



Burden of disease associated with asthma among the adult general population of five Middle Eastern countries: Results of the SNAPSHOT program

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ABSTRACT

Background: Asthma affects millions worldwide resulting in a significant disease burden. However, data on asthma burden from the Middle East is limited. This analysis describes the asthma burden in Egypt, Turkey and a Gulf cluster (Kuwait, Saudi Arabia and United Arab Emirates) as part of the SNAPSHOT program.

Methods: SNAPSHOT was an observational, cross-sectional program carried out by telephone in a random sample of the adult general population of the five above mentioned countries. Quotas were defined per country demographics. Subjects were considered to have asthma if they fulfilled the screening criteria, based on the global Asthma Insights and Reality studies. Data collected included demographics, physician consultations, and asthma control (measured by the Asthma Control Test; ACT). Quality of life was assessed using the EuroQol Five-Dimension questionnaire (EQ-5D); and limitations to daily activities using the modified Sheehan Disability Scale (SDS).

Results: 939 subjects answered questions related to asthma burden. Overall, 367 (44.2%) reported uncontrolled asthma (ACT ≤ 19), and reported significantly lower EQ-5D-3L utility values (0.6 ± 0.4) and EQ-VAS scores (60.7 ± 24.2) compared to controlled subjects (0.8 ± 0.3 and 75.3 ± 19.8 respectively) ($p < 0.0001$). A significantly higher proportion with uncontrolled asthma also reported experiencing impact on activities of daily living compared to subjects with controlled asthma ($p < 0.0001$). Overall, 355 (37.8%) asthma subjects were followed by a physician. However, most visits were unscheduled (695/78.0%).

Conclusion: Uncontrolled asthma imposes a significant burden in these Middle Eastern countries resulting in increased frequency of healthcare use, lower quality of life, and a higher impact on daily life compared to controlled asthma.

1. Introduction

Asthma is a serious public health challenge, affecting millions worldwide, placing an increasing burden on governments, healthcare infrastructure, families, patients and caregivers. Data from the 2013 Global Burden of Disease (GBD) study estimates that worldwide approximately 489,000 people died from asthma in 2013 [1], and the

number of disability-adjusted life years (DALYs) lost due to asthma was over 22 million, which translates to almost 1% of all DALYs lost [2]. Accurate data on the prevalence and disease burden of asthma is essential to implement effective strategies to address this growing problem.

Asthma is known to have a profound impact on quality of life, not only due to its physical effects, (such as discomfort from symptoms,

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night time awakenings and impaired physical activity), but also its psychological and social effects, such as increased levels of anxiety or depression and limitations on work/school and social life [3]. The guidelines for asthma management published by the Global Initiative for Asthma (GINA) define the primary long-term goal to be the achievement of asthma control. This consists of two domains: optimising the day-to-day control of the disease and minimising the risk of poor future outcomes [4]. Uncontrolled or undertreated asthma imposes a far greater burden in terms of frequency of healthcare use, quality of life and productivity, than that which is well-controlled and properly treated [5–7]. Strategies towards improving access to care and medication, patient education and adherence to treatment, as well as the continued development of more effective or convenient therapies can help reduce the burden of asthma globally [3]. Training of healthcare professionals and improved implementation of asthma management guidelines are an essential part of successfully managing asthma and promoting the delivery of quality asthma care. GINA published a major revision to the guidelines for the management and prevention of asthma in 2014 [8] and has recently released an update [4]. However, uptake of guidelines is generally considered to be poor and many patients remain poorly controlled despite the availability of effective treatments.

Recent data on the disease burden attributable to asthma in the Middle East are scarce, despite the widely-acknowledged impact of this disease on the daily lives of people with asthma. The Asthma Insights and Reality (AIR) surveys have been conducted in many countries worldwide, including several countries in the Middle East and North Africa (MENA) region, with the aim of assessing prevalence, symptom severity, control and management of the disease with respect to the GINA guidelines [9]. The Asthma Insights and Reality in Turkey (AIRET) study was conducted in 2005 [10]. The Asthma Insights and Reality in the Gulf and Near East (AIRGNE) study was conducted in 2008 and covered five countries: Jordan, Kuwait, Lebanon, Oman and the United Arab Emirates (UAE) [11]. The Asthma Insights and Reality in the Maghreb (AIRMAG) study was also conducted in 2008 in the North African countries of Algeria, Morocco and Tunisia [12,13]. In addition, a national household survey was conducted in Saudi Arabia in 2013 [14]. These studies reported a low level of asthma control resulting in a significant impact on the lives of those with the disease and/or on healthcare resources. The findings of these studies indicate that improved levels of asthma control are required, and identify better implementation of the treatment guidelines and improving patient education as potential areas for improvement.

SNAPSHOT is a cross-sectional, observational, population based program in adults that investigates the burden of disease associated with asthma in five countries in the Middle East using an identical methodology; the impact of asthma on quality of life and daily activities, and the increased burden due to uncontrolled disease. This information will help to inform strategies to address this growing problem and ultimately to reduce the burden of asthma in the region.

2. Methods

2.1. Summary of the SNAPSHOT protocol

The SNAPSHOT program was a multi-country, cross-sectional, observational study conducted in a random sample of the adult general population of five countries (Egypt, Turkey, Kuwait, Saudi Arabia, and the UAE) between July 2014 and February 2016. The objective of the SNAPSHOT program was to provide updated epidemiological data on the prevalence, burden of disease, quality of life and healthcare resource use attributed to four chronic diseases in the participating countries, namely: asthma, allergic rhinitis, bipolar disorder and benign prostatic hyperplasia (BPH). The complete methodology and study rationale have been described in detail elsewhere [15].

The program was conducted over the telephone and carried out by

computer-assisted personal interviewing (CAPI) with the information collected via web-based electronic data capture. A target sample of 10,000 subjects from the adult general population of Turkey and Egypt and 15,000 for the Gulf cluster (comprised of Kuwait, Saudi Arabia and the UAE) was defined based on country demographics in terms of age and gender, using the most recent census data, using a random stratified sampling method. In the Gulf cluster, it was difficult to reach the target sample size, and since the combined number of interviews conducted to date in Saudi Arabia, Kuwait and UAE showed that the study objectives could be achieved from a sample size perspective recruitment was stopped in February 2016 and the database locked on 11th April 2016.

Subjects who agreed to participate in the study were first invited to complete the screening questionnaire to identify subjects fulfilling the criteria for the diseases of interest and to document social and demographic characteristics, as well as the presence of co-morbidities. Respondents who met the criteria for one or more diseases were invited to continue the interview by replying to a detailed, disease specific questionnaire. This questionnaire collected additional information on burden of disease, disease management and healthcare resource utilisation. If respondents screened positive for more than one disease, they were randomised by the CAPI system to respond to only one of the disease-specific questionnaires, to limit the duration of the interview. For all subjects, the interview ended with the EuroQoL Five-Dimension questionnaire (EQ-5D) (©EuroQol Research Foundation. EQ-5D™ is a trade mark of the EuroQol Research Foundation) [16,17]. The full interview was conducted in one telephone call. Interviews were proposed in Arabic, English or Turkish using translated validated questionnaires and conducted by trained staff of local specialised CROs; Omega (Turkey) for interviews in Turkey and Infomine Healthcare Research (Egypt) for interviews in the Arabic-speaking countries. Data management and analysis were performed by MS Health (Morocco).

2.2. Data collected for this analysis

The analysis presented here focuses solely on asthma and aims to provide information on the burden of this disease across the countries studied. The case definition used for asthma was based on the criteria used in the global AIR studies [9]. As part of the screening questionnaire, subjects were asked whether they had been told by their doctor that they suffer from asthma; whether they had experienced one of the following symptoms over the last 12 months: wheezing, nocturnal coughing, chest tightness or breathlessness; whether they had experienced an asthma attack in the last 12 months; whether they had used asthma medications in the last 12 months and whether they used Ventolin or inhaled bronchodilators or a short acting β agonist in the last 12 months. A positive answer to any of the latter three questions led to classification of the interviewee as a subject with asthma. It is important to note that the criteria were designed to collect information on the current prevalence (last 12 months) and not the lifetime prevalence of the disease. Details about symptoms, level of asthma control, healthcare resource use and the impact of asthma on daily activities and quality of life were collected.

Control of asthma was assessed using the Asthma Control Test (ACT); a five-item patient reported outcome measure for the assessment of asthma control. A score > 19 indicates controlled asthma; a score ≤ 19 indicates asthma that is not controlled [18]. The ACT has been validated in studies in both Turkish [19] and Arabic [20]. Daily activities were assessed using a modified version of the Sheehan Disability Scale (SDS). This is a patient reported outcome measure for assessing impairment of functioning in daily activities. Three functional areas of daily life are considered in this questionnaire: work / school life; social life / leisure activities and family life / home responsibilities (the SDS was used with the permission of the SDS copyright holder Professor DV Sheehan. © Sheehan DV 1996 & 2008 & 2016) [21,22]. For this analysis, the timeframe used to assess symptom impact was 'over the past

12 months' and the scale was scored on a five point Likert scale. The response options used were 'not at all / mildly / moderately / markedly / extremely'. During the analysis of the results, when a subject was asked whether their asthma disrupted each of these functional areas a subject answering 'not at all' was classified as 'no' and a subject answering 'mildly/moderately/markedly/extremely' was classified as 'yes'. Quality of life was assessed using the three-level EuroQol Five-Dimension questionnaire (EQ-5D-3L), a standardised questionnaire used to measure health-related quality of life, consisting of a descriptive profile covering five areas (mobility, self-care, usual activities, pain or discomfort and depression or anxiety) and a single index for health status scored on a visual analogue scale (VAS) [16,17]. Subjects were also asked how frequently they consulted a physician for their asthma in the last 12 months. Responses were classified as not seeking healthcare (never); occasionally seeking healthcare (once or every three to six months); and frequently seeking healthcare (every two months or more).

2.3. Statistical analysis

The data presented here are for the asthma population of 2124 subjects who accepted to participate in the study, completed all the screening questionnaires and were identified as subjects with asthma. Categorical and ordinal variables are presented as frequency counts with percentages and 95% Confidence Intervals (CI) when appropriate. Continuous variables are presented as mean values with standard deviation. Potential associations between categorical variables were tested using the χ^2 test and the Kruskal-Wallis test was used for continuous variables. A two-sided probability threshold of 0.05 was considered as statistically significant. All statistical analyses were performed using SAS® Version 9.4 (SAS, Cary, USA).

2.4. Ethics

The program followed Guidelines for Good Epidemiological Practice (GEP) and pertinent local rules and regulations for each participating country. The protocol and amendments were submitted to the appropriate independent ethics committee in each country for approval. The following ethics committees approved the SNAPSHOT program: In Egypt, the Ministry of Health and Population, Central Directorate for Research and Health Development; In Kuwait, the Kuwait University Health Sciences Centre Ethical Committee; in Turkey, Ankara University Medical Faculty Ethics Committee; and in the UAE, the Ethics and Research Committee of the University of Sharjah. In Saudi Arabia, no ethics approval was required, since SNAPSHOT was an epidemiological, cross sectional, population based program and as such is out of scope of the Saudi Food and Drug Authority (SFDA) approval and/or notification. The SNAPSHOT program was conducted via telephone. At the start of the telephone call, subjects were asked to provide verbal consent to participate, and this was recorded in the CAPI system by the interviewee. No financial incentive to participate was offered to subjects and it was not possible to link the telephone number dialled and the respondent's data in the program database. All data collected was kept confidential and anonymous.

3. Results

3.1. Program population

Overall, 33,486 subjects completed the screening questionnaire. Of these, 2124 subjects fulfilled the case definition for asthma and 939 (44.2%) completed the detailed asthma questionnaire and constituted the asthma population used to investigate the burden of disease; the results of which are the subject of this manuscript. The comparison of demographics for the responders and non-responders can be seen in Table 1.

Table 1

Demographics of the overall asthma population (n = 2124), comparing those subjects that responded to the detailed asthma questionnaire (n = 939) with those that did not respond (n = 1185).

Variable		Overall (n = 2124)	
		Responders n = 939	Non-responders n = 1185
Gender n (%)	Count	939	1185
	Men	399 (42.5)	600 (50.6)
	Women	540 (57.5)	585 (49.4)
Age group n (%)	Count	939	1185
	18-34 years	385 (41.0)	481 (40.6)
	35-49 years	273 (29.1)	392 (33.1)
	≥ 50 years	281 (29.9)	312 (26.3)
BMI n (%)	Count	894	1037
	Underweight	23 (2.6)	40 (3.9)
	Normal weight	252 (28.2)	312 (30.1)
	Overweight	312 (34.9)	333 (32.1)
	Obese	307 (34.3)	352 (33.9)
Smoking status n (%)	Count	938	1135
	Non-smoker	599 (63.9)	779 (68.6)
	Smoker or former smoker	339 (36.1)	356 (31.4)

3.2. Symptoms reported at asthma diagnosis

Subjects (n = 939) reported a range of symptoms present at asthma diagnosis; the most commonly reported being: chest tightness (64.7%), followed by breathlessness (62.1%), and wheezing (57.9%). The range of symptoms reported is shown in Fig. 1.

3.3. Asthma control

Overall 44.2% (n = 367) of subjects with asthma reported that their asthma was uncontrolled (ACT ≤ 19). At a country level, a significantly higher percentage of asthma subjects in Egypt (56.2%; n = 136) had uncontrolled asthma compared to the Gulf cluster (38.2%; n = 99) and Turkey (40.0%; n = 132) ($p < 0.0001$). These results are shown in Table 2.

3.4. Impact of asthma on quality of life and daily activities

The overall EQ-5D-3L utility value and EQ-VAS score in the asthma population was 0.75 (± 0.33) and 68.85 (± 22.96) respectively. At a country level, the Gulf cluster reported a higher mean EQ-5D-3L utility value and EQ-VAS score than Egypt and Turkey (Table 3). Overall, almost 50% of subjects reported some disruption to their work/school, social life / leisure activities and family life / home responsibilities. Fewer subjects in the Gulf cluster reported disruption to all aspects of daily life compared to Egypt and Turkey (Table 3). Overall, subjects reported being absent from school/work for 13.9 (± 42.0) days and unproductive for 17.1 (± 49.2) days.

3.5. Healthcare sought by subjects with asthma

Overall 37.8% (n = 355) of subjects were followed by a physician for their asthma; approximately one third in Egypt and the Gulf cluster (32.1% and 30.0% respectively), and almost half (49.3%; n = 173) in Turkey ($p < 0.0001$). Overall, the majority (78.0%; n = 695) of consultations were not scheduled. At a country level, very few consultations were scheduled visits in Egypt and the Gulf cluster (11.8% and 13.1% respectively). However, in Turkey over a third of the consultations were scheduled (39.0%) ($p < 0.0001$). These results are shown in Table 4.

In the last 12 months, most subjects (56.2%; n = 514) described themselves as occasionally seeking healthcare. Only 14.1% (n = 129)

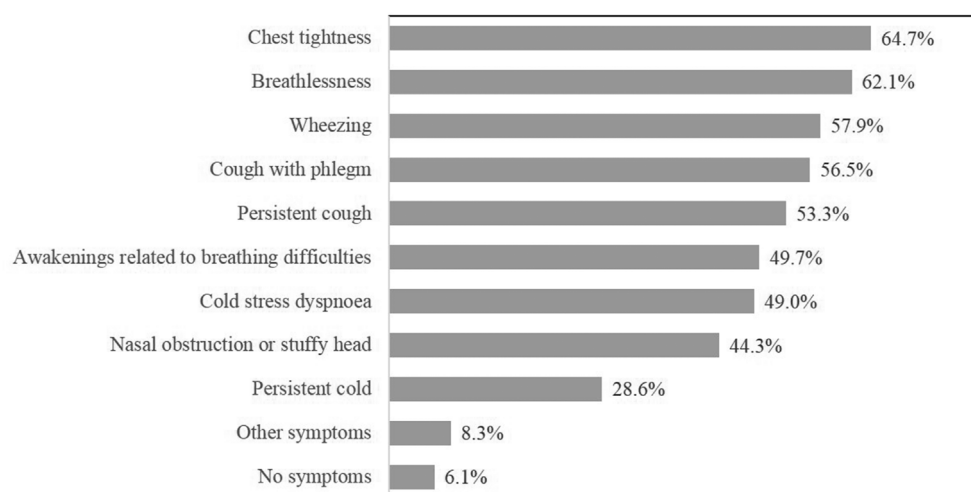


Fig. 1. Initial symptoms of asthma reported by the asthma population. Subjects ($n = 939$) were asked to describe the symptoms that led to a physician consultation when the initial asthma diagnosis was confirmed and whether any other symptoms were apparent at that time.

Table 2

Level of asthma control reported by the study population. Asthma control was measured using the Asthma Control Test (ACT), by country and overall; p values were calculated using the χ^2 test.

	Overall n = 939	Egypt n = 277	Gulf cluster n = 310	Turkey n = 352	P-value
Count	831	242	259	330	< 0.0001
Uncontrolled asthma (≤ 19) n (%)	367 (44.2)	136 (56.2)	99 (38.2)	132 (40.0)	
Controlled asthma (> 19) n (%)	464 (55.8)	106 (43.8)	160 (61.8)	198 (60.0)	

frequently sought healthcare and 29.4% ($n = 269$) did not seek healthcare at all. However, although the trend remained the same in each country/cluster, Turkey reported a significantly higher proportion of subjects occasionally seeking healthcare (67.2%; $n = 229$) and significantly fewer subjects who did not seek healthcare (20.2%; $n = 69$) ($p < 0.0001$) than the other countries studied. These results are shown in Table 4.

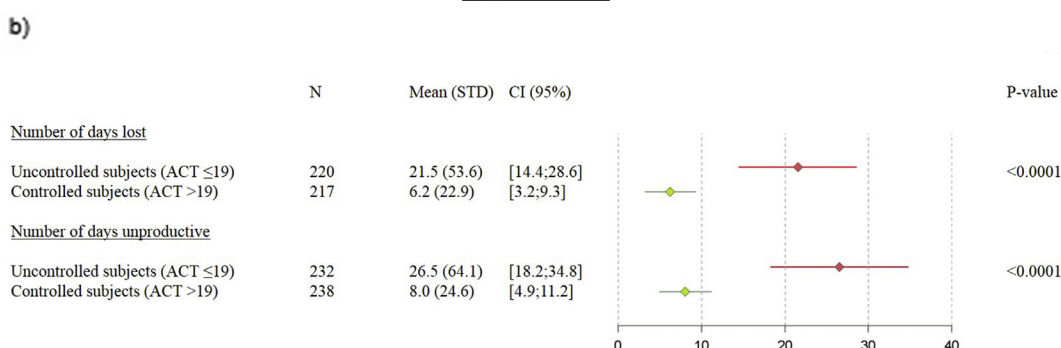
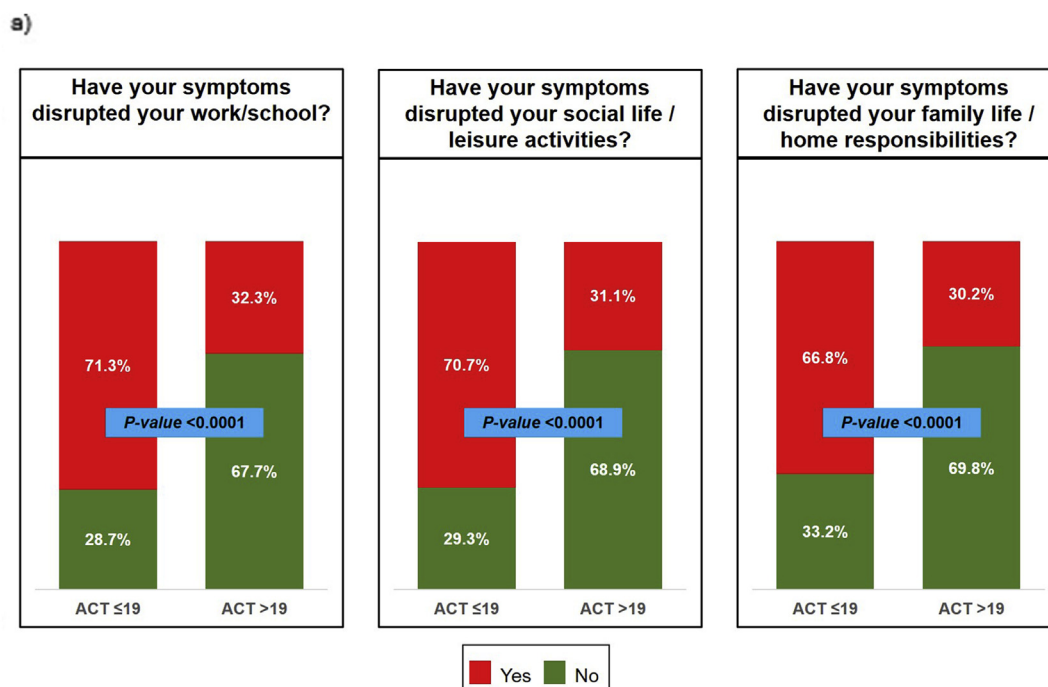
Table 3

Quality of life and impact of asthma on daily activities reported by the asthma population ($n = 939$). Quality of life was measured using the EQ-5D-3L questionnaire and described using the reported EQ-5D-3L utility value and EQ-VAS scores ($^{\circ}$ EuroQol Research Foundation. EQ-5DTM is a trade mark of the EuroQol Research Foundation). Impact on daily activities was measured using the modified Sheehan Disability Scale (SDS). ($^{\circ}$ Sheehan DV 1996 & 2008 & 2016).

		Overall n = 939	Egypt n = 569	Gulf cluster n = 866	Turkey n = 366	P-value
EQ-5D-3L Utility Value	Count	806	235	253	318	< 0.0001
	Mean ($\pm$ STD)	0.75 ($\pm$ 0.33)	0.73 ($\pm$ 0.38)	0.85 ($\pm$ 0.25)	0.68 ($\pm$ 0.33)	
EQ-VAS Score	Count	793	235	253	305	< 0.0001
	Mean ($\pm$ STD)	68.85 ($\pm$ 22.96)	67.43 ($\pm$ 23.62)	78.58 ($\pm$ 19.59)	61.86 ($\pm$ 22.27)	
Have your symptoms disrupted your work/school?	Count	827	237	256	334	0.0028
	No	419 (50.67%)	104 (43.88%)	151 (58.98%)	164 (49.1%)	
	Yes	408 (49.33%)	133 (56.12%)	105 (41.02%)	170 (50.9%)	< 0.00001
	Count	826	237	256	333	
Have your symptoms disrupted your social life / leisure activities?	No	426 (51.57%)	107 (45.15%)	165 (64.45%)	154 (46.25%)	< 0.00001
	Yes	400 (48.43%)	130 (54.85%)	91 (35.55%)	179 (53.75%)	
Have your symptoms disrupted your family life/home responsibilities?	Count	821	235	255	331	< 0.0001
	No	442 (53.84%)	115 (48.94%)	169 (66.27%)	158 (47.73%)	
	Yes	379 (46.16%)	120 (51.06%)	86 (33.73%)	173 (52.27%)	< 0.0001
	Count	437	168	183	86	
On how many days in the past 12 months did your symptoms cause you to miss work/school or be unable to carry out your normal daily responsibilities?	Mean ($\pm$ STD)	13.9 ($\pm$ 42.0)	23.7 ($\pm$ 59.2)	6.7 ($\pm$ 21.2)	10.1 ($\pm$ 29.3)	< 0.0001
	Count	470	180	203	87	
On how many days in the past 12 months did you feel so impaired by your symptoms, that even though you went to work/school, your productivity was reduced?	Mean ($\pm$ STD)	17.1 ($\pm$ 49.2)	25.4 ($\pm$ 61.9)	12.1 ($\pm$ 41.9)	11.9 ($\pm$ 29.2)	< 0.0001

Table 4Type and frequency of physician consultation by country and overall; p values were calculated using the χ^2 test.

		Overall n = 939	Egypt n = 277	Gulf cluster n = 310	Turkey n = 352	P value
No. of subjects followed by a physician	Count	938	277	310	351	< 0.0001
	Yes	355 (37.8%)	89 (32.1%)	93 (30.0%)	173 (49.3%)	
Type of visit	Count	892	271	298	323	< 0.0001
	Scheduled	197 (22.1%)	32 (11.8%)	39 (13.1%)	126 (39.0%)	
Frequency of consultation	Unscheduled	695 (78.0%)	239 (88.2%)	259 (86.9%)	197 (61.0%)	< 0.0001
	Count	914	272	301	341	
	Do not seek	269 (29.4%)	90 (33.1%)	110 (36.5%)	69 (20.2%)	< 0.0001
	Occasionally seek	514 (56.2%)	138 (50.7%)	147 (48.8%)	229 (67.2%)	
	Frequently seek	129 (14.1%)	44 (16.2%)	44 (14.6%)	41 (12.6%)	

**Fig. 2.** Correlation between asthma control test (ACT) score and disease impact. a) The proportion of subjects reporting disruption to their daily activities by disease control; p -values were calculated using the χ^2 test b) Number of days lost or unproductive by disease control; p -values were calculated using the Kruskal Wallis test.

days significantly higher (26.5 ± 64.1) than those whose asthma was controlled (8.0 ± 24.6) ($p < 0.0001$). These data are presented in Fig. 2b.

3.7. Impact of asthma control on quality of life

Subjects with controlled asthma (ACT score > 19) had a significantly higher ($p < 0.0001$) EQ-VAS score (75.3 ± 19.8) than those with uncontrolled asthma (60.7 ± 24.2), and a significantly higher ($p < 0.0001$) EQ-5D-3L utility value (0.8 ± 0.3) than those with uncontrolled asthma (0.6 ± 0.4). This trend was applicable across all countries and the cluster of countries studied. The results are shown in

Fig. 3.

3.8. Impact of asthma control on frequency of physician consultation

In Egypt, 79.0% of those who frequently sought healthcare reported uncontrolled asthma compared to only 46.9% of those who did not seek healthcare ($p = 0.0044$). In the Gulf cluster 72.2% of those who frequently sought healthcare had uncontrolled asthma compared to 26.3% of those who did not seek healthcare ($p < 0.0001$). In Turkey, the difference was less pronounced with 57.5% of subjects who frequently sought healthcare exhibiting uncontrolled asthma compared to only 34.9% of those who did not seek healthcare ($p = 0.0530$). These results

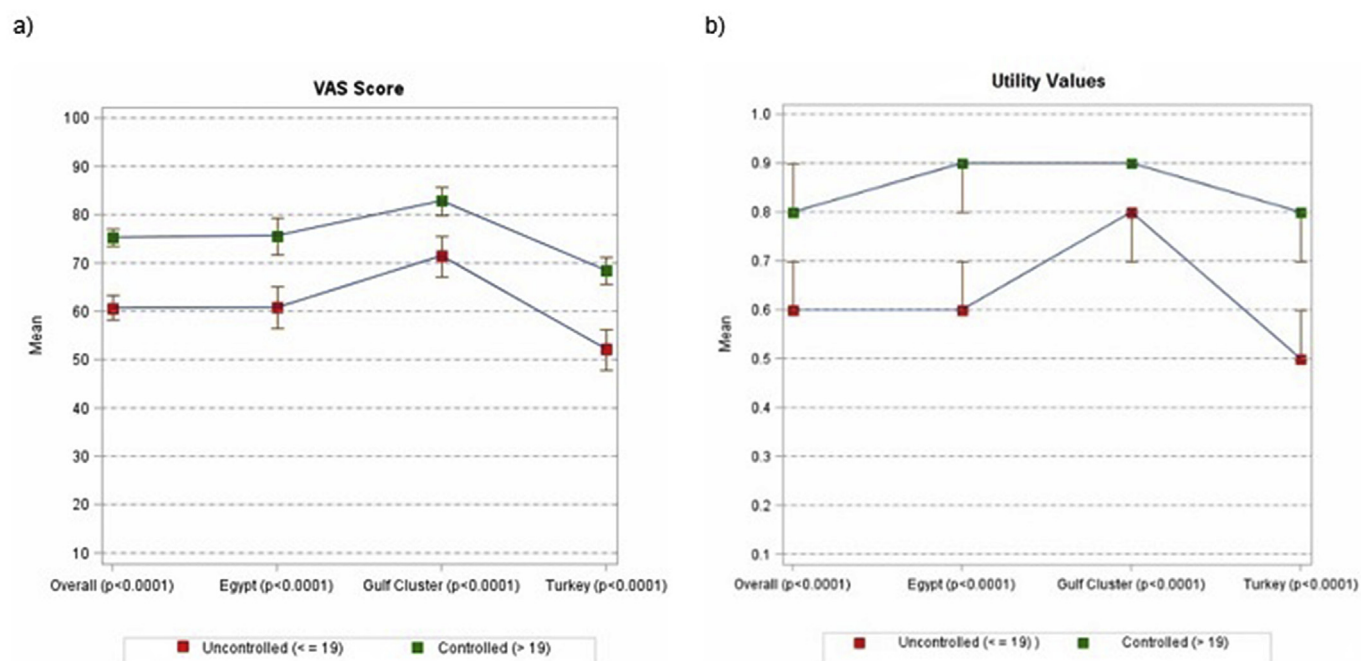


Fig. 3. Impact of asthma control, measured by the Asthma Control Test (ACT) on quality of life, measured by the three-level EuroQol Five-Dimension questionnaire (EQ-5D-3L). a) Comparison of the mean EQ-VAS score between those subjects whose asthma is under control and those with uncontrolled asthma. The mean EQ-VAS score with the 95% CI is presented for each country b) Comparison of the mean EQ-5D-3L utility value between those subjects whose asthma is under control and those with uncontrolled asthma. The mean EQ-5D-3L utility value with the 95% CI is presented for each country. The p -values were calculated using the Kruskal–Wallis test.

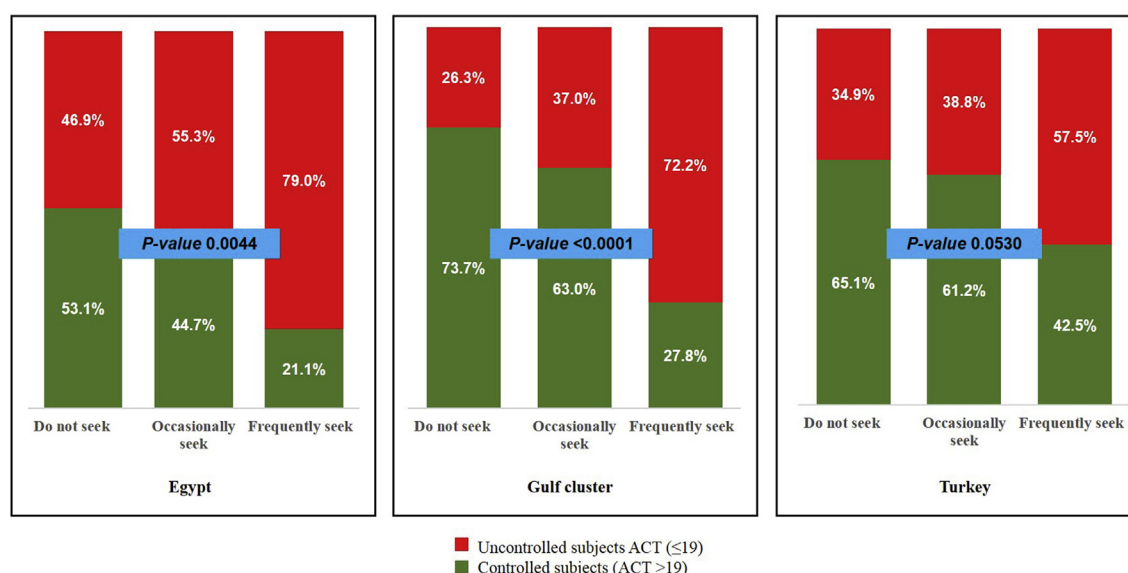


Fig. 4. Impact of asthma control on frequency of physician consultation. Proportion of controlled (ACT > 19) and uncontrolled subjects (ACT ≤ 19) by country/cluster and frequency of physician consultation; the p -values were calculated using the χ^2 test.

are presented in Fig. 4.

4. Discussion

This study reports that the burden of disease attributable to asthma in the five countries studied is considerable. Many subjects were seeking healthcare and a high proportion reported that their asthma remained uncontrolled. The disease burden is amplified in those with uncontrolled asthma; subjects with controlled asthma reported fewer physician visits than those with uncontrolled disease, and asthma control was found to have a positive impact on quality of life and

disability with respect to the activities of daily living.

The overall SNAPSHOT program population was 33,486 screened subjects of whom 2124 screened positively for asthma. As per the study design, approximately 85% of subjects began the detailed asthma questionnaire, therefore the initial participation rate was high. However, a proportion of those eligible did not complete the entire questionnaire; 939 subjects provided all the requested information and completed the questionnaire, thus constituting the study population (a completion rate of 44.2%). This could pose a potential risk of inclusion bias. However, a review of the demographics did not reveal major differences between those who did versus did not respond to the

questionnaire. It should also be noted that a conservative approach was used to determine the cut-off for inclusion; only those subjects who successfully completed the entire detailed questionnaire were included in the study population. The drop-out rate could be due, at least in part, to the long questionnaire and therefore lengthy interview process. In addition, the SNAPSHOT program investigated the prevalence and burden of four chronic diseases (asthma, allergic rhinitis, benign, prostatic hyperplasia and bipolar disorder), and a similar drop-out was seen across all four diseases after completion of the screening questionnaire, suggesting that this phenomenon was not restricted only to asthma, again supporting the fact that the length of the interview process may have contributed to the drop out of subjects observed. In addition, whilst the study population represents only 44% of the asthma population, 939 subjects represent a large enough sample size to enable meaningful and statistically relevant conclusions to be drawn from the data.

The primary goal for asthma management as per the GINA guidelines is asthma control, which is achieved through both optimising the day-to-day control of the disease and minimising future outcomes [4]. Data obtained in a clinical trial setting such as the Gaining Optimal Asthma Control (GOAL) study indicate that control as defined by the guidelines is possible using the available therapies [23]. However, it is well documented that a significant number of patients still report uncontrolled asthma despite the availability of effective medication. For example, the multinational International Asthma Patient Insight Research (INSPIRE) study carried out in 11 European countries, reported that half of the patients who took part, all of whom had a physician confirmed diagnosis of asthma and were prescribed regular treatment, had uncontrolled disease [24]. It has frequently been reported over recent years that the level of asthma control routinely achieved falls below the goals for long-term asthma management. Despite increased awareness of the importance of achieving asthma control and the availability of effective treatments, this is an area that remains a problem for effective asthma management. In the United States, data from the Real-world Evaluation of Asthma Control and Treatment (REACT) survey in 2005 reported that 55% of patients surveyed had uncontrolled asthma [25]. Data from the cross-sectional, self-reported, European National Health and Wellness Surveys conducted in France, Germany, Italy, Spain and the UK, report that 53.5% of patients surveyed had uncontrolled asthma in 2010 [7]. More recently, the International cross-sectional and longitudinal assessment on asthma control (LIAISON) study reported that asthma control was suboptimal in 56.5% of patients [26]. The European Community Respiratory Health Survey II (ECRHS II), carried out in 11 European countries, also reported a high proportion of European adults with uncontrolled asthma [27]. Taking this into consideration, it is not unexpected that the SNAPSHOT program revealed that the proportion of subjects with uncontrolled asthma was high across all countries and the cluster of countries studied, and of the same order of magnitude with the published literature.

The fact that uncontrolled asthma leads to increased healthcare utilisation is widely reported in the literature in many regions of the world [28,29]. For example, data from the 2006 U.S. National Health and Wellness Survey reported that subjects with asthma control reported fewer visits to their medical provider [29], and the results of the 2011 Asia-Pacific Asthma Insights and Management (AP-AIM) survey found that subjects with controlled asthma reported significantly fewer visits to a medical provider for their asthma compared to those who were partly controlled or uncontrolled [28]. In line with these findings, data from the SNAPSHOT program in the Middle East indicate that across all countries and the cluster of countries studied, subjects with uncontrolled asthma seek physician consultation more frequently than those whose asthma is controlled. This is intuitive for unscheduled consultations (and most consultations in this study were unscheduled), since a patient whose treatment regimen is keeping symptoms under control is less likely to require consultation, other than for routine check-ups, than a subject with frequent exacerbations. This has been

previously documented in the Middle East and North Africa (MENA) through the AIR studies. The AIRGNE study documented increased hospitalisations and emergency room visits in the Gulf countries as a result of uncontrolled asthma [11] and the AIRMAG study reported an increase in physician consultations for those with uncontrolled asthma in the Maghreb [13].

The SNAPSHOT study also showed that most subjects with asthma in the countries studied, particularly in Egypt and the Gulf cluster (more than two thirds) are not followed by physicians, and the majority (over 80%) of patients seek unscheduled visits which usually reflects poor asthma outcomes. However, over 60% of patients in the Gulf cluster and Turkey have an ACT score > 19 indicating their asthma is under control. One hypothesis is that many of the subjects have mild intermittent disease rather than persistent asthma. As such, many are not followed by a physician since they may only visit a physician when they experience symptoms, which could be infrequently. At the time of answering the questionnaire these subjects may have felt that their symptoms were under control. Interestingly, data from SNAPSHOT reports that in Turkey, more subjects with asthma are followed by a physician, subjects appear to seek healthcare more frequently and are more likely to have scheduled/programmed visits, compared to Egypt and the Gulf cluster. In addition, their asthma is comparatively well-controlled. This could be due to the accessibility of healthcare and the way asthma care is managed in Turkey compared to the other countries studied; such as differences in the balance between primary and secondary care, disparities in the level of patient education, or inequalities in terms of access to care since Turkey now has universal health coverage [30], which is not the case in the other countries studied at the time the study was conducted. It may be reasonable to expect patients with controlled asthma to be well-controlled because they have regular programmed physician visits at which control is assessed and treatment adapted as necessary. However, studies have shown that patients with low asthma control, often do not have their treatment adapted to meet their needs despite regular follow up. A study in France found that most of the patients recruited experienced poor asthma control despite receiving regular maintenance treatment, and remained so during follow-up visits, yet treatment adaptations were very infrequent [31]. Regular, scheduled follow-up visits where asthma control is assessed and therapy is tailored to the individual needs of the patient could improve asthma control in the Middle East and throughout the world.

In addition to the effects of asthma control on healthcare utilisation, it has been documented that uncontrolled asthma leads to a lower quality of life, greater productivity loss and a higher impact on activities of daily living [5,7,32–34]. As expected, the results presented here support this finding, documenting a significant burden of asthma, the extent of which is associated with the level of asthma control. A study in primary care clinics in Spain reported a strong correlation between poor asthma control and lower quality of life measured by the EQ-5D questionnaire [35]. Another study carried out in the Portuguese city of Matosinhos on a random sample of 180 patients over 18 years of age diagnosed with asthma showed a strong correlation between asthma control and quality of life [34]. In addition, the international LIAISON study reported that sub-optimal control was associated with poorer asthma-related quality of life [26]. Data presented here highlight that subjects with uncontrolled asthma report a lower quality of life compared to subjects whose disease is controlled.

Data from the ECRHS II study showed that severity of asthma symptoms was associated with quality of life [36] and burden of disease as measured by reduced activity days and healthcare utilisation [37]. The impact of asthma control on elements of daily living has been assessed in numerous studies such as The Epidemiology and Natural History of Asthma: Outcomes and Treatment Regimens (TENOR) study, which used the Work Productivity and Activity Impairment Questionnaire (WPAI:Asthma) in patients with either severe or difficult-to-treat asthma and reported that uncontrolled asthma correlated with higher impairment [33]. However, the SDS specifically, has been used

in few previous studies to assess the impact of asthma on work/school, social and family life.

It should be noted that the SDS has been modified for use in this study, and data analysis has been discussed with the author of the scale to ensure correct interpretation of the results. The use of the 12 month timeframe for this study, particularly for the questions concerning the number of days lost/unproductive enables the data to be more relevant for governments and healthcare bodies to aid in developing healthcare policy. The questionnaire has been validated for use in face-to-face interviews but was administered by telephone in this study, which should not affect the validity of the data collected. Finally, the questionnaire has been scored on a five point Likert scale as opposed to the scoring methodology used when the questionnaire was developed. The original scale is rated by the respondent from 1 to 10 and the scores are then regrouped into five classes (a score of 0 = not at all, 1–3 = mildly, 4–6 = moderately, 7–9, markedly, 10 = extremely), simplification of the scoring system to the five classes is more suitable for scoring as part of a long telephone interview.

Most of the studies that have used the SDS to assess the impact of asthma on work/school, social and family life have investigated asthma as a co-morbidity of depression [38,39]. A Nigerian study known as the Ibadan Study of Ageing (ISA), carried out in the elderly (over 65 years old) residing in Yoruba-speaking areas of Nigeria, compared the impact of depression on disability with that of common physical conditions, one of which was asthma. This study reported that 13.6% of subjects with asthma rated themselves as severely disabled in any of the four domains of the SDS [40]. In addition, a cross-sectional, observational study investigating the costs associated with workdays lost and healthcare resource use due to asthma, using the SDS, has been conducted in Spain, and consistent with the findings presented here, has shown a significantly higher level of disability in uncontrolled asthma patients compared to those with controlled asthma [41]. The SNAPSHOT study marks the first time the SDS (although a modified version) has been used in the Middle East to assess the impact of asthma and specifically the impact of asthma control on functionality.

SNAPSHOT is a cross-sectional, population-based program with a large sample size using consistent methodology across all countries involved; the screening criteria for asthma were based on the definition used in the global AIR studies; and data on asthma control and the impact of asthma on quality of life were collected using validated questionnaires (ACT, EQ-5D-3L). Limitations of the study include the fact that the survey was telephone based, which could introduce a sampling bias if certain groups do not have access to a telephone, such as those in more remote, rural areas. Also, as described earlier, a number of subjects did not complete the entire detailed asthma questionnaire, possibly due to the lengthy interview process and were therefore excluded from the study population. Furthermore, since the survey was telephone-based, the diagnosis of asthma was not confirmed by a physician. This can make a differential diagnosis of asthma more challenging. In addition, the screening criteria for inclusion in the asthma population did not depend on a subject reporting to have received an asthma diagnosis by a physician but was based primarily on symptoms and treatment, which could lead to an overestimation of prevalence. It is well-known that access to healthcare infrastructure and primary care is lower in the Middle East compared to Europe. Therefore, if the case definition used had restricted inclusion to those subjects who had a confirmed asthma diagnosis by a physician, it would have ignored many subjects with undiagnosed asthma, the proportion of which is thought to be higher in this region compared to Europe. However, as part of the screening questionnaire, subjects were asked whether they had been told by a physician that they had asthma, and of the 939 subjects with asthma who completed the detailed questionnaire, 74.9% (n = 703) had a confirmed asthma diagnosis, providing confidence in the prevalence estimate reported here. There is also the issue of potential contamination of the asthma population with COPD patients since COPD often presents with similar symptoms to

asthma. However, smoking is considered a major risk factor for COPD [42], and the majority (approx. 65%) of the asthma population in this study are non-smokers. In addition, COPD is known to be a progressive disease, the prevalence of which increases with age. It is much more common in those over the age of 50 compared to the younger population [43], and the majority of subjects in the SNAPSHOT asthma population (70%) are below the age of 50. As is the case for all studies that collect data retrospectively, there is a risk of recall bias. However, this is minimised by setting the inclusion criteria for the asthma population based on exacerbations and treatments over the last 12 months as opposed to simple symptom reporting.

In conclusion, to address the burden of disease related to asthma in the Middle East and implement effective healthcare strategies, it is important to have up to date information on the current impact of asthma in the region. The SNAPSHOT asthma study provides current data on the asthma burden in the Middle East, highlighting the improved quality of life and functionality exhibited by asthma subjects as a result of asthma control. However, further research is needed to understand the reason for the high level of uncontrolled disease, as many factors are likely to play a role. These findings reinforce the need for improved asthma control; for strategies to enable physicians to follow the appropriate treatment guidelines; for improved patient education on the benefits of adhering to prescribed treatment regimens; and for caregivers to include improvements to the quality of life of patients as part of their treatment strategy.

5. Declarations

Availability of data and material

Editors can seek information from the corresponding author regarding whether anonymised patient level data can be made available.

Conflict of interest

Abdelkader El Hasnaoui, Fayaz Aziz, and Luqman Tariq are employees of and shareholders in GlaxoSmithKline (GSK), which funded the SNAPSHOT program. Hesham Tarraf is currently also employed by GSK but at the time the program was conducted he participated in his capacity as Professor of medicine and allergy at the University of Cairo. Aaicha Lahlou is a director of MS Health, the clinical and epidemiological research company that implemented this program on behalf of GSK. Adam Doble is a director of Foxymed, a medical communication and consultancy company which participated in the design of the program and the interpretation of the results on behalf of GSK. The authors declare to have no further conflict of interest.

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