Prevalence and predictors of suboptimal control of childhood bronchial asthma: a community-based study in Dekerness District, Egypt

Prevalența și predictorii controlului suboptimal al astmului bronșic la copil: un studiu în comunitate în zona Dekerness, Egipt

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Abstract

Objective. *To estimate the prevalence of suboptimal control of bronchial asthma (BA) among children in Dekerness district, Egypt, and to identify its risk factors in the community setting.*
Population and method. *This is a community-based cross-sectional descriptive study carried out in Dekerness District, Egypt, during a period from May 1, 2016 to April 30, 2017. The targeted population was children aged 2-17 years old, living in the study area. A total of 201 asthmatic children identified in a previous study were included in the current study. Data were collected by a questionnaire completed through direct interview with the mother/caregiver and the child. GINA guidelines were used for the diagnosis of asthma control. Partly and uncontrolled asthma was considered as a suboptimal control.*
Results. *The overall prevalence of suboptimal asthma control was 47.2%. The logistic regression analysis revealed that the independent predictors of suboptimal control are the lack of asthma controller treatment (AOR=2.1), lack of written asthma action plan (AOR=9.8), and using nebulizer therapy (AOR=2.2).*
Conclusions. *Suboptimal asthma control is highly prevalent among children and adolescents in Dekerness District. The use of asthma controller treatment, asthma action plan and the proper use of nebulizer therapy may contribute to a more optimal asthma control.*
Keywords: ***bronchial asthma, suboptimal control, medication adherence, written asthma action plan, nebulizer***

Rezumat

Obiective. *Estimarea prevalenței controlului suboptimal al astmului bronșic la copiii cu astm din zona Dekerness, Egipt, și identificarea factorilor de risc pentru astm în zonă.*
Populație și metodă. *Acesta este un studiu descriptiv, transversal, desfășurat în comunitate, în zona Dekerness, Egipt, în perioada 1 mai 2016 – 30 aprilie 2017. Populația-țintă a fost reprezentată de copii cu vârste între 2 și 17 ani care locuiesc în zona de studiu. Un total de 201 copii astmatici identificați într-un studiu precedent au fost incluși în studiul curent. Datele au fost culese cu ajutorului unui chestionar completat prin interviu direct al mamei sau îngrijitorului copilului. Ghidul GINA a fost folosit pentru diagnosticul controlului astmului. Astmul parțial controlat și cel necontrolat au fost încadrate drept control suboptimal.*
Rezultate. *Prevalența globală a controlului suboptimal a fost de 47,2%. Regresia logistică a identificat ca factori de risc independenți pentru controlul suboptimal al astmului lipsa medicației de control (AOR=2,1), lipsa planului de acțiune scris (AOR=9,8) și utilizarea medicației folosite prin nebulizare (AOR=2,2).*
Concluzii. *Controlul suboptimal al astmului este foarte prevalent printre copiii și adolescenții din zona Dekerness. Folosirea medicației de control al astmului, oferirea unui plan de acțiune scris, precum și folosirea corectă a terapiei prin nebulizator pot contribui la un mai bun control al astmului.*
Cuvinte-cheie: ***astm bronșic, control suboptimal, aderența la medicamente, plan de acțiune în astm, nebulizator***

Introduction

Bronchial asthma (BA) is a public health problem and its prevalence is increasing in all countries, regardless of their level of development, being generally underdiagnosed and undertreated in low-income countries[1]. Asthma is reported as one of the most common chronic diseases in childhood, impairing the quality of life of patients and their families, and incurring high costs to the health care system and society[2].

Achieving asthma control remains an elusive goal for the majority of patients worldwide[3,4]. Although BA cannot be controlled, effective treatments are available to achieve optimal control[2]. The goals of asthma treatment are to control the clinical manifestations and to improve lung function. However, the correct assessment of asthma control is not straightforward. Holgate et al.[5] concluded that the assessment of control varied markedly among healthcare professionals, as well as patients. They concluded both physicians and patients tend to overestimate the level of asthma control, with a subsequent risk of undertreatment.

Standard treatment regimens for persistent asthma include regular use of inhaled corticosteroids combined with long- and short-acting β2 agonists as needed[6]. However, despite the availability of effective treatment, a substantial proportion of adults, as well as children with asthma, are not optimally controlled[3,4,7]. The failure in asthma control can be considered the result of the complex interaction among different variables, such as the implementation of guidelines, some disease-related factors (e.g., the presence of comorbidi-

ties such as gastro-esophageal reflux disease, sleep disturbances, obstructive sleep apnea, and rhinitis); patient-related factors (e.g., adherence to treatment and coping strategies) and provocative agents[2,8,9,10]. The GINA guidelines have been widely accepted by classifying asthma as controlled, partly controlled and uncontrolled [11].

To the best of the authors' knowledge, there is a dearth of information about the control of childhood asthma at the community level in Egypt. This study aims to estimate the level of suboptimal control of childhood asthma and its associated factors in the community.

Population and method

This cross-sectional descriptive community-based study was carried out in Dekerness District during a period from May 1, 2016 to April 30, 2017. Dekerness District is situated about 200 km north-east of Cairo and includes the capital city (Dekerness) and many rural areas, being mainly an agricultural community with an estimated total population of 336,163.

The target population is asthmatic children aged 2-17 years old. A total of 201 asthmatic children were included in the study. These were identified during a previous community-based study[12] on the prevalence of childhood asthma covering 1500 children selected by proportional multistage cluster sample from both rural and urban areas of the study area.

Data was collected at home visits, after coordination with the head of the family. The questionnaire was through direct interview with the mother or caregiver and the child. **Data collected** included:

1. Child data – name, age, gender and birth order.

2. Socio-demographic characteristics of each family were addressed using the socioeconomic scale of El-Gilany et al.[13]. This is a valid and reliable scale consisting of seven domains, with a total score of 84 (a higher score indicating better socioeconomic status). The seven domains are: education and culture, occupation, family structure, family possessions, economic, home sanitation, and health care utilization pattern. The scale was categorized into four socioeconomic levels according to the three quartiles.

3. The International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire was used for the diagnosis of BA. Phase I ISAAC questionnaire was translated into Arabic and validated by Osman[14]. BA was operationally defined based on the history of both wheezing or whistling in the chest in the last 12 months, and if the child ever had asthma whether a physician diagnosed it or not.

4. The characteristics of asthma: trigger factors (associated morbidities, exposure to passive smoking, and contact with pets or birds), family history, and duration and treatment practices.

5. GINA[15] guidelines were used for diagnosis of asthma control. This guideline distinguishes between controlled, partly controlled and poorly controlled asthma. Asthma is well controlled if: daytime symptoms occur ≤2 times per week; there are no limitations of activities due to asthma and there are no night-time symptoms; rescue medication is needed ≤2 times per week. In this study, the uncontrolled and partially controlled were merged together and considered as suboptimal control.

6. The Arabic version of Morisky's medication adherence scale (MMAS-8), translated and validated by Ashur et al.[16], was used to measure the treatment adherence of known asthmatic during the past two weeks. The score of the MMAS-8 ranged from 0 to 8, and each item carried one point. The first seven items required a yes (1) or no (0) answer, while the eighth was answered on a 5-point Likert scale that was dichotomized into "always," "usually", "sometimes" or "every now and then" (0) or "never/rarely" (1). The final score described the adherence levels; a perfect eight meant high adherence, a score from seven to six meant medium adherence and, finally, a score less than six meant low adherence[17].

Ethical consideration. The protocol was approved by the institutional review board (IRB) of Faculty of Medicine, Mansoura University. The consent of the head of the family for home visits and interview on a mutually agreed day and time was obtained.

Statistical methods. Data entry and analysis was done using Statistical Package for Social Sciences (SPSS) version 16. Qualitative variables were summarized by number and percent. Pearson Chi-square was used to compare the qualitative variables between groups. Crude odds ratios (OR) and their 95% confidence interval (CI) were calculated. Significant factors in bivariate association were entered into binary stepwise multivariate logistic regression model using a forward Wald method to determine independent predictors of suboptimally controlled asthma. Adjusted ORs and their 95% CI were calculated. P ≤0.05 was considered as statistically significant.

Results

Table 1 shows that 47.2% of childhood asthma is suboptimally controlled (9% uncontrolled and 38.2% partially controlled). The suboptimally controlled asthma was significantly higher in slums and rural than urban areas (56.2%, 52.2% and 29.6%, respectively, with p=0.006). However, it does not show any significant variation with the other socio-demographic and child factors studied.

Table 2 shows that contact with pets is significantly associated with suboptimally controlled asthma (69.6% vs. 42.8%; p=0.004). Also, the lack of both asthma controller treatment and written asthma action plan for treatment is associated with significantly higher rates of suboptimally controlled asthma (58.2% vs. 40.2%, with p=0.01, and 80.4% vs. 34.5%, with p≤0.001, respectively). Using a nebulizer is associated with a significantly higher rate of suboptimally controlled asthma (77.3% vs. 43.6%; p=0.003). Low adherence to treatment shows significant association with suboptimally controlled asthma compared to medium/high adherence to treatment (51.6% vs. 31.8%; p=0.02).

Table 3 shows that the most independent predictors of suboptimally controlled asthma were: lack of asthma controller treatment (AOR=2.1), lack of written asthma action plan (AOR=9.8), and using nebulizer therapy (AOR=2.2).

Discussion

This community-based study revealed that about half (47.2%) of childhood asthma is suboptimally controlled, with the majority of them (38.2%) partially controlled and 9%

Table 1 Suboptimal control of asthma in relation to sociodemographic and child characteristics

	Total asthmatic	Suboptimal control No (%)	Significance test	COR (95%CI)
Overall	n=201	95 (47.2)	---	(40.0- 54.0)
Residence				
Slums	48	27 (56.2)	χ2=7.3, p=0.006	3.05 (1.25-7.53)
Rural	99	52 (52.5)	χ2=7.3, p=0.006	2.6 (1.23-5.66)
Urban (r)	54	16 (29.6)	-	1
Father's education				
Illiterate	31	18 (58.1)	χ2=1.92, p=0.16	1.95 (0.68-5.63)
< secondary school	23	9 (39.1)	χ2=0.03, p=0.85	0.9 (0.28-2.91)
Secondary /technical school	106	51 (48.1)	χ2=0.52, p=0.46	1.31 (0.59-2.89)
>secondary school (r)	41	17 (41.5)	-	1
Mother's education				
Illiterate	13	3 (23.07)	χ2=2.8, p=0.09	0.31 (0.06-1.42)
<secondary school	13	5 (38.4)	χ2=0.48, p=0.4	0.65 (0.16-2.56)
Secondary /technical	118	59 (50)	χ2=0.01, p=0.9	1.04 (0.52-2.05)
>secondary school (r)	57	28 (49.12)	-	1
Father's occupation				
Farmers/ manual workers	118	67 (56.8)	χ2=1.6, p=0.2	1.6 (0.8-3.1)
Trades/business/others	37	7 (18.9)	χ2=6.4, p=0.01	0.28 (0.09-0.84)
Semi-professional/Professional (r)	46	21 (45.7)	-	1
Mother's occupation				
Non-working	169	81 (47.9)	χ2=0.2, p=0.7	1.2 (0.6-2.2)
Semi-professional/Professional (r)	32	14 (43.8)	-	1
Crowding index				
>one person per room	160	80 (50.0)	χ2=2.3, p=0.1	0.5 (0.28-1.17)
≤one person per room (r)	41	15 (36.6)	-	1
Socioeconomic level				
Very Low	65	34 (52.3)	χ2=1.12, p=0.28	1.52 (0.65-3.57)
Low	41	25 (61.0)	χ2=3.03, p=0.08	2.17 (0.83-5.72)
Middle	52	18 (34.6)	χ2=0.52, p=0.4	0.74 (0.29-1.84)
High (r)	43	18 (41.9)	-	1
Child age				
≤5 years	111	54 (48.6)	χ2=0, p=0.9	1.03 (0.4-2.6)
5-10years	65	29 (44.6)	χ 2= 0, p=0.7	0.87 (0.31-2.43)
>10 years (r)	25	12 (48.0)	-	1
Gender				
Male	118	57 (48.3)	χ 2= 0.12, p=0.7	1.11 (0.6-2.02)
Female (r)	83	38 (45.8)	-	1
Birth order				
≥3rd child	182	86 (47.3)	FET, p=1.00	1.00 (0.35-2.82)
>3rd child (r)	19	9 (47.4)	-	1

FET =Fishers exact test, **COR** = crude odds ratio, **CI** = confidence interval

uncontrolled. This rate of suboptimal control is intermediate to rates reported from both developing and developed countries. Much lower rates of 14.6% and 17.9% were reported from Japan and Nigeria, respectively[18,19]. Higher rates of 64% and 64.4% were reported from Saudi Arabia and from another Nigerian study, respectively[20,21]. The rates of suboptimal asthma control ranged from 32% to 86% in other developed countries[22-28].

This marked variability in the rate of suboptimal control could be attributed to the interaction of multiple factors. Firstly, in contrast to the current community-based study, nearly all of the previous studies are hospital/clinic-based. Cases attending hospitals are usually the uncontrolled severe asthma. However, with adequate care and therapy, which vary from country to country, most of the cases might be controlled. In the community setting, most of the cases are expected to be of mild to moderate severity, which can be easily controlled. Furthermore, hospital-based studies may not totally reflect the true picture of what is happening in the community. Secondly, there is a marked variability between socio-demographic features of studied children, as well as their personal and environmental triggers in different studies. Thirdly, the tool used for the assessment of asthma control differs from one study to another. Fourthly, in the current study the assessment of asthma control was subjective, based on mothers' and/or children's reports. The possibility of recall and social desirability biases cannot be excluded. Also, the perception of asthma control differs according to the knowledge, educational and cultural backgrounds of the subject interviewed. D'Urzo[29] and O'Byrne[30] concluded that many patients fail to perceive their level of asthma control. This factor is important when a symptom-based approach is being used to assess asthma control.

Table 2 Other factors associated with suboptimal control of asthma

		Total asthmatic N=201	Suboptimal control No (%)	Significance test	COR (95%CI)
Parental consanguinity	Yes	39	19 (48.7)	χ2=0.04, p=0.8	1.07 (0.5-2.1)
	No (r)	162	76 (46.9)	-	1
Passive smoking	Yes	106	52 (49.1)	χ 2= 0.2, p=0.5	1.11 (0.6-2.02)
	No (r)	95	43 (45.3)	-	1
FH of chest allergy	Yes	103	45 (43.7)	χ 2= 1.08, p=0.2	0.7 (0.4-1.3)
	No (r)	98	50 (51.0)	-	1
FH Allergic rhinitis	Yes	30	12 (40.0)	χ2=0.7, p=0.3	0.7 (0.3-1.5)
	No (r)	171	83 (48.5)	-	1
FH Allergic dermatitis	Yes	31	11 (35.5)	χ2=0.5 , p=0.16	1.95 (0.68-5.63)
	No (r)	170	84 (49.4)	-	1
Allergic conjunctivitis	Yes	14	6 (42.8)	χ2=0.2, p=0.6	0.77 (0.23-2.58)
	No (r)	187	92 (49.2)	-	1
Contact with birds	Yes	121	65 (53.7)	χ2=0.12, p=0.7	0.9 (0.49-1.66)
	No (r)	80	45 (56.2)	-	1
Contact with pets	Yes	33	23 (69.6)	χ2=7.9, p=0.004	3.07 (1.29-7.41)
	No (r)	168	72 (42.8)	-	1
Duration of asthma (years)					
	<5	141	66 (46.8)	χ2=0.3, p=0.5	1.41 (0.39-5.25)
	5-9	47	24 (51.1)	χ2=0.64, p=0.4	1.76 (0.4-7.02)
	10 & more (r)	13	5 (38.5)	-	1
Controller treatment	No (r)	79	46 (58.2)	χ2=6.2, p=0.01	2.08 (1.12-3.85)
	Yes	122	49 (40.2)	-	1
Asthma action plan	No	56	45 (80.4)	χ2=34.1, p≤0.001	7.8 (3.5-7.6)
	Yes (r)	145	50 (34.5)	-	1
Type of treatment					
Nebulizer	No (r)	179	78 (43.6)	-	1
	Yes	22	17 (77.3)	χ2=8.9, p=0.003	4.4 (1.6-12.5)
Cough remedies	Yes	127	61 (48)	χ2=0.08, p=0.7	1.08 (0.6-1.9)
	No (r)	74	34 (45.9)	-	1
Oral bronchodilators	Yes	158	75 (47.5)	χ2=0.01, p=0.9	1.04 (0.5-2.16)
	No (r)	43	20 (46.5)	-	1
ICS	Yes	137	58 (42.3)	χ2=4.2, p=0.04	0.54 (0.28-1.02)
	No (r)	64	37 (57.8)	-	1
Adherence to treatment					
	Low	157	81 (51.6)	χ2=5.7, p=0.02	2.28 (1.1-4.9)
	Medium or high (r)	44	14 (31.8)	-	1

FH = Family history; **ICS** = Inhaled corticosteroids; **COR** = crude odds ratio, **CI** = confidence interval

The main aim of asthma treatment is to achieve and maintain the control of the disease, as well as to prevent exacerbations and chronic airflow obstruction. Controller medications for children include inhaled and systemic glucocorticosteroids, leukotriene modifiers, long-acting inhaled beta 2-agonists, theophylline and cromones. Once the control of asthma is obtained and maintained for at least three months, the maintenance treatment should be gradually reduced, being minimally kept for the control of symptoms[11,31-33].

In this study, only three independent predictors of suboptimally controlled asthma were identified to predict about 75% of the variability in asthma control. These are the lack of asthma controller treatment, the lack of written asthma action plan, and using nebulizer therapy.

The lack of controller treatment (i.e., not taking regular treatment) is an independent predictor of suboptimal asthma control. This is in agreement with most of the previous

Table 3 Multivariate logistic regression analysis of independent predictors of suboptimal control of asthma

Predictors		β	P	AOR (95%CI)
Controller treatment	No	0.74	0.03	2.1(1.03-4.28)
	Yes (r)	-	-	1
Written asthma action plan	No	2.2	<0.001	9.8(4.16-23.3)
	Yes (r)	-	-	1
Nebulizer	No (r)	-	-	1
	Yes	1.6	0.014	2.2(1.5-10.7)
	Constant	1.63		
	Percent correctly predicted	74.6		
	Model χ2	73.4, p<0.001		

AOR = Adjusted odds ratio, CI = confidence interval

studies[34-36], which found that the controller treatment prevented severe asthma attacks and hospital admission. On the other hand, one study found that patients receiving prophylactic therapy were significantly more likely to need hospital admission[37].

Written asthma action plans (WAAPs) have become a core component of asthma management.

This plan facilitates the early detection and treatment and is an essential part of the self-management of exacerbations[38], reduces healthcare utilization and improves the quality of life[39]. In the current study, the lack of WAAP is a significant independent predictor of suboptimal asthma control. This agrees with many previous studies in different countries[38,40-42], which concluded that WAAPs have been associated with improved outcomes and may protect against death from asthma. Khan et al.[43] concluded that the provision of personalized WAAPs may have a useful role in the management of children with partly controlled asthma, but is no better than the standard care. They recommended asthma education as a critical component in the prevention of exacerbations in children with partly controlled asthma. On the other hand, many studies found that adding a formal WAAP did not lead to better outcomes[4,23,44-47] and may even lead to worse outcomes[48,49]. Kelso[50] in his review concluded that providing WAAP did not improve outcomes beyond asthma education alone. This variation could be attributed to variation in severity of asthma, contents of the plan and patients/caregivers perception of its usefulness, as well as if there were ongoing education programs.

Asthma drugs can be administered in different ways (oral, inhaled and intravenous), with inhalation being the route of choice. The most common inhalation devices are the pressurized inhaler and nebulizers. Nebulizers are not the devices of choice for routine maintenance treatment, and should only be used in special situations[51], such as acute severe asthma and in children too young to use other devices[52]. Hsu and Parke[53] concluded that metered-dose inhalers with a spacer are as good as, or better than, nebulizers for children with asthma.

In this study, using a nebulizer was associated with poor asthma control, which was contrary to most of the guidelines. Inhalation is the preferred route for many asthma medications used today. The nebulizer is one option available for asthma treatment, if the patient has difficulty manipulating the pressured multidose inhaler (pMDI) and spacer. Nebulizer is considered as a rescue medication and its excessive use usually associated with poorly controlled asthma. Butz et al.[54] found that many families fail to properly use nebulizers. Patients using nebulizers at home experienced problems at all stages, including problems prior to nebulization (e.g., setting up equipment, lack of instructions, manual clearness and time required); during medication administration (e.g., inhalation technique, duration of nebulization and understanding how to achieve optimal efficacy); post-administration (inadequate cleaning of nebulizer components, access to accessories and use of damaged parts or self-repairs); as well as other problems (e.g., noise, weight and non-portability of equipment)[55]. Butz et al.[56] observed a high rate of morbidity in children with asthma who currently used nebulizers, including frequent emergency room visits, hospitalizations, day and night symptoms, and school absences. Also, Cates et al.[57] reported that nebulizer delivery produced outcomes that were not significantly better than metered-dose inhalers delivered by spacer in adults or children. The pMDIs have many advantages – e.g., deliver medication in a reliable and convenient multidose presentation, are small sized, portable, relatively inexpensive, quick to use and free of contamination. Despite these advantages, the asthmatic child may fail to synchronize actuation with inhalation, and there is a poor lung deposition even with good inhalation techniques. Patients who are able to use pMDIs correctly have better asthma control as defined by the GINA strategy document. Patients prescribed pMDIs should be carefully instructed in technique and have their ability to use these devices tested.

The current study found that low adherence to treatment was associated with suboptimal asthma control in bivariate analysis, but it was excluded from the logistic regression. Previous studies from Brazil and South Africa reported high risk of uncontrolled asthma among nonadherent patients[27,58]. The compliance with medical prescriptions tends to decline steeply over time. The patients with chronic diseases in high-income countries frequently do not use their medications as recommended by clinicians. In low- and middle-income countries, nonadherence is more critical because of the mix of limited access to healthcare, lack of appropriate diagnosis, and low availability or affordability of essential medicines[59]. In contrary to the current study, previous studies found that poor asthma control was associated with low family income in Canada[25]; family history of asthma and maternal work outside home in USA[26]; and low socioeconomic standards in Nigeria[19]. Again, most of the previous studies are hospital-based, including severe asthma cases with different referral patterns and quality of care.

Limitations

Despite being the first community-based study on childhood asthma control in Egypt, this study suffers some limitations. Asthma control was based on children's/parent's reporting, as the objective assessment of lung function control by spirometry was not feasible under the field condition. Thus, the recall and social desirability biases may be present. Also, genetic factors associated with poor asthma control were not studied. Furthermore, it is a local study and its results cannot be generalized at the national level.

Recommendations

To improve asthma control, all asthmatic children and their parents should be provided with an individualized WAAP appropriate to their level of asthma control and health literacy. They should know how to recognize and respond to worsening asthma. Prophylactic or maintenance therapy should be encouraged with good adherence to treatment. Special attention needs to be given to children using nebulizers, to teach and reinforce proper technique for nebulizers and other delivery devices. A nationwide community-based survey is advocated to assess factors affecting childhood asthma control, with further in depth evaluation of the value of nebulizer in the management of asthma. ■

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