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Estimation of Lifetime Dental Expenses for Diabetics*

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ABSTRACT

Objectives : The objective of this study was to estimate a Korean's lifetime dental expenses depending on diabetics. Methods : We analyzed the Korea Health Panel Survey from 2010 to 2017. The samples of diabetics extracted from 137,588 using R version 3.0 in the data of outpatient dental care and estimation of lifetime dental expenditures for diabetics generated using Excel. Results : The results showed that an estimate of average per capita lifetime dental expenditure was about 6.5 million won for men (33 years) and about 6.4 million won for women (30 years). About 50% of their lifetime dental expenditure for diabetics incurred after age 65. Conclusions : Dental care professionals should always effort to control risk factors in diabetics under 65 years to reduce dental expenses and improve to oral health promotion.

1. Introduction

The aging of the population and changes taking place in lifestyles are continuously increasing the occurrence of chronic diseases and their social burdens (Cha & Yun, 2015). According to the '2020 Key Statistics for Health Insurance' published by the National Health Insurance Service, the total medical expenses posted KRW 8,954.5 billion, which is an increase of 0.6% year on year, and the medical expenses for the elderly aged 65 and older captured 43.1% (NHIS, 2021), respectively. Chronic disease is being stressed as a typical cause of this increase in the medical expenses for the elderly (RIHP, 2021).

Chronic disease is one which persists over a long time with mild symptoms over a period of 6 months or 1 year or longer, and the increase in the chronic disease may negatively affect the health insurance finances and household economy overall (Cha & Yun, 2015). Furthermore, 80.1% of all of the causes of death are chronic diseases, and 7 of the top 10 causes of death are chronic diseases. The World Health Organization (WHO) has designated cardiovascular diseases and diabetes as the major chronic diseases, and is also requiring measures at the national level

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(KDCPA, 2021).

Meanwhile, among the chronic diseases, diabetes (Cha & Yun, 2015), which is estimated to have affected 190 million people across the world, is steadily increasing in Korea (Cha & Yun, 2015; Shin, 2019), along with the increased rate of use of outpatient due to the occurrence of oral problems with diabetics, while the occurrence of various complications of diabetes has caused the rising expenditures of medical expenses (Shin, 2019). In particular, approximately 90% of diabetics suffer from type 2 diabetes (Chung et al., 2017), and the chronic hyperglycemia caused by it is associated with renal, nervous system, vascular and immune system dysfunction (Alam et al., 2014) as well as causes chronic inflammation (Shoelson et al., 2006). As for the oral related issues, there are the inflammation of periodontal tissue (Costa et al., 2017), occurrence of dry mouth and root caries (Albert et al., 2012; Garton & Ford, 2012), loss of adhesion of periodontal tissue and chromophore in saliva include oral problems such as the increase in chromogranin A (Kogawa et al., 2016), periodontal disease (Demmer et al., 2012; Kim et al., 2014; Khader et al., 2006) along with a negative effect on glycemic control (Weinspach et al., 2013) as reported. Given such complications, all medical personnel including dental personnel are required to provide the comprehensive medical services to the diabetics (Choi, 2020), and the awareness of oral health is increasing for the diabetes management (Yoo, 2016). In particular, the dental health personnel are required to provide the continuous oral health interventions to prevent and delay the oral diabetes complications (Choi, 2020).

The increase in the dental expenditures is causing burdens on the individuals and households (Kim, 2016). Hence, a policy alternative for the medical expenses due to dental disease is required (Kim & Kwag, 2021), and it is also the point in time to estimate the medical expenses through understanding the size of medical expenses and identify the factors which incur the medical expenses.

Studies on the medical expenditure has increased since the 2000s (Pubmed, 2021). In connection with the estimation of medical expenses, the estimation of lifetime medical expenses (Chia & Tsui, 2005; Jung et al., 2011), estimation of lifetime medical expenses of cancer patients (Jung & Ko, 2009), and the estimation of the end-of-life related expenses of cancer patients (Yang, 2017), etc., have been studied, and are used as the basic data for predicting the size of medical expenses. In connection with the dental expenditures, outpatient medical expenditure and dental outpatient expenditure related calculation (Kim et al., 2012), comparison of trends in dental outpatients' use from 2008 to 2011 (Jung, 2014), children and adolescents' dental outpatient use and medical expenditure related analysis (Jung, 2016) have been studied, and as for the studies related to the estimation of dental expenditures, there are the study which estimated the dental cost of all dental care users by dividing the total age by 5 years (Sohn et al., 2020) and the study which estimated the lifetime dental expenditures of periodontal disease patients (Kim & Kwag, 2021). In a previous study (Jung et al., 2011), the estimation of lifetime dental expenditures made it possible to predict the future dental expenditures by figuring out the amount of dental expenditures, notwithstanding which, a wide ranging study on the estimation of lifetime dental expenditures has not been conducted. Accordingly, this study seeks to identify the public expenditure of the dental expenditures through the estimation of dental expenditures of diabetics, which causes complica-

tions in the oral cavity, and also provide the basic data for devising a plan to efficiently manage the dental expenditures.

2. Research Method

2.1 Research Data and Research Subject

This study used data from the Korean medical panel for 8 years from 2010 to 2017, which were surveyed separately by the name of diabetes among the medical panel data from 2008 until 2017. The subjects of study were 10,633 cases of dental treatment among 2,173 outpatient data of the diabetics out of 2,220,112 cases of outpatient treatments of 137,588 people. Of which, the number of dental treatments for men under the age of 33 and for women under the age of 30 was 9 and 2, each respectively, and based on which, there was a possibility that the estimate of dental expenditures at the relevant age could be expanded, and hence, those equivalent to or older than the relevant age were extracted as the subjects of analysis.

2.2 Statistical Analysis

As for the analytical method of this study, the outpatient treatment data of diabetics were extracted by using R (version 3.6), and the dental expenditures estimation was performed by using Excel. As for the actual dental expenditures made, the total dental expenditures made by the diabetics for 1 year were calculated, and the average amount by gender and age was estimated, and the relevant amount was named as the total dental expenditures for 1 year. The lifetime dental expenditures were estimated by accumulating the total dental expenditures for 1 year by age, and the Statistical Office's complete life table (by 1 year old) were applied (KOSIS, 2021) as the survival probability for estimation (Chia & Tsui, 2005).

$$\sum_{i=1}^{n} c_i p_i$$

c_i : amount spent as the dental expenditures by an i-year-old who is a diabetics

p_i : probability of survival up to age i

3. Results

3.1 Distribution of Dental Expenditures Made by Diabetics

It turned out that the dental expenditures made by men who are diabetics over their lifetime were the largest at the age of 39 and 80, and the dental expenditures made by women over their lifetime were the largest at the ages of 38, 88, and 90, respectively Figure 1.

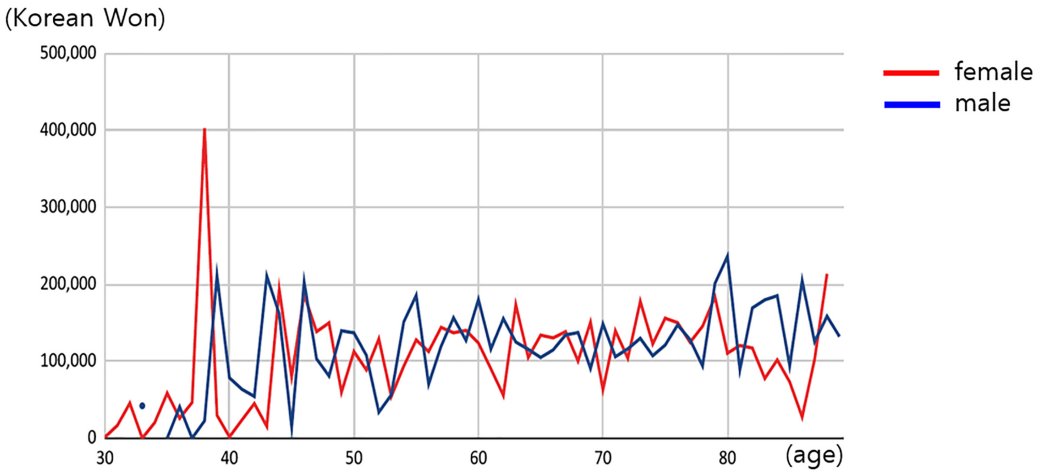

Fig. 1. Distribution of dental expenditures for diabetics

3.2 Estimation of the Lifetime Dental Expenditures by Diabetics

The lifetime dental expenditures which will be made for life due to diabetes were estimated to be approximately KRW 6.5 million for a 33-year-old male and approximately KRW 6.4 million for a 30-year-old female. As a result of comparing the lifetime dental expenditures by gender, it was estimated that the lifetime dental expenditures for the male diabetics were greater than the lifetime dental expenditures of the female diabetics during the entire lifetime except for age 90 Figure 2. Furthermore, it was estimated that the relative lifetime dental expenditures of 65 year olds were 50.4% for men and 49.5% for women, respectively Table 1.

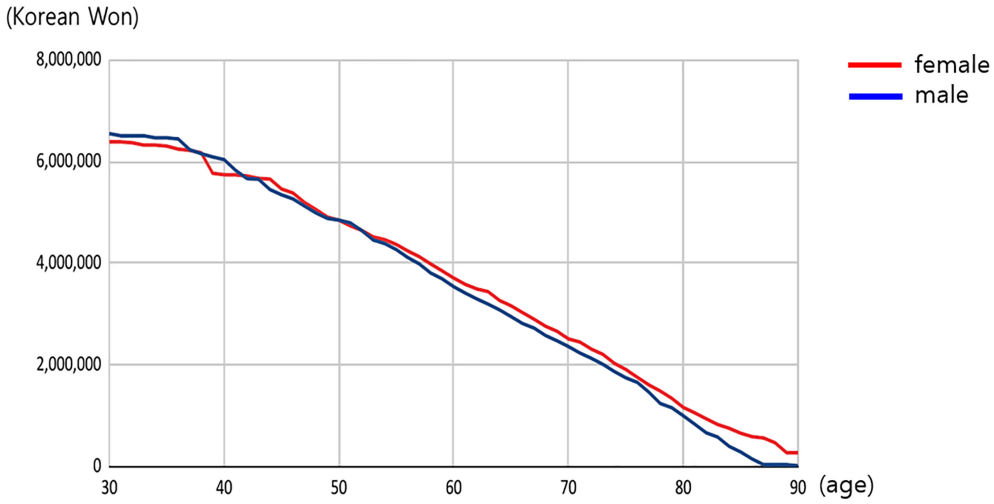

Fig. 2. Estimation of lifetime dental expenditures for diabetics

Table 1. Lifetime per capita dental expenditures and the relative lifetime dental expenditures for men and women

Age (yrs)	Male		Female	
	Lifetime per capita dental expenditure (Korean Won)	Relative lifetime dental expenditure (%)	Lifetime per capita dental expenditure (Korean Won)	Relative lifetime dental expenditure (%)
30[a]/33[b]	6,551,573	100.0	6,389,325	100.0
40	6,235,260	95.1	5,742,117	89.9
50	5,127,458	78.3	4,848,774	75.9
60	3,987,656	60.9	3,710,811	58.1
65	3,301,064	50.4	3,164,229	49.5
70	2,726,332	41.6	2,513,528	39.3
80	1,465,845	22.4	1,165,710	18.3
85	666,506	10.2	658,461	10.3
90	38,880	0.6	275,760	4.3

[a]ref. of female, [b]ref. of male

4. Discussion

The increase in the incidence of various complications of diabetes is causing an increase in the medical expenses (Shin, 2019). Since such diabetes is included among the causes of the increase in the dental expenditures (NHIS, 2021), the dental medical personnel are required to pay more attention to the management of chronic disease patients. Furthermore, the dental expenditures increase the burden of medical expenses since there are many uninsured treatments (Park et al., 2011). Previously, the chronic disease related maintenance efforts were focused on the oral health interventions available in the clinic for the chronic disease patients (Choi, 2020), and now, various measures to secure the stability and continuity of household and national medical finances and the need to present desirable policy directions are needed, while the need to implement them is further rising (Jung & Ko, 2009).

Hence, this study has verified the dental expenditures made by the diabetics through the Korea Health Panel Survey's data, which may represent the entire medical status in Korea, and the lifetime dental expenditures which may be made over a lifetime were estimated based on the amount of dental expenditures made from the age of 33 for men and from the age of 30 for women. Consequently, the lifetime dental expenditures estimated based on the diabetics' dental expenditures were approximately KRW 6.5 million for a 33-year-old male and approximately KRW 6.4 million for a 30-year-old female. Of which, it was apparent that the men's lifetime dental expenditures is approximately 65% of the estimated lifetime dental expenditures of a 33-year-old male with periodontal disease in a previous study (Kim & Kwag, 2021) compared to approximately KRW 9.9 million, while the lifetime dental expenditures of a 30-year-old female with periodontal disease was approximately KRW 7.5 million, which may be inferred to be approximately 85% of the relevant amount. Meanwhile, in the study of Sohn et al. (2020), the results of estimating the lifetime dental expenditures of

all dental visitors, which were not of the patients with specific diseases, estimated that it was approximately KRW 28 million for a 33-year-old male and approximately KRW 30 million for a 30-year-old woman. Compared with the lifetime dental expenditures of diabetics estimated in the results of this study, it is apparent that the men account for approximately 23% and women approximately 21%. As is evident based on such results, it was verified that the ratio of dental expenditures for the diabetics was large.

Furthermore, the lifetime dental expenditures of the diabetics estimated in this study were estimated to be larger than those of the female diabetics over their entire lifetime, except for the age of 90. This may be since the men with periodontal disease are more exposed to the factors influencing diabetes than women as the men with periodontal disease have the greater lifetime dental expenditures than women (Kim & Kwag, 2021). In particular, it is thought that the health behavioral factors including smoking, drinking, and stress may have caused an effect (Lim, 2014).

Meanwhile, the estimated relative lifetime dental expenditures for a 65 year old in this study was 50.4% for men and 49.5% for women, respectively. In a study by Jung & Ko (2009), which estimated the lifetime medical expenses, the relative lifetime medical expenses for a 65 year old were 64.1-69.2%, and the relative lifetime medical expenditures for those with periodontal disease were estimated to be 66.4-75.7% (Kim & Kwag, 2021), respectively. Hence, since the dental expenditures of diabetics before the age of 65 occur more than the medical expenses, if efforts are made to control the various risk factors by life cycle, it is considered that the oral health management of diabetics may be efficiently managed early. Hence, in order to prevent the oral complications caused by diabetes, the dental personnel need to periodically monitor the diabetics, provide the comprehensive oral health intervention for minimizing oral infections, and the need for mutual cooperation between dental and endocrine medical staff is required, as is apparent (Choi, 2020; Yoo, 2016).

As for the contribution made by this study, the Korea Health Panel Survey, Korea Welfare Panel Survey, Korea Labor Panel Survey, and the Household Financial Welfare Survey, etc. were primarily used in the previous studies conducted in connection with the medical expenses, yet in this study, the Korean medical panel's data from 2010 to 2017 for a total of 8 years were used to enhance the efficiency of estimation. However, caution is required in interpreting the results given the following limitations. When estimating the lifetime dental expenditures, the effect of the lifetime dental expenditures was underestimated by reflecting the dental expenditures of a specific age for which the dental expenditures did not occur as they were, and it is also thought that the inclusion of the dental treatment expenses for the uninsured care would have yielded the same effect. Hence, in the follow-up studies, it is expected that the estimation of the lifetime dental expenditures will be made considering the estimated amount for the age at which the dental expenditures do not incur and the part of the non-insured medical expenses.

5. Conclusion

As a result of analyzing the outpatient dental cost of the diabetics in the medical panel data from 2010 to 2017, the following conclusions were reached.

1. The lifetime dental expenditures of the diabetics were estimated to be approximately KRW 6.5 million for a 33 year old male and approximately KRW 6.4 million for a 30 year old female.
2. It was estimated that approximately 50% of the diabetics' lifetime dental expenditures were incurred at or after the age of 65.

Based on the results above, it is necessary to discuss and manage the practical and effective management of the dental expenditures for the diabetics, and it would also be determined that the efforts to control various risk factors of the diabetics under the age of 65 ought to be continuously made.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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