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Incidence and Prevalence of Skin Cancers in South Korea from 2008 to 2016: A Nation-Wide Population Based Study

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Background: In South Korea, there have been few nationwide epidemiologic studies about premalignant actinic keratosis (AK), squamous cell carcinoma *in situ* (Bowen's disease), nonmelanoma skin cancer (NMSC), malignant melanoma of the skin (MM), Kaposi's sarcoma (KS), connective and soft tissue cancers, or mycosis fungoides (MF).
Objective: Using a nationwide population-based study, we attempted to measure the incidence and the prevalence of the above-mentioned tumors in South Korea.
Methods: The database we used included all claims in the Korean National Health Insurance program and the Korean Medical Aid program from 2008 to 2016. The International Classification of Diseases, 10th revision (ICD-10) was used to record diagnoses in this database. This data included AK, Bowen's disease, NMSC, MM, KS, connective and soft tissue cancers, and MF.
Results: The age-standardized incidence and prevalence rate of AK, Bowen's disease, NMSC, MM, KS, connective and soft tissue cancers, as well as MF increased during the periods we investigated. The incidence and prevalence rate of AK and NMSC have increased two- to three-fold. In the case of Bowen's disease, MM, KS, connective and soft tissue cancers, or MF, we observed no significant tendency in age-standardized incidence or prevalence.
Conclusion: We confirmed that the age-standardized incidence and prevalence rates of NMSC and AK tended to increase. These results might contribute to developing preventive and therapeutic strategies for skin cancers and may become a source for further studies.

Keywords: Incidence, Korea, Prevalence, Skin neoplasms

INTRODUCTION

Skin cancer is one of the most commonly occurring cancers, and understanding the incidence of this trend is crucial. This is important for planning prevention and treatment strategies and allocating medical resources. The incidence and trends of nonmelanoma skin cancer (NMSC) and cutaneous melanoma have been relatively well reported in western countries[1-6], and there have been two Korean studies[7,8] about these. However in South Korea, there have been few nationwide epidemiologic studies about Kaposi's sarcoma (KS), connective and soft tissue cancers, or cutaneous T-cell lymphoma[7,8]. Korea has the National Health Insurance (NHI) System, and it is relatively easy to obtain nationwide data, although some diseases have not been clearly classified based on the system.

In order to establish appropriate policy about skin cancer

and research the problem, we analyzed the incidence and prevalence rates of the above skin tumors in Korea.

MATERIALS AND METHODS

We analyzed skin cancer data from NHI System Claims Database from 2008 to 2016. This database included all claims provided by the Korean NHI program and the Korean Medical Aid program during the given period. The International Classification of Diseases, 10th revision (ICD-10) was used to record diagnoses in the database. Our definition for malignant melanoma (MM) is based on the ICD-10 code series from C43.0 to C43.9 and D03. For NMSC, we used the C44.0-C44.9 ICD-10 codes, which are defined as other and unspecified malignant skin neoplasms, depending upon their location. KS was designated as ICD-10 codes C46.0 to C46.9 according to body sites, soft tissue cancer as C49.0 to C49.9, mycosis fungoides (MF) as C84.0, Bowen's disease as D04.0 to D04.9, and actinic keratosis (AK) as L57.0.

The data included details regarding patient age and sex, as well as information related to diagnosis and treatment. We investigated the age-standardized incidence and prevalence rates. Incidence is defined in terms of the occurrence of new disease cases in a population over a specified period of time. Prevalence is the proportion of patients in the population who have a particular disease at a particular time or over a specified period of time.

Age standardization is a way to adjust the crude rate to account for differences in population age structures when comparing crude rates for different periods of time, geographical areas, or subgroups of the population. The age-standardized rate of a population is the summary rate it would have if it had a standard age structure. Age-standardized incidence and prevalence rates were calculated as the sum of weighted incidence rate for each five-year age group using Segi's world standard population.

We also checked age-specific incidence rates for representative skin cancers. Age-specific incidence rates equal the total number of new cases limited to a particular age group, which is divided by the at-risk population for that category. This study is the exemption of IRB.

RESULTS

Age-standardized incidence rate

In general, the incidence rate of all the skin cancers investigated in this study tended to increase from 2008 to 2016. The incidence rate of AK and NMSC increased significantly, from 6.86 to 17.96 and 6.32 to 10.11 per 100,000 person-years. However, Bowen's disease, MM, KS, connective and soft tissue cancers, and MF have not increased significantly (Table 1).

Age-standardized prevalence rate

In this study, the incidence and prevalence rates for all skin cancers have increased proportionally and continuously from 2008. The AK and NMSC prevalence rates have especially increased sharply, from 7.52 to 22.93 and 9.15 to 19.20 per 100,000 person-years. The prevalence rates of MM, KS, MF, and connective tissue tumor have tended to increase, although their incidence rates have not increased very much (Table 2).

Age-specific incidence of representative skin cancers

The overall incidence rate of all skin cancers in this study has tended to increase with age, with a peak incidence age being in the 70s in AK, Bowen's disease, NMSC, but in the 60s in MM and connective tissue tumors (Table 3).

Table 1. Age-standardized incidence rate of representative skin cancers

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016
Actinic keratosis	6.86	7.67	8.04	10.39	11.73	13.20	15.02	16.60	17.96
Bowen's disease	2.12	1.86	2.13	1.89	1.89	1.98	2.04	2.09	2.51
Non melanoma skin cancer	6.32	6.44	6.66	7.51	7.83	8.20	8.82	9.15	10.11
Malignant melanoma	2.27	1.99	2.09	2.24	2.29	2.24	2.59	2.39	2.63
Kaposi's sarcoma	0.20	0.17	0.25	0.26	0.23	0.24	0.23	0.26	0.28
Connective tissue tumor	2.55	2.43	2.52	2.54	2.61	2.56	2.72	2.87	2.88
Mycosis fungoides	0.17	0.20	0.16	0.19	0.16	0.16	0.17	0.17	0.24

Age-standardized incidence rate is expressed in 100,000 person-years.

Table 2. Age-standardized prevalence rate of representative skin cancers

Variable	2008	2009	2010	2011	2012	2013	2014	2015	2016
Actinic keratosis	7.52	8.76	9.64	12.27	14.28	16.29	18.53	20.80	22.93
Bowen's disease	2.47	2.27	2.66	2.48	2.55	2.76	2.98	3.11	3.67
Non-melanoma skin cancer	9.15	10.33	11.11	12.54	13.68	14.70	16.13	17.42	19.20
Malignant melanoma	3.79	3.81	4.10	4.42	4.69	4.87	5.41	5.40	5.82
Kaposi's sarcoma	0.35	0.34	0.42	0.46	0.43	0.46	0.48	0.50	0.56
Connective tissue tumor	6.09	6.51	7.08	7.42	7.80	8.01	8.50	8.99	9.51
Mycosis fungoides	0.39	0.49	0.47	0.51	0.53	0.55	0.61	0.64	0.72

Age-standardized prevalence rate is expressed in 100,000 person-years.

Table 3. Age-specific incidence of representative skin cancers

Age (yr)	Actinic keratosis	Bowen's disease	Non-melanoma skin cancer	Malignant melanoma	Kaposi's sarcoma	Connective tissue tumor	Mycosis fungoides
0~9	0.90	0.04	0.07	0.06	0.00	0.13	0.01
10~19	1.14	0.06	0.09	0.10	0.00	0.19	0.03
20~29	0.68	0.14	0.19	0.15	0.00	0.25	0.05
30~39	0.57	0.13	0.30	0.19	0.01	0.28	0.04
40~49	0.72	0.14	0.52	0.24	0.01	0.34	0.04
50~59	1.21	0.22	0.94	0.34	0.01	0.43	0.04
60~69	2.12	0.42	1.69	0.47	0.01	0.49	0.04
70~79	2.77	0.49	2.17	0.45	0.02	0.36	0.03
>80	1.80	0.41	1.93	0.31	0.01	0.18	0.01
Total	11.94	2.06	7.89	2.30	0.07	2.63	0.30

Age-specific incidence is expressed in 100,000 person-years (2008~2016). Nonmelanoma skin cancer and Bowen's disease incidence rates tend to increase with age.

DISCUSSION

Throughout this study, we identified the prevalence and incidence of AK, Bowen's disease, NMSC, MM, KS, connective and soft tissue cancers, and MF in South Korea. In particular, the incidence and prevalence of AK, KS, connective and soft tissue cancers, or MF are not as well-known as compared to NMSC or MM in other countries[5,9].

The age-standardized incidence and prevalence rate of all skin cancers included in this study has tended to increase. The reason for this phenomenon is probably the low mortality rate of NMSC and the change to an aging society in Korea. We especially confirmed that age-standardized incidence and prevalence rates of NMSC and AK tended to increase sharply as compared to other cancers. It is well known that AK, a premalignant lesion, usually progresses to squamous cell carcinoma (SCC) through SCC *in situ* (Bowen's disease). Therefore, it is reasonable to assume that the incidence of Bowen's disease also increases. However, we could not find any tendency in the incidence rate of Bowen's disease. This might be because of this study's short observation time of eight years, because it may take a long time for AK to change into Bowen's disease. Alternatively, Bowen's disease often occurs in areas not exposed to sunlight, and the incidence of Bowen's disease may not necessarily correlate with the incidence of AK.

In two previous Korean studies[7,8], the incidence rate of NMSC and MM increased. However, the increase is usually higher in NMSC than in MM. The present study also found that the incidence rate of NMSC was higher than MM during the examination period.

According to reports from western countries, such as the Netherlands and Sweden[10,11], the incidence of UV-related skin

tumors (such as basal cell carcinoma [BCC], SCC, or MM) increased significantly and more steeply than did those of other skin malignancies.

In Korean studies of incidence rates by age[7,8], the incidence of melanoma, BCC, and SCC increased the most in those over 80 years of age. The peak age of AK, Bowen's disease, and BCC was greatest among those who are 61~80 years of age. In the present study, age-specific incidence rates for NMSC and AK is in the 70s. Thus, the incidence trend for NMSC is similar to the previous study. However, the peak incidence age for MM is in the 60s, unlike the previous Korean study[8]. Melanoma has been known to be a highly aggressive skin cancer with a higher disease-specific death rate than SCC or BCC. Thus, it is postulated that its peak incidence might be lower than NMSC, including SCC or BCC. On the other hand, the increased rate of incidence in other cancers except NMSC and AK was not significant. In the Netherlands data[10], no significant incidence increases were observed for lymphomatous, appendageal, fibromatous, or myomatous carcinomas during 1989~2005. Spanish data also shows[12] that there was no significant increase in the incidence of dermatofibrosarcoma protuberans, adnexal, or skin appendage neoplasm over the entire period, even when the analysis was done for both sexes, either together or separately.

The limitation of this study is that it does not distinguish between BCC and SCC because it is based on the ICD-10 code data, which could not make this distinction.

However, these results may have implications for establishing prevention and treatment strategies for skin cancer and may lead to additional research.

CONFLICTS OF INTEREST

The authors have nothing to disclose.

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DATA SHARING STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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