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Research Article
Autonomic Dysfunction and Quality of Life in Children with Asthma

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Abstract

Background and Objective: Bronchial asthma is one of the most common chronic diseases among school children. The prevalence of school children's asthma is rising in Saudi Arabia. The aim of this study was to assess the association between modifiable environmental risk factors and autonomic dysfunction among the school-aged children. **Materials and Methods:** The study duration was performed from 14 April to 22 June, 2023, the study was carried out on 58 school-age children diagnosed with bronchial asthma. This study utilized a structured interview schedule titled "Bronchial Asthma Lifestyle Structured Assessment Interview Schedule". The statistical analysis was utilized using Statistical Package for Social Sciences (SPSS) version 13.0 for data description and statistical analysis of the results. The Chi-square tests were used for significance tests. **Results:** The study revealed that child gender, family income, father's education level, family history of asthma and smoking around the child emerged as significant factors. Additionally, elements such as seasonal variations, food allergies and household conditions like ventilation and sleep patterns were identified as influential in childhood asthma occurrence. **Conclusion:** These findings shed light on the complex interplay between genetics, environment, lifestyle and autonomic dysfunction in understanding childhood asthma that can pave the way for a more comfortable and supportive lifestyle for children dealing with asthma.

Key words: Bronchial asthma, quality of life, autonomic dysfunction, lifestyle, children

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Competing Interest: The author has declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Bronchial asthma is one of the most common chronic diseases among school children. The prevalence of school children asthma is rising in Saudi Arabia[1]. It has a significant influence on public health, with impacts on patients' quality of life, healthcare expenses, morbidity and mortality. Bronchial asthma is a clinical syndrome characterized by episodic reversible airway obstruction, increased bronchial reactivity and airway inflammation[2]. These recurrent episodes manifest through distressing symptoms such as coughing, wheezing, breathlessness and potential agitation, profoundly disrupting the daily lives of affected school-age children[3]. The association between modifiable environmental risk factors and bronchial asthma among school-aged children in Taif City as a comparative analysis with healthy peers should be assessed to control or reduce the disease burden.

Inflammatory cells, their mediators, smooth muscle and airway epithelium and the nervous system all interact intricately to cause asthma. Asthma and autonomic imbalance are linked; bronchial sensitivity to cholinergic constrictors is increased and sensitivity to adrenergic bronchodilators may be decreased[4]. The control of inflammation is another function of the brain mechanisms. The inhibition of macrophage activation and the release of inflammatory mediators are caused by the activation of the vagus nerve. According to Bonaz *et al.*[5], that examining a series of children with asthma is essential to further elucidate the relationship between disease severity and autonomic dysfunction. Due to rising of the bronchial asthma, which is one of the most common chronic diseases among the school children. Autonomic imbalance is associated with asthma, with an increase in bronchial sensitivity to cholinergic constrictors. The aim of this study is to assess the association between modifiable environmental risk factors and autonomic dysfunction among 116 participants of school-aged children.

MATERIALS AND METHODS

Research design: This study adopts a descriptive approach to evaluate the lifestyle of school-age children with bronchial asthma. The study was conducted at the Pediatric Emergency of Alhada Armed Forces Hospitals within Taif City, the study duration was performed from 14 April, 2023 to 22 June, 2023.

Subjects: A convenient sample of 58 school-age children diagnosed with bronchial asthma and their mothers attending the setting, were included in the study.

Inclusion criteria involved: Age range between 6 and 12 years.

Exclusion of status asthmatics cases:

- Absence of other health issues
- Duration of the disease for at least six months

Tools: The study utilized a structured interview schedule titled "Bronchial Asthma Lifestyle Structured Assessment Interview Schedule". This tool, developed by the researcher after a comprehensive review of relevant literature comprised three distinct parts:

- **Part one:** Socio-demographic details of the school-age children with bronchial asthma and their mothers, encompassing various factors such as age, sex, birth order, residence, maternal age, occupation, education and environmental aspects like housing conditions and exposure to potential triggers
- **Part two:** Medical history and clinical data of the children with bronchial asthma, encompassing signs, symptoms, frequency, intensity of attacks and triggering factors
- **Part three:** Focused on assessing the lifestyle of the studied children with bronchial asthma, evaluating areas such as diet, sleeping patterns and daily activities, including exercise, hygiene and compliance with medication

Methods: An official letter seeking permission for research implementation was sent to the relevant authorities of the study settings. The study tool was meticulously developed following an extensive literature review by the researcher. Validation of the tool was conducted by five pediatric experts, yielding a validation rate of 92%. The tool's reliability was ascertained by collecting data from five asthmatic children using the questionnaire twice, with a one-month interval, revealing a high alpha reliability correlation coefficient of 0.90.

A pilot study involving 50 school-age children with bronchial asthma was conducted for feasibility and applicability testing. These children were subsequently excluded from the final subject pool. The purpose of the study was explained to both school-age children and their mothers, obtaining formal consent for their participation. Individual interviews were conducted with each child and their mother to collect requisite data, tailored according to the child's age, with sessions lasting 10-15 min per child. Data collection spanned from May 2023 to June 2023, ensuring confidentiality.

Ethical consideration: The current study was performed after ethical approval of ethics committee at Taif University under approval number: 44-143 and the committee is accredited by the National Committee for Bioethics with No. (HAO-02-T-105).

Data analysis: After data collection, it was coded and transferred into specially designed formats suitable for computer feeding. Frequency analysis and manual revision were used to detect possible errors. The Statistical Package for Social Sciences (SPSS) version 13.0 was utilized for data description and statistical analysis of the results. Scores were used to evaluate the lifestyle of school-age children with bronchial asthma. The Chi-square tests were used for significance tests. The 0.05 level was used as the cut-off value for statistical significance.

Scoring system: Total school-age children's lifestyle scores were calculated according to children's answers to each question of lifestyle elements. Each item of the questions took one score. The high score was given for positive items such as having food allergies, not having sleep disturbances, practicing exercises, taking medication on time and participating in group activities. The low score was given to negative items.

Total adjusted scores of children's lifestyle were categorized as follows:

Good lifestyle : 75 to 100%
Neutral life : 50 to less than 75%
Bad lifestyle : Less than 50%

RESULTS

A case-control study is a retrospective investigation that begins by examining a particular disease's occurrence and traces back to identify potential causes. This method juxtaposes children afflicted with the disease (cases) against those unaffected (controls). Often referred to as a retrospective study, this approach is time-efficient and cost-effective. The Chi-square tests were subsequently utilized to scrutinize the factors influencing the occurrence of the disease.

The study included data related to (n = 116) participants of school-aged children affected with bronchial asthma, 58 of them with bronchial asthma and 58 subjects were non-asthmatic subjects as shown in Table 1.

According to the demographic characteristics data of asthmatic and non-asthmatic subjects presented in (Table 2), the results revealed that bronchial asthma is more common in male subjects than female ones. Also, the school absenteeism of three days per month in the asthmatic subjects is more than that of the non-asthmatics. Moreover, the extant school absence that affects academic achievement is more in the affected subjects compared to the non-asthmatic children.

According to the family demographics data presented in (Table 3), the results indicate that factors such as family size, family income, mother's education level and the presence of smokers in the family do not exhibit statistically significant effects as causative factors for asthma. However, the father's education level, family history of asthma and smoking in the presence of the child emerged as factors that have a statistically significant impact on the occurrence of asthma among the asthmatic children compared to the non-asthmatic subjects.

Based on the comparison of demographic risk factors data of children with asthma compared to the healthy subjects (Table 4), the data indicate that factors such as seasonal variations, food allergies and specific food items exhibit a statistically significant impact as causative factors for asthma. Also, the avoidance of the allergen foods in the asthmatic subjects was highly significant as compared with the non-asthmatic group.

Based on (Table 5) the data revealed that asthmatic children have a highly significant frequency of hospital visits compared to non-asthmatic children reported hospital attendance. Additionally, difficulty in breathing emerged as a prominent and distinct symptom among asthmatic children as sputum, cough, breathing difficulty, whistling and chest tightness showed a significant change compared to the non-asthmatic healthy subjects. Moreover, the asthmatic attack at night was reported at a high rate in the asthmatic group compared to the non-asthmatic subjects. In addition, the asthmatic group was reported to a flu vaccine administration regularly compared with recorded control subjects. Also, the asthmatic group take asthmatic medicine regularly as compared to the non-asthmatic children.

Based on the direct comparison of childcare and surrounding factors data of asthmatic and non-asthmatic children represented in (Table 6), the results indicated that the asthmatic group spent significantly less exercising time per day compared to the non-asthmatic group. Also, exercises cause a significant precipitation of asthmatic attacks in diseased cases compared to the healthy control group and the diseased subjects significantly avoided the exercises that triggered the asthma attack. Moreover, the houses of the diseased subjects were cleaned significantly less than those of the healthy ones.

Table 1: Overview of demographic characteristics in the sample population

Variables		N	%
Do you work or study at Taif University?	No	93	80.2
	Yes	23	19.8
Total		116	100.0
Residence	Taif	101	87.1
	Outside Taif	15	12.9
Total		116	100.0
Profession	Journalist	1	0.9
	Housewife	30	25.9
	Student	21	18.1
	Unemployed	1	0.9
	Military	10	8.6
	Government employee	44	37.9
	Employee (private sector)	9	7.8
Total		116	100.0
Nationality	Saudi	100	86.2
	Non-Saudi	16	13.8
Total		116	100.0
Gender	Female	32	27.6
	Male	84	72.4
Total		116	100.0
Child age	6-8 years	60	51.7
	8-10 years	31	26.7
Total		116	100.0
Birth month	October-March	69	59.5
	April-September	47	40.5
Total		116	100.0

Table 2: Comparative analysis of demographic characteristics between non-asthmatic and asthmatic children

		Non-asthmatic children		Asthmatic children		Total				
Variables		N	%	N	%	N	%	Pearson χ^2	df	p-value
Child gender	Female	16	27.6	16	27.6	32	27.6	0.000	1	0.000
	Male	42	72.4	42	72.4	84	72.4			
Total		58	50.0	58	50.0	116	100.0			
Child age	6 - 8 years	30	51.7	30	51.7	60	51.7	0.072	2	0.965
	8-10 years	16	27.6	15	25.9	31	26.7			
	10-12 years	12	20.7	13	22.4	25	21.6			
Total		58	50.0	58	50.0	116	100.0			
Born month	October-March	35	60.3	34	58.6	69	59.5	0.036	1	0.85
	April-September	23	39.7	24	41.4	47	40.5			
Total		58	50.0	58	50.0	116	100.0			
Child education	Illiterate	2	3.4	4	6.9	6	5.2	0.703	1	0.402
	Primary	56	96.6	54	93.1	110	94.8			
Total		58	50.0	58	50.0	116	100			
Number of absent	One day/month	13	22.4	17	29.3	30	25.9	1.819	3	0.611
days of school	Three days/month	12	20.7	15	25.9	27	23.3			
	One day/2 months	10	17.2	9	15.5	19	16.4			
	One day/3 months	23	39.7	17	29.3	40	34.5			
Total		58	50.0	58	50.0	116	100.0			
Compensating children for	Get private lessons	5	8.6	9	15.5	14	12.1	1.389	2	0.499
being absent from school	Increase their study hours at home	21	36.2	18	31.0	39	33.6			
	Their parents' assistant	32	55.2	31	53.4	63	54.3			
Total		58	50.0	58	50.0	116	100			
To what extent does school	Sometimes	28	48.3	26	44.8	54	46.6	5.126	2	0.077
absence affect academic	No	24	41.4	17	29.3	41	35.3			
achievement	Yes	6	10.3	15	25.9	21	18.1			
Total		58	50.0	58	50.0	116	100			
Residence	Urban	6	10.3	11	19.0	17	14.7	1.723	1	0.189
	Countryside	52	89.7	47	81.0	99	85.3			
Total		58	50.0	58	50.0	116	100			

Table 3: Comparative analysis of family demographics between non-asthmatic and asthmatic children

		Non-asthmatic children		Asthmatic children		Total				
Variables		N	%	N	%	N	%	Pearson χ^2	df	p-value
Family size	<6	41	70.7	30	51.7	71	61.2	5.462	2	0.056
	6-8	14	24.1	19	32.8	33	28.4			
	>8	3	5.2	9	15.5	12	10.3			
Total		58	50.0	58	50.0	116	100.0			
Family income	High	24	41.4	24	41.4	48	41.4	5.1	2	0.078
	Medium	33	56.9	27	46.6	60	51.7			
	Low	1	1.7	7	12.1	8	6.9			
Total		58	50.0	58	50.0	116	100.0			
Father education level	Illiterate	0	0.0	3	5.2	3	2.6	8.893	3	0.031
	Primary	3	5.2	5	8.6	8	6.9			
	Secondary	16	27.6	24	41.4	40	34.5			
	Advanced	39	67.2	26	44.8	65	56.0			
Total		58	50.0	58	50.0	116	100.0			
Mother education level	Illiterate	1	1.7	3	5.2	4	3.4	2.885	3	0.410
	Primary	7	12.1	8	13.8	15	12.9			
	Secondary	19	32.8	24	41.4	43	37.1			
	Advanced	31	53.4	23	39.7	54	46.6			
Total		58	50.0	58	50.0	116	100.0			
Does anyone in the family	No	30	51.7	18	31.0	48	41.4	4.300	1	0.038
have asthma?	Yes	28	48.3	40	69.0	68	58.6			
Total		58	50.0	58	50.0	116	100.0			
If yes, the relationship	Brothers	14	50.0	10	25.0	24	20.7	21.790	5	0.001
with the child	Father/mother	12	42.9	20	50.0	33	28.4			
	Grandfather/ Grandmother	1	3.6	7	17.5	15	12.9			
	Uncle	1	3.6	0	0.0	2	1.7			
	Aunt	0	0.0	3	7.5	3	2.6			
Total		28	41.2	40	58.8	68	58.6			
Does anyone in the	No	35	60.3	36	62.1	71	61.2	0.036	1	0.849
family smoke?	Yes	23	39.7	22	37.9	45	38.8			
Total		58	50.0	58	50.0	116	100.0			
Smoking in the presence	No	20	87.0	11	50.0	89	76.7	4.848	2	0.012
of the child	Yes	3	13.0	11	50.0	14	12.1			
Total		23	51.1	22	48.9	45	38.8			

Table 4: Comparative analysis of surrounding factors between non-asthmatic and asthmatic children

		Non-asthmatic children		Asthmatic children		Total				
Variables		N	%	N	%	N	%	Pearson χ^2	df	p-value
Season in which	Autumn	3	5.2	2	3.4	5	4.3	20.317	4	0.000
asthma increases	Spring	1	1.7	7	12.1	8	6.9			
	Winter	33	56.9	42	72.4	73	62.9			
	Summer	4	6.9	7	12.1	11	9.5			
	Uninfected	17	29.3	0	0.0	19	16.4			
Total		58	50.0	58	50.0	116	100.0			
Does the child have a	No	55	94.8	36	62.1	79	68.1	23.670	2	0.000
food allergy?	Yes	3	5.2	22	37.9	25	21.6			
Total		58	50.0	58	50.0	116	100.0			
Foods that cause seizures?	No	57	98.3	41	70.7	98	84.5	14.796	1	0.000
	Yes	1	1.7	17	29.3	18	15.5			
Total		58	50.0	58	50	116	100.0			
Foods cause allergy	No	58	100.0	34	58.6	34	29.3	160.810	2	0.000
avoidance?	Yes	0	0.0	24	41.4	24	20.7			
Total		58	50.0	58	50.0	50.0	100.0			

Table 5: Comparative analysis of childcare between non-asthmatic and asthmatic children

		Non-asthmatic children		Asthmatic children		Total				
Variables		N	%	N	%	N	%	Pearson χ^2	df	p-value
Has the child been to	No	22	37.9	11	19.0	16	13.8	18.433	2	0.000
the hospital before?	Yes	36	62.1	47	81.0	83	71.6			
Total		58	50.0	58	50.0	116	100.0			
Which of the following	Sputum	1	1.7	1	1.7	2	1.7	29.610	5	0.000
symptoms does the child feel	Cough	21	36.2	13	22.4	34	29.3			
when a seizure occurs?	Difficulty breathing	15	25.9	29	50.0	44	37.9			
	Whistling	2	3.4	6	10.3	8	6.9			
	Tight chest	2	3.4	8	13.8	10	8.6			
	Other	17	29.3	1	1.7	18	15.5			
Total		58	50.0	58	50.0	116	100.0			
Does the child have an	No	40	69.0	13	22.4	34	29.3	33.444	2	0.000
asthma attack at night?	Yes	18	31.0	45	77.6	63	54.3			
Total		58	50.	58	50.0	116	100.0			
Flu vaccination	Never	15	25	22	37.9	37	31.9	15.154	3	0.002
	Some years	19	32	18	31	37	31/9			
	Uninfected	17	29	3	5.2	20	17.2			
	Regular annually	7	12	15	25.9	22	19			
Total		58	50.0	58	50.0	116	100			
Does the child take	No	30	51.7	10	17.2	40	34.5	17.980	2	0.000
medicine regularly on time?	Yes	28	48.3	48	82.8	76	65.5			
Total		58	50.0	58	50.0	116	100.			
Poor self-care?	No	58	100	53	91.4	111	95.7	3.344	1	0.067
	Yes	0	0	5	8.6	5	4.3			
Total		58	50.0	58	50.0	116	100			

Table 6: Comparative analysis of childcare and surrounding factors between non-asthmatic and asthmatic children

		Non-asthmatic children		Asthmatic children		Total				
Variables		N	%	N	%	N	%	Pearson χ^2	df	p-value
Exercise/sport	No	22	37.9	20	34.5	42	36.2	0.037	1	0.847
	Yes	36	62.1	38	65.5	74	63.8			
Total		58	50.0	58	50.0	116	100.0			
How much time does	Less than an hour	45	77.6	39	67.2	84	72.4	7.397	2	0.025
the child spend exercising/	One to two hours	13	22.4	14	24.1	27	23.3			
day?	More than two hours	0	0.0	5	8.6	5	4.3			
Total		58	50.0	58	50.0	116	100.0			
Exercise/sport	No	46	79.3	23	39.7	69	59.5	17.312	1	0.000
causing asthma?	Yes	12	20.7	35	60.3	47	40.5			
Total		58	50.0	58	50.0	116	100.0			
Exercise/sports that trigger	No	34	58.6	18	31.0	52	44.8	7.843	1	0.005
asthma attacks avoidance?	Yes	24	41.4	40	69.0	64	55.2			
Total		58	50.0	58	50.0	116	100.0			
Adequate ventilation in	No	7	12.1	12	20.7	19	16.4	1.007	1	0.316
the house	Yes	51	87.9	46	79.3	97	83.6			
Total		58	50.0	58	50.0	116	100.0			
Congestion indicator?	<2 people/bedroom	39	67.2	33	56.9	72	62.1	0.915	1	0.339
	$\geq$2 people/bedroom	19	32.8	25	43.1	44	37.9			
Total		58	50.0	58	50.0	116	100.0			
Are there cockroaches	No	55	94.8	53	91.4	108	93.1	0.134	1	0.714
in the house?	Yes	3	5.2	5	8.6	8	6.9			
Total		58	50.0	58	50.0	116	100.0			
Is the floor of the house	No	26	44.8	27	46.6	53	45.7	0.035	1	0.852
covered?	Yes	32	55.2	31	53.4	63	54.3			
Total		58	50.0	58	50.0	116	100.0			
How many times is	Once	6	10.3	14	24.1	20	17.2	7.510	2	0.023
the house cleaned	Twice	13	22.4	19	32.8	32	27.6			
per week?	Three times or more	39	67.2	25	43.1	64	55.2			
Total		58	50.0	58	50.0	116	100.0			

Table 6: Continued

Variables		Non-asthmatic children N	%	Asthmatic children N	%	Total N	%	Pearson χ^2	df	p-value
How to clean the house?	Regular sweeping	19	32.8	28	48.3	47	40.5	2.289	1	0.130
	Floor cleaning	39	67.2	30	51.7	69	59.5			
Total		58	50.0	58	50.0	116	100.0			
Birds or animals with fur in the house?	No	52	89.7	48	82.8	100	86.2	0.653	1	0.419
	Yes	6	10.3	10	17.2	16	13.8			
Total		58	50.0	58	50.0	116	100.0			
Visiting friends?	Sometimes	29	50.0	22	37.9	51	44.0	3.631	2	0.163
	No	11	19.0	8	13.8	19	16.4			
	Yes	18	31.0	28	48.3	46	39.7			
Total		58	50.0	58	50.0	116	100.0			
Participation in group activities	No	10	17.2	17	29.3	27	23.3	1.738	1	0.187
	Yes	48	82.8	41	70.7	89	76.7			
Total		58	50.0	58	50.0	116	100.0			
The house heated when the weather is cold?	No	6	10.3	9	15.5	15	12.9	0.306	1	0.580
	Yes	52	89.7	49	84.5	101	87.1			
Total		58	50.0	58	50.0	116	100.0			
Eating meat in the past 12 months?	Never or only sometimes	11	19.0	17	29.3	28	24.1	5.407	2	0.067
	Once or twice a week	25	43.1	30	51.7	55	47.4			
	Most of all days	22	37.9	11	19.0	33	28.4			
Total		58	50.0	58	50.0	116	100.0			
Eat fruit in the past 12 months?	Never or only sometimes	9	15.5	5	8.6	14	12.1	1.552	2	0.460
	Once or twice a week	32	55.2	37	63.8	69	59.5			
	Most of all days	17	29.3	16	27.6	33	28.4			
Total		58	50.0	58	50.0	116	100.0			
Consumption of soft drinks in the past 12 months	Never or only sometimes	31	53.4	39	67.2	70	60.3	3.163	2	0.206
	Once or twice a week	18	31.0	15	25.9	33	28.4			
	Most of all days	9	15.5	4	6.9	13	11.2			
Total		58	50.0	58	50.0	116	100.0			

DISCUSSION

Asthma is one of the most prevalent chronic conditions in childhood illnesses and its prevalence of school children asthma is rising in Saudi Arabia[6]. Beyond its health impacts, asthma in school-aged children extends its influence across multiple spheres, affecting sleep patterns, physical activity, family dynamics and coping mechanisms. The current assessment revealed that bronchial asthma is more common in male than female ones. The current results indicated that factors such as seasonal variations, food allergies and specific food items exhibit a statistically significant impact as causative factors for asthma. The current results revealed that asthmatic children have a highly significant frequency of hospital visits compared to non-asthmatic children. Additionally, difficulty in breathing emerged as a prominent and distinct symptom among asthmatic children as sputum, cough, breathing difficulty, whistling and chest tightness showed a significant change compared to the non-asthmatic healthy subjects. Moreover, the asthmatic attack at night was reported at a high rate in the asthmatic group compared to the non-asthmatic subjects. The primary goal of asthma management remains centered on enabling children to lead as normal a life as possible while minimizing limitations. Avoiding the environmental risk factors is essential to limit or prevent the occurrence of asthma, while targeting muscarinic receptors gives a good promise in the therapy of bronchial asthma[7].

Like most kids, children with asthma love to be physically active. They may enjoy sports, physical education classes, or even just playing games on the weekends and after school. A few of these activities cause the child with asthma to experience respiratory symptoms[8]. The results of this study indicated exercise cause precipitation of the asthmatic attack in the diseased children and they spend less exercising time per day compared to the non-asthmatic group. Also, they avoided the exercises that trigger the asthma attack. The inspired air is typically heated to 37°C and completely saturated with water vapor by the airways, which explains these data. Exercise-related rapid breathing loses heat and moisture. This was exacerbated by Caggiano *et al.*[9].

The results of this survey revealed that the highest prevalence rate of bronchial asthma was reported in male subjects than female ones. These data were in accordance with Dharmage *et al.*[10], who reported that the higher prevalence of asthma symptoms in boys than in girls, possibly due to the smaller diameter and greater tone of the airway in boys, in addition to the elevated levels of immunoglobulin E.

Also, the results of this study are in accordance with the data of Sheikh *et al.*[11], who proved a family history of asthma has been shown to be significantly associated with asthma risk, especially among children.

The data of this study reported also that smoking in the family in the presence of the child has a significant impact on the occurrence of asthma among asthmatic children. These results were in accordance with Sheikh *et al.*[11]. Smoke, including tobacco smoke, is a common trigger for asthma. Children are particularly sensitive to tobacco smoke as their lungs are smaller and more delicate and are still developing and there is a high association between severe asthma and passive smoking (family member at home who smoked)[12].

The results of the study showed that higher asthma prevalence rates and disease morbidity have been found in children from low socioeconomic states with low family income and low father's education level[13]. These data were in accordance with Lu *et al.*[14], who reported that children living in low-income households often experience increased stress, such as family conflict, chronic family stress, lower quality home environments and exposed more to polluted air and water which are believed to be a risk factor for asthma. Also, children living in low-income households are more likely to experience reduced parental support and lower adherence with asthma medications[15].

The results of this survey revealed that asthmatic children were subjected to difficulty in breathing with distinct symptom as sputum, cough, dyspnea, whistling and chest tightness. Asthma is associated with autonomic nervous system imbalance in the form of increased bronchial sensitivity to cholinergic constrictors and possibly decreased sensitivity to β2-adrenergic dilators[16]. Bronchospasm, airway edema and excessive mucus secretion can result from abnormal regulation of the autonomic nerves innervating the tracheo-bronchial tree. The pathophysiology of bronchial hyperactivity is thought to be significantly influenced by increased parasympathetic activity relative to sympathetic activity[17]. A third component of the autonomic nervous system is the noradrenergic, noncholinergic system, which passes in the vagus nerve and produces bronchodilation[18]. The recorded nocturnal dyspnea in this survey might be explained by the fact that the parasympathetic tone is increased at night which in accordance with Sinha *et al.*[19]. Studies using cholinergic blockade indicate that an increase in airway parasympathetic tone contributes significantly to the development of nocturnal asthma. The intrinsic sympathetic tone has no role in nocturnal asthma. However, there is an evidence that the activity of the NANC bronchodilation system is impaired in the early morning leading to the imbalance of airway caliber toward the development of overnight bronchoconstriction[19].

Using peripheral muscarinic receptors as their primary means of communication, parasympathetic nerves regulate the inflammation and symptoms of allergic diseases. Pharmacologic blockade of parasympathetic nerve signaling also prevents symptoms and allergic inflammation. Smooth muscle, epithelial cells and submucosal glands are supplied by parasympathetic postganglionic nerves[20].

The VIP and NO are examples of noncholinergic neurotransmitters that can be released by parasympathetic nerves. Additionally, fibroblasts and inflammatory cells that are not innervated by parasympathetic nerves have muscarinic receptors. The ACh released from non-neuronal sources, like epithelial cells, may reach these cells[21]. The G Protein-Coupled Receptors (GPCRs) are a broader family of receptors that includes the 5 members of the muscarinic receptor family. Submucosal glands contain M1 receptors, airway smooth muscle contains M2 receptors and mucus glands and smooth muscle contain M3 receptors. According to Milankovic and Lazarevic-Pasti[21], the M3 receptor is thought to be the primary mechanism for neuronally mediated bronchoconstriction and mucus secretion. Sensitized people who are exposed to antigens have increased contraction of their airway smooth muscle, which is mediated by parasympathetic nerves. Acetylcholine is a parasympathetic neurotransmitter has a paracrine action that regulates airway inflammation. It was found that muscarinic receptors are present on mast cells, macrophages, neutrophils and eosinophils. The M1/M2/M3 is found in mast cells, M3/M4/M5 is found in macrophages, M1/M2/M3 is found in alveolar macrophages and M3/M4/M5 is found in eosinophils[22]. A sufficient amount of antigen exposure causes mast cells to become activated, releasing powerful mediators like prostaglandin D2, thromboxane B2, histamine, leukotrienes and platelet-activating factors. These mediators will cause coughing, wheezing and dyspnea[23].

Additionally, based on the results of the previous recent study of El-Megharbel *et al.*[24] that supported using of some natural flavonoid metal complexes in treatment of SRAS-CoV-2 via some receptors that are related also to asthma incidence

and its consequences and the effect of some food additives on the pulmonary tissues' structure and thus, this support the same current results and the necessity for elevation of the public awareness and also validate the importance of asthma treatment that may consequently lead to pulmonary serious infections and increase the protection against any pandemic.

Moreover, in the chronic inflammatory conditions of the airways, the parasympathetic and muscarinic signaling is linked to the development of structural changes in the airways; a phenomenon commonly referred to as airway remodeling. Airway remodeling is progressive and correlates with disease severity with irreversible decline in lung function in patients with chronic disease[25].

This study recommended that more public program awareness is needed to limit the environmental triggers of asthma. Awareness with educational programs should be done excessively for the school children.

The limitation of this study was that the study with larger sample size are needed to clarify more conclusive knowledge about the risk factors of asthma.

CONCLUSION

Although, knowledge of asthma in Saudi Arabia has been improved, yet more public awareness is needed to limit the environmental triggers of asthma. Awareness with educational programs should be done for mothers and fathers and the school children. Many studies with larger sample size are needed to clarify more conclusive knowledge about the risk factors of asthma. More research targeting the autonomic dysfunction gives a good promise for the therapy and the proper usage of asthma medications.

SIGNIFICANCE STATEMENT

Asthma and autonomic imbalance are linked by increased bronchial sensitivity to cholinergic constrictors. This study's objective is to evaluate the relationship between 116 school-aged children's modifiable environmental risk factors and autonomic dysfunction. The 58 of them had bronchial asthma, while the remaining 58 were not asthmatic. A convenient sample of mothers and school-age children with bronchial asthma diagnoses were present. The "Bronchial Asthma Lifestyle Structured Assessment Interview Schedule" was the structured interview schedule used in the study. The results of the study showed that smoking around the child, family income, father's educational attainment, gender of the child and family history of asthma were all significant variables. Furthermore, factors like food allergies, seasonal changes and home attributes like ventilation and sleeping habits were found to have an impact.

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