# **Original Research Article**

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# Effect of asthma on school performance among intermediate school students in Riyadh city, 2015-2016

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## **ABSTRACT**

**Background:** Studies about impact of asthma on school performance are limited in the published literature especially in Saudi Arabia. This study was done to assess the effect of asthma on school performance and examine the relationship between asthma control and school achievement.

**Methods:** A cross-sectional study with a follow up of participants until the end of 2nd semester of (2015-2016). It was conducted among governmental intermediate school students (males and females 13 to15 years old) in Riyadh city, Saudi Arabia. Riyadh city is divided into five main sectors; two schools were randomly selected from each sector. Students were recruited from all three grades (first, second and third year) with a total sample of 1058 students. A self-administered questionnaire was given to the students at the start of the 2<sup>nd</sup> semester. The students' exam results were collected at the end of the 2<sup>nd</sup> semester.

**Results:** After adjusting for covariates, a significant difference in final average points was found between students with uncontrolled asthma (n=87) and controlled asthma (n=107) with an adjusted mean difference of 5.38 (95% CI 2.09-8.67 p<0.001). No significant difference in final average points was found between asthmatic (n=210) and non-asthmatic (n=848) students with an adjusted mean difference of 1.24 (95% CI-0.57-3.06) p=0.179. Significant associations were detected between gender, nationality, socioeconomic status and poor school performance p<0.01.

**Conclusions:** The study results suggest that students with uncontrolled asthma are more likely to perform worse in all subjects than students with controlled asthma.

**Keywords:** Asthma, Control, School performance

## INTRODUCTION

Asthma is the most common chronic airway disorder and affects mainly children.<sup>1</sup> It is a complex disorder characterized by recurrent attacks of wheezing, coughing and shortness of breath.<sup>1</sup> Asthma is estimated to affect around 334 million people globally.<sup>2</sup>

Education is an important aspect of child development, and asthma can impact a child's quality of life, which can lead to more absences, less participation in school activities and poor academic performance. A study

conducted by Bener et al in Qatar found that over half of all asthmatic children had poor examination scores that significantly differed from their healthy peers (p<0.001; poor, 34.5% and average, 31.4%).<sup>3</sup> Similarly, in a population based sample of American children in grades 1 to 12 that compared asthmatic children to their healthy peers, asthmatic children were more likely to experience grade failure (18% vs 15%), learning disabilities (9% vs 5%) and more absences. Even after adjusting for demographic factors, children in fair-poor health were two times more likely to report learning disability compared with those in good-excellent health.<sup>4</sup>

Although these studies above found a negative relationship between asthma and school achievement, another community-based study conducted by Silverstein et al in Rochester, Minnesota (2001) included a cohort of children with asthma (n=92) with age- and sex-matched non-asthmatic control subjects and 640 school-years of observation. They found no significant difference in grade point average -0.07 (95%CI -0.17, 0.02), grade promotion, or class rank of graduating students and concluded children with asthma performed similarly in school to children without asthma.<sup>5</sup>

Studies on the impact of asthma on school performance are limited in the published literature especially in Saudi Arabia. This study was conducted to assess the effect of asthma and explore in more depth the relationship between asthma control and school achievement to provide a better understanding of the problem for health professionals and the community.

## **METHODS**

## Study design

This was a quantitative, observational cross-sectional study that followed participants until the end of the 2016 school year. Recruitment began on 08-February-2016 for fifteen days. All the questionnaires were completed during the recruitment period. Students were followed until the end of the final exam period of the second semester of the 2015-2016 school years. Final exam results (the end point) were available on 30-May-2016. The students were followed for average of 105 days for approximately 15 weeks.

## Sample size and setting

A total of 1058 students were enrolled in the study. Two hundred ten students (19.8%) were asthmatic, and 848 (80.2%) were non-asthmatic..

The study was conducted in general governmental intermediate schools (boys and girls) in Riyadh city. Unlike the private and international schools in Riyadh, governmental schools share the same official curriculum and use the same grading system from the ministry of education.

A complete list of all intermediate schools in Riyadh city was obtained from the General Administration for Education for Riyadh region on 26 November 2015. Private, international and Qur'anic schools were excluded from the list.

Riyadh city is divided into five main regions, central, north, east, south, and west. For each region, two schools were selected by simple random sampling using computer generated numbers (using OpenEpi: Open Source Epidemiologic Statistics for Public Health, Version 3.01). Ten schools were selected (five with boys

and five with girls) representing Riyadh city. Another list was generated in case any school refused to participate.

## Student recruitment

## Asthmatic students

After explaining the purpose of the study to the school administration and obtaining their permission, all asthmatic students in all three levels (13-15 years old) of each selected school were invited to participate. Each student who identified himself/herself as asthmatic were gathered in one place (usually the library or resources room) and given a questionnaire to fill out. In total, 210 asthmatic students were recruited from all schools.

#### Non-asthmatic students

From each selected school, one class was selected per grade by simple random technique, and all students who were present at that time were included. Three classes per school, usually with 18-39 students, were selected. A total of 848 controls from all ten selected schools were recruited.

## **Tools**

## **Questionnaire**

Self-administered questionnaires were distributed at the start of the 2nd semester in March 2016, which were completed by the students and returned the same day. Before completing the questionnaire, a brief introduction to the study was given and students were instructed on how to fill out each question on the questionnaire.

The questionnaire contained three parts:

## Part 1: Demographic data

Included: name, age, gender, nationality, year level, class number, school name and contact number of one parent or guardian.

Part 2: Determined the asthma status, medical history and socioeconomic status (SES) of the parents (7 items).

Item 1 asked if the students suffered from asthma, and item 2 asked the duration of the asthma if item 1 was answered yes.

Item 3 asked about diabetic status, and item 4 asked if the student had other chronic diseases or injuries.

Items 5-7 determined the parents' social status using The Barratt Simplified Measure of Social Status (BSMSS). This is a measure of social status, which is a proxy for socio-economic status. It uses a scoring system range from 8 to 66 points which is sufficient for regression

analysis and creating SES groups based on the data collected.

Part 3: Asthma control test (ACT): 5 items.<sup>6</sup>

ACT is a patient self-administered tool for identifying those with poorly controlled asthma. It is a quick test that provides a numerical score to assess asthma control. Recognized by the National Institutes of Health (NIH) in its 2007 asthma guidelines and clinically validated against spirometry and specialist assessment. ACT can be used as an indication for asthma severity for those 12 years and older, it is available in Arabic and used by ministry of health in Saudi Arabia.

It has 5 items, with a 4-week recall (on symptoms and daily functioning). ACT assesses the frequency of shortness of breath and general asthma symptoms, use of rescue medications, the effect of asthma on daily functioning, and overall self-assessment of asthma control. A 5-point scale is used (for symptoms and activities: 1=all the time to 5= not at all; for asthma control rating: 1=not controlled at all to 5=completely controlled).

The scores ranged from 5 (poor control of asthma) to 25 (complete control of asthma), with higher scores reflecting greater asthma control. An ACT score >19 indicates well-controlled asthma, 16-19 indicates partially controlled asthma and less than 16 indicates uncontrolled asthma.

## Measures

Exposure: Asthma status

## Outcome

*Primary outcome*: School grades (average%): overall average in all subjects e.g. 97.6%.

The Saudi Grading System for intermediate schools: (Excellent 90.00% -100.00%, Very good 75.00% -89.99%, Good 60.00% - 74.99%, Pass 50.00% - 59.99%, Fail 0.00% - 49.99%).

Secondary outcomes

- Specific subjects marks: for math and science a total of 100 marks.
- 2- Total number of days absent.

School performance and exams results

The results were obtained directly from the schools' records by the end of the second semester of the year 1436-1437H (2015-2016).

## Data analysis

Categorical data were summarized as numbers and percentages, and continuous data were summarized as mean, median, standard deviation and interquartile range. Between-group comparisons for categorical variables were performed using the chi-square test, continuous data for two groups were analysed by Student's t-test, and continuous data for more than two groups were analysed by an analysis of variance (one-way ANOVA). Univariate and multiple logistic regression models were used to estimate crude and adjusted odds ratios (OR) with a 95% confidence interval (CI). To identify multivariate independent predictors, a logistic regression model was used. A 2-sided p<0.05 was considered statistically significant. All analyses were performed using IBM® SPSS® v.22.

#### Ethical considerations

Institutional review board (IRB) approval

IRB approval was obtained from King Saud University, College of Medicine on 10-Sep-2015 with reference number 15/0323/1RB and project number E-15-1591.

General Directorate of Education approval

Approval to conduct the study in the schools was obtained from the General Directorate of Education in Riyadh on 16-Nov-2015, with number 37267628.

Students were given the choice of whether to participate in the study. Three refused to participate, and the rest signed the informed consent to join the study.

## **RESULTS**

A total of 1058 subjects enrolled in the study. Males represented 49.1% and females represented 50.9% of the sample. Saudi students were the majority at 81.9%, and non-Saudi students represented 18.1%. Only nine students (less than 1%) were diabetic. Approximately 90% of the children lived with both parents. Parents with college degrees represented a majority, with 27.5% for fathers and 25.9% for mothers. Most parents were of the middle socioeconomic class at 44.7% of the sample. The summary of participant characteristics is given in Table 1.

Among asthmatic students, 119 (57.2%) had asthma for more than three years and approximately 87 students (44.6%) had poorly controlled asthma (Table 2).

## Inferential analysis

Primary analysis

Table 3 shows that the mean of final averages for those with asthma was significantly lower than those without asthma (p-value, 0.029). By using the multiple linear

regression model and after adjusting for gender, SES Score, nationality and living with, the adjusted mean

difference of 1.22, (95% CI, -0.59, 3.03) is not statistically significant with a p-value of 0.187.

**Table 1: Participants characteristics.** 

Variable	Level	N=1058	%
Gender	Male	520	49.1
Gender	Female	538	50.9
Nationality	Saudi	866	81.9
Nationality	Non-Saudi	192	18.1
Asthma	Yes	210	80.2
Astima	No	848	19.8
	1st year (grade)	347	32.8
Grade level	2nd year (grade)	361	34.1
	3rd year (grade)	350	33.1
Diabetes	Yes	9	0.9
Diabetes	No	1049	99.1
Other chronic disease or disability*	Yes	121	11.5
Other chrome disease of disability	No	932	88.5
	Both parents	955	90.6
Living with	With mother	66	6.3
Living with	With father	23	2.2
	Others	10	0.9
	Primary school or less	48	4.5
	Intermediate school	77	7.3
	Partial high school	95	9.0
Father education	High school graduate	201	19.0
rather education	Partial college	60	5.7
	College education	291	27.5
	Graduate degree	126	11.9
	Unknown	160	15.1
	Primary school or less	100	9.5
	Intermediate school	124	11.7
	Partial high school	98	9.3
Mother education	High school graduate	173	16.4
Wither education	Partial college	77	7.3
	College education	274	25.9
	Graduate degree	58	5.5
	Unknown	154	14.6
	Mean	33.58	
	Median	32.50	
SES score of the parents	Minimum	8.00	_
bed score of the parents	Maximum	66.00	
	SD	13.89	_
	IQR	20.00	

<sup>\*</sup>The question was: do you have another chronic disease or disability?

**Table 2: Asthmatics characteristics.** 

Variable	Level	N=210	%	
Asthma duration*	Less than a year	43	20.7	
	From1-3 years	46	22.1	
	More than 3 years	119	57.2	
Asthma control status**	Poor controlled asthma	87	44.6	
	Partially controlled asthma	52	26.6	
	Well-controlled asthma	56	28.7	

<sup>\*</sup> Two cases were missing due to incomplete questionnaires.

<sup>\*\* 15</sup> cases were missing due to incomplete ACT.

Table 3: Comparison of outcome means by presence or absence of asthma.

Variable	Asthma		No Asthma	No Asthma		
	Mean±SD	95% CI	Mean±SD	95% CI	P value*	
Final average	77.47±12.54	(75.76, 79.18)	79.65±12.97	(78.77, 80.52)	0.029	
	Mean Difference	0.029				
	Adjusted mean difference = 1.22, 95%CI (-0.59, 3.03)			0.187**		
No. of absence days	13.15±7.73	(11.99,14.15)	13.21±9	(12.65, 13.89)	0.929	
Math score	66.28±16.95	(63.91, 68.64)	69.99±17.84	(68.76, 71.21)	0.009	
Science score	65.8±15.76	(63.60, 67.99)	68.43±16.22	(67.31, 69.54)	0.042	

<sup>\*</sup> using Independent Samples T-Test

Table 4: Association between asthma control and academic performance.

Asthma status	N	Mean of the final average	Std. Deviation	Std. Error	95% confidence Lower bound	interval for mean Upper bound	P value
Uncontrolled	87	74.14	13.67	1.46	71.23	77.05	
Partially controlled	52	79.49	11.42	1.58	76.31	82.67	0.006*
Well-controlled	55	80.33	11.35	1.53	77.26	83.40	_

<sup>\*</sup>Test used One-Way ANOVA

Table 5: Comparison between students with uncontrolled and controlled asthma and academic performance.

Variable	Controlled asthma* n=107	Uncontrolled asthma n=87	D volue	
variable	Mean + SD	Mean + SD	P-value	
T21 A	79.92±11.34	74.14±13.67	0.002**	
Final Average	Mean Difference = 5.78 95% CI (2	2.23, 9.32)	.0.001***	
	Adjusted mean difference 5.38 (95	<0.001***		

<sup>\*</sup> Controlled asthma if ACT score 16 and more

Table 6: Students characteristics and school performance.

Covariate	Level	School performance**		Crude OR (95%CI)	P value	Adjusted* OR (95%CI)	P value
		Poor	Good	(75 /001)	value	(75 /001)	value
Gender	Male	144	373	2.1 (1.55, 2.83)	< 0.001	1.93 (1.39, 2.68)	< 0.001
Gender	Female	84	453	Reference			
Nationality	Saudi	199	666	1.5 (0.99, 2.26)	0.053	2.11 (1.32,3.37)	0.002
	Non-Saudi	29	160	Reference			
Grade level	1 <sup>st</sup> Year	90	254	1.66 (1.16, 2.39)	0.006	1.60 (1.06, 2.40)	0.024
	2 <sup>nd</sup> Year	75	285	1.21 (0.83, 1.76)	0.305	1.20 (0.80, 1.81)	0.384
	3 <sup>rd</sup> Year	63	287	Reference			
Other chronic	Yes	23	98	0.81 (0.50, 1.32)	0.409	0.71 (0.42, 1.21)	0.214
disease or disability	No	204	724	Reference			
SES score	One unit incr	ease		0.95 (0.93, 0.96)	< 0.001	0.95 (0.92, 0.99)	0.007

<sup>\*</sup> Multiple regression analysis model was used. Adjustment is done for Gender, Nationality, Living With, SES Score, Other chronic disease or disability.

Table 4 shows that the mean of the final average for uncontrolled asthma (n=87) is significantly lower than the mean for well-controlled asthmatic students (n=55), p<0.01.

After adjusting for covariates, a significant difference in final average points was found between students with uncontrolled asthma (n=87) and controlled asthma (n=107) with an adjusted mean difference of 5.38 (95% CI, 2.09-8.67; p<0.001), as shown in Table 5.

<sup>\*\*</sup> using multiple linear regression model.

<sup>\*\*</sup>Using Independent Samples T-Test

<sup>\*\*\*</sup>Multiple linear regression analysis model was used and adjusted for age, gender, nationality, and SES score.

<sup>\*\*</sup> The reference category is: Good Performance. Poor performance if final average score  $<\!\!70\%$ 

Table 6 shows that males were more likely to perform worse on exams with adjusted OR 1.93, (95% CI, 1.39, 2.68, p<0.001). Saudi students significantly had lower performance than non-Saudi students with adjusted OR 2.11 (95% CI, 1.32, 3.37, p=0.002)..

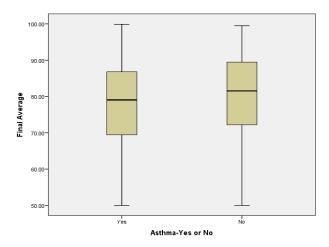


Figure 1: Boxplot of final average comparing asthma to non-asthma.

## DISCUSSION

This study examined the relationship between asthma and school performance among intermediate school students in Riyadh city, Saudi Arabia. The students were followed throughout the second semester of 2016. A total of 1058 students were enrolled in the study, and 210 (19.8%) were asthmatic, while 848 (80.2%) were non-asthmatic, with a ratio of approximately 4:1. The study did not find negative effect except for those with uncontrolled asthma. This study also explores the relationship between gender, nationality, grade level, socioeconomic status and academic performance. The results indicate that gender, nationality and socioeconomic status are strongly associated with poor academic performance p<0.01.

In comparing asthmatic with non-asthmatic students, and after adjusting for socio-demographic factors, the study did not find an association between asthma and poor school performance. However, when comparing uncontrolled with controlled asthmatic students, the results showed a strong association between poor school performance and poor asthma control, with an adjusted mean difference of 5.38 (95%CI 2.09-8.67 p<0.001). Older published studies in the literature were inconclusive on whether asthma impacts school performance. Recently, more studies have shown significant association between asthma severity and academic performance. Similar to this study's findings, Kohen concluded that students with the most severe asthma had the worst school performance.

Although several studies found asthmatic students to be at higher risk of absenteeism, our study did not find similar results. This might be explained by inaccurate absence records being provided by the schools. 4,5,10-14

The results also showed that lower socioeconomic status was associated with poor school performance. The correlation between SES and school achievement is well-established in the literature. Similar to this study's findings, a meta-analysis by Sirin confirmed that lower SES leads to poor school achievements.<sup>15</sup>

#### Limitations

The study was conducted over one school semester. A longer follow-up period would be more appropriate to test the long-term impact of asthma on school performance. Asthma control was evaluated only once during a winter month, and repeated evaluations multiple times during one school year is advisable.

Recruitment relied on known asthma diagnoses, which were reported by the students themselves due to a lack of reliable health records in the schools.

## **CONCLUSION**

Uncontrolled asthma is related to poor academic performance among school students. It is important to evaluate students' asthmatic status at the beginning of each school year. Proper asthma management guidelines are available in Saudi Arabia. A health education campaign is recommended for health practitioners to implement these guidelines. This will help to improve patients' asthmatic status and increase community awareness.

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Ethical approval: The study was approved by the

Institutional Ethics Committee

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