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Risk factors for poor asthma control and impaired quality of life in a Caribbean population

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ABSTRACT

Objective: Asthma, a major cause of disability and reduced quality of life, has a high global prevalence and burden of death. Despite the propitious guidelines, a substantial portion of asthmatics reportedly have poorly controlled disease. In the current study, we have examined risk factors for uncontrolled asthma in specialty clinics and its association with impaired quality of life.

Methods: A multicentre cross-sectional survey of asthma patients, 18 years and older, was conducted in Trinidad. Asthma Control Test (ACT) and the Juniper Mini Asthma Quality of Life Questionnaire (Mini AQLQ-J) were used to assess the disease control and quality of life, respectively. Data were analyzed using the Chi-square test and multivariable logistic regression controlling for gender.

Results: Of a total of 428 patients included, asthma was uncontrolled in 72.4% and asthma related quality of life was moderate to severely impaired in 86% of the studied population. In the multivariate regression models, poorly controlled asthma was associated with obesity (OR 2.25; 95% CI 1.30–3.39), late-onset asthma (OR 1.72; 95% CI 1.04–2.84), features of sleep apnea (OR 1.77; 95% CI 1.01–3.07) and depression (OR 2.01; 95% CI 1.04–3.86). Impaired quality of life was associated with Indo-Caribbean ethnicity (OR 3.19; 95% CI = 1.68–6.06).

Conclusions: In this Caribbean population, uncontrolled asthma was independently associated with obesity, late-onset disease, and comorbidities of sleep apnea and depression. Poor asthma-related quality of life was independently associated with Indo-Caribbean ethnicity.

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Introduction

Asthma, a major cause of disability and reduced quality of life, has a high global prevalence and burden of death (1). Despite guidelines to attain daily symptom control, reduced exacerbations and declining lung function (2), asthmatics suffer high morbidity with persistent symptoms, exacerbations and poor disease control. Among 8000 European patients asthma was uncontrolled in 45%, and 44% received a course of oral steroids in the previous year (3). In a cross-section of Hungarian patients under specialist management, 64% had partial or uncontrolled asthma and obesity was a frequent risk factor (4).

A 2009 Trinidadian community study documented self-perceived and measured control as 69.3% and 22.4%, respectively (5). Following revised Caribbean asthma guidelines (6), these respective parameters changed to 81.9% and 45.2% in specialty clinics (7).

Poor asthma control associated with worse health status (8,9) and quality of life (10) in community settings, has not been examined in Caribbean populations, to our knowledge. We examined risk factors for uncontrolled asthma in specialty clinics and its association with impaired quality of life.

Methods

Study design and setting

A multicentre cross-sectional survey of asthma patients, 18 years and older, was conducted in Trinidad. Trinidad and Tobago, a high socio-demographic development indexed (SDI) (11) southern Caribbean country, with a population of 1.3 million and two dominant ethnic groups of African and Indian descent, is reported to have a high burden of childhood asthma (12) and non-communicable diseases in the region

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(13). This population is served by four chest clinics located in various speciality health care facilities across the country which receive referrals for severe asthma cases. Adult patients attending chest clinic were invited to participate over a period of six months. The study details were explained and consenting adult patients were recruited consecutively as they presented for treatment at the chest clinics. Each consenting participant completed and signed an informed consent. The study was conducted over a six-month period.

Ethical approvals were granted by the Ethics Committees of the University of the West Indies, and the relevant Health Authorities. Procedures were followed in accordance with the ethical standards of these local committees on human experimentation and with the revised Helsinki Declaration 2000.

Inclusion-exclusion criteria

An adult asthmatic patient was defined as one, aged ≥ 18 years, who had received a physician's diagnosis of bronchial asthma and had been prescribed with bronchodilators in the previous 12 months. Pregnant patients and those with a history of lifetime smoking of five packs of cigarettes or more, chronic obstructive pulmonary disease (COPD), bronchiectasis, interstitial lung diseases, pulmonary tuberculosis, lung malignancy, and cardiac failure were excluded.

Questionnaires

Patients were interviewed using a pretested questionnaire, which informed on demography, self-reported physician diagnosed comorbidities, triggers of asthma exacerbations, the number of asthma exacerbations and visits to the Emergency Department (ED) in the last one year, hospital admissions in the past five years and ever being intubated in their lifetime. Anthropometric measures were also measured and all comorbidities were self-reported.

Data analyses

The data were analyzed at the $p = 0.05$ level of significance. Some variables presented were derived from existing variables. Frequent exacerbations was defined as having a history of two or more exacerbations in the last twelve months. Reporting of at least two out of three cardinal symptoms viz; snoring, witnessed apneas and daytime sleepiness were considered as presence of sleep apnea features. Disease control, evaluated on the Asthma Control Test (ACT), was defined

as uncontrolled (ACT score < 20) and controlled (ACT score ≥ 20) (14). The Juniper Mini Asthma Quality of Life Questionnaire (Mini AQLQ-J) was used to create asthma quality of life impairment (AQLI) defined as impaired for those with poor/moderate AQLQ (scores 1–2 = poor and 3–5 = moderate) and not impaired as those with a good AQLQ (scores rated 6–7) (15). BMI was calculated and used as a measure of general obesity. Central obesity was defined as having an abnormal waist circumference ≥ 94 cm for males and ≥ 80 cm for females (16).

Descriptive statistics were examined for all variables and chi-square test conducted to examine associations between demographic, comorbid conditions and asthma related variables by gender (see Tables 1 and 2). The independence of demographic and asthma related variables with ACT (controlled and uncontrolled) AQLI (impaired and not impaired) were examined in Tables 3 and 4. Logistic regression was used to model asthma control status and impaired quality of life while controlling for gender. Significant independent variables obtained from the chi-square test presented in Tables 3 and 4 were entered into each model and resulting odds ratios are presented in Tables 5 and 6. The IBM SPSS Version 25 was used to run analysis.

Results

Of 428 patients, the majority were female (81.3%), ≥ 40 years (80.4%), of Indo-Caribbean descent (61.9%), and obese/overweight (71.7%) (Table 1). More women (76.7%) than men (50.0%) were obese and overweight ($p < 0.001$). Approximately 75% of patients had an abnormal waist circumference, and this observation was significant for 80.7% of women compared with 47.5% of men ($p < 0.001$).

The most commonly reported co-morbid conditions were gastro-esophageal reflux (GERD) (53.0%), hypertension (47.2%), allergic rhinitis (45.1%), anxiety (42.8%), features of sleep apnea (35%), and depression (32.5%) (Table 1). More women than men reported they suffered from anxiety (46% vs 28.7%, $p = 0.005$), depression (35.3% vs 20.0%, $p = 0.008$), allergic rhinitis/sinusitis (47.7% vs 33.8%, $p = 0.024$) and GERD (55.5% vs 42.5%, $p = 0.036$).

As many as 75.2% of patients had late-onset asthma (Table 2). About a third of the studied population suffered from asthma for between 1 and 10 years. Environmental triggers and allergies (73.8%) were most commonly reported to set off asthma. Nearly three-quarters of patients (72.4%) suffered two

Table 1. Demographic and co-morbid conditions of study participants by gender (N = 428).

	Total (n = 428)	Gender		p-value
		Males (n = 80; 18.7%)	Females (n = 348; 81.3%)	
Demographics				
Age (years)				0.016
18–29	37 (8.6%)	13 (16.3%)	24 (6.9%)	
30–39	48 (11.2%)	6 (7.5%)	42 (12.1%)	
40–49	70 (16.4%)	11 (13.8%)	59 (17.0%)	
50–59	114 (26.6%)	15 (18.8%)	99 (28.4%)	
60–69	98 (22.9%)	18 (22.5%)	80 (23.0%)	
70+	61 (14.5%)	17 (21.3%)	44 (12.6%)	
Ethnicity				0.183
Afro-Caribbean	124 (29.0%)	20 (25.0%)	104 (29.4%)	
Indo-Caribbean	265 (61.9%)	56 (70.0%)	209 (60.0%)	
Mixed/ other	39 (9.1%)	4 (5.0%)	35 (10.1%)	
Body Mass Index				<0.001
Underweight (<18.5 kg/m ²)	11 (2.6%)	3 (3.8%)	8 (2.3%)	
Normal (18.5–24.9 kg/m ²)	110 (25.7%)	37 (46.3%)	73 (21.0%)	
Overweight (25–29.9 kg/m ²)	132 (30.8%)	23 (28.7%)	109 (31.3%)	
Obese (≥30 kg/m ²)	175 (40.9%)	17 (21.3%)	158 (45.4%)	
Waist circumference				<0.001
Normal	109 (25.5%)	42 (52.5%)	67 (19.3%)	
Abnormal ^a	319 (74.5%)	38 (47.5%)	281 (80.7%)	
Co-morbid conditions (self-reported)				
Hypertension	202 (47.2%)	34 (42.5%)	168 (48.3%)	0.351
Cardiac disease	78 (18.2%)	18 (22.5%)	60 (17.2%)	0.272
Diabetes mellitus	101 (23.6%)	15 (18.8%)	86 (24.7%)	0.257
Sleep apnea features ^b	150 (35.0%)	21 (26.3%)	129 (37.1%)	0.067
Anxiety	183 (42.8%)	23 (28.7%)	160 (46.0%)	0.005
Depression	139 (32.5%)	16 (20.0%)	123 (35.3%)	0.008
Allergic rhinitis/ sinusitis	193 (45.1%)	27 (33.8%)	166 (47.7%)	0.024
Skin allergies	94 (22.0%)	13 (16.3%)	81 (23.3%)	0.171
Gastro-oesophageal reflux	227 (53.0%)	34 (42.5%)	193 (55.5%)	0.036

Exposure variable: Gender.

^aSleep apnea features: at least two of three cardinal symptoms present: snoring, witnessed apneas and daytime sleepiness.^bAbnormal waist circumference: ≥ 94 cm for males and ≥ 80 cm for females.**Table 2.** Reported asthma related variables by gender (N = 428).

	All n = 428 (%)	Gender		p-value
		Males n = 80 (18.7%)	Females n = 348 (81.3%)	
Age of onset				0.733
Early (< 12 years)	106 (24.8%)	21 (26.3%)	85 (24.4%)	
Late (≥ 12 years)	322 (75.2%)	59 (73.8%)	263 (75.6%)	
Duration of asthma				0.373
1–10 years	136 (31.8%)	20 (25.0%)	116 (33.3%)	
11–20 years	78 (18.2%)	18 (22.5%)	60 (17.2%)	
21–30 years	71 (16.6%)	16 (20.0%)	55 (15.8%)	
>30 years	143 (33.4%)	26 (32.5%)	117 (33.6%)	
Trigger factors				0.023
Environmental ^a	316 (73.8%)	60 (75.0%)	256 (73.6%)	
Infections	32 (7.5%)	0 (0.0%)	32 (9.2%)	
Emotional	34 (7.9%)	9 (11.3%)	25 (7.2%)	
Multiple/unknown	46 (10.7%)	11 (13.8%)	35 (10.1%)	
Frequent exacerbations^b (in last 12 months)	310 (72.4%)	55 (68.8%)	255 (73.3%)	0.414
Ever visited emergency department (in last 12 months)	232 (54.2%)	38 (47.5%)	194 (55.7%)	0.182
Admitted to hospital (in last 5 years)	172 (40.2%)	25 (31.3%)	147 (42.2%)	0.071
Ever intubated in lifetime	31 (7.2%)	8 (10.0%)	23 (6.6%)	0.291
Asthma control status (ACT score <20)	310 (72.4%)	53 (66.3%)	257 (73.9%)	0.170
Asthma quality of life impairment				0.811
Not impaired (AQLQ 6–7)	60 (14.0%)	11 (13.8%)	49 (14.1%)	
Moderately impaired (AQLQ 3–5)	305 (71.3%)	59 (73.8%)	246 (70.7%)	
Severely impaired (AQLQ 1–2)	63 (14.7%)	10 (12.5%)	53 (15.2%)	

Exposure variable: Gender.

^aIncluding allergens.^bDefined as two or more exacerbations in the last 12 months.

Table 3. Demographic and asthma related variables by disease control status and quality of life impairment ($N = 428$).

	Asthma control status				<i>p</i> -value	Asthma quality of life impairment ^a				<i>p</i> -value
	Uncontrolled		Controlled			Impaired		None		
	(<i>n</i> = 310) %		(<i>n</i> = 118) %			(<i>n</i> = 368) %		(<i>n</i> = 60) %		
Gender					0.170					0.939
Female	257	73.9%	91	26.1%		299	85.9%	49	14.1%	
Male	53	66.3%	27	33.8%		69	86.3%	11	13.8%	
Age (years)					0.066					0.003
18–29	19	51.4%	18	48.6%		27	73.0%	10	27.0%	
30–39	34	70.8%	14	29.2%		45	93.8%	3	6.3%	
40–49	52	74.3%	18	25.7%		59	84.3%	11	15.7%	
50–59	86	75.4%	28	24.6%		107	93.9%	7	6.1%	
60–69	76	77.6%	22	22.4%		83	84.7%	15	15.3%	
70+	43	70.5%	18	29.5%		47	77.0%	14	23.0%	
Ethnicity					0.064					<0.001
Afro-Caribbean	80	64.5%	44	35.5%		96	77.4%	28	22.6%	
Indo-Caribbean	200	75.5%	65	24.5%		242	91.3%	23	8.7%	
Mixed/ other	30	76.9%	9	23.1%		30	76.9%	9	23.1%	
Body Mass Index					0.007					0.479
Under/Normal ($<24.9 \text{ kg/m}^2$)	75	62.0%	46	38.0%		104	86.0%	17	14.0%	
Overweight ($25\text{--}29.9 \text{ kg/m}^2$)	97	74.0%	34	26.0%		109	83.2%	22	16.8%	
Obese ($\geq 30 \text{ kg/m}^2$)	138	78.4%	38	21.6%		155	88.1%	21	11.9%	
Waist circumference^b					0.611					0.929
Abnormal	229	71.8%	90	28.2%		274	85.9%	45	14.1%	
Normal	81	74.3%	28	25.7%		94	86.2%	15	13.8%	
Age of Onset					0.007					0.572
Late (≥ 12 years)	244	75.8%	78	24.2%		280	87.0%	42	13.0%	
Early (< 12 years)	66	62.3%	40	37.7%		88	83.0%	18	17.0%	
Duration of asthma					0.980					0.580
1–10 years	99	72.8%	37	27.2%		114	83.8%	22	16.2%	
11–20 years	55	70.5%	23	29.5%		65	83.3%	13	16.7%	
21–30 years	52	73.2%	19	26.8%		63	88.7%	8	11.3%	
>30 years	104	72.7%	39	27.3%		126	88.1%	17	11.9%	
Trigger factors					0.605					0.013
Environmental ^c	30	65.2%	16	34.8%		280	88.6%	36	11.4%	
Infections	232	73.4%	84	26.6%		24	75.0%	8	25.0%	
Emotional	22	68.8%	10	31.3%		30	88.2%	4	11.8%	
Multiple/unknown	26	76.5%	8	23.5%		34	73.9%	12	26.1%	

Dependent variables: Asthma Control Status and Asthma Quality of Life Impairment.

^aDichotomized: Impaired to AQLQ 1–5; Not Impaired AQLQ 6–7.^bBased on WHO definition for waist circumference. Abnormal waist circumference: ≥ 94 cm for males and ≥ 80 cm for females.^cIncludes allergens.

or more exacerbations, and more than half (54.2%) made at least one visit to the ED in the past year. Asthma was uncontrolled in 72.4% of patients without any gender differentiation. The prevalence of moderate to severely impaired quality of life (AQLI) was as high as 86%, affecting males and females equally. Uncontrolled asthma was significantly associated with impaired quality of life ($p < 0.001$) (Supplementary Table 1).

In the bivariate analysis, demographic characteristics associated with AQLI were age ($p = 0.003$), Indo-Caribbean ethnicity ($p < 0.001$) and environmental/allergic triggers ($p = 0.013$) (Table 3). Significant demographic associations with uncontrolled asthma were overweight, obesity and late-onset asthma ($p = 0.007$ for all variables). The bivariate analysis of comorbid conditions (Table 4) associated with uncontrolled asthma were hypertension ($p = 0.021$), features of sleep apnea ($p < 0.001$), GERD ($p = 0.038$),

depression ($p < 0.001$) and anxiety ($p = 0.003$). AQLI was associated with sleep apnea features ($p = 0.001$), GERD ($p = 0.014$), depression ($p = 0.001$), and anxiety ($p = 0.003$). Uncontrolled asthma was associated with frequent exacerbations, ED visits ($p < 0.001$ for both) and hospital admission in the last five years ($p = 0.001$). Disease manifestations and AQLI were associated with frequent exacerbations and ED visits ($p < 0.001$ for both).

In the multivariate regression model for demographic variables and asthma control status (Table 5), the odds of uncontrolled asthma were more likely with obesity (OR 2.25; 95% CI 1.30–3.39); late-onset asthma (OR 1.72; 95% CI 1.04–2.84) was also a predictor of uncontrolled disease. The odds of demographic variables associated with AQLI were 4.70 times more likely in those aged 30–39 and 3.99 times in those aged 50–59 years (respective 95% CI

Table 4. Co-morbid conditions and disease manifestations by asthma control status and quality of life impairment ($N = 428$).

	Asthma control status					Asthma quality of life impairment ^a					p-value
	Uncontrolled		Controlled			Impaired		None			
	(n = 310)	%	(n = 118)	%		(n = 368)	%	(n = 60)	%		
Comorbid illnesses											
Hypertension	157	77.7%	45	22.3%	0.021	177	87.6%	25	12.4%	0.355	
Cardiac disease	59	75.6%	19	24.4%	0.483	65	83.3%	13	16.7%	0.456	
Diabetes mellitus	79	78.2%	22	21.8%	0.136	92	91.1%	9	8.9%	0.091	
Sleep apnea features ^b	125	83.3%	25	16.7%	<0.001	140	93.3%	10	6.7%	0.001	
Gastro-oesophageal reflux	174	76.7%	53	23.3%	0.038	204	89.9%	23	10.1%	0.014	
Skin allergies	75	79.8%	19	20.2%	0.071	85	90.4%	9	9.6%	0.160	
Allergic rhinitis/ sinusitis	148	76.7%	45	23.3%	0.074	168	87.0%	25	13.0%	0.565	
Depression	119	85.6%	20	14.4%	<0.001	131	94.2%	8	5.8%	0.001	
Anxiety	146	79.8%	37	20.2%	0.003	168	91.8%	15	8.2%	0.003	
Manifestation of asthma											
Frequent exacerbations ^c (in last 12 months)	254	81.9%	56	18.1%	<0.001	283	91.3%	27	8.7%	<0.001	
Ever visit emergency department (in last 12 months)	199	85.8%	33	14.2%	<0.001	218	94.0%	14	75.4%	<0.001	
Admitted to hospital (in last 5 years)	139	80.8%	33	19.2%	0.001	152	88.4%	20	11.6%	0.243	
Ever intubated in lifetime	23	74.2%	8	25.8%	0.820	28	90.3%	3	9.7%	0.470	

Dependent variables: Asthma Control Status and Asthma Quality of Life Impairment.

^aDichotomized: Impaired to AQLQ 1–5; Not Impaired AQLQ 6–7.

^bClinical features: at least two of three cardinal symptoms present: snoring, witnessed apneas and daytime sleepiness.

^cDefined as two or more exacerbations in the last 12 months.

1.14–19.34 and 1.34–11.90). The model showed that impaired asthma-related quality of life was 3.19 times more in people of Indo-Caribbean ethnicity, than the Afro-Caribbean population (OR 3.19; 95% CI = 1.68–6.06). In the logistic regression model for comorbid conditions (Table 6), the odds of uncontrolled asthma were 1.77 times more likely with features of sleep apnea (95% CI 1.01–3.07) and 2.01 times more likely with depression (95% CI 1.04–3.86). Frequent exacerbations and ED visits in the last 12 months were 3.05 and 2.36 times, respectively more likely to be associated with uncontrolled asthma (95% CI, 1.77–5.25 and 1.35–4.13, respectively). The odds of AQLI were 2.25 times more likely with frequent exacerbations (95% CI 1.18–4.31) and ED visits (OR 3.01; CI 1.43–1.56).

Discussion

The foremost finding from this observational study is that comorbid conditions, obesity and late-onset asthma are the main risk factors that challenge asthma management and its control in this Caribbean population. As many as 72.4% of patients had uncontrolled disease, comparable to the >80% of patients with severe asthma in specialist care in the IDEAL study (17). The observed large proportion of patients with uncontrolled asthma in this population is probably due, as reported elsewhere (18), to the patient selection with severe asthma, referred from primary care. A contributory factor could be treatment non-

adherence, which we did not explore. The female majority in this population is in line with reports of higher frequency of uncontrolled asthma in women (19) though female asthma prevalence is generally higher and plausibly women are proactive about health wellness.

The studied population was predominantly overweight and obese (71.7%), reflecting a similar distribution in Trinidad's population of 1.3 million people, of whom 63.1% are overweight and 32.3% obese (20), with a disproportional impact on women. Given its high prevalence in the Trinidad population (21), obesity is a critical determinant of the adult asthma phenotype, and a well-documented risk factor for asthma (22) so that resident systemic inflammation might link the two conditions. Tay et al. reported higher BMI was an independent risk factor for exacerbations, lesser control, and poorer AQLQ scores (23). Yet in another interesting study neither overweight nor obesity were associated with hospital asthma readmissions, indicating the association remains unclear and merits deeper exploration of the relationship (24). Late-onset asthma was a predictor for uncontrolled asthma. Its high prevalence in this mostly obese female population is supported by the recent description of the late-onset asthma phenotype with obesity predominantly affecting women (25). Considering that early and late-onset asthma appear to be different phenotypes, one can speculate that they are differentially impacted by increases in BMI. In late-onset asthma, Holguin et al. found obesity and increased

Table 5. Odds ratios for demographic and disease related variables associated with poor asthma control status and impaired quality of life ($N = 428$).

	Poor asthma control status			Impaired asthma-related quality of life ^a		
	OR	95% CI		OR	95% CI	
		LC	UC		LC	UC
	Multivariate analysis					
	adj OR ^c	95% CI		adj OR ^d	95% CI	
		LC	UC		LC	UC
Age (years)						
18–29	ref			ref		
30–39	1.45	0.56	3.75	4.70	1.14	19.34
40–49	1.64	0.67	4.02	1.28	0.45	3.58
50–59	1.89	0.83	4.33	3.99	1.34	11.90
60–69	1.89	0.79	4.53	1.32	0.50	3.49
70+	1.66	0.68	4.09	1.01	0.37	2.76
Ethnicity						
Afro-Caribbean	ref			ref		
Indo-Caribbean	1.54	0.94	2.51	3.19	1.68	6.06
Mixed/ other	1.70	0.72	4.00	1.08	0.43	2.67
Body Mass Index						
Under/Normal (<24.9 kg/m ²)	ref					
Overweight (25–29.9 kg/m ²)	1.68	0.96	2.94			
Obese (≥30 kg/m ²)	2.25	1.30	3.91			
Age of onset						
Early than 12 years	ref					
12 years or after	1.72	1.04	2.84			
Trigger factors						
Environmental ^b				ref		
Infections				0.45	0.17	1.15
Emotional				0.81	0.26	2.52
Multiple/unknown				0.40	0.18	0.90

^aDichotomized: Impaired to AQLQ 1–5; Not Impaired AQLQ 6–7.^bIncludes allergens.

Enter Method used in Logistic Regression: Variable(s) entered based on significance in univariate analysis.

^cLogistic regression model for asthma control status statistically significant, $\chi^2(7) = 24.85$, $p = 0.006$; model explained 8.23% (Nagelkerke pseudo R²) of the variance in ACT and correctly classified 73.8% of cases and able to predict 97.1% uncontrolled; model was a good fit (Hosmer and Lemeshow, $p = 0.279$).^dLogistic regression model for quality of life impairment statistically significant, $\chi^2(7) = 39.5408$, $p < 0.001$; model explained 15.9% (Nagelkerke pseudo R²) of the variance in quality of life impairment and correctly classified 85.5% of cases and able to predict 99.5% impairment; model was a good fit (Hosmer and Lemeshow, $p = 0.81$).

asthma severity are potentially more likely to have a causal association (26), which is concerning as, the community continues to age. The strong association of obesity with asthma affecting more women and Indo-Caribbean people calls for further study on the complexity of ethnicity and gender affecting asthma control. Borrell et al. (27) explored these associations in 8–21-year olds of different ethnicities across the United States and Puerto Rico, adding to increasing evidence that age, gender, and race play an essential role in the association between obesity and asthma control. From recent asthma surveillance data, 38.8% of adults have current asthma and are obese in the USA (28). Obesity is associated with worsening asthma symptoms and poor asthma control, leading to increases in medication use and hospitalizations, imposing a considerable economic burden. Prospective cohort studies to understand any connection between asthma and obesity in Caribbean peoples, among different asthma phenotypes and

ethnicities could be a way forward. Hypertension, GERD, features of sleep apnea, depression and anxiety were associated comorbidities with uncontrolled asthma, but in the multivariable model, only depression and features of sleep apnea emerged as significant associates for uncontrolled asthma. Comorbid disease frequently exists with asthma possibly influencing exacerbations. Lisspers et al. (29) reported at least 20% prevalence of hypertension, anxiety and depression in a large observational cohort study in more than 33 000 asthmatics. Both depression and anxiety have been reported as risk factors for poor asthma control (30). The large proportion of obese patients in this population is a considered factor, depression may be disproportionately prevalent in asthmatics and obese patients. Boudreau et al. (31) examined the mediating effect of depression on the obesity-asthma relationship and found symptoms of depression facilitated poor asthma control and high BMI. Uncontrolled asthma was associated with impaired quality of life, also

Table 6. Odds ratios for co-morbid conditions and asthma manifestations associated with poor asthma control status and impaired quality of life ($N = 428$).

	Poor asthma control status			Impaired asthma-related quality of life		
	OR	95% CI		OR	95% CI	
		LC	UC		LC	UC
Multivariate analysis						
adj OR ^c	95% CI		adj OR ^d	95% CI		
	LC	UC		LC	UC	
Comorbidities						
Hypertension	1.58	0.96	2.59	1.13	0.62	2.08
Sleep apnea features ^a	1.77	1.01	3.07	2.08	0.97	4.44
Gastro-oesophageal reflux	1.35	0.84	2.19	1.77	0.97	3.24
Depression	2.01	1.04	3.86	1.94	0.78	4.79
Anxiety	1.04	0.59	1.82	1.35	0.65	2.81
Manifestation of asthma						
Frequent exacerbations ^b (in last 12 months)	3.05	1.77	5.25	2.25	1.18	4.31
Ever visit emergency department (in last 12 months)	2.36	1.35	4.13	3.01	1.43	6.35
Admitted to hospital (in last 5 years)	1.35	0.80	2.29	0.82	0.43	1.56

^aSleep apnea features: at least two of three cardinal symptoms present: snoring, witnessed apneas and daytime sleepiness.

^bDefined as two or more exacerbations in the last 12 months.

Enter Method used in Logistic Regression: Variable(s) entered based on significance in univariate analysis.

^cLogistic regression model for asthma control status statistically significant, $\chi^2(7) = 86.06$, $p < 0.001$; model explained 26.3% (Nagelkerke pseudo R²) of the variance in ACT and correctly classified 77.3% of cases and able to predict 92% uncontrolled; model was a good fit (Hosmer and Lemeshow, $p = 0.70$).

^dLogistic regression model for quality of life impairment statistically significant, $\chi^2(7) = 52.08$, $p < 0.001$; model explained 20.6% (Nagelkerke pseudo R²) of the variance in quality of life impairment and correctly classified 86.7% of cases and able to predict 99.7% impairment; model was a good fit (Hosmer and Lemeshow, $p = 0.88$).

observed, with low AQLQ scores in severe asthma in the IDEAL study (17). Impaired quality of life in patients with frequent exacerbations and ED visits is supported by earlier work of Luskin et al. (32). A significant association between impaired asthma-related quality of life and uncontrolled asthma, has been demonstrated previously (18,33). Studies on ethnicity dependent asthma control have reported worse outcomes in the African-American population in comparison with Caucasians (34). However, in the current study Afro and Indo-Caribbean populations did not exhibit such disease control variations. Nevertheless, quality of life was significantly impaired in the Indo-Caribbean population than their African counterparts. To our knowledge, this important finding has not been reported earlier in the literature.

Features of sleep apnea and obesity were both associated with uncontrolled asthma. In a 2009–2011 U.S. nationwide inpatient study in asthma hospitalizations, sleep apnea and obesity, were both associated with more health resource utilization and worse inpatient outcomes than obesity alone, suggesting further study of sleep apnea, and obesity in poorly controlled asthma (35). In adults with uncontrolled asthma, abdominal adiposity and poor sleep quality were associated with poorer asthma control, after adjusting for BMI (36). Obesity is also a predictor for uncontrolled

asthma (37,38). Whether a bi directional relationship exists between asthma and obesity, or sleep apnea where each disorder adversely influences the other one merits further research to elucidate mechanisms linking sleep quality and disorders (e.g. OSA) or obesity to asthma control,

Strengths and limitations

We did not do polysomnography, but relied on a questionnaire to elicit features of sleep apnea and recommend polysomnography screening to diagnose sleep apnea. A strength of the study is that it looks at patients with severe asthma in real life at specialist centers in Trinidad. The results, however, cannot be applied to patients with asthma of mild to moderate severity in community health care. We acknowledge a possible recall bias in recording the age of asthma onset. The study has an inherent limitation common to observational, cross-sectional studies with self-reported data, in that the cause-effect relationship is difficult to determine. Hence the difficulty is relevant to uncontrolled asthma as a cause or consequence of the impaired quality of life and whether obesity causes depression, sleep apnea and uncontrolled disease or vice versa. Future studies to explore such confounding effects will generate more robust evidence on the

interaction between overweight and obesity, depression, sleep apnea and impaired quality of life in the patient with uncontrolled asthma.

Conclusions

This study provides a broad outline of asthma control status and related quality of life in Trinidadian adult patients with severe disease. In this Caribbean population, uncontrolled asthma was independently associated with obesity, late-onset disease, and comorbidities of sleep apnea features and depression. Poor asthma-related quality of life was independently associated with an Indo-Caribbean ethnicity which needs further confirmation with longitudinal studies.

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Declaration of interest

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Supplementary Material

Supplementary Table 1. Association between Asthma Control and Asthma-Related Quality of Life

		Asthma Control Status				<i>p-value</i>
		Uncontrolled (n=310) %		Controlled (n=118) %		
Asthma-Related Quality of Life						<0.0001
Impaired	294	79.9%	74	20.1%		
Not impaired	16	26.7%	44	73.3%		