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Effect of Allergic Rhinitis on the Use and Cost of Health Services by Children with Asthma

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Purpose: Allergic rhinitis (AR) is common among children with asthma and exacerbates asthma symptoms. To assess the incremental utilization and cost of asthma-related health services due to concomitant AR among asthmatic children. **Materials and Methods:** Asthma-related claims were extracted from the Korean National Health Insurance (NHI) claims database, which covers 97% of the population. Per-capita utilization and costs of asthma-related services were determined from the societal perspective. **Results:** Of 319,714 children (1 - 14 years old) with chronic asthma in 2003, 195,026 had concomitant AR (prevalence 610 per 1,000 asthmatic children). Children with AR had 1.14 times more outpatient visits, 1.30 times more emergency department (ED) visits, and 1.49 times more hospitalizations than children without AR. More children with AR used general hospitals (7.17%) than children without AR (3.23%). The ratios of unit pharmaceutical costs per outpatient visit, ED visit, and admission between children with and without AR were 1.27, 1.20, and 1.14. Total annual expenditure combining direct health care, transportation, and caregivers' costs, were $273 and $217 for children with and without AR, respectively. **Conclusion:** Health service utilization and costs for asthma were greater for asthmatic children with AR. More frequent ED visits and admissions among asthmatic children with AR suggest poorer control and more frequent exacerbations. Higher unit cost of pharmaceuticals during visits, tendency to receive asthma care from a higher-level facility, and greater risk of ED visit or admission all contributed to the additional economic burden of AR.

Key Words: Asthma, allergic rhinitis, cost of illness, health care cost

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INTRODUCTION

Asthma and allergic rhinitis (AR) are leading causes of illness in childhood and place a substantial burden on health care systems worldwide. The prevalence of childhood asthma varies from nation to nation. One of the highest prevalences is observed in the UK, where at least 20% of children are affected by asthma.[1] Childhood AR, characterized by mucosal inflammation in response to allergen exposure, also shows a high prevalence rate, with prevalence worldwide of up to 40% in 13- and 14-years-old.[2] AR is common among patients with asthma and it increases the risk of acute exacerbation of asthma symptoms.[3-5] Understanding the component health care costs and health care utilization patterns of asthmatic children with AR is essential to designing the most cost-effective strategy to improve patient outcome and minimize the total cost to society.

In comparison to the wealth of data on the cost of illness of asthma, there is much less information about the cost of illness of AR.[6] The literature on the incremental economic burden of AR on patients with asthma is particularly sparse, especially in children, and previous studies of this subject relate to US[7,8] or UK populations.[9] As it is difficult to extrapolate the results to other countries, which have different health care utilization patterns and cost structures, studies on Asian populations are necessary for efficient local resource allocation.

The main data sources for earlier asthma and AR cost studies were medical charts, patient reports, localized administrative data sets, or

nationally representative (but not nationwide) primary care databases. Approaches that use self-reported data to extrapolate economic consequences from the local to the national level rely on assumptions that may not be accurate. Some studies have partially overcome the former limitation by using administrative data sets. For example, Grupp-Phelan and colleagues compared health care utilization and costs of children with both asthma and AR to those of children with asthma alone among subjects at a health maintenance organization.[8] Although that study examined a larger population sample than the studies relying on medical chart reviews or patient questionnaires, it was based on only 1 HMO program and was not representative of the country as a whole. Thomas and colleagues used a nationally representative primary care database from the UK, but this did not include the entire national population.[9]

Centralized insurance claims databases in countries like Korea that have a national health care system show health service utilization of the entire population for specific medical conditions over extended periods of time.[10] The objective of this study, therefore, was to use the NHI claims database of Korea to assess the incremental health service use and costs of concomitant AR in treating childhood asthma.

MATERIALS AND METHODS

Data sources

We used the electronic administrative claims records of the Korean NHI database as a major data source to track health care services provided to asthmatic children during 2003. The NHI claims database includes all medical and prescription drug claims for covered services provided to about 97% of the population. All asthma-related claims were extracted for children with asthma with and without AR. An asthma-related claim was defined as a primary, secondary, or tertiary diagnosis of asthma and an expenditure greater than 0 dollar for a prescribed anti-asthma medicine. We aggregated each patient's claims to produce patient-level information on the total annual asthma-related health service utilization and cost. For data not included in the NHI database, we used the Korean National Health and Nutrition Survey (NHNS) and various publicly available sources specified in detail below.

Study cohort

Children 1 to 14 years of age were defined as having asthma if they had at least two medical claims with a primary, secondary, or tertiary diagnosis of asthma, indicated by International Classification of Disease (ICD)-9 code 493.X and a prescription for an anti-asthma medicine in 2003. Anti-asthma medicines included beta-agonists, methylxanthines (theophylline), mast cell stabilizers (cromolyn, nedocromil), anti-leukotrienes, anti-cholinergics, and corticosteroids. A complete list was created on the specific drugs (oral, injected, and inhaled) that were available and covered by the NHI for the treatment of childhood asthma. An admission claim with a record of a prescription for an anti-asthma medicine and a procedural code for arterial blood gas analysis or nebulizer treatment of the lower airways, which are routine procedures for patients hospitalized for asthma, was classified as an asthma case even if it was not accompanied by a primary, secondary, or tertiary diagnosis of asthma. Similarly, we considered outpatient visits without a diagnosis of asthma as asthma cases if they included a prescription for an inhaled corticosteroid or a leukotriene modifier, which are used only to treat asthma in Korea. Children with asthma claims with a co-diagnosis of chronic obstructive pulmonary disease, cystic fibrosis, bronchitis, bronchiolitis, pneumonia, or emphysema were excluded.

Among all children identified with asthma, those with at least one medical claim during 2003 with a primary, secondary, or tertiary diagnosis of AR(ICD-9 code 477.X) or prescriptions of oral 2nd generation antihistamines (acrivastine, cetirizine, ebastine, fexofenadine, loratadine, and mizolastine) or intranasal glucosteroids (beclomethasone, budesonide, fluticasone, mometasone, and triamcinolone) were defined as having concomitant AR. The remaining children were defined as having asthma without AR.

To determine AR-related prescription medicines, we conducted a literature review and consulted a group of pediatricians.[9,11] The AR-related prescription medicines include 1st-, 2nd-, and 3rd-generation antihistamines, intranasal steroids, oral and topical decongestants, and leukotriene receptor antagonists. Not all of these medicines were suitable to be used to identify AR cases since they are not specific to AR or not used to treat pediatric patients. For example, 1st-generation antihistamines, and oral and topical decongestants are frequently used to treat common colds. The 3rd-generation antihistamines are rarely used to treat children under 15 year in Korea. Because leukotriene receptor antagonists are used to treat both asthma and AR, it is not easy to determine whether the use of this medicine is for AR. On the other hand, the pediatrician panel members agreed that the 2nd-generation antihistamines and intranasal steroids are mostly prescribed to treat pediatric AR but rarely prescribed to treat common colds. A complete list was created for the specific drugs of the 2nd-generation antihistamines and intranasal steroids that were available and covered by the NHI for the treatment of childhood AR.

Outcome variables

The outcomes of interest were health service utilization and cost. Patient encounters were classified into non-urgent outpatient visits, urgent ED visits, and hospital admissions. A claim was categorized as an ED visit if it included an emergency care charge, was submitted from an ED, or occurred during the night, weekend, or holiday. Total asthma-related costs were assessed from the societal perspective and computed as the sum of the cost for direct health service, transportation for visits to health care providers, and caregivers' time spent on outpatient visits or inpatient stays of asthmatic children.

Direct health service costs were divided into insured and uninsured costs. Insured costs were given in the NHI data. Uninsured costs for each claim were computed from the proportion of uninsured costs among total health care costs, previously estimated on the basis of hospital charge records.[12] The reported proportion of uninsured costs was 31.1% for the 15 most frequent conditions requiring outpatient visits and 19.9% for admission with asthma or chronic pulmonary disease. We measured pharmaceutical costs as "anti-asthma pharmaceutical costs" and "all pharmaceutical costs". Anti-asthma pharmaceutical costs only included prescribed anti-asthma medicines only and all pharmaceutical costs were the sum of anti-asthma medicines and all other medicines prescribed during an asthma-related visit or admission.

Transportation costs for visits to health care institutions for outpatient or inpatient care were estimated by multiplying the average round-trip transportation cost by the total number of asthma-related visits and admissions in the country per year. The average round-trip cost for different types of institutions based on the 2001 Korean NHNS has been estimated at $2.60 (using a 2001 exchange rate of 1,000 Korean Won for 1 US dollar).[13] The average round-trip cost in 2001 was converted for 2003 using the ratio of the price index for transportation in 2003 (109.1) to that in 2001 (104.2).

For working mothers, the cost of the loss of time due to physician visits or admission was measured as forgone wages, following the human capital approach. If mothers did not participate in the labor market, we used the "replacement cost approach"[14] which quantifies the cost of replacing the homemaker's time spent in the home with commercially available services (e.g. cleaning, child care). The average daily time cost for a Korean woman 30 - 49 years of age was calculated from their labor market participation rate,[15] average daily wage,[16] and market price for the daily wage of a domestic worker.[17] We assumed that the primary caregivers of asthmatic children were their mothers and that the age range of mothers of children 1 to 14 years of age was 30 to 49 years. Finally, the total time cost for asthma-related visits or admissions was estimated as the product of the total number of visits or admissions, average time spent for a visit or inpatient stay, and average hourly or daily time cost for a Korean woman 30 to 49 years of age. The average time spent for an outpatient visit to different types of institutions (20.3 minutes) was obtained from

the 2001 NHNS.[18]

Data analysis

We compared per-capita utilization and costs of asthma-related services for asthmatic children (i.e. children identified as receiving anti-asthma treatments) to AR (i.e. children identified as receiving anti-rhinitis treatments) and asthmatic children without AR. Per-capita utilization and costs were expressed as visits, hospitalizations, inpatient days, or dollars spent per child per year. Cost and utilization ratios were computed as per-capita cost (or utilization) for asthmatic children with AR divided by per-capita cost (or utilization) for asthmatic children without AR. Mean treatment costs for an outpatient visit, ED visit, and hospitalization were also compared. Statistical significance testing in nationwide administrative datasets usually has no practical meaning because the patient groups are so large that all between-group differences are significant. Therefore, tests of statistical significance were not performed.

RESULTS

Of 319,714 children identified as having chronic asthma in 2003, 195,026 had concomitant AR, yielding a prevalence of 61.0% or 610 per 1000 asthmatic children. The prevalence of AR among asthmatic children increased with age. School-age children (6 - 14 years of age) with asthma showed the highest prevalence of AR (61.4%), followed by children 2 - 5 years (61.3%), and children 1 to < 2 years (58.0%; Table 1).

Table 2 shows the number and percentage of children with at least one recorded use of an asthma-related service during the study year by service category and institution type. A greater percentage of children with AR had at least one asthma-related admission (0.96% versus 0.64%) and ED visit (0.79% versus 0.69%) than those without AR. There were more stays or visits in hospitals, general hospitals, and tertiary care hospitals by children with AR (3.89%, 7.17%, and 3.04%, respectively) than by children without AR (2.16%, 3.23%, and 1.52%). Children with asthma alone (96.53%) tended to visit clinics more often than did children with concomitant AR (93.64%).

Per-capita utilization of asthma-related health services was greater among asthmatic children with AR. On average, children with AR had 1.14 times more outpatient visits than those without AR. For ED visits and hospital admissions, per-capita utilization by children with AR was 1.30 and 1.49 times greater, respectively, than by those without AR (Table 3). Asthmatic children with AR had 29% greater total asthma-related

Table 1. Proportion of Asthmatic Children with or without Allergic Rhinitis by Sex and Age

	All asthmatic children n (%)*	With AR n (%)†	Without AR n (%)†
Total (n)	319,714	195,026 (61.0)	124,688 (39.0)
Gender			
Boys	183,935 (57.5)	113,228 (61.6)	70,707 (38.4)
Girls	135,779 (42.5)	81,798 (60.2)	53,981 (39.8)
Age (yrs)			
1 to < 2	35,247 (11.0)	20,443 (58.0)	14,804 (42.0)
2 to 5	195,414 (61.1)	119,865 (61.3)	75,549 (38.7)
6 to 14	89,053 (27.9)	54,718 (61.4)	34,335 (38.6)

AR, allergic rhinitis.
*Column percent.
†Row percent.

Table 2. Distribution of Asthmatic Children by Type of Health Service and Institution

	No. of children using asthma-related services (%)		
	Total (n = 319,714)	Children with AR (n = 195,026)	Children without AR (n = 124,688)
Type of service			
Non-urgent outpatient visit	319,577 (99.96)	194,957 (99.96)	124,620 (99.95)
Urgent ED visit	2,398 (0.75)	1,543 (0.79)	855 (0.69)
Hospital admission	2,674 (0.84)	1,877 (0.96)	797 (0.64)
Type of institution			
Tertiary care hospital	7,815 (2.44)	5,920 (3.04)	1,895 (1.52)
General hospital	18,004 (5.63)	13,977 (7.17)	4,027 (3.23)
Hospital	10,284 (3.22)	7,590 (3.89)	2,694 (2.16)
Clinic	302,978 (94.77)	182,617 (93.64)	120,361 (96.53)

ED, emergency department; AR, allergic rhinitis.

Table 3. Annual Per-Capita Use and Insured Costs of Asthma-Related Health Services by Asthmatic Children with or without Allergic Rhinitis in 2003

Type of service	Asthmatic children		Ratio†
	With AR	Without AR	
Per-capita utilization			
Non-urgent outpatient visit	8.221	7.203	1.14
ED visit	0.012	0.009	1.30
Admission	0.010	0.007	1.49
Inpatient days	0.053	0.034	1.54
Per-capita insured costs (in 2003, US $)			
Non-urgent outpatient visit	81.4	70.5	1.15
ED visit	0.5	0.43	1.16
Admission	3.5	2.2	1.57
All pharmaceuticals*	75.1	51.6	1.46
Anti-asthma pharmaceuticals	27.7	17.2	1.61
Total	160.6	124.8	1.29

AR, allergic rhinitis; ED, emergency department.
*"All pharmaceuticals" were anti-asthma medicines and all other medicines prescribed during an asthma-related visit or admission.
†Ratios were computed as the per-capita utilization for asthmatic children with AR divided by the per-capita utilization for asthmatic children without AR.

insured costs than children without AR: $160.60 versus $124.80 per child per year. The average annual per-capita costs of all pharmaceuticals and anti-asthma medicines prescribed during asthma visits or admissions were 46% and 61%, greater for children with AR than for children without AR respectively. For both children with and without AR, outpatient visits were the greatest single-

Table 4. Mean Unit Costs of Asthma-Related Health Services for Asthmatic Children with or without Allergic Rhinitis in 2003

Type of service	Asthmatic children		Ratio
	With AR (US $)	Without AR (US $)	
Outpatient visit	9.9	9.8	1.01
ED visit	42.7	47.9	0.89
Admission	342.2	323.6	1.06
Pharmaceuticals*			
During outpatient visit	9.0	7.1	1.27
During ED visit	6.9	5.7	1.20
During admission	88.2	77.2	1.14

AR, allergic rhinitis; ED, emergency department.
Treatment costs only include insured costs.
*All pharmaceuticals, i.e., anti-asthma medicines and all other medicines prescribed during an asthma-related visit or admission.

category expenditure (50.7% and 56.5%, respectively), followed by prescribed medicines (46.8% and 41.4%) (Table 3).

Mean treatment costs per outpatient visit, ED visit, and admission were similar for children with and without AR. However, expenditures for pharmaceuticals during a visit or admission were greater for children with AR than for those without AR. The ratios between the two groups (with AR:without AR) of mean pharmaceutical costs during an outpatient visit, ED visit, and admission were 1.27, 1.20, and 1.14, respectively (Table 4).

Total expenditure, combining direct health service, transportation, and caregivers' time costs, for asthmatic children with AR was 1.26 times greater than total expenditure for children with asthma alone. Direct health service costs accounted for 85.0% and 83.7% of total expenditure for asthmatic children with AR and without AR respectively (Table 5).

DISCUSSION

This study adds to our understanding about the impact of comorbid AR among asthmatic children on the use of health care services and costs related to asthma. Asthmatic children used 14 - 54% more health care services if they had concomitant AR. The tendency to seek asthma care from a higher-level institution such as a general hospital or tertiary care hospital was more pronounced among asthmatic children with AR. The ratio of per-capita costs for asthmatic children with and without AR varied depending on the type of service with the greatest ratios seen for pharmaceuticals. For anti-asthma pharmaceuticals, annual per-capita spending for insured services was about 61% greater for asthmatic children with AR than for those without AR.

The incremental effect of comorbid AR on medical care costs of treating asthma has consistently been observed in previous studies. For example, analysis of medical charge data for a random sample of 1,412 asthmatic children younger than 15 years old from the asthma incidence and prevalence cohorts of Rochester, Minnesota, showed that the total annual medical care charges for children with comorbid AR were almost twice those for children with asthma alone.[7] Another US-based study of enrollees in a staff model Health Maintenance Organization reported that mean total health care costs for asthmatic children with multiple visits for upper respiratory comorbidities such as AR, otitis media, or sinusitis, were 1.7 times higher than for children with asthma alone.[8] Finally, according to multivariable analyses from a recent population-based historical cohort study conducted in the UK,

Table 5. Annual Per-Capita Costs (in 2003 US $) of Asthma-Related Health Services for Asthmatic Children with or without AR

Type of service	Direct costs (I)			Transportation cost (II)	Caregiver's time cost (III)	Total cost (I)+(II)+(III)
	Insured costs		Uninsured costs			
	Insurer payment	Patient co-pay				
Children with AR						
Outpatient visits (1)	53.3	28.1	36.8	22.3	16.1	156.6
ED visits (2)	0.24	0.26	0.23	0.03	-	0.8
Admissions (3)	2.8	0.71	0.88	0.03	2.4	6.9
All pharmaceuticals (4)*	52.7	22.5	33.73	-	-	108.9
Anti-asthma pharmaceuticals	19.4	8.3	12.45	-	-	40.1
Total (1)-(4)	109.0	51.6	71.6	22.4	18.5	273.1
Children without AR						
Outpatient visits (1)	47.4	23.1	31.8	19.6	14.1	136.0
ED visits (2)	0.21	0.23	0.20	0.02	-	0.7
Admissions (3)	1.8	0.45	0.56	0.02	1.6	4.4
All pharmaceuticals (4)*	36.9	15.4	23.19	-	-	75.6
Anti-asthma pharmaceuticals	12.0	5.1	10.81	-	-	28.0
Total (1)-(4)	86.4	39.2	55.8	19.6	15.7	216.6
Ratio†	1.28			1.14	1.18	1.26

AR, allergic rhinitis; ED, emergency department.
*"All pharmaceutical costs" were the summed costs of anti-asthma medicines and all other medicines prescribed during an asthma-related visit or admission.
†Mean costs for asthmatic children with AR divided by mean costs for asthmatic children without AR.

comorbid AR was an independent predictor of a higher risk of asthma-related hospitalization and greater costs for all categories of asthma medications ($p < 0.05$).[9]

Interestingly, the unit treatment cost (average treatment cost per visit or admission) was similar for the two groups. In contrast, the unit pharmaceutical cost during a visit or admission was 27% to 14% greater among asthmatic children with AR. This suggests that pharmaceuticals are an important source of the additional health care expenditures due to AR among asthmatic children. Thus, effective control of AR symptoms could contribute to a reduction in the use and costs of pharmaceuticals. The incremental indirect cost, expressed in terms of the opportunity cost for the caregiver's time loss, was about 18% higher for children with AR than for those without AR. This suggests that the caregiver's time cost is also an important component of AR-related costs.

The 1-year prevalence of treated AR in the Korean asthmatic population of 1 to 14-year-old children in 2003 was estimated as 61.0%. Although methods of identifying asthmatic children with concomitant AR varied, we can compare our results with those of previous studies. A population-based study conducted in the US estimated that 38.5% of asthmatic children younger than 15 year had concomitant AR.[7] In a retrospective cohort study conducted in UK, about 19.7% of children 6 to 15 year old had both asthma and AR.[9] The prevalence in all of these

studies is relatively low. The reason may lie in underreporting/under-diagnosis/undertreatment of AR in administrative databases used in previous studies. A recent post-hoc analysis of a well-characterized clinical trial population suggests that 61% of children aged 6 - 14 years with asthma also have physician-diagnosed and self-reported AR.[19]

In this study, the presence of asthma was defined by both a diagnosis of asthma and treatment with an anti-asthma medicine. It is not unusual in Korea for providers to up-code a patient's diagnosis to a disease that is more severe than their actual condition in order to justify treatment and increase reimbursement. The use of an anti-asthma medication was included in addition to a diagnosis of asthma to minimize the misclassification of up-coded asthma as true asthma cases.

Unlike asthma cases, we determined the presence of concomitant AR by either a diagnosis or treatment with an anti-AR medicine. The prevalence of AR among asthmatic children was only 22.5% if AR cases were identified by both diagnosis and the use of an anti-AR medicine. Considering the tendency of under-diagnosis or under-treatment of AR,[9,11] we thought that classifying AR cases by either a diagnosis or AR-related medicine was appropriate to minimize missing AR subjects.

Pharmaceutical costs were measured as "anti-asthma pharmaceutical costs" and "all pharmaceutical costs". In clinical practice, patients are treated with antibiotics, medicines for indigestion, and other medicines in addition to anti-asthma medicines. The cost of all pharmaceuticals, including anti-asthma medicines and other related medicines, reflects the true cost of pharmaceuticals prescribed for childhood asthma.

Several limitations to this research should be addressed in future studies. First, given the nature of insurance claims data, we were unable to identify asthmatic children who did not receive treatment. This could have led to overestimation of the per-capita cost of asthma. Similarly, because the NHI does not cover over-the-counter drugs, these costs did not appear in the administrative data and were not represented in the study results. Second, a prevalence-based approach was taken to quantify the economic burden of childhood asthma, where both incident and prevalent cases were considered over a one-year period.[20] Per-capita health service utilization and costs were calculated by dividing the total national utilization or costs by the number of incident and prevalent asthma cases identified in 2003. If only prevalent asthma cases were considered (i.e., children with pre-existing asthma before 2003), we would underestimate the true costs of the combined population of incident and prevalent cases. In addition, per-capita utilization and costs were calculated on a per-calendar year rather than a per-person year basis. For example, a patient who was diagnosed with asthma for the first time in July 2003 and had 3 outpatient visits in the remaining part of the year would be counted as having 3 visits per calendar year although the number of visits per person-year would be 6 (3 visits/0.5 year).

Third, if patients with or without AR in this study were identified by medical chart review, it would be possible to have more confidence in identifying true AR cases. However, since our dataset was national medical claims data and claims data do not have detailed clinical information, we relied on diagnosis code and the use of AR-related prescription medicines in identifying AR cases. Based on the literature review[11,12] and consultation with the pediatrician panel, we considered that the diagnosis code and AR-related prescription medicines would be the best possible information that can be used from claims data to identify AR cases. However, this is apparently a limitation of the study due to the nature of claims data. A future study, evaluating the validity of diagnosis of AR in NHI claims data would be helpful to assess the accuracy of AR cases identified on the basis of diagnosis of AR.

In conclusion, asthmatic children had substantially higher utilization and costs for treating asthma if they had concomitant AR. Asthma-related ED visits and admissions were about 1.30 to 1.49 times more frequent among asthmatic children with AR than those without, suggesting poorer control and more frequent exacerbations among asthmatic children with AR. Higher unit costs of pharmaceuticals during a visit or admission, a greater tendency to receive asthma care

from higher level health care institutions, more frequent asthma-related visits, and a greater risk of ED visits or admission all contributed to the added economic burden resulting from AR. Compared to prior studies of the incremental cost of AR, the present study has the advantage of a centralized national claims database representing the entire medically insured population of the country. In addition, it is the first nationwide study addressing the issue of health care costs related to concomitant asthma and AR in patients in an East Asian country. These findings, therefore, uniquely contribute in their potential to enhance the understanding of the effect of concomitant AR on the use and costs of health services for childhood asthma.

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REFERENCES

1. Chung F, Barnes N, Allen M, Angus R, Corris P, Knox A, et al. Assessing the burden of respiratory disease in the UK. Respir Med 2002;96:963-75.
2. Strachan D, Sibbald B, Weiland S, Aït-Khaled N, Anabwani G, Anderson HR, et al. Worldwide variations in prevalence of symptoms of allergic rhinoconjunctivitis in children: the International Study of Asthma and Allergies in Childhood (ISAAC). Pediatr Allergy Immunol 1997;8:161-76.
3. Bousquet J, Van Cauwenberge P, Khaltaev N; Aria Workshop Group; World Health Organization. Allergic rhinitis and its impact on asthma. J Allergy Clin Immunol 2001;108 (5 Suppl):S147-334.
4. Schoenwetter WF, Dupclay L Jr, Appajosyula S, Botteman MF, Pashos CL. Economic impact and quality-sof-life burden of allergic rhinitis. Curr Med Res Opin 2004;20:305-17.
5. Blaiss MS. Cognitive, social, and economic costs of allergic rhinitis. Allergy Asthma Proc 2000;21:7-13.
6. Weiss KB, Sullivan SD. The health economics of asthma and rhinitis. I. Assessing the economic impact. J Allergy Clin Immunol 2001;107:3-8.
7. Yawn BP, Yunginger JW, Wollan PC, Reed CE, Silverstein MD, Harris AG. Allergic rhinitis in Rochester, Minnesota residents with asthma: frequency and impact on health care charges. J Allergy Clin Immunol 1999;103:54-9.
8. Grupp-Phelan J, Lozano P, Fishman P. Health care utilization and cost in children with asthma and selected comorbidities. J Asthma 2001;38:363-73.
9. Thomas M, Kocevar VS, Zhang Q, Yin DD, Price D. Asthma-related health care resource use among asthmatic children with and without concomitant allergic rhinitis. Pediatrics 2005;115:129-34.
10. Birnbaum HG, Cremieux PY, Greenberg PE, LeLorier J, Ostrander JA, Venditti L. Using healthcare claims data for outcomes research and pharmacoeconomic analyses. Pharmacoeconomics 1999;16:1-8.
11. Crown WH, Olufade A, Smith MW, Nathan R. Seasonal versus perennial allergic rhinitis: drug and medical resource use patterns. Value Health 2003;6:448-56.
12. Jung HJ. Estimating non-covered medical cost. Health Insurance Forum 2002;1:73-97 (Korean).
13. Yang BM. Developing criteria for estimating standard costs used in economic evaluation studies for medicines (technical report: Korean). Seoul, Korea: Health Insurance Review Agency; 2004. p.149.
14. Drummond MF, O'Brien BJ, Stoddart GL, Torrance GW. Chapter 7. Cost-benefit analysis. In: Methods for the economic evaluation of health care programmes. Oxford: Oxford University Press; 2005. p.216.
15. Korea National Statistics Office. Age- and gender-specific participation rate to labor market 2002. Available form: URL: http://www.kosis.kr.
16. Korean Ministry of Labor. Statistics for wage structure. 2002. Available form: URL: http://www.laborstat.molab.go.kr.
17. Korea YWCA. Personal talk with Korea YWCA administrator 2004.
18. Yang BM. Developing criteria for estimating standard costs used in economic evaluation studies for medicines (technical report: Korean). Seoul, Korea: Health Insurance Review Agency; 2004. p.152-3.
19. Garcia-Garcia ML, Wahn U, Gilles L, Swern A, Tozzi CA, Polos P. Montelukast, compared with fluticasone, for control of asthma among 6- to 14-year-old patients with mild asthma: The MOSAIC study. Pediatrics 2005;116:360-9.
20. Kang HY, Kim HJ, Park TK, Jee SH, Nam CM, Park HW. Economic burden of smoking in Korea. Tob Control 2003;12:37-44.