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ORIGINAL ARTICLE

Association of asthma with obesity among adolescents exposed to environmental tobacco smoke

Panagiota Kitsantas, PhD¹ and Francis Aguisanda, BS²¹Department of Health Administration and Policy, George Mason University, Fairfax, VA, USA and ²National Center for Advancing Translational Sciences, National Institutes of Health, Rockville, MD, USA**Abstract**

Objective: The purpose of this study was to examine the association between asthma diagnosis and obesity among adolescents exposed to environmental tobacco smoke (ETS). **Methods:** The sample included 28 807 adolescents (13–17 years old) from the National Survey of Children's Health (NSCH) (2011–2012). **Study design:** The NSCH is a US cross-sectional telephone survey that included at least one child between the ages of 0 and 17 years residing at a household during the time of the interview. Descriptive statistics were used to describe sample characteristics and assess the prevalence of asthma among adolescents with obesity exposed to ETS. Logistic regression models were built to assess the effect of obesity on asthma diagnosis within the context of ETS exposure. **Results:** The prevalence of asthma among adolescents was 10.4% and the obesity was 13.2%. Adolescents with obesity exposed to ETS within the home were significantly ($p < 0.05$) more likely to have an asthma diagnosis (23%) compared with non-obese (10.9%) residing in similar households. Adjusted odds ratios showed that adolescents with obesity were 2.07 (95% CI, 1.15, 3.70) times more likely to have asthma if they were exposed to ETS inside their homes. **Conclusion:** The findings indicate that adolescents with obesity are more likely to be diagnosed with asthma if they are exposed to ETS in the household. It is important that the association between obesity and asthma is examined within the context of environmental risk factors in future studies, as this may shed some light to underlying mechanisms between these two serious public health issues.

Keywords

Adolescents, asthma, childhood obesity, environmental tobacco smoke, exposure, public health

History

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Introduction

Asthma and obesity are some of the most common chronic conditions affecting youth in the United States. The prevalence of asthma in adolescents ranges from 10 to 11% [1], while obesity rates for children ages 12–19 have been escalating in the last few years [2]. This parallel increase of asthma and obesity has raised questions as to whether they might be linked. A number of recent longitudinal and prospective studies have found an association between asthma and obesity and that being overweight or obese increases the likelihood of asthmatic symptoms [3–5]. Longitudinal studies indicate that high body weight may precede asthma [6], although the reverse has been shown by others, where asthma may lead to obesity [7]. Further, this association tends to differ by age. According to Ahmad et al. [8], the strongest associations of asthma and obesity among US children were for the age group from 0 to 6 years old, with weaker (but still significant) associations in the 7–12 and 13–17 age groups.

Although several risk factors have been identified for either asthma or obesity in adolescents separately, it is not clear what the relationship between asthma and obesity might be within the context of common risk factors. For example, it is well known that the risk of asthma can greatly increase for children exposed to environmental tobacco smoke (ETS) [9–11] mold, pet dander, and dust mite/cockroach allergens [12]. The most severe among these is ETS [9]. While some studies have shown links between asthma and obesity, ETS and asthma, or ETS and obesity, there is a great lack of research studies on the association between asthma and obesity among adolescents exposed to ETS. Based on previous research findings, we hypothesized that adolescents (13–17 years old) with obesity who are exposed to ETS will have a higher prevalence of asthma diagnosis than adolescents with obesity who are not exposed to ETS. We address this question using data from the National Survey of Children's Health (NSCH).

Methods

The NSCH data set that was used in this study was collected from 2011 to 2012 by the Centers for Disease Control and Prevention (CDC). The present study was exempt from the Institutional Review Board at the researchers' institution since it used secondary data analysis from an existing data set.

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The NSCH was a random, cross-sectional telephone survey of households with at least one child between the ages of 0 and 17 years old. One child per household was randomly selected to be the subject of the survey. Surveys in English and Spanish were provided to the parent or guardian responsible for the health and well being of the sampled child in the household. The data encompasses interviews from 95 677 children from every state and the District of Columbia. The response rate for the landline sample was 38.2%, 15.5% for the cell phone sample, and 23% for the combined dual-frame sample. The completion rate of the surveys was 54.1% for the landline samples and 41.2% for the cell-phone samples. More information regarding this survey may be found at <http://childhealthdata.org/learn/NSCH> and <http://www.cdc.gov/nchs/slaits/nsch.htm#2011nsch>.

In this study, data ($n = 28\,807$ adolescents) were used from adolescents between the ages of 13 and 17 years old. The outcome variable was a dichotomous yes/no for asthma diagnosis which was assessed based on the survey questions “Does [child’s name] currently have asthma”, and “Has a doctor or a health professional ever told you that [child’s name] has asthma”. The primary independent variable included child’s body mass index (BMI) which was calculated by the NSCH based on the 2000 Centers for Disease Control BMI-for-age and gender growth curves [13]. Children were classified as underweight (≤ 5 th percentile), normal weight (> 5 th but less than the 85th percentile), overweight (≥ 85 and less than 95th), and obese (≥ 95 th percentile). From this variable, we created a dichotomous variable called non-obese (< 95 th percentile) and obese (≥ 95 th percentile). The ETS variable consisted of ETS exposure inside the house, ETS exposure but not inside the house, and non-ETS exposure. This variable was created by NSCH based on the survey question “Does anyone in the household use cigarettes, cigars, or pipe tobacco?”. If participants responded “yes”, then they were asked “Does anyone living inside of [child’s name]’s home smoke inside the home?”.

A number of independent variables were included in the analyses to control for potential confounding effects. These included children’s gender, race/ethnicity, federal poverty level, and consistency of health insurance. These variables were selected to be included in the analyses as they have been found by previous research studies to influence asthma diagnosis [8]. However, other variables (e.g. family structure) that have been considered in previous studies [8] were not included in the analyses of the present study since preliminary analyses showed no significant associations with asthma diagnosis. Race/ethnicity was composed of white non-Hispanic, black non-Hispanic, Hispanic and Other non-Hispanic (Asian, American Indian, Alaska Native, Native Hawaiian or Pacific Islander, and multi-racial). The poverty level variable was also created by NSCH. It was derived from the household income, and classifications were created based on the Department of Health and Human Services Federal Poverty guidelines: 0–99% of the Federal Poverty Level (FPL), 100–199% FPL, 200–399% FPL, and $\geq 400\%$ FPL [14]. Health insurance coverage was derived from the question “During the past 12 months/Since [his/her] birth], was there any time when [he/she] was not covered by any health insurance?”. This resulted in a dichotomous variable of

“consistently insured during past year” and “currently uninsured or periods of no coverage during year”.

The NSCH survey involves a complex design and it requires the use of sampling weights. In all the analyses of this study, population-based estimates were obtained based on the sampling weights NSCH has created. Descriptive statistics were performed to assess the characteristics of the sample. The prevalence of asthma diagnosis within the population of youth with obesity by ETS status was investigated using weighted percent estimates with 95% confidence intervals. The Chi-square test was used to determine any significant differences in asthma diagnosis between children with and without obesity by ETS. Further, Chi-square analyses were conducted to examine any associations between asthma diagnosis and the independent variables that were used in this study by ETS status. Logistic regression models were built to determine the effect of obesity on asthma diagnosis based on ETS, adjusting for a number of covariates. Odds ratios and 95% confidence intervals (CI) were computed. All analyses were weighted to account for the complex survey design and were performed using the complex sampling design module in SPSS [15]. The weighting variables used in the analyses were created and provided by NSCH. These weight variables (e.g. names of weighting variables: STATE, SAMPLE-strata variable, IDNUMR-cluster variable, and NSCHWT-weight variable) are adjusted for several complex design issues in NSCH such as non-response, issues with telephone lines, state population counts, children from Metropolitan Statistical Area (MSA), or non-MSA and several others. Further, a subpopulation procedure was used to obtain correct estimates since this study examined a specific age group of children.

Results

A total of 28 807 children who fit the criteria of the study (e.g. adolescents 13–17 years old) were included in the analytic sample. Table 1 describes the sample characteristics (weighted percents and standard errors). A slightly higher proportion (51.3%) of the sample was males.. The majority of the sample was white non-Hispanic (56.5%), 14.4% were black non-Hispanic, 19.8% were Hispanic, and 9.2% indicated other. The prevalence of asthma was 10.4% while the obesity rate was 13.2%. The distribution of households across the various FPL were 19.0% for $< 100\%$ of FPL, 20.5% were between 100% and 200%, 28.7% were within 200–400%, and 31.8% were above 400% FPL. Most (88.9%) had consistent health insurance coverage throughout the past year. ETS exposure inside the house was 7.4%, 17.5% indicated ETS exposure but not inside the house, while 75.1% of the adolescents were not exposed to ETS.

Prevalence rates for asthma diagnosis among adolescents with or without obesity by ETS exposure status are shown in Table 2. Adolescents with obesity exposed to ETS in the household were significantly ($p = 0.002$) more likely to have an asthma diagnosis (23%) compared with non-obese adolescents (10.9%) who were also exposed to ETS in the home. Prevalence rates of asthma diagnosis among adolescents with or without obesity exposed to ETS outside the house were not significantly different ($p = 0.132$). Similar results were

Table 1. Characteristics of study sample ($n = 28\,807$).

	Weighted % (standard error)
Gender	
Male	51.3 (0.7)
Female	48.7 (0.7)
Race/ethnicity	
White non-Hispanic	56.5 (0.7)
Black non-Hispanic	14.4 (0.5)
Hispanic	19.8 (0.7)
Other	9.2 (0.4)
Asthma	10.4 (0.4)
Obese	13.2 (0.5)
Federal poverty level	
<100%	19.0 (0.6)
100% to <200%	20.5 (0.6)
200% to <400%	28.7 (0.6)
≥400%	31.8 (0.6)
Consistency of health insurance	
Consistently insured throughout past year	88.9 (0.5)
Currently uninsured or periods with no insurance	11.1 (0.5)
Environmental tobacco smoke (ETS)	
ETS exposure inside the house	7.4 (0.3)
ETS exposure but not inside the house	17.5 (0.5)
Non-ETS	75.1 (0.6)

Table 2. Prevalence of asthma diagnosis among adolescents with obesity by exposure to environmental tobacco smoke (ETS).

	Asthma diagnosis	
	Weighted % (95%CI)	<i>p</i> Value
ETS exposure inside the house		0.002
Obese	23.0 (15.3, 33.0)	
Non-Obese	10.9 (8.4, 14.1)	
ETS exposure but not inside the house		0.132
Obese	17.2 (12.6, 23.1)	
Non-obese	13.1 (11.0, 15.6)	
Non-ETS exposure		0.984
Obese	9.7 (7.8, 12.0)	
Non-obese	9.7 (8.7, 10.8)	

observed for the children in households without ETS exposure ($p = 0.984$).

No significant differences were observed in asthma diagnosis between males and females exposed to ETS inside the home or between males and females not exposed to ETS at all (Table 3). However, males exposed to ETS outside their households were significantly more likely to have asthma diagnosis than females ($p = 0.05$). Significant differences were found in asthma diagnosis across different racial/ethnic groups for ETS exposure outside the house and non-ETS exposed groups. In both these groups, black non-Hispanic children were more likely to have been diagnosed with asthma ($p < 0.001$) compared with other racial/ethnic groups. Adolescents exposed to ETS inside or outside of the house were significantly more likely ($p < 0.05$) to have an asthma diagnosis if they were living at or below 100% of the FPL than higher FPL levels. A higher percentage of adolescents with asthma diagnosis who were exposed to ETS

in the home were consistently insured throughout the year (14.9% versus 6.3%).

Logistic regression analyses, upon controlling for a number of covariates, revealed that adolescents with obesity exposed to ETS in the home were 2.07 (95% CI: 1.15–3.70) times more likely to have asthma than adolescents without obesity residing in similar households. This did not hold true for adolescents with obesity who were not exposed to ETS or were exposed to ETS outside their homes. Black adolescents were 2.64 (1.56, 4.35) times more likely to be diagnosed with asthma compared with white adolescents if they were exposed to ETS outside their home. Similar findings were found for the black adolescents who were not exposed to ETS.

Discussion

In this study, the prevalence of asthma for adolescents between the ages of 13 and 17 years old was similar to the reported US population of asthmatic adolescents by the CDC [1]. The findings of this study support recent evidence that there is a positive association between asthma and obesity in adolescents [6,8]. Asthma was particularly evident among those adolescents with obesity who were exposed to ETS inside the house, even after controlling for several potential confounders. We also found that adolescents with obesity and with ETS exposure outside the house or who were not exposed to ETS did not show a significant elevation of asthma risk (Table 4). These findings indicate that the positive association between asthma and obesity in adolescents might be influenced by external factors such as ETS, particularly when this exposure to ETS is observed in closed environments such as inside a house. One may expect ETS exposure to increase the risk of asthma development in children with obesity, since both asthma and obesity have been linked to ETS independently [9,16,17].

Overall, the negative effects of obesity on asthma have been observed in several studies, although a number of studies have not provided a link between these two serious health issues. For example, some studies did not find a significant association between obesity and asthma severity in adolescents [18]. Others demonstrated that obesity was associated with asthma, lower lung function, and reduced atopy [19]. It has been suggested that genetic factors might explain this association [20,21], while others proposed that obesity may trigger inflammation leading to asthma development [22]. In the current study, we could not investigate possible mechanisms between asthma and obesity due to the cross-sectional nature of the NSCH data. However, the present findings indicate that this association differs based on ETS exposure. Further research should examine this association within the context of ETS and other environmental exposures.

Beside the cross-sectional nature of this data set, other limitations include self-reported information with regard to asthma diagnosis, body weight, and height from which the measure of BMI was derived. These self-reported data can introduce bias into the analyses. Although the participants in the current study did not self-diagnose themselves with asthma, rather they responded to the question ‘‘Has a doctor or a health professional ever told you that [child’s name] has asthma’’ as yes/no, the vague definition of asthma can pose an

Table 3. Asthma diagnosis and other sample characteristics by exposure to environmental tobacco smoke (ETS).

	Asthma diagnosis					
	ETS exposure inside the house Weighted % (95%CI)	<i>p</i> Value	ETS exposure but not inside the house Weighted % (95%CI)	<i>p</i> Value	Non-ETS exposure Weighted % (95%CI)	<i>p</i> Value
Gender		0.33		0.05		0.81
Male	15.4 (11.3, 20.6)		15.4 (12.5, 18.8)		9.3 (8.1, 10.7)	
Female	12.4 (9.0, 16.9)		11.4 (9.0, 14.3)		9.6 (8.2, 11.1)	
Race/ethnicity		0.316		0.00		0.00
White non-Hispanic	15.4 (11.6, 20.2)		11.2 (9.2, 13.6)		8.7 (7.8, 9.8)	
Black non-Hispanic	15.0 (9.4, 23.0)		28.1 (20.4, 37.4)		15.2 (12.3, 18.8)	
Hispanic	11.1 (8.3, 23.0)		12.2 (7.4, 19.4)		6.9 (4.8, 9.8)	
Other	6.7 (3.7, 11.8)		12.6 (8.2, 18.7)		10.5 (7.4, 14.7)	
Poverty level		0.05		0.03		0.13
<100%	18.4 (13.3, 24.8)		19.2 (14.3, 25.3)		11.6 (9.0, 14.8)	
100% to <200%	13.0 (8.1, 20.2)		12.2 (8.9, 16.5)		9.9 (7.6, 12.9)	
200% to <400%	7.9 (5.2, 11.7)		11.9 (9.0, 15.5)		8.0 (6.8, 9.4)	
≥400%	14.3 (6.7, 26.1)		11.3 (7.8, 16.1)		9.3 (7.9, 10.9)	
Consistency of health insurance		0.006		0.54		0.77
Consistently insured throughout past year	14.9 (11.7, 18.7)		13.8 (11.8, 16.1)		9.4 (8.4, 10.4)	
Currently uninsured or periods with no insurance	6.3 (3.4, 11.4)		11.5 (6.4, 19.7)		9.9 (6.8, 14.1)	

Table 4. Odds ratio (OR) and 95% confidence intervals (CI) for asthma diagnosis among adolescents based on environmental tobacco smoke exposure (ETS).

	Asthma diagnosis		
	ETS exposure inside the house Adjusted OR (95% CI)	ETS exposure but not inside the house Adjusted OR (95% CI)	Non-ETS exposure Adjusted OR (95% CI)
Obesity			
Obese	2.07 (1.15, 3.70)	1.23 (0.74, 1.97)	0.94 (0.71, 1.23)
Non-obese	Reference	Reference	Reference
Gender			
Male	1.28 (0.77, 2.12)	1.24 (0.86, 1.78)	0.94 (0.75, 1.18)
Female	Reference	Reference	Reference
Race/ethnicity			
White non-Hispanic	Reference	Reference	Reference
Black non-Hispanic	0.72 (0.35, 1.43)	2.64 (1.56, 4.35)	1.67 (1.23, 2.28)
Hispanic	0.62 (0.21, 1.84)	1.03 (0.55, 1.92)	0.73 (0.47, 1.12)
Other	0.37 (0.17, 0.77)	1.15 (0.68, 1.96)	1.15 (0.75, 1.75)
Poverty level			
<100%	1.21 (0.44, 3.36)	1.59 (0.87, 2.91)	1.35 (0.94, 1.96)
100% to <200%	0.88 (0.32, 2.44)	1.08 (0.62, 1.91)	1.04 (0.74, 1.48)
200% to <400%	0.49 (0.18, 1.32)	0.99 (0.58, 1.68)	0.83 (0.65, 1.06)
≥400%	Reference	Reference	Reference
Consistency of health insurance			
Consistently insured throughout past year	Reference	Reference	Reference
Currently uninsured or periods with no insurance	0.39 (0.18, 0.83)	0.79 (0.39, 1.62)	1.09 (0.70, 1.72)

important limitation. It has been reported that when answers from questionnaires with regard to asthma are validated with clinical diagnoses such as lung conditions, self-reported questions on asthma have a sensitivity mean of 36% with a range of 7–80% [23]. The specificity has been reported anywhere between 74 and 100% (specificity) with a mean of 94% [23]. However, the strengths of this study include a

relatively large sample size that is representative of the US adolescent population.

Conclusion

In summary, this study shows that obese adolescents are more likely to be diagnosed with asthma if they are exposed to ETS inside the household. It is important that the association

between obesity and asthma is examined within the context of environmental risk factors in future studies, as this may shed some light to underlying mechanisms between these two serious public health issues. Healthcare providers should always strive to identify potential environmental exposures such as ETS exposures since they may pose serious asthma triggers, especially among adolescents with obesity.

Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

References

1. Akinbami LJ, Moorman JE, Liu X. Asthma prevalence, health care use, and mortality: United States, 2005–2009. *Natl Health Stat Rep* 2011;32:1–16.
2. Ogden C, Carroll M, Kit B, Flegal K. Prevalence of childhood and adult obesity in the United States, 2011–2012. *JAMA* 2014;311:806–814.
3. Saha C, Riner M, Liu G. Individual and neighborhood-level factors in predicting asthma. *Arch Pediatr Adolesc Med* 2005;159:759–763.
4. Gonzalez-Barcala FJ, Pertega S, Perez-Castro T, Sampedro M, Sanchez-Lastres J, San-Jose-Gonzalez MA, Bamonde L, et al. Obesity and asthma: an association modified by age. *Allergol Immunopathol* 2013;41:176–180.
5. Black MH, Smith N, Porter AH, Jacobsen SJ, Koebnick C. Higher prevalence of obesity among children with asthma. *Obesity* 2012;20:1041–1047.
6. Flaherman V, Rutherford GW. A meta-analysis of the effect of high weight on asthma. *Arch Dis Child* 2006;91:334–339.
7. Abramson NW, Wamboldt FS, Mansell AL, Carter R, Federico MJ, Wamboldt MZ. Frequency and correlates of overweight status in adolescent asthma. *J Asthma* 2008;45:135–139.
8. Ahmad N, Biswas S, Bae S, Meador KE, Huang R, Singh KP. Association between obesity and asthma in US children and adolescents. *J Asthma* 2009;46:642–646.
9. Sturm JJ, Yeatts K, Loomis D. Effects of tobacco smoke exposure on asthma prevalence and medical care use in North Carolina middle school children. *Am J Public Health* 2004;94:308–313.
10. Mannino DM, Moorman JE, Kingsley B, Rose D, Repace J. Health effects related to environmental tobacco smoke exposure in children in the United States. *Arch Pediatr Adolesc Med* 2001;155:36–41.
11. Hugg TT, Jaakkola MS, Ruotsalainen RO, Pushkarev VJ, Jaakkola JJ. Parental smoking behaviour and effects of tobacco smoke on children's health in Finland and Russia. *Eur J Public Health* 2008;18:55–62.
12. Skoner D. Controlling asthma: why we must do better? *Contemp Pediatr* 2001;18:49–62.
13. Clinical Growth Charts [Internet]. Centers for Disease Control; 2000 May 30 [updated 2009 Aug 4]. Available from: http://www.cdc.gov/growthcharts/clinical_charts.htm [last accessed 23 Dec 2014].
14. Blumberg S, Foster E, Frasier A. Design and operation of the National Survey of Children's Health. *Vital Health Stat* 2012;1:131–132.
15. SPSS Statistics for Windows. Version 22.0. Armonk, NY: IBM Corp; 2013.
16. Kries R, Toschke A, Koletzko B, Slikker W. Maternal smoking during pregnancy and childhood obesity. *Am J Epidemiol* 2002;156:297–298.
17. McConnell R, Shen E, Gilliland F, Jerrett M, Wolch J, Chang C, Berhane K. A longitudinal cohort study of body mass index and childhood exposure to secondhand tobacco smoke and air pollution: the Southern California children's health study. *Environ Health Perspect* 2014;123:1–29.
18. Mansell AL, Walders N, Wamboldt MZ, Carter R, Steele DW, Devin JA, Monica TH, et al. Effect of body mass index on response to methacholine bronchial provocation in healthy and asthmatic adolescents. *Pediatr Pulmonol* 2006;41:434–440.
19. Musaad SM, Patterson T, Ericksen M, Lindsey M, Dietrich K, Succop P, Khurana Hershey GK, et al. Comparison of anthropometric measures of obesity in childhood allergic asthma: central obesity is most relevant. *J Allergy Clin Immunol* 2009;123:1321–1327.
20. Xu B, Pekkanen J, Laitin MRT. Body build from birth to adulthood and risk of asthma. *Eur J Public Health* 2002;12:166–170.
21. Camargo CA, Weiss ST, Zhang X, Willett WC, Speizer FE. Prospective study of body mass index, weight change, and risk of adult-onset asthma in women. *Arch Intern Med* 1999;159:2582–2588.
22. Chinn S, Rona RJ. Can the increase in body mass index explain the rising trend in asthma in children? *Thorax* 2001;56:845–850.
23. Toren K, Brisman J, Jarvholm B. Asthma and asthma-like symptoms in adults assessed by questionnaires. A literature review. *Chest* 1993;104:600–608.