Determinants of Arthritis and the Impact of Oral Health among Middle and Older Adults of Korea: From the 7th KNHANES (2016-2018)

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Abstract

Arthritis and oral health problems are dramatically increasing. But rare studies were existed. Our study was aimed to investigate major affecting factors of arthritis and impact of oral health. A total of 4722 participants aged 35 and older were involved in cross-sectional study with the 7th KNHANES, nationally reliable data. To find out the determinant factors of arthritis and the impact of oral health, multi-variable- logistic regression of complex- sampling- methods by SPSS was used. Arthritis was defined as doctors diagnosed one.As results of our research, the prevalence of arthritis were 31.0% of aged 65 and over group and 8.1% of 35-64 aged-group. The most major determinants of arthritis were education level, gender(female), oral health (chewing ability), including ageing among middle-older Koreans. The next determinant factors of arthritis were alcohol drinking, obesity and dietary supplements significantly. Within our knowledge, this study is the first one about determinants of arthritis and oral health. The noticeable point was high-lightening on the importance of chewing ability known as important indicator of general health and quality of life.Therefore, well specified and tailored public health interventions considered by education level, oral health, gender, ageing and enhancing and focusing on chewing ability level should be urgently prepared to manage arthritis.

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Introduction

Modifiable risk factors such as smoking, drinking, obesity, diet and sleep time are important

health behaviors well known causing of lots of chronic diseases and arthritis including osteoarthritis and rheumatoid arthritis(Hughes SL, et al, 2018; Vergis S, et al, 2018; Mears M, et al, 2019; Johansson K, et al, 2018) . And it was reported that the plausible and epidemiological association between oral health, rheumatoid arthritis and Alzheimer's disease were reported though the mechanisms were not identified with genetic and immune vulnerabilities (Olsen I,et al, 2018; Jeong SH, et al, 2018). The oral health in institutionalized

elderly was revealed as major deficits lowering of general health conditions (Brandt S, et al, 2018). And it was reported that the treatment of periodontitis was resulted in reducing the activity of rheumatoid arthritis disease (Alebooyeh N, Moghimi J, Hasani A, et al., 2018; Zhao X, Liu Z, Shu D, et al. 2018) . Chronic cigarette smoking was reported to be the cause of changing of periodontal tissue and resulted in hypersensitivity of inflammation (Antal M, Battancs E, Bocskai M, et al., 2018). Most patients of rheumatoid arthritis were reported to being present generalized gingivitis (Mohamad W M W, Jia SK, Ghazali WSW, et al., 2018). The longer time, after quitting smoking in the former- smokers, was connected to lowering periodontitis (ALHarthi SS, Natto ZS, Midle JB, et al., 2019). Menopausal status of female was reported to be related to functional disability of rheumatoid arthritis (Mollard E, Pedro S, Chakravarty E, et al., 2018). And chronic osteoarthrits was reported to be potentially related with life quality of all ageing elderly (Marks, R., 2018). Physical activity was also reported to reduce the symptoms of osteoarthritis (Knoll N, Hohl DH, Motter S, et al., 2018). Through a longitudinal study, it was reported that coffee drinking was related with lowering risk of osteo-arthritis (Chang HC, Hsieh CF, Lin YC, et al., 2018). And also, poor dietary quality was reported to be associated with inflammation of rheumatoid arthritis (Vergis S, Schiffer L, White T, et al.,2018; Bärebring L, Winkvist A, Gjertsson I, et al. 2018) and especially coffee drinking was reported to be related with lowering the risk of osteoarthritis of pre-menopausal women and men(Chang HC, Hsieh CF, Lin YC, et al., 2018). Lately, the close relationship between the rheumatoid arthritis and oral health like the periodontal diseases was reported in Korea (Jung ES, et al, 2019). But even though the vast economic burden of arthritis (Shi Q, Li KJ, Treuer T, et al. 2018) and growing its importance there were weak evidences on the association of arthritis and the impact of oral health in view of considering chewing ability. Therefore, we investigated in order to examine about the major related factors of arthritis and the impact of oral health among middle and older people of Korea. These data will provide the guidance on managing personal lifestyle of intervening public health strategies of arthritis and oral health education for the successful healthy ageing.

Materials and Methods

We used the representative national data of the 7th KOREA- NATIONAL- HEALTH And NUTRITION- EXAMINATION- SURVEY to test major determinants of arthritis including osteoarthritis and rheumatoid- arthritis and oral health status through the data of general characteristic, socio-economic and health related life-style factors. The 7th KNHANES was performed from 2016 to 2018. Stratified sampling methods of two state were used. The data were surveyed and collected by the approval with Institutional- Review- Board, Korea- Centers for Disease- Control - Prevention.

Study-population

Age and gender of health questionnaire were used as demographic characteristics. With the basis of distribution of arthritis (Hur NW, Choi CB, Uhm WS, et al.,2008), 4722 participants were divided into 35-64 and ≥65 aged group by consideration of middle and older age group.

Study-analysis

We analyzed 4722 participants aged ≥ 35 to find out the major affecting determinants of arthritis and the impact of oral health by complex sampling methods with multiple logistic regression using SPSS (ver. 21.0). The data of arthritis was used by doctor's diagnosed one. We selected as the variable of arthritis including rheumatoid arthritis and osteo-arthritis and used self-questionnaires for the prevalence of arthritis. And we used the chewing ability as the important represent variable of oral health status physiologically and psychologically. Smoking, alcohol drinking, obesity physical activity and sleep time were as health related behaviors and life-style factors. Smoking was divided into- smoking or non-smoking (included former-smokers). Obesity was classified by 3 groups: under, normal and over weighted. Physical activity was divided into as 'yes' or 'no'. Sleep time was classified into 2 groups: normal group (7-8 hrs./day) and abnormal group(< 7hrs/day, > 8hrs/day). Breakfast and coffee consumption were divided into as 'yes' or 'no'. Sedentary time was classified into as 5hrs./day, 6-10hrs./day and over 10 hrs./day. The variables of socio-economic status were education level, presence of spouse, occupation and income. The education level was divided as follows: under elementary, middle school, high school, over college. Presence of spouse was categorized as 'yes' or 'no'. Occupation was divided into as "office' and 'business owner'. Income was also classified to low, middle-low, middle-high and high by quartile. In view of psychological aspects, the variable, stress was divided into as 'yes' or 'no'. The variable of oral health status, chewing ability, was classified into 5 groups; very uncomfortable, uncomfortable, average, comfortable and very comfortable state. The significance level of statistics was .05 (p < . 05).

Results and Discussion

After inclusion and exclusion criteria applying, 4722 participants were included [Table 1]. Prevalence of arthritis was 31.0% in 65 and older aged group and 8.1% in 35-64aged group. One thirds of them (31.0%) was the prevalence of arthritis among elderly.

Table 1. Prevalence of arthritis of 35-64 and 65 and older aged group

CharacteristicDivision		Age		Total
		35~64	65 and over	
Arthritis	N0	2930(91.9)	1042(69.0)	3972(86.8)
	Yes	284(8.1)	466(31.0)	750(13.2)
	Total	3214(77.9)	1508(22.1)	4722(100.0)

[Table 2] reveals on the relationship between the arthritis and affecting factors, and oral health status according to general characteristics by X2 test. Arthritis prevalence was especially higher among lower- education group, over 65 aged group than the 35-64 aged one, no presence of spouse than having spouse and alcohol drinking group than non-alcohol drinking one in order. In view of oral health status, arthritis prevalence was much higher among lower chewing ability group and the trend was linear. The arthritis prevalence was more recorded in gender(female) than male, smoking(present) than non-smoker, obesity group than normal weight group, occupation (self-running) group than office workers, and in no physical activity(aerobic) group than physical activity(aerobic) group. While, there was no association of arthritis in the aspects of sleep time, stress, coffee consumption, sedentary life style and dietary supplements group.

Table 2. Demographic characteristics by the presence of arthritis of the middle and older participants

Characteristic	Division	Arthritis			p^a
		N0	Yes	Total	
Age	35~64	2930(91.9)	284(8.1)	3214(100.0)	< .001
	65 and over	1042(69.0)	466(31.0)	1508(100.0)	
Gender	Male	1896(95.1)	127(4.9)	2023(100.0)	< .001
	Female	2076(79.1)	623(20.9)	2699(100.0)	
Education level	≤Elementary	829(67.6)	421(32.4)	1250(100.0)	< .001
	Middle school	457(82.0)	121(18.0)	578(100.0)	
	High school	1231(91.5)	126(8.5)	1357(100.0)	
	≥ College	1425(95.6)	73(4.4)	1498(100.0)	
Presence of spouse	No	532(69.7)	263(30.3)	795(100.0)	< .001
	Yes	3276(89.5)	476(10.5)	3752(100.0)	
Occupation	Self-running	1218(84.1)	289(15.9)	1507(100.0)	< .001
	Office	2644(88.8)	394(11.2)	3038(100.0)	
Income	Low	939(83.6)	228(16.4)	1167(100.0)	.001
	Middle-low	996(87.5)	181(12.5)	1177(100.0)	
	Middle-high	997(87.4)	176(12.6)	1173(100.0)	
	High	1028(88.9)	163(11.1)	1191(100.0)	
Smoking (present)	No	1716(93.4)	153(6.6)	1869(100.0)	< .001
	Yes	2233(81.7)	589(18.3)	2822(100.0)	
Alcohol drinking	No	3496(89.0)	535(11.0)	4031(100.0)	< .001
	Yes	455(71.2)	209(28.8)	664(100.0)	
Obesity	Under	121(89.5)	15(10.5)	136(100.0)	< .001

	Normal	2440(88.5)	393(11.5)	2833(100.0)	
	Obesity	1396(83.8)	341(16.2)	1737(100.0)	
Physical activity(aerobic)	No	2250(85.0)	487(15.0)	2737(100.0)	< .001
	Yes	1692(89.2)	256(10.8)	1948(100.0)	
Sleep time	Abnormal(<7hrs., >8hrs.)	2126(86.1)	442(13.9)	2568(100.0)	.127
	Normal(7-8hrs/day)	1818(87.8)	300(12.2)	2118(100.0)	
Stress	No	3012(87.3)	534(12.7)	3546(100.0)	.124
	Yes	934(85.6)	207(14.4)	1141(100.0)	
Breakfast	No	316(90.2)	39(9.8)	355(100.0)	.032
	Yes	3059(85.6)	630(14.4)	3689(100.0)	
Coffee	No	217(87.5)	38(12.5)	255(100.0)	.658
	Yes	1403(86.2)	288(13.8)	1691(100.0)	
Sedentary time	≤ 5 hrs.	1244(87.2)	221(12.8)	1465(100.0)	.118
	6-10 hrs.	1948(87.8)	333(12.2)	2281(100.0)	
	≥11 hrs.	694(84.8)	168(15.2)	862(100.0)	
Dietary supplements	No	1700(86.7)	317(13.3)	2017(100.0)	.278
	Yes	1675(85.4)	352(14.6)	2027(100.0)	
Chewing ability	Very uncomfortable	207(74.6)	83(25.4)	290(100.0)	< .001
	Uncomfortable	755(79.2)	244(20.8)	999(100.0)	
	Average	702(86.6)	139(13.4)	841(100.0)	
	Comfortable	944(89.7)	126(10.3)	1070(100.0)	
	Very comfortable	1339(91.7)	150(8.3)	1489(100.0)	

[a] Chi-Squared-test.

[Table 3] shows association of arthritis and affected factors before adjustment. Through simple logistic regression, it was found that the strong related factors of arthritis were education level, ageing, gender(female), oral health (chewing ability), the presence of spouse, alcohol drinking and smoking in order. The next factors of arthritis were occupation, obesity, income, aerobic physical activity, sedentary time, sleep time and stress significantly.

Table 3. Related factors of arthritis and oral health status of the middle and older participants

Variable		OR	95% CI	p
Age	35~64	Reference		
	65 and over	4.563	3.904-5.335	.000
Gender	Male	Reference		
	Female	4.497	3.594-5.627	.000
Education level	≤ Elementary	9.559	7.368-12.400	.000
	Middle- school	4.850	3.514-6.695	.000
	High- school	1.963	1.488-2.590	.000
	College≤	Reference		
Presence of spouse	No	3.364	2.738-4.132	.000
	Yes	Reference		
Occupation	Self-running	1.571	1.329-1.857	.000
	Office	Reference		
Income	Low	1.485	1.175-1.876	.001
	Middle-low	1.111	0.889-1.389	.351
	Middle-high	1.141	0.931-1.398	.201
	High	Reference		
Smoking (present)	No	Reference		
	Yes	2.892	2.307-3.625	.000
Alcohol drinking	No	Reference		
	Yes	2.996	2.497-3.595	.000
Obesity	Under	.834	0.461-1.508	.034

	Obesity	1.561	1.301-1.873	.000
	Normal	Reference		
Physical activity(aerobic)	No	1.437	1.195-1.727	.000
	Yes	Reference		
Sleep time	Abnormal(<7hrs., >8hrs.)	1.250	1.038-1.506	.019
	Normal(7-8hrs/day)	Reference		
Stress	No	Reference		
	Yes	1.227	1.030-1.460	.022
Breakfast	No	.612	0.429-0.872	.007
	Yes	Reference		
Coffee	No	Reference		
	Yes	1.224	0.788-1.903	.367
Sedentary time	≤ 5 hrs.	Reference		
	6-10 hrs.	.939	0.768-1.149	.018
	≥11 hrs.	1.341	1.052-1.708	.003
Dietary supplements	No	Reference		
	Yes	1.168	0.962-1.418	.116
Chewing ability	Very uncomfortable	3.548	2.613-4.817	.000
	Uncomfortable	2.904	2.215-3.808	.000
	Average	1.766	1.373-2.273	.000
	Comfortable	1.216	0.940-1.572	.136
	Very comfortable	Reference		

[Table 4] explains the major determinants of arthritis and the impact of oral health among 35 and older participants. By multiple logistic regression showed that education level, gender (female), chewing ability, ageing, drinking, obesity and dietary supplements were statistically associated with arthritis. While smoking, presence of spouse, occupation and income had having no relations with arthritis.

Table 4. The major related factors of arthritis and the impact of oral health status of the middle and older participants

Variable		OR	95% CI	p
Age	35~64	Reference		
	65 and over	2.128	1.380-3.282	.001
Gender	Male	Reference		
	Female	2.827	1.593-5.018	.000
Education level	≤ Elementary	3.440	1.864-6.349	.000
	Middle- school	2.229	1.218-4.076	.010
	High- school	1.671	1.036-2.696	.036
	College≤	Reference		
Presence of spouse	No	1.233	0.806-1.887	.332
	Yes	Reference		
Occupation	Self-running	1.118	0.807-1.549	.501
	Office	Reference		
Income	Low	1.107	0.712-1.722	.649
	Middle-low	0.950	.619-1.460	.815
	Middle-high	1.144	0.762-1.715	.514
	High	Reference		
Smoking (present)	No	Reference		
	Yes	1.264	0.752-2.124	.374
Alcohol drinking	No	Reference		
	Yes	1.593	1.019-2.490	.041
Obesity	Under	1.465	0.567-3.782	.872

	Obesity	1.580	1.159-2.155	.004
	Normal	Reference		
Physical activity(aerobic)	No	0.773	0.554-1.078	.128
	Yes	Reference		
Sleep time	Abnormal(7hrs.>, 8hrs.<)	1.127	0.828-1.533	.445
	Normal(7-8hrs/day)	Reference		
Stress	No	Reference		
	Yes	1.116	0.797-1.565	.520
Breakfast	No	0.989	0.542-1.804	.971
	Yes	Reference		
Coffee	No	Reference		
	Yes	1.177	0.681-2.033	.557
Sedentary time	≤ 5 hrs.	Reference		
	6-10 hrs.	1.173	0.772-1.782	.648
	≥11 hrs.	1.071	0.767-1.497	.454
Dietary supplements	No	1.445	1.016-2.056	.041
	Yes	Reference		
Chewing ability	Very uncomfortable	1.798	0893-3.621	.100
	Uncomfortable	2.284	1.463-3.567	.000
	Average	1.975	1.213-3.216	.006
	Comfortable	1.733	1.080-2.780	.023
	Very comfortable	Reference		

Through our study revealed that the major determinants of arthritis were the education level, oral health (chewing ability), gender (female), and ageing in order. The next affecting determinants were alcohol drinking problems, obesity and dietary supplements. The prevalence of arthritis was 15.8%. But the prevalence of arthritis was found as lower state than we expected and the direct cause was seemed to be due to including the younger age of participants.Education level, the representative of socioeconomic status, was the strong determinant of arthritis in our study, and some of that was in common with the result of Croatia's study (Parat K, Radić M, Borić,K, et al. 2018) and their result also support the collaboration of health care professionals such as rheumatologists and oral health care associates for improving of oral health considering socio-economic status.The chewing ability, as the indicator of oral health, which was found as the important factor through our study, was also reported to be associated with having functional disability and low social capital causing of the edentulism (Pengpid S, et al, 2018) . And to keep good oral health such as treating periodontitis resulting in reducing of arthritis (Alebooyeh N, Moghimi J, Hasani A, et al., 2018; Calderaro DC, Corrêa JD, Ferreira G A, et al., 2017) was found to be as the managing and strategy of preventing arthritis. Also, it was reported that the quality of life, health and frailty were better in older people with remaining teeth of home-dwelling (Hoeksema AR, Peters LL, Raghoebar GM, et al, 2018) and it means that encouraging people to keep good status of oral

health should be accomplished by health care professionals. And the salivary flow, as the index of oral health, was reported to be showed as remarkable reduction of salivary one in early rheumatoid arthritis through observational study (Crincoli V, Anelli MG, Quercia E, et al., 2019). Oral health education also should be recommended to prevent progression in periodontitis and gingivitis disease for patients of arthritis (Mohamad W M W, Jia SK, Ghazali WSW, et al., 2018) . Especially, rheumatoid- arthritis was deeply related to tooth loss as the cause of chewing difficulty, the major determinant factor of oral health (Kim JW, Park JB, Yim HW, et al., 2018). According to current findings of Netherlands's study, in addition to common oral problems, health and quality- of- life were better among home-dwelling elderly of keeping and remaining teeth (Hoeksema AR, Peters LL, Raghoebar GM, et al., 2018) which was directly associated with chewing ability. Also, the satisfaction of oral health was achieved by treating the patients of chronic periodontitis(El Sayed N, Baeumer A, El Sayed S, et al. 2019) which was closely connected with chewing ability.Gender difference were founded as the impacting factor of arthritis in our study and it was partially supported though some of those results of the other study (Mollard E, Pedro S, Chakravarty E, et al.,2018; Rao Y, Xu X, Liu D, et al., 2918) were in common with ours.Ageing as the factor of arthritis was well known one in other studies (Pengpid S, et al, 2018) as well ours.Obesity as the relevant factor of arthritis, which had been revealed in our results, was also common with USA's study (Hughes SL, Tussing-Humphreys L, Schiffer L, et al., 2018 Vergis S, Schiffer L, White T, et al., 2018; Mears M, Tussing-Humphreys L, Cerwinske L, et al.,2019).Dietary supplements which had statistically relations with arthritis in our study, have consistency with the one of Sweden's study (Bärebring L, Winkvist A, Gjertsson I, et al., 2018). And well- balanced diet reported to be beneficial for preventing autoimmunity of rheumatoid arthritis [30]. Also, the potential link between arthritis and fiber intake (Dai Z, Zhang Y., 2018) was reported and supported those some of our study results. And it was supported that dietary intervention was reported to be very important factor in obesity related osteo-arthritis (Vergis S, Schiffer L, White T, et al., 2018).Coffee consumption, as the non-relevant factor of arthritis of our study, which have had inconsistency with the results of the Taiwanese study which was identified as lowering risk of osteoporosis in premenopausal women and men (Chang HC, Hsieh CF, Lin YC, et al., 2018) was caused of partial differences of the study sample characteristics.Smoking which was known as the factor of lowering oral health status which was changing the periodontal tissues finally leading to hypersensitivity on inflammatory challenge (Antal M, Battancs E, Bocskai M, et al.,2018), was not associated with arthritis after adjustment through our study, and those difference was caused of sample characteristics and the methods of the study. And the patient of rheumatoid arthritis with present smoking was reported to have beneficial aspects to participate

periodontal program of treatment for the status of better oral health (Beyer K, Zaura E, Brandt BW, et al., 2018).The outstanding perspectives of our research was dealing with arthritis and the oral health status in view of chewing ability which is the most key factor of general health affected physically and psychologically on successful ageing. Through our results, Government, local authorities and public health professionals of the community should urgently prepare the prevention strategies of arthritis focusing on oral health improving for the healthy ageing in Korea. And further evidence- based researches on these relationships should be continued and supported worldwide.

Conclusion

In conclusion, the determinants of arthritis and the impact of oral health were identified as education level, gender, chewing ability, ageing, alcohol drinking, obesity, dietary supplements and presence of spouse. And the prevalence of arthritis was 31.0%(over 65 aged) and 8.1%(35-64 aged group). Therefore, personalized and various education program focusing on oral health may be urgently required to prevent and to manage the arthritis in view of primary health care by government, local and community levels.

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