Journal of Asthma

ISSN: 0277-0903 (Print) 1532-4303 (Online) Journal homepage: https://www.tandfonline.com/loi/ijas20

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To cite this article: Jose Eduardo Delfini Cançado, Marcio Penha, Shaloo Gupta, Vicky W. Li, Guilherme Silva Julian & Eloisa de Sá Moreira (2019) Respira project: Humanistic and economic burden of asthma in Brazil, Journal of Asthma, 56:3, 244-251, DOI: 10.1080/02770903.2018.1445267

To link to this article: https://doi.org/10.1080/02770903.2018.1445267

Published online: 29 Mar 2018.

JOURNAL OF ASTHMA
2019, VOL. 56, NO. 3, 244–251
https://doi.org/10.1080/02770903.2018.1445267

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ECONOMICS

Respira project: Humanistic and economic burden of asthma in Brazil

Jose Eduardo Delfini Cançado, MD[a], Marcio Penha, MD, MSC[b], Shaloo Gupta, MS[c], Vicky W. Li, MPH[c], Guilherme Silva Julian, BPharm, MSc[d], and Eloisa de Sá Moreira, PhD[d]

[a]Santa Casa da Misericórdia de São Paulo, São Paulo, Brazil; [b]Astrazeneca do Brasil, São Paulo, Brazil; [c]Kantar Health, New York, NY, USA; [d]Evidências – Kantar Health, São Paulo, Brazil

ABSTRACT

Objective: To determine the association of asthma on health-related quality of life (QoL), productivity, and use of healthcare resources among adults in Brazil. *Methods*: Data were analyzed from the 2015 Brazil National Health and Wellness Survey, a cross-sectional survey with 12,000 adult respondents. Asthma and control groups were compared with respect to health-related QoL, asthma control, work productivity, and adherence. Generalized linear models were developed to compare asthma-related associations controlling for potential confounding factors. *Results*: Among respondents, 4.1% (n = 494) reported an asthma diagnosis; those without asthma symptoms were used as the control group (n = 11,487). Regarding asthma control, 51.2% of patients had uncontrolled asthma, 36.4% partially controlled asthma, and 12.3% were fully controlled. Short-acting β2 agonists were the most commonly used class of drugs (38.5%). Approximately 32.4% of asthma patients were considered fully adherent to their treatment. In multivariable analyses, asthma patients presented lower health-related QoL and had more frequent visits with medical healthcare providers (6.1 *versus* 4.2) emergency room visits (1.0 *versus* 0.5), and more hospitalizations (0.4 *versus* 0.2), than control respondents six months prior to the study ($p < 0.05$). Rates of absenteeism and presenteeism varied between 11.5% and 7.4% ($p < 0.05$) and 30.4% and 20.9% ($p < 0.001$) between asthma patients and controls, respectively. *Conclusions*: Asthma had a negative association on health-related QoL, work productivity, and use of healthcare resources. Excessive use of short-acting β2 agonists and poor treatment adherence reflect poor asthma control and suggest the need to implement new strategies for asthma treatment in Brazil.

ARTICLE HISTORY
Received 27 November 2017
Revised 19 February 2018
Accepted 20 February 2018

KEYWORDS
Asthma; activity impairment; healthcare resource use; quality of life; burden of asthma; disease control

Introduction

Asthma is one of the most prevalent chronic diseases in the world. Approximately 235 million people currently suffer from asthma, according to the World Health Organization (WHO) (1), and this figure has been increasing in recent decades. If the current trends continue to rise, it is estimated that there may be an additional 100 million asthmatics globally by 2025 (2, 3). In Brazil, more specifically, asthma affects over 6 million adults, according to the National Health Survey (PNS) of the Ministry of Health (MoH) and the Brazilian Institute of Geography and Statistics (IBGE) (4).The resulting prevalence of asthma among Brazilian adults, of 4.4%, agrees with that estimated by the World Health Survey, which included 70 countries (5). PNS also showed that 43% of the affected women and 30% of the affected men had an exacerbation, and 80% of them used an asthma medication in the 12 months prior to the survey (6).

Patients with asthma also experience significant physical and psychological burdens that, consequently, may produce several negative health outcomes. Nocturnal symptoms and sleep pattern disruptions (awakenings) have been reported in 51% and daily symptoms in 56% of patients with asthma in Latin America (7). Asthma negatively influences the quality of life (QoL) of patients; increased psychological disorders such as depression and anxiety have been associated with both mild and severe asthma. (8–10).

Asthma patients also suffer from significant losses in work productivity (e.g., absenteeism, presenteeism, and overall work impairment) and activity impairment outside of the workplace (e.g., problems completing daily activities) (2, 3). These individuals also place a heavy burden on the healthcare system, making particularly frequent healthcare provider visits, emergency room (ER) visits, and hospitalizations (7, 10). The disease is, therefore, associated with high expenditure that include both direct (e.g., hospital admissions and pharmaceuticals) and indirect costs (e.g., time lost from work and premature death), making asthma one of the most expensive diseases due to the significant healthcare utilization associated with this condition (2, 3). The burden of asthma in

CONTACT Shaloo Gupta Shaloo.Gupta@kantarhealth.com Kantar Health, 11 Madison Ave # 12, New York, NY 10010, USA.
The abstract of this paper was presented at XI Brazilian Asthma Congress on August 2–5, 2017 in Fortaleza, Brazil.

many countries is of sufficient magnitude to warrant its recognition as a priority disorder in government health strategies. In Brazil, few studies have analyzed the association of asthma on patients' health-related QoL and their use of healthcare resources, making it difficult to define and develop public health policies in this country that target asthma.

This study investigated the humanistic and economic burden of asthma among adults in Brazil, in terms of the association of asthma on health-related QoL and productivity as well as the use of healthcare resources to diagnose and treat the disease.

Methods

Data source

This study included data from the 2015 Brazil National Health and Wellness Survey (NHWS, $n = 12{,}000$), a self-administered, internet-based questionnaire from a large sample of adults living in Brazil (aged ≥18 years). In total, a survey link was sent to 328,496 individuals. All respondents needed to be 18 years and older and we use quote groups for age and gender to be representative of the Brazilian population. All 12,000 respondents in the study met the inclusion criteria, provided informed consent, and completed the questionnaire. To reduce selection bias and increase the representativeness of findings to the adult population in Brazil, the Brazil NHWS was supplemented by Computer-Assisted Web Interviewing to reach people without internet access. A stratified random sampling strategy, with strata by gender and age, was also used (based on data from the International Database of the United States Bureau of the Census). To further correct for any inherent sampling bias with respect to socioeconomic status, custom sampling weights were calculated through a ranking procedure (based on data from the *Instituto Brasileiro de Geografia e Estatística*) to ensure demographic representativeness. Several peer-reviewed publications have previously compared the NHWS with other governmental sources (11–13). NHWS is reviewed and approved by the Essex Institutional Review Board (IRB) and by local Brazilian IRB (#1.722.654). All respondents provided their informed consent prior to participating and were only known by a unique identifier.

Sample

This analysis focused on individuals with a self-reported asthma diagnosis. Respondents were first asked whether they experienced asthma in the last 12 months. In the case of an affirmative response, respondents were subsequently asked whether they had received an asthma diagnosis by a physician. Only individuals who answered "yes" to both questions were defined as asthma patients in this study. Non-asthma controls were also included in this study (respondents not experiencing asthma). Self-reported asthma subjects who did not have a physician diagnosis were excluded from further analysis.

Covariates

Demographic variables included sex, age, race/ethnicity, marital status, annual household income, education, and socioeconomic status. Regarding socioeconomic status, the classification from the Brazilian Institute for Geography and Statistics (IBGE) was adopted, which is based on household's gross monthly income: class A, above 20 times the National Minimum Salary (NMS); class B, greater than 10 to 20 times the NMS; class C, greater than 5 to 20 times the NMS; class D, greater than 2 to 5 times the NMS; class E, up to 2 times the NMS (14).

Health history variables included smoking habits, alcohol consumption, number of days of vigorous exercise for at least 20 minutes in the past month, and body mass index (BMI). The Charlson Comorbidity Index (CCI), which represents a weighted sum of multiple comorbid conditions predictive of mortality (e.g., HIV/AIDS, diabetes, and congestive heart failure), was also calculated (15). Higher scores indicate a greater comorbid burden.

Additional asthma-related variables were also reported for descriptive purposes. These variables included medication use and medication class, along with years diagnosed with asthma, diagnosing physician type, and causes of asthma attacks.

Outcome variables

This study included responses from the revised Medical Outcomes Study 36-Item Short Form Survey Instrument (SF-36v2), a multipurpose, generic health-related QoL instrument composed of 36 questions (16). Two summary scores are also calculated: physical component summary (PCS) and mental component summary (MCS) scores. For the purpose of the present analyses, PCS and MCS summary scores were utilized as normed scores. This was achieved by transforming the raw scores for the items to a mean of 50 and a standard deviation of 10 for the US population. Scores were interpreted relative to this population average of 50, as well as with other comparison groups of interest. Higher scores indicate better quality of life.

In addition to generating profile and summary PCS and MCS scores, the SF-36v2 was also used to generate a health state utility score. This was achieved through application of the SF-6D algorithm, which takes six domains from the SF-36v2. The SF-6D is a preference-based single

index measure for health using general population values (17). The SF-6D index has interval scoring properties and yields summary scores on a theoretical 0–1 scale. Higher scores indicate better QoL.

Work productivity was assessed using the Work Productivity and Activity Impairment General Health (WPAI-GH) questionnaire, a six-item validated instrument consisting of four metrics: absenteeism (the percentage of work time missed because of one's health in the past seven days), presenteeism (the percentage of impairment experienced while at work in the past seven days because of one's health), overall work productivity loss (an overall impairment estimate that is a combination of absenteeism and presenteeism), and activity impairment (the percentage of impairment in daily activities because of one's health in the past seven days) (18). Only respondents who reported being employed full-time, part-time, or self-employed provided data for absenteeism, presenteeism, and overall work impairment. All respondents provided data for activity impairment.

Healthcare utilization was defined by the number of healthcare provider (HCP) visits, the number of emergency room (ER) visits, and the number of times hospitalized during the six months prior to participation. The number of HCP visits included several specialties, such as internist, allergist, neurologist, and general practitioner, among other specialties.

The Asthma Control Test (ACT) (19) and the Morisky, Green, and Levine Medication Adherence Scale (MGLS) were used for analyses that only included asthma respondents. ACT contains five asthma-specific questions to determine respondents' level of asthma control. Based on the scoring used for this instrument, an ACT score of 19 or less is considered "not well controlled," scores between 20 to 24 is considered "partially controlled", and scores 25 are considered "totally controlled." Adherence to asthma medication was assessed using the 4-item MGLS (20). This scale consists of four questions that were used to assess adherence to asthma prescription medication. Complete adherence was defined as having a score of 4. Non-adherence was defined as having a score of 3 or less.

Statistical Analysis

Descriptive analyses

The underlying distributions of patient characteristics, asthma characteristics, treatment variables, and outcomes for participants were summarized, which informed the appropriateness of the planned approach as well as suggested how different levels of the variables should be grouped for analyses. Categorical variables were reported using counts and percentages. Continuous variables were reported using means and standard deviations.

Bivariate analyses

Bivariate comparisons were conducted that examined the burden of asthma (those diagnosed with the disease were compared with non-asthmatic controls). Demographic and patient characteristic differences between asthma groups were examined. These results served as the basis for identifying covariates for the multivariable models (in addition to variables of theoretical importance). For categorical variables, chi-square tests were used to determine statistically significant differences, whereas one-way ANOVAs were used for continuous variables. *P* values were provided for omnibus tests (e.g., one-way ANOVA or chi-square).

Multivariable analysis

Respondents living with and without asthma differed in sociodemographic and health characteristics. Outcomes were, therefore, compared using generalized linear models (GLMs) to control for covariates. Covariates were selected after examining significant differences during the bivariate comparisons for asthma versus non-asthma control comparisons. Covariates examined included: age, sex, employment status (not among the three work-related WPAI metrics), education, social economic status (SES), insurance type, alcohol consumption, and CCI. GLMs specifying normal distributions and identity link functions were used for predicting normally distributed outcomes (e.g., health outcome measures) and GLMs specifying negative binomial distributions with log link functions were used for predicting outcome variables with skewed distributions (e.g., work productivity). Normal GLMs (with identity link) are robust models for normal distributions, even those with minor deviations from normality. Negative binomial models correct standard errors of highly skewed distributions to compensate for model under dispersion.

Adjusted means for all outcomes were calculated for each group to help illustrate the pattern of results. Tables depicting the results of regression analyses are also provided.

Results

Bivariate analysis

Among the total 11,981 respondents included in this study, 4.1% ($n = 494$) reported having an asthma diagnosis; the remaining 95.9% ($n = 11{,}487$) of the respondents comprised the non-asthma control group. Asthma respondents were younger (mean age 36.3 *versus* 40.4 years, $p < 0.001$), more commonly women (59.9% *versus* 48.7%, $p < 0.001$), and reported more comorbidities (CCI mean 0.7 *versus* 0.3, $p < 0.001$) than control

Table 1. Demographics by asthma diagnosis.

		Asthma		
N =	Total *N* = 11,981	Asthma *N* = 494	Non-Asthma controls *N* = 11,487	*P* Value
Age (years)				<0.001
Mean ± SD	40.18 ± 15.38	36.29 ± 13.21	40.35 ± 15.44	
Sex				<0.001
Male (%)	6,091 (50.8%)	198 (40.1%)	5,893 (51.3%)	
Female (%)	5,890 (49.2%)	296 (59.9%)	5,594 (48.7%)	
Race/Ethnicity[A]				0.303
White (%)	7,537 (62.9%)	329 (66.6%)	7,208 (62.7%)	
Black (%)	944 (7.9%)	31 (6.3%)	913 (7.9%)	
Brown (%)	2,981 (24.9%)	113 (22.9%)	2,868 (25.0%)	
Other (%)	519 (4.3%)	21 (4.3%)	498 (4.3%)	
Marital status				0.601
Single (%)	5,230 (43.7%)	210 (42.5%)	5,020 (43.7%)	
Married/living with partner (%)	6,751 (56.3%)	284 (57.5%)	6,467 (56.3%)	
University education				0.025
Less than 4-year degree (%)	6,770 (56.5%)	255 (51.6%)	6,515 (56.7%)	
4-year degree or more (%)	5,211 (43.5%)	239 (48.4%)	4,972 (43.3%)	
Employed (FT/PT/SE)				0.001
No (%)	3,728 (31.1%)	121 (24.5%)	3,607 (31.4%)	
Yes (%)	8,253 (68.9%)	373 (75.5%)	7,880 (68.6%)	
Annual household income				0.873
R$ 1000 or less (%)	1,051 (8.8%)	44 (8.9%)	1,007 (8.8%)	
R$ 1001–R$ 6500 (%)	5,182 (43.3%)	219 (44.3%)	4,963 (43.2%)	
R$ 6501 or above (%)	4,430 (37.0%)	182 (36.8%)	4,248 (37.0%)	
Declined to answer (%)	1,318 (11.0%)	49 (9.9%)	1,269 (11.0%)	
Socioeconomic status[B]				0.001
A (%)	1,582 (13.2%)	82 (16.6%)	1,500 (13.1%)	
B (%)	7,163 (59.8%)	314 (63.6%)	6,849 (59.6%)	
C (%)	3,019 (25.2%)	96 (19.4%)	2,923 (25.4%)	
D (%)	200 (1.7%)	2 (0.4%)	198 (1.7%)	
E (%)	17 (0.1%)	0 (0.0%)	17 (0.1%)	
Insurance type				<0.001
Public (%)	5,871 (49.0%)	198 (40.1%)	5,673 (49.4%)	
Private (%)	6,110 (51.0%)	296 (59.9%)	5,814 (50.6%)	
BMI				0.143
Underweight [< 18.5] (%)	434 (3.6%)	20 (4.0%)	414 (3.6%)	
Normal [18.5–24.9] (%)	5,274 (44.0%)	214 (43.3%)	5,060 (44.0%)	
Overweight [25.0–29.9] (%)	3,985 (33.3%)	147 (29.8%)	3,838 (33.4%)	
Obese [>30] (%)	2,122 (17.7%)	107 (21.7%)	2,015 (17.5%)	
Declined to answer (%)	166 (1.4%)	6 (1.2%)	160 (1.4%)	
Alcohol use				0.026
Do not drink alcohol (%)	4,672 (39.0%)	169 (34.2%)	4,503 (39.2%)	
Drink alcohol (%)	7,309 (61.0%)	325 (65.8%)	6,984 (60.8%)	
Smoking behavior				0.351
Non-smoker (%)	7,442 (62.1%)	297 (60.1%)	7,145 (62.2%)	
Smoker (%)	4,539 (37.9%)	197 (39.9%)	4,342 (37.8%)	
Days in the past month exercise				0.216
Mean ± SD	7.64 ± 9.00	8.13 ± 9.16	7.62 ± 8.99	
Charlson comorbidity index (1987)				<0.001
Mean ± SD	0.32 ± 0.89	0.70 ± 1.25	0.30 ± 0.86	

R$ = Brazilian Real, SD = SD: standard deviation. A: Self-declared ethnicity/race categories were defined based in the Brazilian Institute for Geography and Statistics (IBGE) definitions; B: Classification according Brazilian Institute for Geography and Statistics (IBGE).

respondents. Also, compared with controls, asthma respondents tended to be of a higher socioeconomic status, higher education level, be employed (75.5% *versus* 68.6%), and have private insurance (all $p < 0.05$). Complete demographic characteristic of asthma and non-asthma respondents are presented in Table 1.

Respondents with asthma had significantly lower health-related QoL than non-asthma controls on MCS (mean 42.11 *versus* 46.62), PCS (47.73 *versus* 51.60), and SF-6D (0.64 *versus* 0.71) (all $p < 0.001$). Respondents with asthma also reported significantly higher absenteeism (13.12% *versus* 7.54%), presenteeism (35.21% *versus* 21.42%), overall work impairment (40.95% *versus* 25.27%), and activity impairment (37.85% *versus* 24.19%) compared to respondents without asthma (all $p < 0.05$). In addition, asthma respondents had significantly more frequent HCP visits (mean 7.88 *versus* 4.44), ER visits (1.40 *versus* 0.59), and hospitalizations (0.67 *versus* 0.25) relative to non-asthma control respondents (all $p < 0.05$), during the 6 months prior to participating in the survey. Comparisons of outcome variables (i.e., health-related QoL, work productivity and activity impairment, and

Table 2. Health-related quality of life, labor force participation, WPAI, and healthcare resource use by asthma diagnosis.

	Asthma			
N =	Total *N* = 11,981	Asthma DX *N* = 494	Non-Asthma controls 11,487	*P* Value
SF-36v2: Mental component summary				<0.001
N	11,981	494	11,487	
Mean ± SD	46.43 ± 10.60	42.11 ± 10.55	46.62 ± 10.56	
SF-36v2: Physical component summary				<0.001
N	11,981	494	11,487	
Mean ± SD	51.44 ± 7.81	47.73 ± 8.18	51.60 ± 7.75	
SF6D: Health state utility score				<0.001
N	11,981	494	11,487	
Mean ± SD	0.704 ± 0.13	0.639 ± 0.12	0.707 ± 0.13	
Absenteeism %				<0.001
N	7,606	347	7,259	
Mean ± SD	7.79 ± 18.75	13.12 ± 22.69	7.54 ± 18.51	
Presenteeism %				<0.001
N	7,652	351	7,301	
Mean ± SD	22.06 ± 28.24	35.21 ± 30.10	21.42 ± 27.99	
Overall work impairment %				<0.001
N	7,606	347	7,259	
Mean ± SD	25.99 ± 31.48	40.95 ± 33.03	25.27 ± 31.23	
Activity impairment %				<0.001
N	11,981	494	11,487	
Mean ± SD	24.75 ± 29.19	37.85 ± 29.94	24.19 ± 29.03	
Healthcare provider visits in past 6 months				<0.001
N	11,981	494	11,487	
Mean ± SD	4.58 ± 6.80	7.88 ± 11.09	4.44 ± 6.52	
ER visits in the past 6 months				<0.001
N	11,981	494	11,487	
Mean ± SD	0.62 ± 2.40	1.40 ± 3.73	0.59 ± 2.32	
Hospitalizations in the past 6 months				<0.001
N	11,981	494	11,487	
Mean ± SD	0.27 ± 1.55	0.67 ± 2.44	0.25 ± 1.50	

SD = SD: standard deviation; ER = Emergency room.

healthcare resource use) are reported for asthma and non-asthma respondents in Table 2.

Out of the 494 asthma respondents, the mean ACT score was 18.48; 51.2% scored ≤19 (partially controlled), 36.4% scored 20–24 (well controlled), and 12.3% scored 25 (total control). A majority of asthma respondents (61.9%) reported currently taking prescription medications to control or treat their condition. Short-acting $\beta 2$ agonists (SABA) were the most commonly used class of drugs (38.5%), along with ICS/LABA (17.2%) and ICS (12.3%). Approximately 32.4% of asthma patients were considered totally adherent to their treatment regimens. Asthma-related variables were examined for all respondents with self-reported asthma diagnosis in Table 3.

Multivariable analyses

After controlling for covariates, patients with asthma presented lower health-related QoL in the mental (mean 43.8 *versus* 46.5), physical (48.2 *versus* 51.6), and health utility score (0.66 *versus* 0, 71) components; they also had more frequent visits to HCPs (6.1 *versus* 4.2), and to the ER (1.0 *versus* 0.5) as well as hospitalizations (0.4 *versus* 0.2) than the control group in the 6 months prior to the study (all $p < 0.005$). Rates of absenteeism and presenteeism varied between 11.5% and 7.4% ($p < 0.05$) and 30.4% and 20.9% ($p < 0.001$) between patients and control group, respectively. See Table 4 for full results of these multivariable analyses.

Discussion

Asthma represents a significant humanistic and economic burden. It is not only associated with patient-specific impairments, but also with significant costs to society. Asthma is a burden to the healthcare system, the work productivity of patients, as well as to their QoL (3). Results from this study demonstrate the burden of asthma in Brazil and point to a host of likely negative health outcomes for this population.

Asthma patients in Brazil, similar to other parts of the world (21), have relatively poor health-related QoL. These patients are affected not only by the physical consequences of asthma, but also by the mental health consequences associated with asthma that arise from the burden of living with chronic symptoms. They suffer both within the workplace (e.g., absenteeism, presenteeism,

Table 3. Descriptive for asthma-related variables for all respondents with asthma diagnosis.

	Asthma respondents $N = 494$
Years diagnosed with asthma	
N	447
Mean ± SD	19.07 ± 15.01
Asthma Control Test (ACT) Score	
N	494
Mean ± SD	18.48 ± 4.96
Asthma Control Test (ACT) Score (categorical)	
19 or less (not well controlled) (%)	253 (51.2%)
20–24 (well controlled) (%)	180 (36.4%)
25 (total control) (%)	61 (12.3%)
Take asthma medications	
No (%)	188 (38.1%)
Yes (%)	306 (61.9%)
Adherence to asthma medications (MGLS; 0 = non-adherent to 4 = fully adherent)	
N	306
Mean ± SD	2.61 ± 1.23
Adherence to asthma medications (MGLS; categorical)	
Not fully adherent (<4) (%)	207 (67.6%)
Fully adherent (4) (%)	99 (32.4%)
Medication class: SABA	
No (%)	304 (61.5%)
Yes (%)	190 (38.5%)
Medication class: ICS	
No (%)	433 (87.7%)
Yes (%)	61 (12.3%)
Medication class: LABA	
No (%)	486 (98.4%)
Yes (%)	8 (1.6%)
Medication class: ICS/LABA	
No (%)	409 (82.8%)
Yes (%)	85 (17.2%)
Medication class: SAMA	
No (%)	428 (86.6%)
Yes (%)	66 (13.4%)
Medication class: SAMA/SABA	
No (%)	439 (88.9%)
Yes (%)	55 (11.1%)
Medication class: Antileukotriene	
No (%)	482 (97.6%)
Yes (%)	12 (2.4%)
Medication class: Methylxanthines	
No (%)	465 (94.1%)
Yes (%)	29 (5.9%)
Medication class: LAMA	
No (%)	486 (98.4%)
Yes (%)	8 (1.6%)
Medication class: IgE blocker	
No (%)	489 (99.0%)
Yes (%)	5 (1.0%)

SD = SD: standard deviation; MGLS = Morisky Green Levine Medication Adherence Scale; SABA = Short-Acting Beta Agonists; LABA = Long-Acting Beta-Agonists; ICS = Inhaled Corticosteroids; SAMA = Short-Acting Muscarinic Agonists; LAMA = Long-Acting Muscarinic-Agonists.

and overall work impairment) and outside of the workplace (e.g., impairment completing regular daily activities). This results in asthma patients placing a significant burden on the healthcare system in Brazil, with frequent HCP visits, ER visits, and hospitalizations. Asthma patients and payers in Brazil would benefit from treatment options that help to reduce this burden and associated costs.

Recently, a descriptive study demonstrated that 2,047 people had asthma-related deaths in Brazil (5 deaths/day), with more than 120,000 asthma-related hospitalizations in 2013. Although the numbers of asthma-related deaths and hospital admissions in Brazil have been decreasing from 2008 until 2013 – 10% and 36%, respectively – the absolute numbers are still high, resulting in elevated direct and indirect costs for society (22).

At present, there are several different strategies to treat asthma in Brazil. However, there is a preponderance of SABA use, typically used as "rescue" medication to provide quick relief of asthma symptoms which were also observed in our study. However, treatment with regular doses of ICS alone or in combination with long-acting bronchodilators (LABA) is highly effective in reducing the symptoms and the risk of exacerbations of the disease (23). This suggests that asthma patients in Brazil may need better asthma control and that they should be put on control medication more often, to mitigate the need for rescue medication. Our study noted that most of the asthma patients in this study reported poor control of their asthma and less than one third of them self-reported that they were fully adherent to their treatment regimens. Indeed, poor adherence to maintenance pharmacotherapy is a reality in asthma. Studies confirm that when symptoms worsen, most patients increase SABA use, instead of using controller medication. This behavior might be attributable to several paradoxes in the current treatment paradigm as mild asthma (global initiative for asthma (GINA)-step 1) recommended use of a SABA bronchodilator alone, despite the fact that asthma is a chronic inflammatory disease (23, 24), which may be addressed by an anti-inflammatory reliever approach that combines an ICS and fast-acting LABA instead of SABA monotherapy as a reliever therapy).

Future studies should investigate new approaches to treating asthma in Brazil and globally. These studies would be well-advised to focus not only on the implementation of new pharmaceutical treatments designed to alleviate the physical symptoms of asthma, but also on the implementation of techniques that help to reduce the psychological burdens of this condition. Asthma patients need to feel "in control" of their disease. Achieving this goal will require the implementation of effective physiological and psychological treatments. This means that prescribers will need to have better discussions with their patients to prescribe the best treatment option for each individual.

This study has several limitations. Data from the Brazil NHWS are self-reported and cross-sectional in nature, and statements about causality cannot be made from the study results. Also, respondents may not recollect some data correctly.

Table 4. Health-related quality of life, healthcare resource use, WPAI, and labor force participation by asthma diagnosis, after controlling for covariates.

Dependent variable	Asthma DX	Adjusted mean	SE	95% LCL	95% UCL	*P* Value
SF-36v2: Mental component summary	Asthma DX	43.76	0.451	42.88	44.65	<0.0001
SF-36v2: Mental component summary	Non-Asthma DX	46.55	0.093	46.37	46.73	
SF-36v2: Physical component summary	Asthma DX	48.17	0.343	47.49	48.84	<0.0001
SF-36v2: Physical component summary	Non-Asthma DX	51.58	0.071	51.44	51.72	
SF6D: Health state utility score	Asthma DX	0.66	0.006	0.65	0.67	<0.0001
SF6D: Health state utility score	Non-Asthma DX	0.71	0.001	0.70	0.71	
Healthcare provider visits in past 6 months	Asthma DX	6.11	0.378	5.41	6.89	<0.0001
Healthcare provider visits in past 6 months	Non-Asthma DX	4.16	0.055	4.06	4.27	
ER visits in the past 6 months	Asthma DX	1.03	0.168	0.75	1.42	<0.0001
ER visits in the past 6 months	Non-Asthma DX	0.54	0.020	0.50	0.58	
Hospitalizations in the past 6 months	Asthma DX	0.42	0.096	0.27	0.66	0.0047
Hospitalizations in the past 6 months	Non-Asthma DX	0.22	0.012	0.20	0.24	
Absenteeism %*	Asthma DX	11.51	1.582	8.79	15.07	0.0015
Absenteeism %*	Non-Asthma DX	7.37	0.226	6.94	7.83	
Presenteeism %*	Asthma DX	30.41	2.200	26.39	35.04	<0.0001
Presenteeism %*	Non-Asthma DX	20.88	0.338	20.23	21.55	
Overall work impairment %*	Asthma DX	36.03	2.462	31.52	41.20	<0.0001
Overall work impairment %*	Non-Asthma DX	24.75	0.377	24.03	25.50	
Activity impairment %	Asthma DX	33.20	1.841	29.78	37.01	<0.0001
Activity impairment %	Non-Asthma DX	23.55	0.269	23.03	24.09	

Included all covariates that are significant at 0.10 level in Table 1 demographics for all participants by asthma diagnosis (Age, Sex, University Education, Employment status, Socioeconomic status, Insurance type, Alcohol use, and Charlson comorbidity index).
*Questions only applicable to those working full-time, part-time, or self-employed: Asthma dx = 347 and non-asthma controls = 7,259.
Note: Socioeconomic status C1, C2, D, and E were collapsed into one group for all analyses due to relatively small sample sizes in the D ($n = 200$) and E ($n = 17$) groups.

Conclusion

Asthma had a negative association on health-related QoL, work productivity, and use of healthcare resources. Excessive use of short-acting $\beta 2$ agonists and poor treatment adherence reflect poor asthma control and suggest the need to implement new strategies for asthma treatment in Brazil. The excessive use of SABA and low adherence to prescription medication can be associated with the poor control of asthma among the respondents of the survey. These results suggest that new strategies aiming the improvement of adherence and the reduction of rescue medicine could result in better asthma management and control.

Conflict of interest

The Brazil NHWS is a survey conducted by Kantar Health. Eloisa de Sá Moreira, Guilherme Silva Julian, Shaloo Gupta and Vicky W Li are full-time employees of Kantar Health during the conduct of the study. AstraZeneca purchased access to the Brazil NHWS data and funded the analysis and preparation of this manuscript. Marcio Penha is a full-time employee of AstraZeneca. Jose Eduardo Delfini Cançado in the last 5 years participated in activities sponsored by the pharmaceutical companies: Achè, AstraZeneca, Boehringer-Ingelheim, Chiesi, GSK, Mantecorp, Novartis and Pfizer. He is also the partner owner of Rede Drogal Farmacêutica Ltda.

Funding

This work was funded by AstraZeneca Brazil.

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