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Obesity and Asthma



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Definition of Asthma

- Episodic airflow obstruction
- Increased airways responsiveness
- Airway inflammation (infiltration with eosinophils and T lymphocytes(CD4⁺ T lymphocytes))
- Occurs primarily in early childhood
- 50% of all male asthma cases diagnosed by age 3
- 50% of all female asthma cases diagnosed by age 8

Asthma prevalence in 1973, 1988, 2003 in UK (12 years old)

	1973 (n=817)	1988 (n=1462)	2003 (n=1348)	Difference 2003-1988 95% CI
Asthma overall	5.5	12.0	27.3	15.2 (11.9 to 18.5)
Asthma in last 12 months	4.2	9.1	16.4	7.2 (5.3 to 9.1)
Wheezing ever	17.6	22.3	28.0	5.7 (3.0 to 8.2)
Wheezing in last 12 months	7.9	13.2	19.7	6.5 (5.2 to 7.7)
Hayfever/ allergic rhinitis ever	12.7	14.0	19.7	6.0 (2.7 to 9.3)
Wheezing without cold ever	4.4	13.8	17.8	4.0 (0.9 to 7.1)
Wheezing in last 12 months	-	10.3	18.1	7.8 (6.0 to 12.8)
FEV1 < 80% after exercise*	4.7	7.7	4.7	-2.9 (-2.3 to -0.9)
FEV1 < 80% after exercise†	2.0	4.1	2.4	-1.7 (-2.8 to -0.5)
Hay fever/ allergic rhinitis ever	-	14.0	19.4	5.3 (3.6 to 6.7)
Eczema ever	-	4.8	13.9	9.1 (7.3 to 10.6)

FEV1, peak expiratory flow rate; *n=812, 940 and 1019 in 1973, 1988 and 2003, respectively.

Source: 2005; 1, 200-201

Asthma Trends Among U.S. Adults BRFSS, 2000, 2007

Asthma trend in United States (1980-1999)

FIGURE 2. Estimated annual prevalence* of asthma — United States, National Health Interview Survey, 1980-1999

*Per 1,000 population; age-adjusted to the 2000 U.S. population.

Definition of Obesity

成人肥胖定義

	身體質量指數(BMI) (kg/m ²)	腰圍 (cm)
體重過輕	BMI < 18.5	X
正常範圍	18.5 ≤ BMI < 24	
異常範圍	過重：24 ≤ BMI < 27 輕度肥胖：27 ≤ BMI < 30 中度肥胖：30 ≤ BMI < 35 重度肥胖：BMI ≥ 35	

學

寧緩和醫

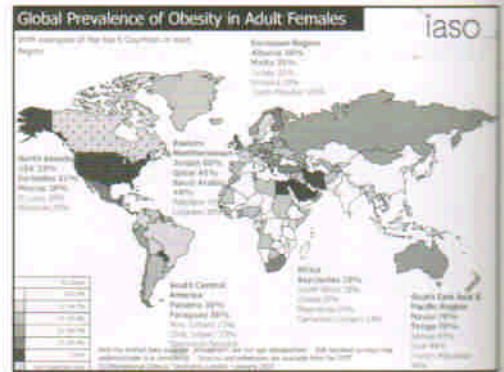
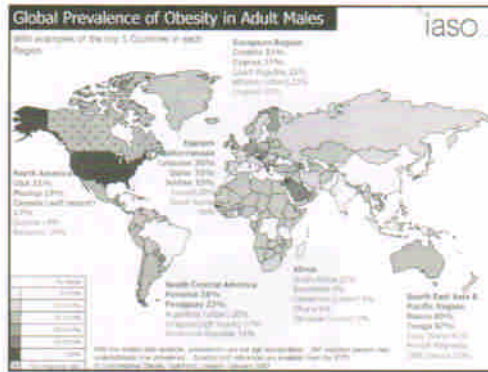


BMI (Quetelet Index), devised in 1835 by Labmert Adolphe Quetelet



Figure 1. Labmert Adolphe Quetelet (1796-1874). This image is taken from a poster which appeared in the London in 1841.

Prevalence of Obesity



Obesity Trend

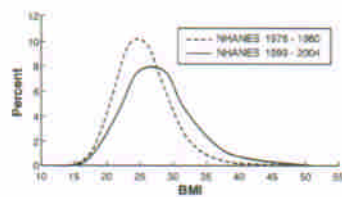
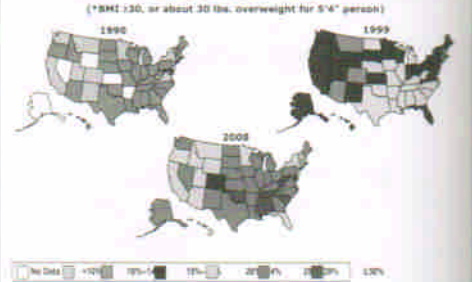


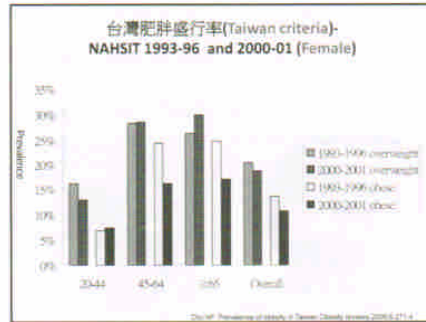
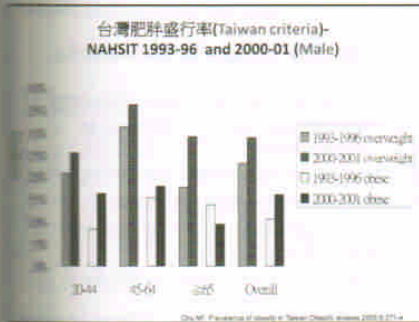
Figure 1. Change in the distribution of BMI between 1976-1980 and 1999-2004, for adults aged 20-74 years in the United States.

Obesity Trends* Among U.S. Adults

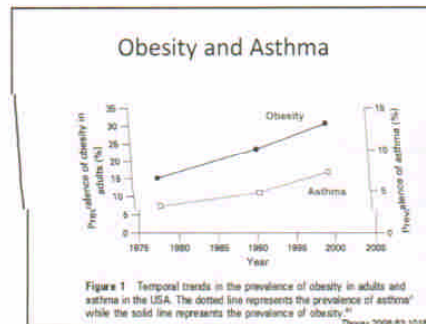
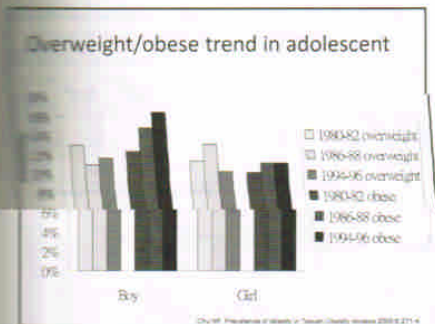




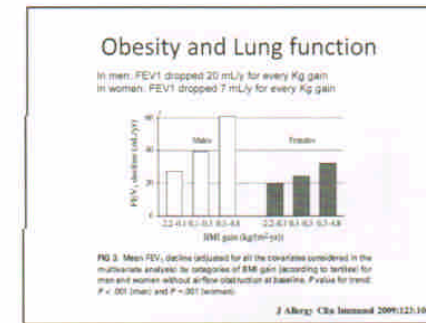
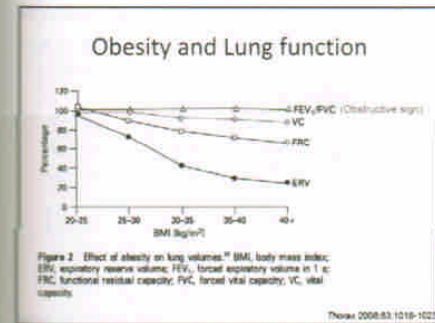
Obesity



Overweight/obese trend in adolescent

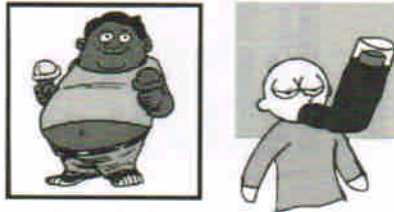


Obesity and Lung function





What is the epidemiologic Evidence for an Association between Obesity and Asthma



Obesity and prevalent Asthma

- Cross-sectional studies suggest an excess of obesity among adults with asthma than without asthma
- Typically self-reported BMI and Asthma
- BMI principal measure of adiposity
- Reported relative risk of asthma in obesity ranges between 1.0 - 3.0
- Some studies reported a stronger effect in women than in men

J Allergy Clin Immunol 2005;115:897-905

Cross-sectional studies

Table 1. Association between asthma (asthma or asthma attack), asthma attacks and frequency asthma and fitness (BMI and use of hospital) in the representative sample. Odds ratios for the comparison of the 90th and the 70th centiles of BMI.

	Age (years)			Sex (male)			BMI		
	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value
Asthma									
Unadjusted	1.20	1.07 to 1.37	0.001	1.26	1.12 to 1.47	<0.001	1.31	1.15 to 1.51	<0.001
Adjusted	1.20	1.07 to 1.37	0.001	1.31	1.15 to 1.51	<0.001	1.28	1.12 to 1.48	0.001
Asthma attack									
Unadjusted	1.12	0.97 to 1.30	0.1	1.04	0.87 to 1.24	0.5	1.13	0.96 to 1.34	0.18
Adjusted	1.07	0.92 to 1.25	0.3	1.01	0.85 to 1.20	0.9	1.01	0.86 to 1.19	0.2
Frequency asthma									
Unadjusted	1.30	1.17 to 1.47	<0.001	1.42	1.26 to 1.60	<0.001	1.39	1.21 to 1.61	<0.001
Adjusted	1.20	1.08 to 1.34	0.001	1.28	1.13 to 1.46	<0.001	1.26	1.10 to 1.45	<0.001
Use of hospital									
Unadjusted	1.15	0.99 to 1.34	0.07	1.27	1.09 to 1.49	0.01	1.18	1.01 to 1.38	0.03
Adjusted	1.05	0.90 to 1.23	0.5	1.05	0.89 to 1.23	0.5	1.01	0.86 to 1.17	0.3

Thorax 2001;56: 133-137

BMI and Asthma/atopy in Children-NHNES III

Table 2. Prevalence of asthma, hay fever and atopy (%) in children aged 4-17 years across quartiles of 2 years of body mass index (BMI).

	1st quartile (n=1712)	2nd quartile (n=1762)	3rd quartile (n=1778)	4th quartile (n=1778)	p-value
Asthma ever (asthma)	6.2	6.1	10.3	14.3	<0.001
Unadjusted	5.6	6.0	7.3	10.3	<0.001
Adjusted for asthma (n=124)	6.6	6.7	10.0	14.7	<0.001
Hay fever in past 12 months (n=192)	14.4	16.3	14.7	20.6	<0.001
Unadjusted	13.6	15.0	14.0	19.0	<0.001
Atopy (n=200)	4.2	7.4	7.5	12.2	<0.001
Unadjusted	3.9	6.3	6.0	10.2	<0.001

Table 3. Relative risk of asthma and atopy in children aged 4-17 years after adjusting for potential confounding factors.

	1st quartile (reference)	2nd quartile	3rd quartile	4th quartile	p-value
Asthma ever	1.00	1.01 (0.87 to 1.20)	1.32 (0.98 to 1.77)	1.77 (1.44 to 2.19)	<0.001
Unadjusted	1.00	1.11 (0.92 to 1.34)	1.36 (1.01 to 1.74)	1.89 (1.54 to 2.33)	<0.001
Adjusted for asthma	1.00	0.96 (0.77 to 1.20)	1.28 (0.94 to 1.74)	1.58 (1.24 to 2.01)	<0.001
Hay fever in past 12 months	1.00	1.20 (1.09 to 1.37)	1.02 (0.93 to 1.12)	1.40 (1.24 to 1.57)	<0.001
Unadjusted	1.00	1.24 (1.14 to 1.35)	1.05 (0.95 to 1.16)	1.42 (1.26 to 1.60)	<0.001
Adjusted for asthma	1.00	1.12 (1.01 to 1.24)	0.97 (0.88 to 1.07)	1.34 (1.19 to 1.52)	<0.001
Atopy	1.00	1.59 (1.19 to 2.11)	1.34 (1.09 to 1.65)	1.67 (1.29 to 2.16)	<0.001
Unadjusted	1.00	1.67 (1.21 to 2.32)	1.30 (1.07 to 1.57)	1.78 (1.36 to 2.35)	<0.001
Adjusted for asthma	1.00	1.40 (1.01 to 1.97)	1.20 (0.97 to 1.49)	1.58 (1.19 to 2.12)	<0.001
Number of episodes of asthma	1.00	0.44 (0.40 to 0.49)	0.70 (0.56 to 0.87)	0.92 (0.68 to 1.25)	<0.001
Unadjusted	1.00	0.52 (0.47 to 0.58)	0.78 (0.61 to 1.00)	1.04 (0.75 to 1.47)	<0.001

BMI and Asthma

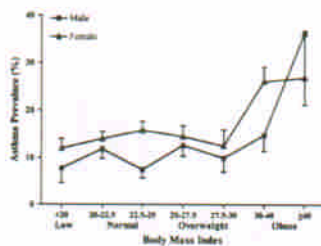


FIG 1. Association between asthma and obesity in the University of Nottingham Twin Register. The prevalence of asthma was assessed according to 7 categories of BMI. The association of asthma and obesity was assessed in each sex for using logistic effects, ordinal regression. The prevalence of asthma increased with greater BMI in women (P < .001) and magnitude in men (P < .05).

Central Obesity and Asthma

TABLE 6. Sex-specific prevalence (%) and adjusted OR (95% CI) of current asthma associated with measures of obesity

	Male subjects (n = 6876)		Female subjects (n = 6845)	
	Prevalence (%)	OR (95% CI)	Prevalence (%)	OR (95% CI)
BMI (kg/m²)				
Underweight	10.0	—	11.2	1.0 (0.7-1.4)
Normal	7.8	1.0	7.1	1.0
Overweight	8.0	1.0 (0.8-1.3)	10.6	1.0 (0.8-1.4)
Obesity				
Males	7.3	0.9 (0.7-1.3)	8.2	0.9 (0.7-1.4)
Females	8.0	1.0 (0.8-1.3)	10.4	1.0 (0.7-1.4)
WC (cm)				
Waist at risk	7.8	1.0	10.4	1.0
Risk level 1	8.3	1.1 (0.7-1.7)	10.9	1.2 (0.8-1.9)
Risk level 2	9.8	1.3 (0.7-2.3)	12.7	1.3 (0.9-2.1)
Waist				
Waist at risk	8.2	1.0	10.0	1.0
Risk level 1	11.7	1.0 (0.7-1.6)	13.1	1.4 (1.0-2.1)
Risk level 2	13.2	1.3 (0.7-2.3)	15.0	1.5 (1.0-2.2)

J Allergy Clin Immunol 2004;113:1280-1287



Central Obesity and Asthma

TABLE 10. Relative risk of current asthma, OR (95% CI), associated with measures of central obesity in obese subjects

Measure	Obese subjects		Non-obese subjects	
	Person	OR (95% CI)	Person	OR (95% CI)
Waist circumference	122	1.08	134	1.0
Waist:hip ratio	107	1.09 (1.04-1.14)	131	1.0 (0.91-1.10)
Waist	74	1.09 (1.02-1.17)	83	1.0 (0.94-1.07)
Waist:hip ratio	74	1.09 (1.02-1.17)	83	1.0 (0.94-1.07)
Waist	103	1.08	116	1.0
Waist:hip ratio	103	1.09 (1.04-1.14)	116	1.0 (0.91-1.10)
Waist	103	1.08	116	1.0
Waist:hip ratio	103	1.09 (1.04-1.14)	116	1.0 (0.91-1.10)
Waist	103	1.08	116	1.0
Waist:hip ratio	103	1.09 (1.04-1.14)	116	1.0 (0.91-1.10)

Central Obesity and Asthma

TABLE 10. ORs and α statistics for the association of the parameters examined with having asthma in the final (adjusted) asthma equation model

Parameter	Odds ratio	
	OR	Estimated coefficient / SE of the estimate
Sex		
White	0.74	-0.29
African American	1.76	0.56
Other	0.89	-0.11
Age (y)	0.99	-0.01
Sex at the time	0.96	-0.02
Sex	0.99	-0.01
Current smoking	0.85	-0.12
Other smoking	0.85	-0.12
Sex		
Male	1.01	0.01
Female	0.99	-0.01
Obesity measures		
Waist circumference (cm)	1.08	0.02
Waist:hip ratio	1.09	0.02
Waist	1.08	0.02
Waist:hip ratio	1.09	0.02
Waist	1.08	0.02
Waist:hip ratio	1.09	0.02

Central obesity was associated with asthma, asthma severity, lower lung function, and reduced atopy in asthmatic subjects.

Central Obesity and Asthma

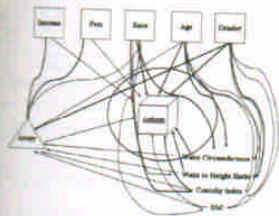


FIGURE 10. A schematic representation of the full structural equation model. Regression pathways are represented by unidirectional arrows. Significant associations are represented by boldface lines.

Cross-sectional Studies

- Numerous studies conclude a relationship exists
- Able to evaluate large numbers of studies
- Challenge are those related to the ability to carefully phenotype both obesity and asthma in large populations
- Difficult to determine causality- obesity lead to asthma, or vice versa?

Prospective Studies

TABLE 11. Relative risk of current asthma in the California Teachers Study cohort

Measure	Current asthma		Asthma without current asthma	
	Person	OR (95% CI)	Person	OR (95% CI)
Waist circumference	122	1.08	134	1.0
Waist:hip ratio	107	1.09 (1.04-1.14)	131	1.0 (0.91-1.10)
Waist	74	1.09 (1.02-1.17)	83	1.0 (0.94-1.07)
Waist:hip ratio	74	1.09 (1.02-1.17)	83	1.0 (0.94-1.07)
Waist	103	1.08	116	1.0
Waist:hip ratio	103	1.09 (1.04-1.14)	116	1.0 (0.91-1.10)
Waist	103	1.08	116	1.0
Waist:hip ratio	103	1.09 (1.04-1.14)	116	1.0 (0.91-1.10)

BMI and asthma incidence in the Black Women's Health Study

TABLE 12. Incidence of asthma in relation to BMI among of subjects and by smoking status, Black Women's Health Study

BMI category	Non-smokers		Smokers	
	Person	OR (95% CI)	Person	OR (95% CI)
<25	14,100	1.0	14,100	1.0
25-29	11,400	1.12	11,400	1.12
30-34	7,500	1.28	7,500	1.28
35-39	3,600	1.45	3,600	1.45
40-44	1,800	1.62	1,800	1.62
45-49	900	1.80	900	1.80
50-54	450	1.98	450	1.98
55-59	225	2.16	225	2.16
60-64	112	2.34	112	2.34
65-69	56	2.52	56	2.52
70-74	28	2.70	28	2.70
75-79	14	2.88	14	2.88
80-84	7	3.06	7	3.06
85-89	4	3.24	4	3.24
90-94	2	3.42	2	3.42
95-99	1	3.60	1	3.60



Selective prospective studies

Study	Population	n	Year(s)	Adjusted OR and 95% CI (BMI < 30)	Unadjusted OR and 95% CI (BMI > 30)
Carmignani and colleagues (10)	General Health II	44,914	4	N/A	N/A
	Men	6		2.7 (2.3-3.1)	2.1 (2.0-2.2)
Chen and colleagues (11)	General Health II	44,914	4	1.0	1.7 (1.4-2.1)
	Men	4,983		1.8 (1.4-2.4)	2.1 (1.7-2.6)
Teed and colleagues (12)	General Health II	44,914	16	1.3 (1.0-1.6)	1.6 (1.3-1.9)
	Men	3,244		1.4 (1.0-1.9)	1.6 (1.3-1.9)
Lombardi and colleagues (13)	General Health II	44,914	7	1.3 (1.0-1.7)	1.6 (1.3-1.9)
	Men	3,244		1.4 (1.0-1.9)	1.6 (1.3-1.9)
Petersen and colleagues (14)	General Health II	44,914	8	1.4 (1.1-1.7)	1.6 (1.3-1.9)
	Men	3,244		1.4 (1.1-1.7)	1.6 (1.3-1.9)
Haines and colleagues (15)	General Health II	44,914	27	1.3 (1.0-1.7)	1.6 (1.3-1.9)
	Men	3,244		1.4 (1.1-1.7)	1.6 (1.3-1.9)
Srinivasan and colleagues (16)	General Health II	44,914	1	1.3 (1.0-1.7)	1.6 (1.3-1.9)
	Men	3,244		1.4 (1.1-1.7)	1.6 (1.3-1.9)

BMI and incident Asthma

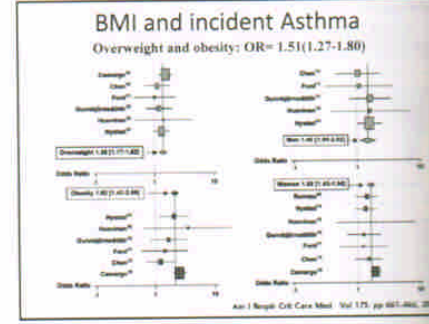
TABLE 2. ODDS RATIOS AND 95% CONFIDENCE INTERVALS OF INCIDENT ASTHMA AFTER 1 YEAR OF FOLLOW-UP IN MAJOR CATEGORIES OF BODY MASS INDEX IN AGGREGATE AND STRATIFIED BY SEX

Endpoint	Total		Men		Women	
	OR (95% CI)	P Value	OR (95% CI)	P Value	OR (95% CI)	P Value
Overweight vs normal BMI	1.3 (1.1-1.6)	<0.01	1.4 (1.1-1.8)	0.02	1.2 (1.0-1.5)	<0.01
Severe vs normal BMI	1.5 (1.3-1.8)	<0.01	1.6 (1.3-2.0)	0.001	1.3 (1.1-1.6)	<0.01
Overweight and severe vs normal BMI	1.0 (0.7-1.4)	>0.05	1.4 (1.0-2.0)	0.03	0.8 (0.6-1.1)	>0.05
Overweight vs normal BMI	1.4 (1.2-1.6)	<0.01	1.7 (1.4-2.1)	0.001	1.1 (1.0-1.2)	>0.05

Obesity and Asthma in children

Table 3. Incidence and odds ratios for asthma or "new asthma" at 8 or 10 years of age in relation to normal weight children at 3 or 6 years of age in children (sample size at 3 or 6 years of age in the representative sample, 1962-84)

BMI at age 3 or 6 (kg/m ²)	8 years		10 years	
	n	OR (95% CI) compared with normal weight	n	OR (95% CI) compared with normal weight
Underweight (<15.7)	4.5	0.67 (0.19 to 2.26)	2.8	0.52 (0.10 to 2.61)
Normal weight (15.7-20.0)	1.2	1.00	1.1	1.00
Overweight (20.0-25.0)	3.7	1.31 (0.43 to 4.00)	10.2	1.49 (0.76 to 2.88)
Obese (>25.0)	20.1	6.74 (2.71 to 16.68)	13.2	4.99 (2.69 to 9.17)



BMI and Asthma Severity

TABLE 2. Multivariate logistic analysis for asthma severity outcomes

Outcome	BMI category with nonoverweight patients (n=30)	
	Overweight (n=10)	Obese (n=20)
Overweight	1.00 (reference)	1.00 (reference)
Severe (last 4 days with asthma symptoms in the past 12 months)	1.89 (0.89 to 4.06)	9.46 (3.71 to 23.86)
Severe (last 4 days with asthma symptoms in the past 12 months)	0.99 (0.45 to 2.14)	1.21 (0.51 to 2.86)
Severe (last 4 weeks with asthma symptoms in the past 12 months)	0.87 (0.44 to 1.70)	1.62 (0.74 to 3.54)
Severe (last 4 weeks with asthma symptoms in the past 12 months)	1.10 (0.55 to 2.20)	1.42 (0.61 to 3.33)
Severe (last 4 weeks with asthma symptoms in the past 12 months)	1.07 (0.53 to 2.14)	1.67 (0.74 to 3.74)
Severe (last 4 weeks with asthma symptoms in the past 12 months)	1.07 (0.53 to 2.14)	1.67 (0.74 to 3.74)
Severe (last 4 weeks with asthma symptoms in the past 12 months)	1.07 (0.53 to 2.14)	1.67 (0.74 to 3.74)

BMI and Asthma Severity

TABLE 3. Bivariate relationships of BMI to asthma outcome measures

Outcome	<25	25-29.9	≥30	P value*
Mini-AQOL				
Mean ± SD	5.3 ± 1.2	5.1 ± 1.2	4.8 ± 1.3	<0.001
Score <3.9	14.1%	17.5%	26.6%	<0.001
ATAQ				
Mean ± SD	0.7 ± 0.9	0.8 ± 1.0	1.2 ± 1.1	<0.001
Score > 1	18.5%	27.3%	38.9%	<0.001
Asthma-related hospitalizations in the past year	3.9%	3.7%	6.8%	.032



BMI and Asthma Severity

TABLE IV. Multiple logistic regression results: independent effect of BMI status with asthma subacute measures (all patients)

Models* and BMI level	OR (95% CI), with BMI <25 kg/m ² as reference		Asthma-related hospitalizations in past year
	Low ACOG score (1-3.9)	High ACOG score (4-7)	
Model 1 Overweight Obese	n = 1113 1.3 (0.9-2.0) 2.4 (1.6-3.5)	n = 1100 1.3 (0.9-1.9) 2.8 (2.0-4.0)	n = 1100 0.4-2.1 2.4 (1.2-4.8)
Model 2 Overweight Obese	n = 957 1.7 (1.0-2.7) 2.9 (1.4-4.8)	n = 945 1.3 (0.9-2.3) 2.7 (1.8-4.1)	n = 945 1.8 (0.6-5.1) 4.2 (1.6-11.2)
Model 3 Overweight Obese	n = 791 1.4 (0.9-2.3) 2.9 (1.7-5.2)	n = 791 1.3 (0.9-2.2) 2.5 (1.6-4.1)	n = 791 2.0 (0.6-6.6) 4.2 (1.3-13.4)
Backward selection Overweight Obese	n = 791 1.5 (0.9-2.7) 2.8 (1.6-4.9)	n = 791 1.4 (0.9-2.3) 2.9 (1.8-4.6)	n = 791 2.3 (0.7-7.5) 4.7 (1.5-14.1)

J Allergy Clin Immunol 2006;117:907-11

Can the increase in BMI explain the rising trend in asthma?

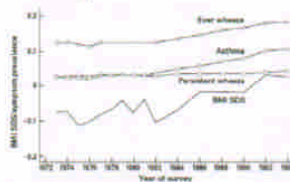


Figure 7. Trend in the prevalence of asthma, ever asthma, persistent asthma, and BMI (kg/m²) in white boys in the representative sample.

Thorax 2001;56:845-850

Can the increase in BMI explain the rising trend in asthma?

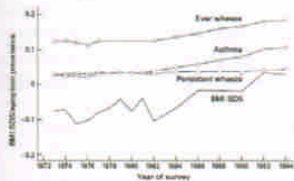


Figure 7. Trend in the prevalence of asthma, ever asthma, persistent asthma, and BMI (kg/m²) in white boys in the representative sample.

Thorax 2001;56:845-8

TABLE IV. Unadjusted trend in asthma prevalence, ever asthma, persistent asthma, and BMI (kg/m²) in white boys in the representative sample in four age 8 to 11 years' with asthma on symptoms and BMI

Measure	BMI (kg/m ²) per year (95% confidence interval)	
	Unadjusted	Adjusted for BMI†
Asthma prevalence	1.06 (1.07 to 1.12)	1.09 (1.07 to 1.11)
Ever asthma	1.05 (1.02 to 1.08)	1.01 (1.01 to 1.04)
Persistent asthma	1.03 (0.98 to 1.08)	1.02 (0.97 to 1.08)
Asthma on symptoms	1.03 (1.02 to 1.04)	1.04 (1.03 to 1.05)
BMI on symptoms	1.05 (1.02 to 1.07)	1.04 (1.02 to 1.07)

†Adjusted for year of birth in children in new.

‡Multivariate estimates with data for asthma and symptoms and BMI.

§Table 3. Unadjusted trend in asthma prevalence, ever asthma, persistent asthma, and BMI (kg/m²) in white boys in the representative sample in four age 8 to 11 years' with asthma on symptoms and BMI

Measure	BMI (kg/m ²) per year (95% confidence interval)	
	Unadjusted	Adjusted for BMI†
Asthma prevalence	1.06 (1.07 to 1.12)	1.09 (1.07 to 1.11)
Ever asthma	1.05 (1.02 to 1.08)	1.01 (1.01 to 1.04)
Persistent asthma	1.03 (0.98 to 1.08)	1.02 (0.97 to 1.08)
Asthma on symptoms	1.03 (1.02 to 1.04)	1.04 (1.03 to 1.05)
BMI on symptoms	1.05 (1.02 to 1.07)	1.04 (1.02 to 1.07)

†Adjusted for year of birth in children in new.

‡Multivariate estimates with data for asthma and symptoms and BMI.

§Table 4. Trend in selected asthma symptoms and in body mass index (BMI) and physical activity from 1992 to 1997 in an English inner city sample of children age 9 years' with symptoms on symptoms and BMI, adjusted for asthma group

¶Multivariate estimates with data for symptoms and BMI, adjusted for asthma group

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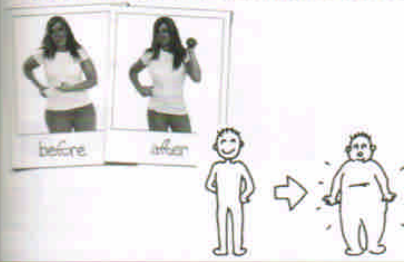
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Weight Change and Asthma Incidence



BMI and asthma incidence in the Black Women's Health Study

J Allergy Clin Immunol 2006;117:909-14

TABLE IV. Incidence of asthma in relation to change in weight since 1995 (baseline) and change in weight since age 18 years. (WHHS 1989-2006)

Change in weight since age 18 y (kg†)	Person-years		Multivariate HR* (95% CI)
	Cases	Controls	
0-8	21,809	47	1.01 (0.72-1.41)
9-14	36,246	149	1.0
15-19	40,075	116	1.07 (0.84-1.37)
20-24	37,373	179	1.26 (1.02-1.56)
25-29	17,173	120	1.15 (0.73-1.77)
≥30	116,933	469	1.89 (1.54-2.30)
Total for trend			P < .0001
Change in weight since 1995 (kg)			
0	71,742	144	0.62 (0.42-0.92)
0-4	131,280	319	1.0
4-8	98,311	246	0.87 (0.65-1.16)
9-14	36,468	131	0.97 (0.75-1.26)
15-19	25,117	82	1.20 (0.89-1.62)
≥20	19,306	82	1.31 (1.12-1.53)
Total for trend			P < .0001



Prospective Studies

Obesity, waist size and prevalence of current asthma in the California Teachers Study cohort

Table 3. Adjusted prevalence ratios for body composition and current asthma and adult-onset asthma among California Teachers Study cohort members

Study	Current asthma		Adult-onset asthma (onset after age 18)	
	OR (95% CI)	OR* (95% CI)	OR (95% CI)	OR* (95% CI)
OR of waist circumference	1.00	1.00	1.00	1.00
<100 cm circumference	1.00	1.00	1.00	1.00
100-124.9 cm circumference	1.15 (1.01-1.30)	1.08 (0.93-1.24)	1.25 (1.02-1.53)	1.15 (0.91-1.46)
125-149.9 cm circumference	1.35 (1.17-1.54)	1.28 (1.09-1.49)	1.55 (1.24-1.94)	1.45 (1.14-1.85)
150-174.9 cm circumference	1.65 (1.43-1.90)	1.58 (1.34-1.86)	1.95 (1.56-2.47)	1.85 (1.45-2.36)
175-200 cm circumference	2.05 (1.77-2.35)	1.95 (1.65-2.29)	2.45 (1.91-3.16)	2.35 (1.77-3.11)
Waist circumference per 10 cm	1.05 (1.02-1.08)	1.04 (1.01-1.07)	1.10 (1.06-1.14)	1.09 (1.05-1.13)
OR of waist circumference per 10 cm	1.00	1.00	1.00	1.00
<100 cm circumference	1.00	1.00	1.00	1.00
100-124.9 cm circumference	1.18 (1.04-1.34)	1.11 (0.97-1.26)	1.28 (1.04-1.58)	1.18 (0.94-1.48)
125-149.9 cm circumference	1.40 (1.24-1.58)	1.34 (1.16-1.53)	1.61 (1.29-2.00)	1.51 (1.18-1.94)
150-174.9 cm circumference	1.70 (1.51-1.91)	1.62 (1.41-1.84)	2.00 (1.56-2.60)	1.90 (1.45-2.50)
175-200 cm circumference	2.10 (1.86-2.36)	2.01 (1.74-2.29)	2.50 (1.91-3.30)	2.40 (1.81-3.20)
Waist circumference per 10 cm	1.00	1.00	1.00	1.00
<100 cm circumference	1.00	1.00	1.00	1.00
100-124.9 cm circumference	1.18 (1.04-1.34)	1.11 (0.97-1.26)	1.28 (1.04-1.58)	1.18 (0.94-1.48)
125-149.9 cm circumference	1.40 (1.24-1.58)	1.34 (1.16-1.53)	1.61 (1.29-2.00)	1.51 (1.18-1.94)
150-174.9 cm circumference	1.70 (1.51-1.91)	1.62 (1.41-1.84)	2.00 (1.56-2.60)	1.90 (1.45-2.50)
175-200 cm circumference	2.10 (1.86-2.36)	2.01 (1.74-2.29)	2.50 (1.91-3.30)	2.40 (1.81-3.20)

*Adjusted for race, age, sex, and smoking.

Weight loss and asthma

Table 1. Studies on weight loss and asthma

Study	Design	Asthma diagnosis	Intervention	Outcome	Results at follow-up
Original Intervention	Year 1-10	History of asthma	USP	1 y	Mean BMI 32.7 (SD 4.9) vs 32.1 (SD 4.9) in men and 32.1 (SD 4.9) vs 31.6 (SD 4.9) in women; no change in 20-24.9 kg/m ²
Weight* 2005 Study	Total = 70; 50% female	History of asthma	USP	1 y	Mean BMI 32.7 (SD 4.9) vs 32.1 (SD 4.9) in men and 32.1 (SD 4.9) vs 31.6 (SD 4.9) in women; no change in 20-24.9 kg/m ²
Weight* 2005 Study	Total = 70; 50% female	History of asthma	USP	1 y	Mean BMI 32.7 (SD 4.9) vs 32.1 (SD 4.9) in men and 32.1 (SD 4.9) vs 31.6 (SD 4.9) in women; no change in 20-24.9 kg/m ²
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Weight loss and asthma

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Weight* 2005 Study	Total = 70; 50% female	History of asthma	USP	1 y	Mean BMI 32.7 (SD 4.9) vs 32.1 (SD 4.9) in men and 32.1 (SD 4.9) vs 31.6 (SD 4.9) in women; no change in 20-24.9 kg/m ²
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Regardless of the type of intervention (surgical vs medical), all 15 studies noted an improvement in at least one asthma outcome after weight loss. Thorax 2008;63:671-676

Weight Change and Asthma Incidence

- In general, weight increase is associated with increased likelihood of developing asthma
- Weight loss had been shown to be of benefit in Asthma- reduce in symptoms, exacerbation frequency, medication use
- Unclear mechanism of improvement (physiologic, immunomodulation??)

BM

Choi*
Farr*
Garcia-Ramos*
Hosmer*
Miyake*
Wain*
Wong*

Meta 1.68 [1.58-1.78]

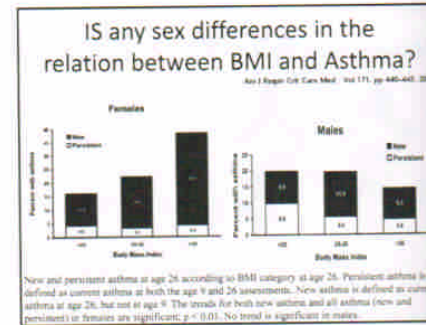
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IS any sex differences in the relation between BMI and Asthma?

TABLE 2. GENERALIZED MIXED LOGISTIC AND LINEAR REGRESSION ANALYSES OF ASTHMA AND ATOPIC VARIABLES ON BMI, ADJUSTED FOR COVARIATES

Variable	Female			Male		
	n	OR	95% CI	n	OR	95% CI
Asthma	2,271	1.14*	(1.05-1.24)	2,259	1.03	(0.93-1.13)
Asthma with AHR	2,113	1.20*	(1.06-1.36)	2,498	0.99	(0.89-1.10)
Asthma without AHR	2,271	1.17*	(1.07-1.28)	2,449	1.00	(0.90-1.11)
Atopy	2,271	1.06	(0.96-1.16)	2,259	1.03	(0.93-1.13)
PCr = 0	1,563	0.91	(0.78-1.06)	1,498	1.02	(0.90-1.15)
PCr = 1	408	0.98	(0.86-1.12)	719	1.00	(0.88-1.13)
Atopy	408	1.18	(0.95-1.46)	811	1.06	(0.94-1.19)
STAT1C %	2,271	1.11*	(1.02-1.21)	2,498	0.92	(0.82-1.03)
log IgE	478	0.94	(0.88-1.00)	591	0.91	(0.83-1.00)

*p < 0.05. CI = confidence interval.



In obesity, visceral adipose cytokines, and adipose tissue through recruitment chemokines such as (but factor (TNF-α), transform



Increased Incidence of Asthma like Symptoms in Girls Who Become Overweight or Obese during the School Years

TABLE 3. OR FOR PERSISTENT AND NEW INFREQUENT AND FREQUENT WHEEZING CASES ASSOCIATED WITH "BECAME OVERWEIGHT OR OBESE" IN FEMALES

	Persistent Infrequent Wheezing ^a		New Infrequent Wheezing ^b	
	n	OR (95% CI)	n	OR (95% CI)
Became overweight or obese	19	3.8 (1.3-7.3)	17	3.8 (1.3-7.3)
Did not become overweight or obese ^c	138	1.0 (1.0-1.0)	133	1.0 (1.0-1.0)

	Persistent Frequent Wheezing ^a		New Frequent Wheezing ^b	
	n	OR (95% CI)	n	OR (95% CI)
Became overweight or obese	8	12.5 (3.0-24.0)	10	38.0 (11.3-21.3)
Did not become overweight or obese ^c	121	1.0 (1.0-1.0)	124	1.0 (1.0-1.0)

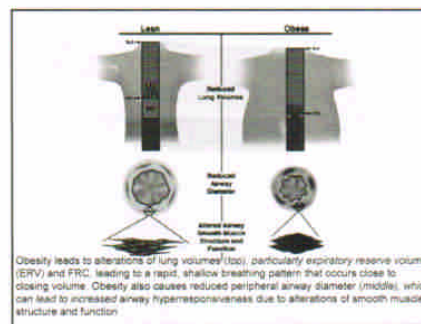
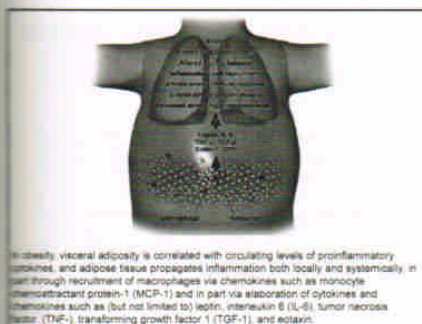
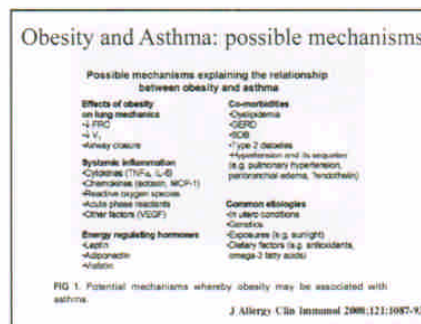
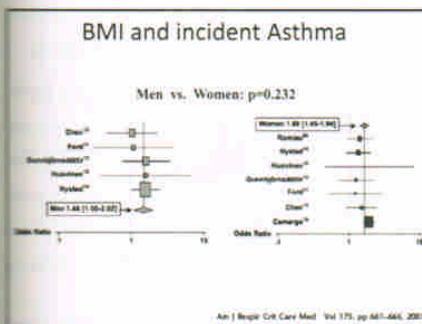
Am J Respir Crit Care Med. Vol 164, pp 1344-1349, 2001

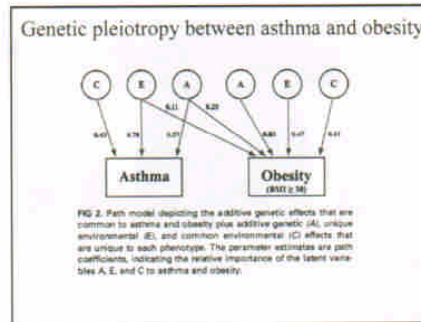
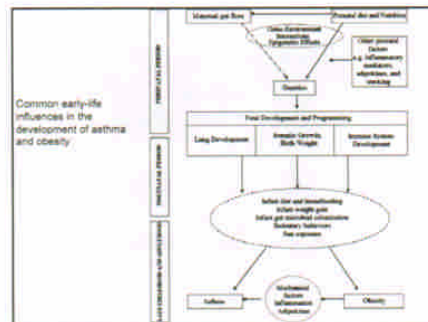
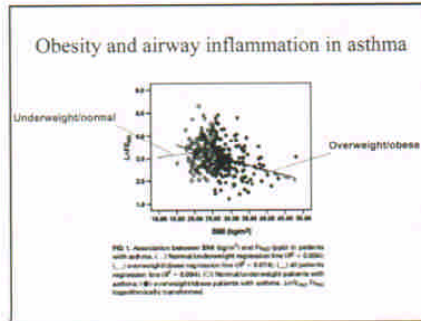
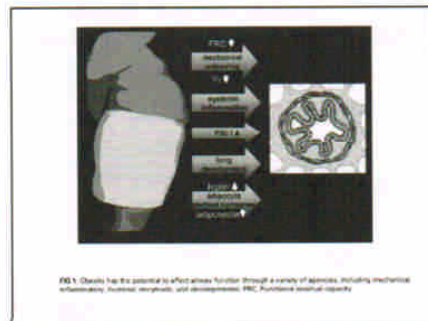
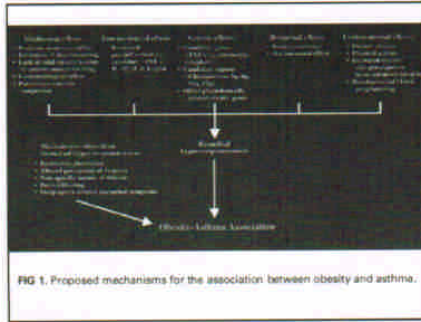
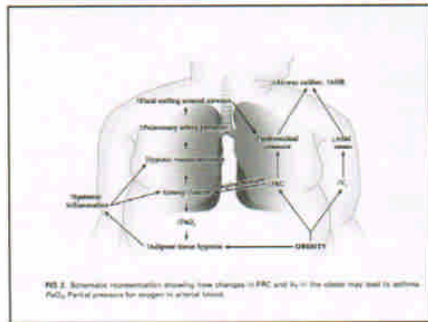
TABLE 4. Asthma incidence by sex, age group, smoking group and obesity group - each mutually adjusted, in asthmatics without history of respiratory distress at baseline^a

Component	All incident cases		Smoking cases 40-49 yr of age per year in this study	
	n	OR (95% CI)	n	OR (95% CI)
Female asthma by study	147	1.0 (1.0-1.0)	53	1.0 (1.0-1.0)
Age group of baseline				
20-29 yr	14	1.0 (1.0-1.0)	7	1.0 (1.0-1.0)
30-39 yr	144	1.0 (1.0-1.0)	46	1.0 (1.0-1.0)
Obesity group				
Never obese	138	1.0 (1.0-1.0)	53	1.0 (1.0-1.0)
Became obese	112	1.0 (1.0-1.0)	12	1.0 (1.0-1.0)
Smoking group				
Non-smoker	148	1.0 (1.0-1.0)	12	1.0 (1.0-1.0)
Smoker	101	1.0 (1.0-1.0)	41	1.0 (1.0-1.0)
Never	81	1.0 (1.0-1.0)	33	1.0 (1.0-1.0)
Current	20	1.0 (1.0-1.0)	8	1.0 (1.0-1.0)

TABLE 5. Net change in prevalence of symptoms and asthma per 10 yr of follow-up in this and by sex

Outcome ^a	Male ^b	Female ^c	Female ^d	prob ^e
Wheeze	0.004-0.0	-0.004-0.0	0.014-0.0	0.001
Wheeze with cough	0.007-0.0	0.003-0.0	0.004-0.0	0.001
Wheeze without a cold	0.003-0.0	0.003-0.0	0.003-0.0	0.001
Ever had asthma	0.004-0.0	0.003-0.0	0.003-0.0	0.001
Never diagnosed asthma	0.003-0.0	0.003-0.0	0.003-0.0	0.001
Incidence of asthma in year 10 months	0.003-0.0	0.003-0.0	0.003-0.0	0.001
Current prevalence	0.003-0.0	0.003-0.0	0.003-0.0	0.001
Current asthma ^f	0.003-0.0	0.003-0.0	0.003-0.0	0.001





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Table 1 Some asthma linkage loci (associated asthma candidate genes) and obesity candidate genes in the same regions

Asthma consensus loci	Obesity candidate gene loci
5q23-31 (IL-4, IL-5, IL-9, GM-CSF, IL-13, CD14)	5q22.3 (ISL1)
6p21.3-q23 (HLA, TNF α)	5q31 (ORL)
	5q32-34 (β2AR)
	6p21.2-q21.1 (GLO1)
	6p21.3 (BFI)
	6p21.3 (TNF α)
11q13 (FCERB, CCH1)	11q13 (ACP2)
	11q13 (UCP3)
12q14-q24.2 (FN1, LTAHL, NOS1)	12q13 (STAT3)
	12q22-q24.1 (IGF1)
	12q24 (CD36L1)

BMJ 2000;320:827-832

Conclusions

- Overweight and obesity are associated with asthma in cross-sectional studies
- Prospective studies had indicated a significant relationship between overweight/obesity and incidence of asthma
- The relationship is similar across sexes and racial and ethnic categories, as well as comparing children and adults

"When the world was a simpler place, the rich were fat, the poor were thin and right-thinking people worried about how to feed the hungry. Now, in much of the world, the rich are thin, the poor are fat, and right-thinking people are worrying about obesity."—The Economist, December 13, 2003