ASSOCIATED FACTORS OF DIABETES AND THE IMPORTANCE OF CHEWING ABILITY OF KOREAN ADULTS: THE 8TH KNHANES

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Abstract

Background/Objectives: Diabetes and poor oral-health are serious problems caused of various morbidity. Previous studies on diabetes triggering dementia have reported but the studies related with general oral-health are not clearing.

Methods/Statistical analysis: To clarify on the associated factors of diabetes, the data was analyzed by complex sampling methods with the latest cross-sectional one from 8th (2020) KNHANES (Korea National Health and Nutrition Examination Survey). To find out the associated factors of Diabetes Mellitus and the importance of chewing ability, it was analyzed by multiple-logistic-regressions with SPSS (ver. 21.0).

Findings: 4,183 participants (20≤) aged were selected and multivariable logistic-regression analysis were used. The prevalence of diabetes was 13.1%. As results, age (65≤) and aged (40-64) group compared to (20-39) aged one, and lower education level were the remarkable factors of diabetes. Chewing difficulty presence, female gender, high BMI (body mass index), no spouse, and sedentary time (5≤) factors were the serious one of diabetes in order, with statistically significance. These results show that ageing, bad oral health and life-style factors are important and influencing one in chronic disease such as diabetes mellitus. To my knowledge, this research is the first one to identify the association of diabetes and chewing ability and socio-life-style factors. These results are valuable as useful data to prevent chronic disease such as diabetes mellitus caused of dementia in the ageing society worldwide.

Improvements/Applications: Therefore, to prevent diabetes, public health professionals should urgently prepare various nursing and public health education programs as well as supporting policies in view of primary health care.

Keywords: diabetes, ageing, gender, BMI, chewing ability, education level

INTRODUCTION

Diabetes mellitus and poor oral health problems are common worldwide. The association between diabetes and oral health was reported [1] which was known as being related with the quality of life, oral conditions and malnutrition among elderly [2]. The harmful effect of diabetes was identified that being robustly connected with oral hygiene [3]. Also, the association between diabetes and edentulism was lately identified among low -and middle- income countries [4]. Especially the oral microbiome was reported to be facilitating the diabetes among pregnant women [5]. Especially diabetes mellitus was known to be associated with the changes of salivary and subgingival microbiome as well as having association with periodontitis [6]. But most medical practitioners have negative attitudes on management of periodontitis of diabetes patients [7]. And that, the trends in increasing state of prevalence of diabetes among US adults, 1999-2018, was already reported [8]. Body mass index(BMI) and waist circumference(WC) were well known as indicators of diabetes for ease use [9]. And it was reported that high prevalence of diabetes was closely connected with socio-demographic factors such as age, marital status, education, unemployment, insurance state and family history [10]. Impact age at diabetes was reported to be inversely related with mortality and vascular complications by meta-analysis and systematic review [11]. Sex difference in diabetes and metabolic regulation was also reported [12]. Diabetes was reported to be triggering frailty, hospitalization and mortality even though it

was including few heterogenous studies[13] . The association between sedentary behavior and diabetes among adults was reported [14] (Italo Ribeiro Lemes et al, 2018) and their strong connection between periodontitis and type 2 diabetes mellitus was also reported by Meta-analysis [15]. It was reported that the prevalence of diabetes mellitus is consistently increasing state [16]. And the prevalence of diabetes mellitus(30≤) was 16.7% in 2020 and also reported to be continually increasing state in Korea[17] . Especially, high prevalence of prediabetes and undiagnosed patients was reported to have periodontitis among elderly [18]. And the diabetes was reported to be the major health problem among adults of China [19]. And some 70-75% coronary artery patients cause of myocardial infarction was reported to have overt diabetes of almost half of those patients [20]. Especially, in 2018, the prevalence of diabetes mellitus was reported to be 28% among elderly and 13.8% of adults in Korea. And that chewing ability was reported to be an important factor to prevent cognitive impairment [21]. Therefore, the data was analyzed to find out on the associated factors of diabetes and the relationship with oral health among Korean adults.

2. Materials and Methods

With the data of the 8th KNHANES (Korea National Health and Nutrition Examination Survey), it was analyzed on 4,183 adults (20≤) to find out the associated determinants of diabetes and the affecting role of oral health in diabetes of Korean adults (20≤) by complex-sampling-methods using multivariable logistic

regression with SPSS (ver. 21.0). Diabetes was defined as diagnosed one by a physician or health professional. Age group was divided to 3 one; 20-39, 40-64, and 65 and older one. Sedentary time was classified as less than 5 hrs. and 5 hrs. and over one. Chewing difficulty factor was divided into yes or no.

2.1. *Study-design*
Diabetes was defined as diagnosed one by a physician or health professional. Age group was divided to 3 one; 20-39, 40-64, and 65 and older one. Sedentary time was classified as less than 5 hrs. and 5 hrs. and over one. Chewing difficulty factor was divided into yes or no.

2.1.1. *Participants and data collection*
4,183 subjects aged (20≤) were chosen and national reliable data (KNHANES) were analyzed and multivariable logistic-regression analysis was used.

2.2. *statistical analysis*
With the 8th KNHANES (2020) data, it was analyzed 4183 study participants, 20 and older aged one. Statistical analysis (including multiple-logistic-regression) was used with complex-sampling-methods using SPSS statistics (ver. 21.0). P-values (p<.05) were considered as significance level.

3. Results and Discussion
Table 1. describes the general factors of study population. Among the 4183 participants, 43.0% were men, 57.0% women. The prevalence of diabetes mellitus was 13.1%. The participants who reported to have chewing difficulty were 966 (23.1%). Age group was classified into 3 one; 20-39(12.6%), 40-64(56.1%) and 65≤ year (31.3%) old group. The number of participants who reported not having spouse were 720(17.2%). Education group was divided to 4 one; Elementary (20.5%), Middle School (12.0%), High school (31.8%) and College (35.7%) graduated. The participants who reported on having sedentary time for more than 5 hours per day were 3015(72.1%). BMI group were classified into 3 one; 18 kg/m^2<, 17-24 kg/m^2, 25 kg/m^2≤. High BMI (≥25) group was 2635(63.0%).

Table 1: Socio-demographic and diabetes of study participants

Variables	N (4183)	%
Gender		
Male	1799	43.0
Female	2384	57.0
Age		
20-39	526	12.6
40-64	2348	56.1
65 over	1309	31.3
Residence		
Urban(Dong)	3295	78.8
Rural(Eup, Myeon)	888	21.2
Marital status (spouse)		
No	720	17.2
Yes	3463	82.8
Income level		
Lowest	975	23.3
Middle-low	1056	25.2
Middle-high	1072	25.6
Highest	1080	25.8
Education level		
Elementary	858	20.5
Middle	501	12.0
High	1329	31.8
College	1495	35.7
Smoking		

No	3558	85.1
Yes	625	14.9
Drinking		
No	525	12.6
Yes	3658	87.4
Physical activity		
No	1098	26.2
Yes	3085	73.8
Sedentary time		
Less than 5 hrs.	1168	27.9
Over 5 hrs.(≥5)	3015	72.1
Sleeping time (7-8hrs/day)		
No	2224	53.2
Yes	1959	46.8
Chewing difficulty		
No	3217	76.9
Yes	966	23.1
BMI		
Low(18>)	111	2.7
Normal(18-24)	1437	34.4
High(≥25)	2635	63.0
Diabetes		
No	3637	86.9
Yes	546	13.1

*Abbreviation: BMI, body mass index

Table 2. presents the relationship between diabetes mellitus and the determinant factors. The respondents of diabetes mellitus were more with significance to be female, be older, living in urban area, in low or high BMI, be in lowest education level, not having spouse, be in more alcohol drinking, be in sedentary time (5hrs.≤) and be in chewing difficulty presence.

Table 2: Prevalence of association between diabetes and the determinant factors

Variables	Diabetes		P-value
	No	Yes	
	N (%)	N (%)	
Gender			
Male	1534(42.2)	265(48.5)	0.005
Female	2103(57.8)	281(51.5)	
Age			
20-39	519(14.3)	7(1.3)	<.001
40-64	2109(58.0)	239(43.8)	
65 over	1009(27.7)	300(54.9)	
Residence			
Urban(Dong)	2877(79.1)	418(76.6)	0.178
Rural (Eup, Myeon)	760(20.9)	28(23.4)	
Marital status (spouse)			<.001
No	569(15.6)	151(27.7)	
Yes	3068(84.4)	395(72.3)	
Income level			
Lowest	827(22.8)	148(27.1)	0.166
Middle-low	924(25.4)	132(24.1)	
Middle-high	939(25.8)	133(24.4)	
Highest	947(26.0)	133(24.4)	
Education level			
Elementary	656(18.0)	202(37.0)	<.001
Middle	406(11.2)	95(17.4)	
High	1187(32.6)	142(26.0)	

College	1388(38.2)	107(19.6)	
Smoking			
No	3102(85.3)	456(83.5)	0.154
Yes	535(14.7)	90(16.5)	
Drinking			
No	423(113.6)	102(18.7)	<.001
Yes	314(88.4)	444(81.3)	
Physical activity			
No	963(26.5)	135(24.7)	0.208
Yes	2674(73.5)	411(75.3)	
Sedentary time			
Less than 5 hrs.	1038(28.5)	130(23.8)	0.012
Over 5 hrs.	2599(71.5)	416(76.2)	
Sleeping time (7-8hrs./day)			
No	1912(52.6)	312(57.1)	0.025
Yes	1725(47.4)	234(42.9)	
Chewing difficulty			
No	803(22.1)	163(29.9)	<.001
Yes	2834(77.9)	383(70.1)	
Body Mass Index (BMI)			
Low (18>)	1286(35.4)	151(27.6)	<.001
Normal (18-24)	109(3.0)	2(0.4)	
High (≥25)	2242(61.6)	393(72.0)	

*Abbreviation: BMI, body mass index

Through analyzing with multiple logistic regressions, as results, aged (65≤) group (OR 11.92; 95% CI: 5.44-26.13; p<.05) and aged (40-64) group (OR 6.61; 95% CI: 3.08-14.18; p<.05) compared to aged (20-39) group adults and elementary educational level (OR 2.13; 95% CI: 1.54-2.93; p<.05) group factors were the most affecting factors of diabetes (Table 3). Next strong factors were chewing difficulty(OR 1.50; 95% CI: 1.23-1.83; p<.05), female gender (OR 1.50; 95% CI: 1.23-1.83; p<.05), high BMI(body mass index)(OR 1.40 ; 95% CI: 1.14-1.73; p<.05), not having spouse (OR 1.39 ; 95% CI: 1.10-1.75; p<.05), and sedentary time for more than 5 hrs. (OR 1.29 ; 95% CI: 1.04-1.61; p<.05), in order.

Table 3: Associated factors of diabetes by multivariable logistic regression analysis

Variables	Diabetes		P-vale
	OR	95% CI	
Gender			
Male		Reference	
Female	1.50	1.23-1.83	<.001
Age			
20-39		Reference	
40-64	6.61	3.08-14.18	<.001
65 over	11.92	5.44-26.13	<.001
Residence			
Urban (Dong)		Reference	
Rural (Eup, Myeon)	0.95	0.76-1.20	0.679
Marital status (spouse)			
No	1.39	1.10-1.75	0.006
Yes		Reference	
Income level			
Lowest	1.03	0.78-1.36	0.832
Middle-low	0.91	0.70-1.20	0.513
Middle-high	0.91	0.70-1.20	0.509
Highest		Reference	
Education level			
Elementary	2.13	1.54-2.93	<.001
Middle	1.96	1.41-2.72	<.001
High	1.30	0.99-1.71	0.061
College		Reference	
Smoking			
No		Reference	
Yes	1.28	0.97-1.69	0.084
Drinking			
No		Reference	
Yes	0.81	0.62-1.05	0.116
Physical activity			
No	1.14	0.92-1.40	0.228
Yes		Reference	
Sedentary time			
Less than 5 hrs.		Reference	
Over 5 hrs.	1.29	1.04-1.61	0.022
Sleeping time (7-8hrs/day)			
No	1.04	0.86-1.26	0.667
Yes		Reference	
Chewing difficulty			
No		Reference	
Yes	1.50	1.23-1.83	<.001
Body Mass Index (BMI)			
Low(18>)	0.15	0.04-0.62	0.009
Normal (18-24)		Reference	
High (≥25)	1.40	1.14-1.73	0.001

*Abbreviation: BMI, body mass index
*Abbreviation: OR, odds ratio
*Abbreviation: CI, confidence interval

Ageing was found to be as the major affecting factor of diabetes and this result was being supported by the study which diabetes was significantly connected with frailty, hospitalization and mortality through meta-analysis and systemic review[22] and including another study on diabetes and ageing [23]. And this result was also supported by the study which was reported to identify the trends in prevalence and incidence of diabetes in Taiwan[24]. And this ageing factor of diabetes was especially supported by the importance of early intervention of dealing diabetes in diabetes diagnosis at younger age to prevent vascular complication and mortality through meta-analysis [25].

Lower education level was found to be major factor of diabetes and this result was supported by another study which was identified on the association between diabetes mellitus and some socioeconomic factors and that higher education may be the protective factor for diabetes and pre-diabetes [23].

Female gender, with diabetes was vulnerable to chewing in our study and this result was having in common with another study which was reported on type 2 diabetes and poor oral health among senior women [1]. In this study, female gender was also found to be affected factor by diabetes and the result was supported by the study which was reported to have being association of female and high prevalence of diabetes [23]. But this result was not consistent with the study which was reported to have higher incidence of diabetes in men for overweight and obesity [24]. And this result on gender factor of this study was also having some consistence with another study which was

identified on sex difference in diabetes susceptibility and metabolic regulation [12].

Chewing difficulty as the index of poor oral health was proved through this study as the indicator of poor oral health which was finally resulted in diabetes. This outcome between diabetes and poor oral health status was supported by another study [6]. Oral health was reported to be related with oral conditions, quality of life and malnutrition among older people [2]. And the case-control study which was reported to have identified the association between type 2 diabetes and periodontitis among adults, was also supportive of this result on oral health even if having some difference of study population and design [25]. Chewing ability, cause of stress among elderly [26] and resulted in incidents of stroke and cognitive or physical frailty among community dwelling elderly [27] , was found to have seriously importance as the major factor of diabetes in this study. And this study result on diabetes and chewing ability was also having some consensus with another study which chewing ability was closely related with hsCRP and HbAlc indicating periodontal status clinically [28] . The study on Self-reported chewing status and glycemic control among adults [29] was also supporting this study results between diabetes and chewing difficulty.

Through this study, high BMI was significantly associated with diabetes, which was having in common with the study results on the associations of body mass index, waist circumference, visceral adiposity index, body shape index of Chinese adults even though they have some difference of study design and race[30] . The result that being obese and overweight was closely associated with diabetes[31], is supporting this study results between diabetes and high BMI. This result on BMI factor of diabetes mellitus was also supported by the case-cohort study which was reported on the close relationship between obesity, unfavorable lifestyle and type 2 diabetes regardless of genetic predisposition [32].

No having spouse was proved to be the serious factor of diabetes in this study and this one was strongly supported by the study which the association of marital status such as widow/divorced was significantly related to diabetes even though the difference of study design and target population [23] . And that the study which the support of partner/spouse was reported to be beneficial in glycemic control and in avoiding associated complications [33] (Lovely Gupta et al, 2019), was also supporting this study result on partner's presence of diabetes mellitus despite of study difference in design and target population.

Long sedentary time was found out to be the major factor of diabetes mellitus and this result was supportive by the cross-sectional analysis which was reported the association between sedentary behavior and diabetes mellitus among Brazilian adults of National Health System [34]. The British Cohort study which was identified on the synergistic relationship between long sedentary time and cardio-metabolic health such as diabetes [35], was also supporting this study result on long sedentary behavior caused of diabetes mellitus. And this long sedentary time factor of diabetes was supported by the study on the close clinically connection between sedentary behavior on intra-day and glucose regulation of type 2 diabetes [36]. And this result was seem to be consistent with the study which was identified on the association of physical activity, sedentary leisure-time and type 2 diabetes by prospective study among 512000 adults of China [37]. But it was reported that moderate-to-vigorous intensity physical activity time was related with lower cardiovascular disease risk regardless of sedentary time in diabetic patients, and those results were to have some difference with this study on and those difference was regarded due to the study design and study population and so on.

Finally, this study was performed among Korean adults (20≤) and these results have limitations to generate to other countries population.

4. Conclusion

This study presents ageing, lower education level, female gender and chewing difficulty factors were the most determinants of diabetes mellitus by analyzing with the data of 8th KNHANES (Korea National Health and Nutrition Examination Survey) with 4183 Korean adults. The next remarkable factors of diabetes were high BMI, no spouse, and sedentary time (5≤) in order. Therefore, public health professionals should do preparing concrete strategies to prevent diabetes triggering dementia as well as threatening general health. Further researches may be continued to explore the basic links between diabetes and oral health.

5. Acknowledgment

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