187))	(N=54)
FVC % predicted	98.2 (17.7)	97.6 (18.0)	99.2 (18.6)	99.0 (17.1)	96.8 (15.2)
FEV1% predicted	95.7 (17.4)	94.8 (17.4)	97.4 (18.2)	95.8 (17.7)	94.9 (13.4)
FEV1/FVC%	86.6 (9.3)	86.6 (9.6)	87.6 (8.8)	85.5 (9.4)	87.0 (9.1)
FEF25-75% predicted	89.2 (29.4)	87.6 (28.9)	90.9 (29.4)	89.9 (28.9)	91.8 (33.9)
Longitudinal Follow-up:					
Average days, mean (SD)	403 (112)	412 (114)	412 (112)	400 (111)	411 (111)
Average visits, mean (SD)	6 (2.2)	6 (2.3)	6 (2.2)	6 (2.2)	6 (2.3)
Change in BMI by Last Visit [c]					
Improved	12.0%	-----	26.3%	18.1%	25.0%
Unchanged	73.5%	83.5%	49.6%	75.6%	75.0%
Worsened	14.5%	16.5%	24.1%	6.3%	-----

[a]STEP1 (SABA only), STEP2 (monotherapy w/low-dose ICS), STEP 3 (monotherapy w/medium dose ICS or combination therapy w/low dose ICS), STEP 4 (combination therapy w/medium dose-ICS), STEP 5 (combination therapy w/high-dose ICS).

[b]Lung function measured in subset of patients able to perform test (assessed in majority of patients >=7 years old).

[c]Change in BMI category (e.g. *improved* from overweight to normal, *unchanged* from overweight, or *worsened* from overweight to obese or morbidly obese) ~ not tested for between group differences due to dependency of definition on initial category.

[†] p<.05 based on chi-square test statistic for categorical factors and ANOVA for continuous factors.

Table 1: Demographic and clinical profile of patients who entered BM program and engaged in care for at least six months, described by BMI percentile classification at baseline.

Time to Achieve Well Controlled Asthma

Approximately 80% of patients with moderate-severe disease achieved well controlled asthma by their 3rd routine follow-up visit (visit interval <=90 days) (Figure 1). These findings were consistent in NW, OW, OB, and MOB patients. Although extended visit interval length occurred infrequently (~20% of follow-up visits), this reduced the cumulative probability of achieving control by visit 3 to under 50% in MOB patients (p=.010), while differential effects were less significant in NW, OW, and OB patients (p>.05).

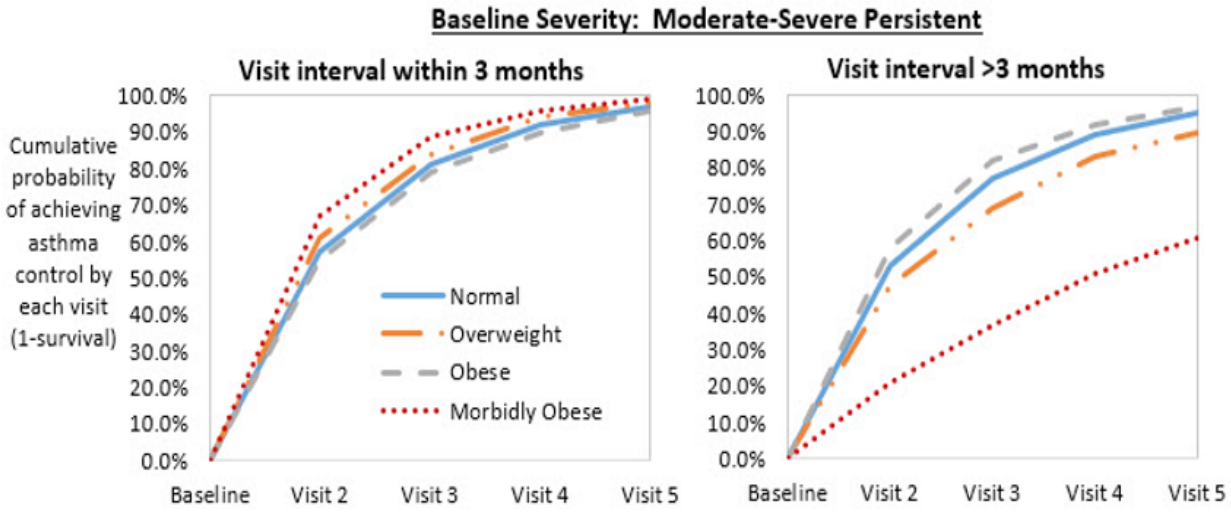

Figure 1: Time to achieve asthma control. Extended visit interval length (>3 months) significantly decreased the cumulative probability of achieving asthma control by each subsequent visit in morbidly obese patients (p=.010). Cumulative probability estimates adjust for the following covariates: BMI risk group (normal, overweight, obese, morbidly obese), baseline severity (mild, moderate-severe), adherent with therapy prescribed at prior visit (Y vs. N), atopic (Y vs. N), visit interval (<=90 d vs. >90 d), gender, age (continuous), and significant interaction effect between visit interval and BMI risk group. Number of subjects remaining at risk.

Lung Function

On average, lung function improved significantly from baseline to last visit in patients with moderate-severe disease across BMI risk groups (p<.05), with exception of a slight decrease in FEV1/FVC% in MOB patients (Table 2). This observed decrease significantly differed from the marginal improvement in average FEV1/FVC% observed in lower BMI risk groups (p=.047). Lung function estimates in patients with intermittent and mild persistent disease were expectedly higher, on average, but followed similar trends with BMI risk group to that observed in patients with moderate-severe persistent disease severity (data not shown).

Mean (95% CI) [a]	Overall	Normal BMI	Overweight	Obese	Morbidly Obese
FEV1% predicted					
Baseline	91.1 (88.7-93.5)	90.2 (87.5-92.9)	91.9 (88.4-95.4)	91.4 (88.3-94.5)	92.1 (88.6-95.6)
Last Visit	99.1 (97.5-100.7)	98.0 (96.0-100.0)	100.1 (97.4-102.8)	100.0 (97.8-102.2)	100.1 (96.4-103.8)
[p<.001, p=.338, p=.974] [¤]	+8.0	+7.8	+8.2	+8.6	+8.0
FVC% predicted [b]					
Baseline	95.7 (93.2-98.2)	95.6 (92.7-98.5)	95.8 (92.1-99.5)	95.9 (92.8-99.0)	95.2 (90.9-99.5)
Last Visit	101.4 (99.8-103.0)	100.0 (98.0-102.0)	102.4 (99.9-104.9)	102.2 (100.0-104.4)	104.5 (100.8-108.2)
[p<.001, p=.063, p=.232] [¤]	+5.7	+4.4	+6.6	+6.3	+9.3

FEV1/FVC%					
Baseline	84.3 (82.9-85.7)	84.1 (82.3-85.9)	84.6 (82.6-86.6)	83.8 (82.0-85.6)	86.0 (83.6-88.4)
Last Visit	86.6 (85.8-87.4)	86.9 (85.9-87.9)	86.7 (85.3-88.1)	86.4 (85.2-87.6)	84.6 (82.4-86.8)
[p=.443, p=.887, p=.047] [¤]	+2.3	+2.8	+2.1	+2.6	-1.4
FEF 25-75% predicted					
Baseline	79.7 (76.4-83.0)	77.8 (73.7-81.9)	80.6 (75.3-85.9)	80.5 (75.4-85.6)	86.1 (77.9-94.3)
Last Visit	93.6 (90.7-96.5)	92.0 (88.5-95.5)	95.1 (90.2-100.0)	95.3 (91.2-99.4)	92.9 (88.6-100.2)
[p=.004, p=.287, p=.291] [¤]	+13.9	+14.2	+14.5	+14.8	+6.8

[a]Means (95% CI) were estimated using generalized estimating equations with normal distribution specified and evaluated at average covariate values (or distribution of categorical factors) in patient population included in each respective model. Adjustment was made for age at entry, gender, atopy, days in BM program thru last visit, baseline severity (intermittent, mild persistent, moderate-severe persistent), baseline BMI risk group (normal, overweight, obese, morbidly obese), visit (baseline or last visit), and forced interaction effects between baseline severity*visit and BMI risk group*visit.

[b]Average FVC% further adjusted for significant interaction effect between age and BMI risk group (significant difference detected after age 9).

[¤] [P-values associated with the following effects: Visit, BMI Risk Group, BMI Risk Group*Visit]

Table 2: Estimated one-year change in lung function across BMI risk groups, described in patients with moderate-severe baseline disease severity after adjustment for potential confounders and effect modifiers [a].

Asthma-Related Morbidity Reductions

Reductions in asthma-related morbidities (Figure 2) and exercise limitations (Figure 3) in patients with moderate-severe baseline severity were achieved in NW, OW, OB, and MOB patients (p<.001). Expected number of ED visits per year was reduced by over 70%. Expected number of hospitalizations per year was reduced by more than 50% with some variation exhibited by BMI risk group (NW 82.1%, OW 58.3%, OB 53.8%, and MOB 72.0%). Average number of asthma-related school days missed was reduced from ten days to one day per year in all BMI risk groups. Probability of exercise limitations hovered around 50% in our moderate-severe patients prior to enrollment in the BM Program. The linear relationship of increased asthma severity and BMI risk with increased probability of exercise limitations observed at baseline (p<.001 and p=.002, respectively, data not shown) diminished with ongoing guideline [17] based care to less than 10% by last visit in all severity and BMI risk groups (p<.001). As expected, patients with intermittent and mild persistent disease had lower average morbidity and probability of exercise limitations than moderate-severe patients at baseline, but ongoing disease managed care also resulted in significant reductions in these less severe patients across all BMI groups (data not shown). OCS fills is an important indicator of asthma risk and post year monitoring showed similarity across BMI risk groups where patients required less than 1.0 per year, on average. Pre year OCS fill data was not available for comparison.

➢ Baseline Severity: Moderate-Severe Persistent

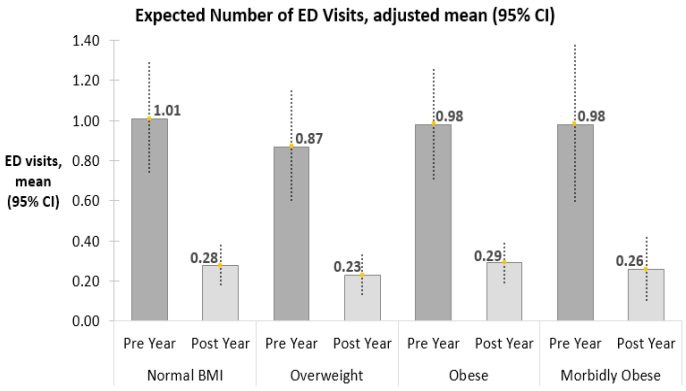

Figure 2: Morbidity reductions (average number of asthma-related ED visits and hospitalizations) significant across baseline BMI categories (p<.001). Means (95% CIs) were estimated using generalized estimating equations with Poisson distribution specified for ED visits and negative binomial specified for hospitalizations at average covariate values (or distribution of categorical factors) in patient population. Adjustment was made for age at entry, gender, atopy, days in BM program thru last visit, baseline severity (intermittent, mild persistent, moderate-severe persistent), baseline BMI risk group (normal, overweight, obese, morbidly

obese), time period (pre or post year), and interaction effects between baseline severity*time period and BMI risk group*time period. Expected number of hospitalizations further adjusted for significant interaction effect between gender and BMI risk group.

➢ Baseline Severity: Moderate-Severe Persistent

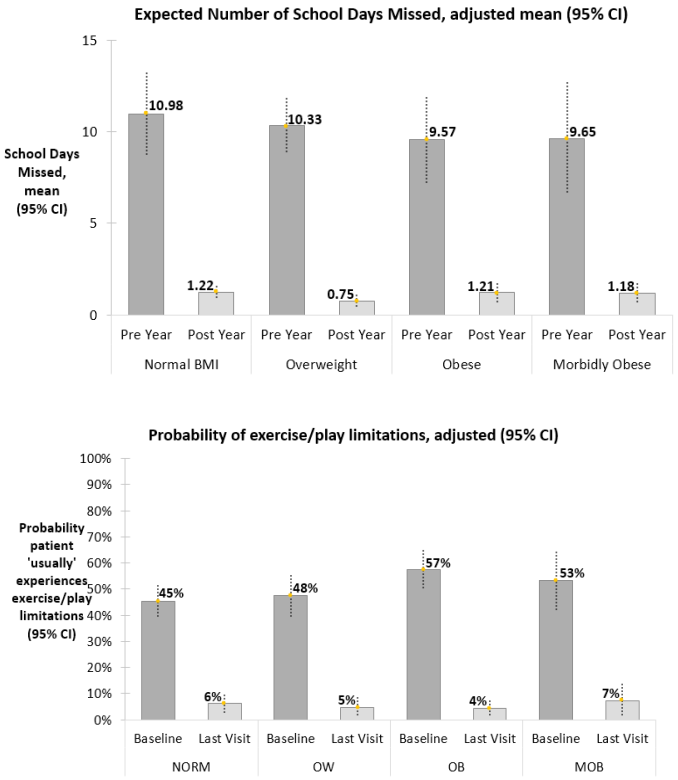

Figure 3: Reduction in average number of school days missed post vs. pre-year and reduction in probability of exercise limitations at last visit compared to initial visit were significant across BMI categories (p<.001). Mean number of asthma-related school days missed (95% CIs) for each BMI risk group were estimated using generalized estimating equations with Poisson distribution specified at average covariate values (or distribution of categorical factors) in patient population. Adjustment was made for age at entry, gender, atopy, days in BM program thru last visit, baseline severity (intermittent, mild persistent, moderate-severe persistent), baseline BMI risk group (normal, overweight, obese, morbidly obese), time period (pre or post year), and interaction effects between baseline severity*time period and BMI risk group*time period. Expected number of school days missed further adjusted for significant interaction effect between age and BMI risk group. Estimated probability of activity limitations were produced using adjusted generalized estimating equations analyses with binomial distribution specified at covariate values representing distribution of categorical factors and average age of 7.7 years in patient population.

Discussion

The BM model of care, which is a community based healthcare delivery system primarily for underserved children with asthma, has been shown to successfully improve asthma control and decrease morbidity despite the fact that many children present with co-morbid condition of obesity [21,24-27]. In the current analyses of 1204 patients we found 22.4% of asthmatic children were obese and 8.3% morbidly obese. Nonetheless, OB and MOB patients were able to achieve significant reductions in ED visits, hospitalizations, school absenteeism, exercise limitations, and exacerbations to levels that were comparable to normal weight patients. The importance of close follow-up, particularly for the more OB patient, was evidenced by achieving 80% cumulative probability of well control asthma by visit 3, similar to patients in lower BMI risk groups with good adherence, when the visit interval did not exceed 90 days. Average spirometric values were in the normal range at baseline and improved by the last visit with exception of FEV1/FVC% in MOB children which slightly decreased, but still remained in normal range. What makes these outcomes so striking is that they occurred despite the fact that the mean step of therapy did not significantly differ across BMI categories after adjustment for severity, nor was there significant loss of weight since most children had either no change in weight category or actually gained weight over the BM implementation period. It should also be noted that nearly 70% of those with persistent asthma were not on controller medication at baseline indicating inadequate therapy at the time of referral. In that situation we did see that a significantly greater percentage of OB and MOB had moderate to severe asthma compared to OW and NW children. That being said, obese patients were not less responsive, on average, to ICS therapy during the BM implementation period. These data suggest that OB and MOB asthmatic children can experience the same benefit from comprehensive BM type care as normal weight children with good continuity of care and adherence to therapy, which requires a lot of work and remains a challenge in underserved populations.

Scott and colleagues utilizing multi-site BM data of over 8,000 patients including our site, found in mild to moderate persistent asthmatic children that factors contributing to well controlled asthma included medication adherence, visit interval, age, race, insurance, and BMI [25]. In our study, we extended the classification of BMI and found routine follow-up care was of critical importance to achieving well controlled disease in MOB children. In both studies, approximately 80% of patients achieved well controlled asthma by visit 3 with good adherence and routine follow-up care. Quinto and associates utilizing a large cohort of children in a managed care model, ages 5-17 years, reported that OB children had worse asthma control compared to NW children [12]. It is not clear how frequently patients received follow-up care in the Quinto study which, as we report here, may have a significant effect on reaching control. Another important consideration is parameterization of asthma control which in their study was based on two variables, short acting beta agonist and oral corticosteroid

dispensing, compared to the NIH multidimensional guideline definition applied in the prior [25] and current study.

Quinto et al found no association between obesity and asthma-related ED visits nor hospitalizations [12], whereas, Black et al found increased healthcare utilization related to obesity [28]. In a recent paper evaluating the influence of OB on asthma across six longitudinal reports, associations between BMI and morbidity outcomes were not consistent and appeared influenced by gender and race [15]. In our study, reductions in average ED visits, hospitalizations, and school days missed following one year of intervention were achieved in all BMI risk groups, even after adjustment for potential influencing factors ($p<.05$). Forno et al using a double blind placebo controlled trial in children 5 -12 years compared budesonide to nedocromil and placebo and found significant reductions in healthcare utilization in NW patients, but not in OW and OB patients, suggesting reduced ICS responsiveness in the latter. Potential reasons for the significant morbidity reductions in our obese asthmatic patients could partially be explained by our intervention strategy where medication therapy is only one component, and by patient composition differences in terms of ethnicity, SES, and baseline severity. Patients in our program predominately represent underserved, inner city, Hispanic children who may have had higher morbidity at baseline which could have provided opportunity for a more dramatic change due to intervention, and results focused on patients with moderate to severe persistent disease. Whereas, all patients in the Forno et al study had mild to moderate persistent disease, 68% were Caucasian, and parents, on average, had completed some college or post high school training. Interestingly, after one year of ICS therapy obese asthmatic children in their study showed improved average FEV1% but not average FEV1/FVC% [14], which was similar to findings in our MOB patients. Although lung function abnormality in OB asthmatic children is usually characterized by obstruction, in contrast to OB asthmatic adults where it is more likely to show a restrictive pattern, the effect of obesity on lung function in children is not fully understood.

We were particularly interested in the effectiveness of our program to reduce exercise limitation in the OB and MOB patient. Our data showed that exercise limitation at baseline was related to severity and BMI risk group, which is consistent with reports showing that both obesity [29] and asthma [30] can limit exercise and increase Exercise Induced Bronchospasm (EIB) severity [31]. Most children in our study population had no change in their BMI classification so the dramatic decrease in exercise limitation was primarily due to their improved asthma status. This improvement could potentially contribute to reduced obesity risk in asthmatic children with encouragement and education regarding healthy life choices.

The major limitation of this study design is the retrospective nature of the analysis which could introduce selection bias compared to a randomized clinical trial design. There was no control group to compare efficacy of the Breath mobile program, so the comparison was between the baseline year and implementation year. However, our goal was to compare the OB and MOB with normal weight asthmatic patients so potential recall bias in symptom and morbidity experience would apply to all BMI categories. Furthermore, we recently reported similar morbidity reduction results in this population utilizing Medical claims data and a control group [26]. However, we did not compare BMI risk groups in that study.

Conclusions

Well controlled asthma associated with reduction in morbidity, decreased exercise limitation, and improved lung function in inner city, primarily Hispanic, asthmatics is achievable even in children with co-morbid condition of obesity. Access to effective community-based care where trust, education, and continuity of care consistent with NAEPP guidelines is possible, as demonstrated by the Breath Mobile Program, can provide an opportunity for asthmatic children in all BMI categories to achieve well controlled disease.

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