Journal of Asthma, 47:276–280, 2010

ISSN: 0277-0903 print / 1532-4303 online
DOI: 10.3109/02770900903584027

informa
healthcare

ASTHMA PREVALENCE AND RISK FACTORS

Factors Associated with BMI in Greek Adults with Asthma

EIRINI GRAMMATOPOULOU, P.T, M.Sc.,[1,*] AIKATERINI HANIOTOU, M.D., PH.D.,[2] ANGELIKI DOUKA, PH.D.,[1] AND DIMITRA KOUTSOUKI, PH.D.[1]

[1]*University of Athens, Department of Physical Education and Sport Sciences, Laboratory of Adapted Physical Activity/Developmental and Physical Disabilities, Athens, Greece*
[2]*General Hospital "Amalia Fleming," Asthma Department, Athens, Greece*

Background. The association between asthma and obesity remains controversial and limited to a few studies. *Objective.* The present study was designed to examine the association between body mass index (BMI) and clinical measures of asthma morbidity in Greek asthma patients. *Study Design.* A cross-sectional study in 100 outpatients at the asthma department of the "Amalia Fleming" General Hospital in Athens, Greece, was conducted. Asthma diagnosis was confirmed by a specialist, according to Global Initiative for Asthma (GINA) guidelines. Participants were classified, with respect to BMI (kg/m^2), in three groups: normal: <25.0, overweight: 25.0–29.9.0 and obese: ≥30.0. Data were modeled through multiple logistic regression analysis for the association of overweight/obesity with the study variables: demographics, asthma severity, smoking, pulmonary function (forced expiratory volume in one second; FEV_1), asthma control (Asthma Control Test; ACT), disability associated with dyspnea (Medical Research Council [MRC] breathlessness scale), and physical activity in leisure time. *Results.* Overweight/obesity was detected in 56 participants (56%). Multivariate regression analysis resulted in an excess risk of overweight/obesity for older participants (odds ratio [OR]: 1.71, 95% confidence interval [CI]: 1.10–2.64 for a 10-year increase in age). *Conclusion.* Age seems to be highly associated with overweight/obesity in Greek adults with asthma who tend to maintain a similar body weight compared to the general population.

Keywords asthma control; body mass index; dyspnea/disability; physical activity

INTRODUCTION

Asthma and obesity are both chronic diseases and have an increasing prevalence in most countries (1). In the USA, overweight prevalence has risen by about 1% per year in absolute terms since the early 1980s, whereas the prevalence of obesity has risen by 0.5% (2). In Europe, obesity has reached epidemic proportions (3, 4). Although asthma affects only 6.5% of the Greek adult population (5), 41.8% and 17.7% is overweight or obese (6), respectively. The relationship between asthma and obesity appears to be quite complex (7). Given the parallel increase in asthma and obesity, they tend to coincide (8). However, preexisting obesity has also been related to the incidence of asthma (1).

Worldwide, cross-sectional studies have shown that the odds of asthma incidence are increased in overweight or obese individuals; however, it cannot be ruled out that asthma may contribute to obesity, perhaps due to inactivity or side effects of systemic corticosteroids (9). In addition, weight loss in asthma patients showed improvement in dyspnea, overall symptoms, rescue medications consumption, severity, impact, activity, pulmonary function, and total health status (1). Obesity may affect directly the asthma phenotype by mechanical effects and genetic interactions with environmental exposures, including physical activity and diet (1). Further, the Barker hypothesis, that chronic diseases develop through adaptations that the fetus makes when it is undernourished, may support the developmental relationship of obesity with asthma (1). Furthermore, cultural environment may influence the development of obesity (10), whereas geographic region might explain the geographic variation of obesity (3). However, it remains unclear whether asthma causes obesity, or vice versa, or whether obesity develops before asthma (11, 12).

Asthmatics are more likely to be obese than nonasthmatics (13). Age (14), socioeconomic factors (15), and inactivity (16) influence the rate of obesity. Adults with asthma impose on themselves limitations in exercise and healthy lifestyle activities (17). However, physical inactivity in leisure time cannot explain the association between obesity and asthma (18). Further, obese patients with asthma compared with nonoverweight subjects have poorer asthma control (8) and 42% odds for severe persistent asthma (19). In general, a high body mass index (BMI) is associated with increased morbidity (20).

Many researchers have studied the risk of incident asthma among overweight/obese children and adults (8). A few studies have investigated the association of asthma with overweight/obesity (8, 11, 12, 18, 19). However, there is a lack of data for the association of overweight/obesity with asthma morbidity indices and the odds of overweight/obesity among asthma adult patients. Finally, there are no recent data regarding the prevalence of overweight and obesity in Greece, based on random and representative samples, for the general population (21), nor for asthma patients.

Based on the above, the present study was designed to examine the relationship between BMI and clinical measures of asthma morbidity (asthma severity, asthma control,

*Corresponding author: Eirini Grammatopoulou, P.T., M.Sc., Ph.D. candidate, Laboratory of Adapted Physical Activity/Developmental and Physical Disabilities, Department of Physical Education and Sport Sciences, National and Kapodistrian University of Athens, Greece; E-mail: igrammat@gmail.com, igrammat@phed.uoa.gr

dyspnea-disability, physical activity in leisure time, forced expiratory volume in one second [FEV_1]) in Greek patients evaluated in the asthma clinic of a tertiary level hospital.

Methods

Study Population

Participants were recruited from the outpatients of the Asthma Department of the "Amalia Fleming" General Hospital in Athens, Greece, from January to July 2009 ($N = 325$). Specified exclusion criteria were cardiovascular disease, neurological disorders, kinetic disability, and inability to comprehend or complete questionnaires in Greek ($N = 85$). A total of 140 patients declined to participate in the study. Therefore, data from 100 asthma outpatients (21 men and 79 women), aged from 18 to 80 years (= 49.98, $SD = 16.87$), were used for the purposes of the present study. All patients clinically diagnosed according to the Global Initiative for Asthma (GINA) (22) had at least a 12% improvement in FEV_1 after bronchodilation (22), were symptomatic during the past 12 months, under specialist care and controlled medications, including inhaled glucocorticosteroids, long-acting inhaled β_2-agonists, and other medication according to GINA (22). With reference to asthma severity (22), 58 patients suffered from mild asthma, 32 patients had moderate and 10 patients had severe asthma. Twenty patients, aged 20–47 years, were current smokers, 72 patients, aged 18–80 years, were nonsmokers, and 8 patients, aged 28–74 years, were ex-smokers. The duration of asthma was above 8 years for 63 patients and below 8 years for 37 patients. According to BMI, 44 patients were normal/underweight (BMI < 25 kg/m^2), 34 participants were overweight, and 22 were obese. The study protocol was approved by the Research Ethics Committee of the "Amalia Fleming" General Hospital and the informed consent form was signed by all participants.

Data Collection

Patients were assessed with the following measures: (1) a questionnaire regarding the demographic information, (2) the Asthma Control Test (ACT) (23), (3) the pulmonary function test (FEV_1% predicted values), (4) the Medical Research Council (MRC) breathlessness scale (24), and (5) the questionnaire of Slatin and Grimby for the measurement of the physical activity level in leisure time (25). Standing height was measured with a Raven Minimeter (Raven Equipment, Essex, United Kingdom) to the nearest 0.1 cm, without shoes (26). Weight was measured to the nearest 0.1 kg with a Seca weighting scale (Seca, Hanover, MD), without shoes, in light clothing (11, 26). With respect to the BMI calculation (kg/m^2), participants were classified in normal: <25.0, overweight: 25.0–29.9, overweight: 25.0–29.9, and obese: ≥30.0 groups (27). Finally, severity classification was based on established GINA (22) criteria (intermittent, mild, moderate, and severe asthma).

Pulmonary Function Testing. Pulmonary function tests ($FEV_{1\%}$ predicted values) were performed, based on the 1987 American Thoracic Society recommendations (28). The participants indicated no use of bronchodilators at least 4 hours before the spirometry test (Spiro Sense Spirometry System; Burdick, USA) (22).

Asthma Control. The Asthma Control Test (ACT) (23), which has demonstrated strong psychometric properties, is a five-item self-administered survey designed to assess asthma control during the previous 4 weeks and is scored on a scale from 5 (poorly controlled) to 25 (well controlled).

Dyspnea-Disability. The MRC breathlessness scale (24) quantifies the disability associated with dyspnea and ranges from 1 to 5 (the higher the score, the higher the disability level). The MRC score is highly correlated with the score of other breathlessness scales, lung function (29), and with direct measurements of disability (walking distance) (30).

Physical Activity Level. Participants were asked to state the best-fitting description for their usual leisure time activities in the questionnaire of Slatin and Grimby (25), graded from 1 to 4: (1) sedentary: reading, watching television, or other sedentary activities; (2) moderate: walking, cycling, or moving around in other ways for at least 4 hours weekly; (3) intermediate: participating in recreational athletics, heavy garden work, and so on, for at least 4 hours weekly; and (4) intensive: participating in hard training or athletic competitions, regularly and several times a week. The questionnaire of Slatin and Grimby (25) has been used in published studies (11, 16, 31) and is standardized for the age range of 20–80 years in the study of Lindstrom et al. (16).

Statistical Analysis

Initially, statistical procedures (independent samples t test, χ^2 for categorical data, χ^2 for trend for ordered data) were used as appropriate to assess the differences in sociodemographic and asthma factors between underweight/normal and overweight/obese participants in the study. Subsequently, to examine the association of overweight/obesity with study variables, we modeled the data through multiple logistic regression analysis. BMI was treated as a dichotomized outcome variable and a series of possible confounders were inserted as predictor variables, namely age, educational status, asthma severity, smoking, dyspnea-disability, physical activity in leisure time, asthma control, and FEV_1 in order to estimate odds ratios and respective 95% confidence intervals. Given that, in the current study, females were almost four times as many as males, and comprised 80% of the overweight/obese group, thus gender was not included at the multivariate analysis. The SAS statistical package (Version 9.1; SAS Institute, Cary, NC) was used in all analyses.

Results

Table 1 shows sociodemographic and asthma factors by BMI category. With respect to BMI, the total sample consisted of 44 normal, 34 overweight, and 22 obese patients.

Differences Between Overweight/Obese and Underweight/Normal Participants

Significant differences were found between overweight/obese participants and those having BMI below 25 in terms of age ($p < .0001$), educational status ($p = .0001$), physical activity in leisure time ($p = .001$), asthma control ($p = .03$), FEV_1 ($p = .001$), and dyspnea-disability ($p = .04$). No evidence of significance was observed concerning gender and smoking status, whereas asthma severity seems to have

TABLE 1.—Distribution of 100 study participants with asthma by sociodemographic and asthma morbidity according to body mass index.

Variables	Normal/underweight ($n = 44$)	Overweight/obese ($n = 56$)	p value
Gender			.71
Female	34 (77.3%)	45 (80.4%)	
Male	10 (22.7%)	11 (19.6%)	
Age, years	41.16 ± 14.08	56.91 ± 15.70	<.0001
Education, years			.0001
≤12	6 (13.6%)	28 (50.0%)	
≥13	38 (86.4%)	28 (50.0%)	
Asthma severity			.07
Mild	31 (70.4%)	27 (48.2%)	
Moderate	11 (25.0%)	21 (37.5%)	
Severe	2 (4.6%)	8 (14.3%)	
Smoking			.36
No (ex- + nonsmokers)	37 (84.1%)	43 (76.8%)	
Yes (current smokers)	7 (15.9%)	13 (23.2%)	
MRC scale			.04
1	16 (36.4%)	16 (28.6%)	
2	24 (54.5%)	22 (39.3%)	
3-4	4 (9.1%)	18 (32.1%)	
Physical activity in leisure time			.001
Sedentary	0 (0.0%)	13 (23.2%)	
Moderate	19 (43.2%)	28 (50.0%)	
Intermediate	16 (36.4%)	12 (21.4%)	
Intensive	9 (20.4%)	3 (5.4%)	
Asthma Control Test	18.64 ± 4.98	16.52 ± 4.43	.03
FEV_1% predicted	85.09 ± 13.70	73.48 ± 15.64	.001

Note. Data are presented as mean ± *SD* or *N* (%).

a borderline effect ($p = .07$). Nevertheless, these data serve descriptive purposes mostly and are not directly interpretable because of mutual confounding.

Predicting Overweight/Obesity

To further examine the relation of overweight/obesity with a series of parameters, multiple logistic regression analysis was performed (Table 2). Contrary to the unadjusted results, no evidence for significant associations between BMI and dyspnea-disability, physical activity in leisure time, asthma control, and FEV_1 was noted in the regression model. This change from the unadjusted models to the adjusted one was mainly due to the effect of aging. After adjustment, the association between BMI and age remained essentially unchanged; an excess risk of overweigh/obesity was observed for those who were older (odds ratio [OR]: 1.71, 95% confidence interval [CI]: 1.10–2.64 for 10-year increase in age). Higher education seems to play a protective role against the risk of overweight/obesity, but the result did not reach statistical significance ($p = .11$). An almost borderline significant association of BMI with smoking was also identified; smoking increases the risk of overweight/obesity (OR = 3.12, 95% CI: 0.88–11.15).

DISCUSSION

The present study showed similar prevalence rates of overweight and obesity for Greek asthma patients compared to the norms (6). According to the descriptive findings, Greek overweight/obese asthma patients, compared to the underweight/normal asthma patients, were older, have higher level of dyspnea-disability, poorer asthma control, and lower education, pulmonary function (FEV_1), and physical activity in leisure time; age was revealed as the main associated variable with the overweight/obese Greek patients with asthma. Greek patients with asthma seem to maintain a similar body weight compared to the general population, whereas for similar patients in other countries the prevalence rates of overweight and obesity exceed their national average (2, 8, 32, 33). Further, Papageorgiou et al. (5) reported lower prevalence of self-reported asthma and asthma-like symptoms in the Athens region in Greece than in Sweden or Italy, based on the results from the European Community Respiratory Health Survey. Further, the systematic review of Berghöfer et al (3), concerning obesity prevalence from a European perspective, revealed higher prevalence of obesity in Italy, Spain, Poland, United Kingdom, Czech Republic, and Albania for both sexes than in Greece. The aforementioned findings might be justified by the cultural environment of Greek adults with asthma, i.e., aesthetics, education, religion, attitudes, and values (10) as well as by the geographic region of Greece affecting socioeconomic conditions, lifestyle, and nutritional factors (3). To our knowledge, this is the first study reporting overweight and obese rates among Greek patients with asthma, therefore further research is needed.

Previous reports have linked higher BMI to increased age (8, 34). The present study reinforces these data not only by showing significant differences between overweight/obese and underweight patients but by revealing age as the main associated variable with overweight/obesity in Greek asthma patients. No relative findings have been published up to now and further investigation is needed. Moreover, this finding is consistent with the Greek general population: Yannakoulia et al. (6) reported that overweight and obese subjects compared to the normal were found to be older, less physical active, and with more clinical complications. Further, advancing age resulted in limitation of all forms of physical activities for

TABLE 2.—Multiple logistic regression derived odds ratios (ORs) and 95% confidence intervals (95% CIs) for overweight or obesity among 100 study participants with asthma by sociodemographic and asthma morbidity.

Variable	Category or increment	ORs	95% CIs	p value
Age	10 years more	1.71	1.10–2.64	.02
Education	≤12 years	Baseline		
	≥13 years	0.37	0.11–1.25	.11
Asthma severity	1 level more	1.30	0.48–3.52	.60
Smoking	No	Baseline		
	Yes	3.12	0.88–11.15	.08
MRC scale	1 level more	1.03	0.43–2.49	.94
Physical activity in leisure time	1 level more	0.97	0.41–2.31	.95
Asthma Control Test (ACT)	1 unit more	1.02	0.89–1.17	.79
FEV_1% predicted	10 units more	0.82	0.50–1.32	.41

the Greek elderly (35), which in turn is more pronounced in those with chronic diseases (20). This might be explained by the substantial changes in body composition occurring over the aging process (14). In developing countries, there is positive association between body weight and BMI with age, for both men and women, up to 60 years of age (20), with the largest increase in BMI occuring in the 20–44 and 45–54 age groups (14). Loss of muscle mass begins from 30 to 40 years of age and continues into advanced old age, whereas body fat increases through most of adulthood. Because with increasing age fat replaces fat-free mass, older subjects tend to have a greater proportion of fat than younger individuals with the same BMI (36). Specifically, these changes take place during adulthood, probably as a consequence of an imbalance between energy intake and expenditure, coupled with a progressive reduction of physical activity, and are highly accelerated in old and very old age (16). Asthmatics tend to have higher mean energy expenditure values in younger subjects compared to older subjects (19) because of a decrease in physical activity and in basal metabolic rate (20).

Another aspect revealed is that overweight/obese asthma patients had a lower level of education than the underweight/normal participants. No relevant data exist and therefore further research is needed. Similar conclusions have been reported for the Greek general population in the study of Panagiotakos et al. (21).

Regarding the clinical measures of asthma morbidity, they were worse for the overweight/obese patients compared to those for the underweight/normal patients and in line with previous studies (8, 12, 19, 34). In particular, poor asthma control for Greek overweight/obese patients with asthma means frequent symptoms, functional impairments, and risks of untoward events (37) as well as high cost of asthma management (38). This finding might therefore help towards improving the standards of asthma treatment for Greek patients, reducing morbidity as well as direct and social costs of health care (38).

As for the levels of physical activity and dyspnea-disability among Greek asthmatics, this is the first study reporting significant differences between overweight/obese and underweight/normal patients. Overweight/obese patients seem to adopt a sedentary lifestyle and to have a higher dyspnea-disability compared to the normal/underweight participants. Indeed, in the present study, no normal/underweight patient had a sedentary life. Up to now, researchers have investigated the levels of physical activity between asthmatics and nonasthmatics, both presenting similar levels (13). This might be explained by the fact that the increasing prevalences of obesity, overweight, and physical inactivity were observed in all ages, countries of origin, and educational status (16). Obesity was associated with dyspnea-disability, i.e., the highest BMI was associated with a two times increased risk of dyspnea (34, 39), limitation in everyday activities (39), and walking upstairs or on flat surfaces (40). A high BMI was revealed as a strong predictor of long-term risk for disability across all ages (39). In Greece, physical activity was limited with age (35) and was associated with reduced odds of reporting asthma symptoms (26). On the contrary, sedentary lifestyle and increased body weight seem to promote asthma symptoms (26), whereas unfavorable lifestyle was associated with the prevalence of overweight and obesity (21). Based on the above, it is important to look beyond the patient's airways and advise Greek asthma patients to adopt adequate levels of physical activity, as low levels are associated with increased mortality (41).

The present results did not reveal any significant severity differences between Greek overweight/obese patients and underweight/normal patients with asthma. Our findings support the conclusions of previous studies (7, 8). However, other researchers found that increasing asthma severity is associated with higher occurrence of obesity in asthmatics (12, 19, 42). This might be explained by the different way that asthma severity was measured.

As regards pulmonary function, overweight/obese patients with asthma had lower FEV_1% predicted values compared to the normal/underweight participants. The opposite findings of Lavoie et al. (8) might be due to the self-reported weight and height. Lastly, in healthy adults, obesity impairs respiratory function and structure, leading to physiologic and pathophysiologic impairments (43).

The present study has some potential limitations. It is a cross-sectional study and cannot explain causal relations between overweight/obese and normal/underweight patients with asthma. Further, its results cannot be generalized. It can only give evidence for the associations of BMI with demographics and morbidity indices for adult asthma patients. Moreover, the prevalence of overweight and obesity found in the present study concerns the specific sample of asthmatics in the region of Athens. Future researchers would confirm the findings of the present study with a random sample, investigate the epidemiology of overweight/obesity in Greek adults with asthma, and estimate the effect of dietary habits and physical activity in work on BMI as well.

Despite the above limitations, the present study is the first study in Greece that examined (a) the prevalence of overweight/obesity in asthma adult patients; (b) the differences between overweight/obese and normal adults with asthma as regards demographics, pulmonary function, asthma control, dyspnea-disability, and physical activity in leisure time; and (c) the odds of overweight/obesity in asthma patients. The methodological power of the present study lies in the valid and standardized measures used. Further, the definition of asthma and the classification of asthma severity were not self-reported but based on GINA guidelines (22). Finally, all the participants were under specialist care.

Conclusion

Age seems to be the main factor associated with overweight/obesity in Greek adults with asthma as in the general population worldwide. The findings of the present study should alert public health authorities, researchers, and all professionals involved in asthma management for action. Lifestyle changes across age should control weight and improve asthma symptoms and morbidity indices.

Acknowledgments

The authors wish to thank GlaxoSmithKline for the no charge permission to use the Greek translation version of the Asthma control Test, as well as Dr. Nectarios Stavrou and Dr. Konstantinos Kostikas for reviewing the manuscript.

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. Steious-Aarniala B, Poussa T, Kvarnstrom J, Gronlund EL, Ylikahri M, Mustajoki P. Complex interactions in complex traits: obesity and asthma. Thorax 2001; 56(Suppl):ii64–ii74.
2. Flegel KM, Caroll MD, Kuczmarksi RJ, Johnson CL. Overweight and obesity in the United States: prevalence and trends, 1960–1994. Int J Obes Relat Metab Disord 1998; 22:39–47.
3. Berghöfer A, Pischon T, Reinhold T, Apovian CM, Sharma AM, Willich SN. Obesity prevalence from a European perspective: a systematic review. BMC Public Health 2008; 8:200.
4. Karkaletsi F, Skordilis E, Koutsouki, D. Planned behavior theory and healthy eating for Greek adults. (2008) Inquir Sport Phys Educ 2008; 6:195–205.
5. Papageorgiou N, Gaga M, Marossis C, Reppas P, Avarlis P, Kyriakou M, et al. Prevalence of asthma and asthma-like symptoms in Athens, Greece. Respir Med 1997; 91:83–88.
6. Yannakoulia M, Panagiotakos DB, Pitsavos C, Stefanidis C. Correlates of BMI misreporting among apparently healthy individuals: the ATTICA study. Obesity 2006; 14:894–901.
7. Saint-Pierre P, Bourdin A, Chanez P, Daures JP, Godard P. Are overweight asthmatics more difficult to control? Allergy, 2006; 61:79–84.
8. Lavoie KL, Bacon SL, Labrecque M, Cartier A, Lemiére C, Ditto B. Higher BMI is associated with worse asthma control and quality of life but not asthma severity. Respir Med 2006; 100:648–657.
9. Beuther DA, Sutherland ER. Overweight, obesity, and incident asthma. Am J Respir Crit Care Med 2007; 175:661–666.
10. Lobstein T, Frelut M-L. Prevalence of overweight among children in Europe. Obes Rev 2003; 4:195–200.
11. Nystad W, Meyer HE, Nafstad P, Tverdal A, Engeland A. Body mass index in relation to adult asthma among 135,000 Norwegian men and women. Am J Epidemiol 2004; 160:969–976.
12. Tavasoli S, Heidarnazhad H, Kazemnejad A, Miri S. Association between asthma severity in two asthma clinics in Teheran. Iran J Allergy Asthma Immunol 2005; 4:179–183.
13. Ford ES, Heath GW, Mannino DM, Redd MD. Leisure time and physical activity patterns among US adults with asthma. Chest 2003; 124:432–437.
14. Bartali B, Benvenuti E, Corsi AM, Bandinelli S, Russo CR, Di JA, Lyretani F, Ferruci L. Changes in athropometric measures in men and women across the life-span: findings from the InCHIANTI study. Soz Proventiv 2002; 47:336–348.
15. Heitman BL. Occurrence and development of overweight and obesity among adult Danes aged 30–60 years. Ugeskr Laeger 1999; 161: 4380–4384.
16. Lindstrom M, Isacsson SO, Merlo J. Increasing prevalence of overweight, obesity and physical inactivity: two population-based studies 1986 and 1994. Eur J Publ Health 2003; 13:306–312.
17. Mancuso CA, Sayeles W, Robbins L, Phillips EG, Raveneli K, Duffy C, Wenderoth S, Charlson ME. Barriers and facilitators to healthy physical activity in asthma patients. J Asthma 2006; 43:137–143.
18. Chen Y, Dales R, Tang M, Krewski D. Obesity may increase the incidence of asthma in women but not men: longitudinal observations from the Canadian National Population Health Surveys. Am J Epidemiol 2002; 155: 191–197.
19. 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; 63:14–20.
20. Elia M. Obesity in the elderly. Obes Res 2001; 9:244–248.
21. Panagiotakos DB, Pitsavos C, Chrysohoou C, Risvas G, Kontogianni M, Zampelas A, et al. Epidemiology of overweight and obesity in a Greek adult population: the ATTICA study. Obes Res 2004; 12:1914–1920.
22. Global Initiative for Asthma (GINA). Global strategy for asthma management and prevention. NHLB/WHO. Available at: http://www.ginasthma.org. Accessed March 8, 2007.
23. Nathan R, Sorkenss CA, Kosinski M, Schatz M, Li JT, Marcus P, et al. Development of the asthma control test: a survey for assessing asthma control. J Allergy Clin Immunol 2004; 113;59–65.
24. Stenton C. The MRC breathlessness scale. Occup Med 2008; 58:226–227.
25. Slatin B, Grimby G. Physiological analysis of middle-aged and old former athletes: comparison with still active athletes of the same ages. Circulation 1968; 38:1104–1115.
26. Priftis KN, Panagiotakos DB, Antonogeoros G, Papadopoulos M, Charisi M, Lagona E, et al. Factors associated with asthma symptoms in schoolchildren from Greece: the Physical Activity, Nutrition and Allergies in Children Examined in Athens (PANACEA) study. J asthma 2007; 44:521–527.
27. National institutes of Health (NIH). NHLBI: Clinical guidelines on the identification, evaluation and treatment of overweight and obesity in adults: the evidence report. Bethesda, MD: NIH; 1998. NIH report no. 98-4083.
28. American Thoracic Society. Standardization of spirometry—1987 update: statement of the American Thoracic Society. Am Rev Respir Dis 1987; 136:1285–1298.
29. Mahler DA, Wells CK. Evaluation of clinical methods for rating dyspnea. Chest 1988; 93:580–586.
30. American Thoracic Society. Dyspnea. Mechanisms, assessment, and management: a consensus statement. Am J Respir Crit Care Med 1999; 159:321–340.
31. Meyer HA, Søgaard AJ, Tverdal A, Selmer RM. Body mass index and mortality: the influence of physical activity and smoking. Med Sci Sports Exerc 2002; 34:1065–1070.
32. Luder E, Ehrlich RI, Lou WY, Melnik TA, Kattan M. Body mass index and the risk of asthma in adults. Respir Med 2004; 98:29–37.
33. Gueurra S, Sherrill DL, Bobadilla A, Martinez FD, Barbie RA. The relation of body mass index to asthma, chronic bronchitis and emphysema. Chest 2002; 122:1256–1263.
34. Sin DD, Jones RL, Man FP. Obesity is a risk factor for dyspnea but not for airflow obstruction. Arch Intern Med 2002; 162:1477–1481.
35. Michalopoulou M, Aggeloussis N, Zisi V, Ventouri M, Kourtessis T, Malliou P. Physical activity patterns of Greek adults aged 60–90 years: age and gender effects. Inquir Sport Phys Educ 2006; 4:87–96.
36. Baumgarter RN, Heymsfield SB, Roche AF. Human body composition and the epidemiology of chronic disease. Obes Res 1995; 3:73–95.
37. Expert Panel Report 3 (EPR-3). Guidelines for the diagnosis and management of asthma—summary report. J Allergy Clin Immunol 2007; 120;S94-S138.
38. Bateman ED. The economic burden of uncontrolled asthma across Europe and the Asia-Pacific region; can we afford to not control asthma? Eur Respir J 2006; 29;56–63.
39. Launer LJ. Body mass index, weight change, and risk of mobility disability in middle-aged and older women. The epidemiologic follow-up study of NHANES. JAMA 1994; 271:1093–1098.
40. Visser M, Langlois JM, Guralnik JM, Cauley JA, Kronmal RA, Robbins J. High body fatness, but not low fat-free mass, predicts disability in older men and women: the Cardiovascular Health Study. Am J Clin Nutr 1998; 68:584–590.
41. Wornsop CJ. Asthma and physical activity. Chest 2003; 124:421–422.
42. Vassaro R, Siroux V, Maccario J, Pin I, Kaufmann F. Asthma severity is associated with body mass index and early menarche in women. Am J Respir Crit Care Med 2005; 171:334–339.
43. Jakes RW, Day NE, Patel B, Khaw K-T, Oakes S, Luben R, et al. Physical inactivity is associated with lower forced expiratory volume in 1 second. Am J Epidemiol 2002; 156;139–147.