



ASTHMA AND OBESITY AMONG CHILDREN IN BASRA

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SUMMARY

Background: Asthma and obesity are two of the most common conditions of childhood and adolescence. The prevalence of asthma has increased worldwide during the last several decades, An increasing trend in body mass index in affluent countries has been paralleled by an increase in asthma and atopic disorders. In addition to an increased risk for asthma, obesity may be associated with asthma severity and/or poor asthma control. **Objectives:** Assess frequency of obesity among asthmatic children and its effect on severity of asthma and to compare between asthmatic children and obese control regarding some factors concerning residence, parental education, dietary habit, and sedentary life style. **Subjects and methods:** A case control study was carried out on 79 asthmatic children (6-12) years (36 males and 43 females) at Basra Maternity and Children Hospital and 210 apparently healthy children (124 males and 86 females). Age and sex were matched in both groups. Mean body mass index (BMI) was assessed in both groups. Asthmatic children were compared with obese children from control in relation to some factors. BMI was assessed in relation to severity of asthma in asthmatic children. **Results:** It was found that mean Body mass index is significantly higher in asthmatic children than control group. (P. value 0.000). Asthmatic females had significantly higher body mass index than males. (P. value 0.000). Both females and males in control group had similar body mass index (P. value >0.05). Obesity and overweight was significantly higher in asthmatic children (90.5% and 43.6%, 54.4% and 25.7%) than control groups respectively. (P. value 0.005), and higher among asthmatic female than male (P. value 0.000). Asthmatic children and obese children from control had higher percentage of mothers with low education, (55.6%, 63%) respectively. Both groups were similar in residence (P. value >0.05). Asthmatic children and obese children from control were similar in dietary habit were had (1-3) snacks/day. (P. value >0.05). Asthmatic children and obese children from control were watching television, playing video games >2hour/day, and had physical activity <1hour/day, in percentage of (72.2%, 81.5%), (75.9%, 77.8%), (81%, 74.1%). (P. value >0.05). Parental asthma and other allergic disease are significantly associated with asthmatic children. (P. value 0.000). **Conclusion:** Body mass index is significantly higher in severe asthma (P. value 0.000). Asthma and Obesity are similar in dietary habit, low education of mothers, residence, sedentary life. **Recommendations:** It is important to measure Body mass index for all asthmatic children and observe respiratory symptoms in obese children. Healthy diet and physical activity are needed to be encouraged in asthmatic and obese children.

KEYWORDS: Asthma Obesity children.

INTRODUCTION

Asthma and obesity are two of the most common conditions of childhood and adolescence.^[1,2] The prevalence of asthma has increased worldwide during the last several decades, particularly in developed countries.^[2] A parallel rise in the prevalence of childhood obesity during the same time period has led to speculation that in addition to these classic risk factors, obesity may explain some of the increased burden of asthma.^[3] A positive association between asthma and obesity has been reported in adults, with such an association being more evident in women and in

adolescent girls than boys.^[4] One of the reports also indicated that asthma severity was associated with overweight.^[5] There are many factor affecting asthma and obesity like diet, Western diet (high in calories, fats, processed food, and relatively low in fresh fruits, vegetables, and fish) may contribute to both obesity and asthma.^[6] Physical activity and exercise also affects both asthma and obesity since sedentary behavior is a risk factor for obesity and is a plausible factor leading to asthma. Children who are overweight sustain less routine physical exertion than their lean counterparts.^[7] Both asthma and obesity shared genetics. Current genetic

understanding has stemmed from discovering associations between obesity and asthma phenotypes and candidate gene variants. For example, several promising genomic areas that contain genes connected with both obesity and asthma (5q23-32, 6p21-23, 11q13, and 12q13-24) have been identified. It has been postulated that the glucocorticoid receptor gene NR3C1 has been involved in the inflammatory responses associated with obesity and asthma.^[8,9] Hormonal effect is also involved as adipose tissue provides feedback regarding energy storage levels to the brain through hormonal release of adiponectin and leptin. Leptin a hormone that acts on the hypothalamus to regulate hunger and satiety, is secreted by adipocytes.^(10,11) Numerous studies have demonstrated a close relationship between a high BMI and asthma during the last decade.⁽¹²⁾ The increase in childhood obesity in recent decades is a worldwide problem.⁽¹³⁾ An increasing trend in body mass index (BMI) in affluent countries has been paralleled by an increase in asthma and atopic disorders. It has also been suggested that the link between a high BMI and asthma could be a recent phenomenon.^[14] In addition to an increased risk for asthma, obesity may be associated with asthma severity and/or poor asthma control.^[15] Obesity may directly affect the asthma phenotype by mechanical effects including airway latching and increasing in airway resistance and responsiveness to methacholine.^[16] Therefore, sex-related patterns of asthma may depend on interrelationships of BMI, lung function, AHR, and dyspnea. Factors related to asthma severity may be similar or different from those related to asthma incidence.^[17]

AIMS OF THE STUDY

Assess frequency of obesity and overweight among asthmatic patients and control, and assessment of BMI in relation to asthma severity in asthmatic children.

Comparison between asthmatic patients and obese control in relation to some selected variables like residence and Parental education, number of meals and snacks, watching TV, Playing video games, Physical exercise and Parental asthma and other allergic disease.

SUBJECTS AND METHODS

A case control study has been carried out on 79 children admitted to emergency unit and pediatric wards at Basra Maternity and Children Hospital with respiratory symptoms (dyspnea, wheeze). Their ages range from (6-12) years, from the 1st March to 31st October 2013. Thirty six (45.6%) were males and 43(54.4%) were females.

Children with clinical diagnosis of asthma present with signs and symptoms of asthma include recurrent wheezing, cough, shortness of breath, chest tightness, exercise limitation, mucoid vomiting, and chronic day and night cough with history of parental asthma, symptoms apart from cold and had history of symptoms

were improved with the use of inhaled or oral asthma medications (bronchodilator) but did not improve with antibiotics or antihistamine therapy, history of factors that trigger these symptoms include viral infections, tobacco smoke, vigorous exercise, allergen or irritant exposures, breathing cold dry air. Chest examination reveals expiratory wheeze and prolonged expiratory phase.^[18,19] Exclusion criteria include CHF, Pulmonary edema or CHD., history of repeated chest infection due to (different causes like Immune deficiency or chronic lung disease. etc.), children with URT conditions like(Chronic rhinitis, Chronic sinusitis) and neurological abnormality (cerebral palsy). Control group includes (210)children; 124 (59%) were males and 86 (41%) were females, apparently healthy and matched for age and sex with cases and selected from 4 primary schools they have no acute or chronic systemic illness and have no history of atopy or eczema or previous hospitalization for respiratory problems. An informed consent was obtained from at least one parent before the recruitment in the study for all children.

A special questionnaire was designed for the purpose of the study. The following information were taken: name, age, sex, residence of the family, education of both parents (Illiterate, Primary, Secondary, High education), dietary habit (number of meals per day (<3, 3), number of snacks per day (none, 1, ≥ 2) were recorded. Physical activity and exercise were assessed by the number of hours spent Watching TV and Playing video games (Watching TV and Playing video games (≤ 2 hours, >2 hours)).^[20] symptoms of asthma, history of asthma and other allergic disease in other family member, asthma severity (Intermittent and Persistent). Intermittent means day time attack < 2 /wk, Persistent includes day time attacks >2 /wk (mild), daily but not throughout the day (moderate) daily & throughout the day (severe).⁽¹⁸⁾ Another questionnaire was designed in Arabic language for control groups and the questions asked to children and their parents to be answered at home which include: name, age, sex, residence of the family, education of both parents, sedentary life style of children, history of parental asthma and allergic disease in family like (allergic rhinitis, eczema).

Methods: patients and controls were underwent physical examination includes systemic examination, vital signs and growth measures, all children were weighed, wearing light clothing, height was taken barefooted to the nearest 0.1cm. obesity and overweight are defined using BMI percentiles; children >2 yrs. old with a BMI ≥ 95 th percentile meet the criterion for obesity, and those with a BMI between the 85th and 95th percentiles fall in the overweight range.^[10] Body mass index (BMI) percentile, was determined using the 2000 Centers for Disease Control and Prevention (CDC) Growth Charts for the United States.^[21] Number and percentage of obesity and overweight were determined in both asthmatic children and control groups. Mean BMI was assessed in both groups. Asthmatic children were

compared with obese children from control in relation to residence and parental education, number of meals and snacks, watching TV, Playing video games and physical exercise with parental asthma and other allergic disease. BMI was assessed in relation to severity of asthma in asthmatic children.

Statistical analysis

Statistical analysis was done using SPSS program V.17, data were expressed by mean \pm Standard Deviation. A comparison of proportions was performed using Chi-Square test and the t-test For all tests. p-value of <0.05 was considered as statistically significant.

RESULTS

The total number of children enrolled in this study was (289) (79) were patients with asthma (45.6%) were male, (54.4%) were female and (210) age and sex matched control groups were (59%) male and (41%) female Table (1). The BMI is more in asthmatic patients than control for both sexes and in asthmatic females than asthmatic males. (p. value 0.000, also show no statistically significant difference between sexes in control.(p. value >0.05) .Table 2. Obesity and overweight are significant

higher in asthmatic children than control) P. value (0.005). Among asthmatic children obesity and overweight are significantly higher in females than males P. value (0.000), while no significant difference between females and males control .P. value (0.910). Both obesity and overweight are significantly higher in females asthmatic than females control. P. value (0.000).Table 3.Both asthmatic children and obese control were similar in residence and education status of both parents High frequency of mothers with low education in both groups. Table 4. There is no statistically significant difference between asthmatic patients and obese control in relation to dietary habit (number of meals and snacks) most of children from two the groups had (1-3) snacks Table 5.

Most of children from two the groups Watching TV and Playing video games more than 2 hours and doing Physical exercise less than 1hour.Table 6 .There is statistically significant association between parental asthma and other allergic disease in asthmatic patients than obese control P. value < 0.05 .Table 7. Persistent asthmatic children have higher BMI than intermittent cases (statistically significant results) P. value < 0.05 Table 8.

Table 1: Asthmatic patients and control (distribution in relation to sex and age...)

Variable		Asthmatic patients No. (%)	Control No. (%)	P. value
Age group (years)	(6-<8)	32(40)	76(36)	0.64
	(8-<10)	22(28)	60(29)	0.89
	(10-12)	25(32)	74(35)	0.71
Sex	Male	36 (45.6)	124 (59)	0.17
	Female	43 (54.4)	86 (41)	0.18
Total		79(100)	210(100)	

Table 2: The mean age and BMI in asthmatic patients and control.

Variable		Asthmatic Patients Mean(SD)	Control Mean(SD)	P.value
Sex	Male	BMI	18.32 (2.43)	16.91(1.78)
		Age	8.91(1.83)	9.19(2.06)
	Female	BMI	22.13(3.09)	16.39(2.43)
		Age	9.30(1.95)	9.41(1.96)

Table 3: Obesity and overweight among asthmatic patients and control.

Variable		Asthmatic Patients No. 79 (%)	Control No. 210 (%)	P. value
Sex	Male	Obese	5(13.8)	24(19.5)
		Over wt.	8(22.2)	26(21)
		total	13(36)	50(40.5)
	Female	Obese	33(76.7)	30(34.9)
		Over wt.	9(20.9)	4(4.7)
		total	42(97.6)	34(39.6)
Total		55(69.6)	84(40)	(0.005)**

4. Residence and parental educational level in asthmatic patients and obese control.

Variables		Asthmatic Patients No. (%)	Obese control No. (%)	P. value
Residence	Urban	36(45.6)	34(63)	0.083
	rural	43(54.4)	20(37)	0.075
Mother education	Illiterate	11(13.9)	12(22.3)	0.182
	Primary	33(41.7)	22(40.7)	0.912

	Secondary	27(34.1)	11(20.4)	0.057
	High educ.	8(10.1)	9(16.6)	0.239
Father education	Illiterate	5(6.3)	2(3.7)	0.317
	Primary	21(26.5)	20(37)	0.166
	Secondary	30(37.9)	12(22.2)	0.053
	High educ.	23(29.1)	20(37)	0.325
Total		79(100)	54(100)	

Table 5: Number of meals and snacks in asthmatic patients and obese control.

Variables	Asthmatic patients No. (%)	Obese control No. (%)	P. value	
Meals	<3	16(20.3)	8(14.8)	0.303
	3	63(79.7)	46(85.2)	0.639
Snacks	0	7(8.9)	4(7.4)	0.796
	1	23(29.1)	18(33.3)	0.611
	≥2	49(62)	32(59.2)	0.785
Total	79(100)	54(100)		

Table 6: Time spent watching TV, playing video games and physical activity in asthmatic patients and obese control.

Variables	Asthmatic patients No. (%)	Obese control No. (%)	(OR)	(95%CI)		P. value
				Lower value	Upper value	
Watching TV	>2hr	57(72.2)	0.589	0.253	1.370	0.21
	≤2hr	22(27.8)				
Playing video games	>2hr	60(75.9)	0.902	0.396	2.055	0.87
	≤2hr	19(24.1)				
Exercise	≥1hr	15(19)	0.670	0.292	1.534	0.34
	<1hr	64(81)				
Total	79(100)			54(100)		

Table 7: History of parental asthma and other allergic disease.

Variables	Asthmatic patients No. (%)	Obese (control) No. (%)	P. value	
Parental Asthma	No	5(6.3)	40(74)	0.000
	Father	16(20.3)	2(3.7)	0.000
	Mother	41(51.9)	9(16.6)	0.000
	Both	17(21.5)	3(5.5)	0.002
Allergic disease	No	6(7.6)	41(75.9)	0.000
	Atopic Eczema	36(45.6)	2(3.7)	0.000
	Allergic Rhinitis	30(38)	7(12.9)	0.000
	Both	7(8.8)	4(7.4)	0.796
Total	79(100)	54(100)		

Table 8: BMI in relation to asthma severity.

Variable	No. (%)	BMI Mean (SD)	P. value	
Asthma severity	Intermittent	27(34.1)	18.18(1.78)	0.000
	Persistent	52(65.8)	21.54(3.46)	
Total		79(100)		

DISCUSSION

The prevalence of both asthma and obesity increased significantly in the last decades. Studies seek to establish relations between them, excessive weight might represent an elevated risk of developing asthma.^[22] This study was done to show the percentage of obesity and overweight among asthmatic children and found that mean BMI, obesity and overweight are higher in asthmatic patients than control, such finding was

comparable to that seen by Braback L,^[14] and Chinn S,^[12] Hussein F, Abdul Kareem A,^[23] Chinn S, Rona RJ.^[24] This may be because asthma predispose children to inactivity and increase dietary intake this in turn may promote to weight gain.^[25] Also this study found that obesity and overweight are more among females asthmatic than males, while obesity and overweight are not associated with sex in control groups. Similar findings seen by Figueroa-Muñoz, Rona RJ, et al.^[4]

Castro-Rodríguez and colleagues,^[26] and Al-Nozha *et al.*^[27] this may be attributed to that females tend to be less physically active than males and by the fact that female have a greater percentage of body fat than male, and might be mediated by female sex hormones. This study found that there was no significant difference between asthmatic patients and obese control in relation to residence, similar findings seen by Hendryx M, *et al.*,^[28] while study from KSA,^[27] showed significant higher prevalence of obesity in urban area while the reverse is true in USA^[29] This urban-rural gradient in asthma prevalence may indicate that certain exposures particular to a westernized, poor, urban environment are different from those in a rural area. It is likely that some combination of exposures associated with the physical, social, and cultural environment contributes to the problem of asthma prevalence seen in these poor urban communities.^[30]

This study found that mother of low educational level was present in significant percentage in both asthmatic patients and obese control, similar results seen by Lamerz A *et al.*^[31] who found that obesity was particularly prevalent in children whose mothers had less than 9 years of education, since mothers are generally responsible for diet intake and upbringing of their children, Children of low education mothers at risk for asthma as compared to high educational level, this agree with Heck KE, *et al.*^[32] and this might be due to lower health care facilities available for their children, other possible explanation is that mother with lower educational level tend to bottle-fed their children more than mother with a higher educational level which may increase risk of asthma more than breast fed children^[33] This study demonstrated that number of meals and snacks were similar in both asthmatic patients and obese control, Musa WA, *et al.*^[20] also found no significant association between obesity and meal and snack while other study done by Field AE, *et al.*^[34] revealed that strong association between obesity and snacks. The snack foods might promote weight gain specially when consumed in addition to, not instead of, regular meals and when have high fat contents and there are some data to suggest that intake of high glycemic foods may promote hunger and increase food intake, which could lead to greater weight gain.^[35] Other study done by Arvaniti F, *et al.*^[36] found that unhealthy lifestyle behaviors, such as snack eating and television /video-game viewing were strongly associated with the presence of asthma and obesity. This study demonstrated that no significant difference between asthmatic patients and obese control in relation to sedentary life style (Watching TV, Playing video games and Physical activity). Large number of asthmatic patient and obese control watching TV and playing video games >2hr. and had low level of Physical activity. Other study done by Hancox and Poulton,^[37] Al-Ghamdi SH.^[38] and Musa WA.^[20] had confirmed that watching television during childhood is associated with an increased BMI these associations were stronger and more consistently significant in girls.

The watching television causes obesity through displacement of physical activity, and increased calorie consumption while watching as a result of advertising, and reduced resting metabolism^[39] Regular participation in high intensity exercise appears protective against being overweight.^[40] Sherriff A, *et al.*^[41] showed an association between time spent watching television and the development of asthma, the greater risk of asthma was not directly caused by watching television, which was used only as an indicator of how sedentary the children's lifestyles were. The finding builds on recent work that points to a link between asthma and low levels of physical activity.

This study had shown that parental asthma and allergic disease were more in asthmatic patient than obese control similar findings seen by Michael A, *et al.*^[25] A strong association between asthma and atopy has been found in clinical studies where over 80% of asthmatic children react to one or more environmental allergens in skin prick tests. This study found that large number of asthmatic children had severe persistent asthma as compared to severe intermittent asthma, and increase BMI associated with severe persistent asthma. This result agree with that found by Camilo DF *et al.*^[42] and Taylor *et al.*^[43] where significant association between persistent asthma and obesity. Persistent asthma interferes in the reduction of the patients' physical activities. Asthmatic individuals are more prone to watching television, excessive usage of video games, having a smaller caloric loss, and higher consumption of industrialized foods which may contribute to more weight gain.

The study concluded that asthmatic patients have higher BMI than control, and Higher BMI among asthmatic female than control female. There is significant number of low educated mother in asthmatic patients and obese control, Both groups were similar in their residence. Asthmatic patients and obese control were spent more than 2 hours Watching TV, Playing video games and doing Physical exercise less than 1hour. History of parental asthma and allergic disease significant in asthmatic patients than obese control. Higher BMI among asthmatic patients with severe persistent asthma than severe intermittent.

Growth assessment and measurement of BMI for all children during their follow up visits help for early detection of overweight and obesity and referral to dietitian to regulate their diet and educate their families about healthy diet and life style changes in relation to decrease watching TV and video games and increase physical activities for better prevention of both asthma and obesity.

REFERENCES

1. Gale R. Epidemiology of adolescent health problems. In: Kliegman R, Stanton B, Schor N, St Geme III J (eds). *Nelson Textbook of Pediatrics*: 20th ed. Philadelphia. WB Saunders Co., 2016; 937-939.
2. Eder W, Ege MJ, von Mutius E. The asthma epidemic. *N Engl J Med.*, 2006; 355(21): 2226–2235.
3. Ross KR, Hart MA. Assessing the relationship between obesity and asthma in adolescent patients. *Adolescent Health, Medicine and Therapeutics*, 2013; 4: 39–49.
4. Figueroa-Muñoz J I, Rona RJ, et al. Association between obesity and asthma in 4–11 year old children in the UK. *Thorax*, 2001; 56: 133–137.
5. Luder E, Melnik T, DiMaio M. Association of being overweight with greater asthma symptoms in inner city black and Hispanic children. *J Pediatr*, 1998; 132: 699–703.
6. Lawson OJ, Williamson DA, Champagne CM, et al. The association of body weight, dietary intake, and energy expenditure with dietary restraint and disinhibition. *Obes Res.*, 1995; 3: 153–161.
7. Belcher BR, Berrigan D, Dodd KW, Emken BA, Chou CP, Spruijt-Metz D. Physical activity in US youth: effect of race/ethnicity, age, gender, and weight status. *Med Sci Sports Exerc*, 2010; 42: 2211–2221.
8. Lang JE, Obesity, Nutrition, and Asthma in Children: *Pediatric Allergy, Immunology, and Pulmonology*, 2012; 25(2): 64-75.
9. Tantisira KG, Weiss ST. Complex interactions in complex traits: obesity and asthma. *Thorax*, 2001; 56(2): 64-73.
10. Sheila Gahagan. Overweight and Obesity. In: Behrman ER, Kliegman RM, Jenson HB (eds). *Nelson Textbook of Pediatrics*. 19th ed. Philadelphia. WB Saunders Co., 2011; 180-184.
11. Juge-Aubry CE, Meier CA. Immunomodulatory actions of leptin. *Mol Cell Endocrinol*, 2002; 194(1-2): 1-7.
12. Chinn S. Obesity and asthma: evidence for and against a causal relation. *J Asthma*, 2003; 40: 1–16.
13. De Onis M, Blossner M, Borghi E: Global prevalence and trends of overweight and obesity among preschool children. *Am J Clin Nutr*, 2010; 92(5): 1257–1264.
14. Bråbäck L, Hjern A, Rasmussen F. Body mass index, asthma and allergic rhinoconjunctivitis. *Respiratory Medicine*, 2005; 99: 1010–1014.
15. Thomson CC, Clark S, Camargo CA Jr; MARC Investigators. Body mass index and asthma severity among adults presenting to the emergency department. *Chest*. 2003; 124: 795–802.
16. Tantisira KG, Weiss ST. Complex interactions in complex traits: obesity and asthma. *Thorax*, 2001; 56: 64–74.
17. ENFUMOSA Study Group. The ENFUMOSA cross-sectional European multicentre study of the clinical phenotype of chronic severe asthma. *Eur Respir J.*, 2003; 22: 470–477.
18. Andrew H, Ronina A, Joseph D, et al. Childhood Asthma. In: Behrman ER, Kliegman RM, Jenson HB (eds). *Nelson Textbook of Pediatrics*. 19th ed. Philadelphia. WB Saunders Co., 2011; 780-801.
19. Mark H, Christopher M, Robert jr. The Respiratory System: Asthma. In: Rudolph , Abraham M, Hostetter M, Lister G, et al. *Rudolph's Pediatrics*. 21th ed. New York. McGraw-Hill Co, 2003; 1950-1956.
20. Musa WA, Hassan MK. Over Weight and Obesity among preschool children in Basra. *MJBU*, 2010; 28: 1-8.
21. Centers for Disease Control and Prevention, National Center for Health Statistics. Prevalence of Overweight Among Children and Adolescents: United States, 2003-2004. Available at: <http://www.cdc.gov/nchs/products/hestats.htm>. Accessed July10, 2006.
22. Lucas SR, Platts-Mills TA. Paediatric asthma and obesity. *Paediatr Respir Rev.*, 2006; 7: 233–238.
23. Hussein F, Abdul Kareem A. Risk factors for acute exacerbation of asthmatic attack among children (1-6) years old in Basrah Maternity and children hospital. A thesis Submitted to the scientific council of pediatrics in partial fulfillment for the degree of Fellowship of the Iraqi Board for Medical Specializations in Pediatrics, 2011; 1-44.
24. Chinn S, Rona RJ. Can the increase in body mass index explain the rising trend in asthma in children?. *Thorax*. 2001; 56: 845–850.
25. Michael A, Rodriguez MA, et al. Identification of population Subgroup of children and adolescents with High Asthma Prevalence. *Arch Pediatr Adolesc Med*, 2002; 156: 269-275.
26. Castro-Rodri'guez JA, Holberg CJ, Morgan WJ, Wright AL, Martinez FD, et al. Increased incidence of asthma like symptoms in girls who become overweight or obese during the school years. *Am J Respir Crit Care Med*, 2001; 163: 1344–1349.
27. Al-Nozha M M, et al. Obesity in KSA. *Saudi Med J.*, 2005; 26(5): 824-829.
28. Hendryx M, Gurka M, et al. Childhood Asthma in Rural-Urban Areas. *West Virginia Rural Health Research Center*, 2012; 8: 1-17.
29. Befort Ch A, Perri M G, et al. Obesity Among Rural and Urban Adults. *The Journal of Rural Health*, 2012; 28: 392–397.
30. Litonjua AA, Carey VJ, Weiss ST, Gold DR. Race, Socioeconomic Factors, and Area of Residence Are Associated With Asthma Prevalence. *Pediatric Pulmonology*, 1999; 28: 394–401.
31. Lamerz A, Kuepper-Nybelen J et al. Social class and obesity prevalence in children. *International Journal of Obesity*, 2005; 29: 373–380.
32. Heck KE, Parker JD. Family Structure, Socioeconomic Status, and Access to Health Care for Children. *Health Services Research*, 2002; 37: 173-186.

33. Scholtens S, Wijga AH, Brunekreef B, et al. Breast feeding, parental allergy and asthma in children followed for 8 years. *Thorax*, 2009; 64: 604–609.
34. Field AE, Austin SB, et al. Snack food intake and weight change. *International Journal of Obesity*, 2004; 28: 1210–1216.
35. Tin SP, Ho SY, Mak KH, Wan KL, Lam TH. Breakfast skipping and change in body mass index in young children. *Int J Obes*, 2011; 35: 899–906.
36. Arvaniti F, Priftis KN, Papadimitriou A, Yiallourous P, et al. Salty-Snack Eating, Television or Video-Game Viewing, and Asthma Symptoms among 10- to 12-Year-Old Children. *J Am Diet Assoc*, 2011; 111(4): 251- 257.
37. Hancox RJ, Poulton R. Watching television is associated with childhood obesity. *Int J Obes*, 2006; 30: 171-175.
38. Al-Ghamdi SH. The association between watching television and obesity in children of school-age in Saudi Arabia. *Journal of Family and Community Medicine*, 2013; 20: 83-89.
39. Stettler N, SignerTh M, et al. Electronic Games and Environmental Factors Associated with Childhood Obesity in Switzerland. *Obesity Research*, 2004; 12: 896 –903.
40. McMurray et al. Physical Activity, Inactivity, and Adiposity. *Obesity Research*, 2000; 8: 130-139.
41. Sherriff A, Maitra A, Ness A R, Mattocks C, Riddoch C, Reilly J J, Paton J Y, Henderson A J. Association of Duration of Television Viewing in Early Childhood with the Subsequent Development of Asthma. *Thorax*, 2009; 64: 321-325.
42. Camilo DF et al. Obesity and asthma: association or coincidence. *J Pediatr (Rio J)*, 2010; 86(1): 6-14.
43. Taylor B, Mannino D, Brown C, Crocker D, Twum-Baah N, Holguin F. Body mass index and asthma severity in the National Asthma Survey. *Thorax*, 2008; 63(1): 14-20.