

한국 성인의 미충족 치과 치료와 DMFT index와의 관련성

정선영¹, 조자원¹, 정운숙², 김혜영³, 김지영⁴, 최연희², 송근배²

¹단국대학교 치과병원 예방치과, ²경북대학교 치의학전문대학원 예방치과학교실, ³강원대학교 보건과학대학 치위생학과, ⁴울산과학대학교 치위생과

Association between unmet needs for dental treatment and the DMFT index among Korean adults

Sun-Young Chung¹, Ja-Won Cho¹, Yun-Sook Jung², Hye-Young Kim³,
Ji-Young Kim⁴, Youn-Hee Choi², Keun-Bae Song²

¹Department of Preventive Dentistry, Dankook University Dental Hospital, Cheonan, ²Department of Preventive Dentistry, School of Dentistry, Kyungpook National University, Daegu, ³Department Dental Hygiene, Kangwon National University, Samcheok, ⁴Department of Dental Hygiene, Ulsan College, Ulsan, Korea

Received: October 18, 2017
Revised: December 11, 2017
Accepted: December 12, 2017

Corresponding Author: Keun-Bae Song
Department of Preventive Dentistry,
School of Dentistry, Kyungpook National
University, 2217 Dalgubeoldae-ro, Jung-gu,
Daegu 41940, Korea
Tel: +82-53-660-6870
Fax: +82-53-423-2947
E-mail: kbsong@knu.ac.kr

Objectives: Unmet needs for dental treatment are one of the potential contributing factors to poor oral health because oral health problems worsen if left untreated. This study aimed to demonstrate the prevalence of and the causes for unmet dental needs, and to evaluate the association between unmet needs for dental treatment and oral health status.

Methods: Data on 3,883 subjects aged ≥ 18 years from the Korean National Oral Health Survey 2006 were analyzed. Information regarding unmet needs for dental treatment was obtained using standardized questionnaires. Eight trained dentists examined decayed, missing, or filled teeth (DMFT). Multiple regression models were built to assess the association between unmet needs for dental treatment and the DMFT scores.

Results: The prevalence of perceived unmet needs for dental treatment was 34.7% among the adult Korean population. Economic constraints were the main cause (38.6%) for unmet dental needs. The average DMFT scores were higher in the subjects with unmet needs for dental treatment than in those without. In individuals with unmet needs for dental treatment within the past 1 year, the number of decayed teeth after adjusting for confounders was likely to be greater by 0.58 and that of missing teeth by 0.27 compared to that in their counterparts with no unmet dental needs in the past 1 year.

Conclusions: Perceived unmet needs for dental treatment were significantly associated with poor oral health status among the adult Korean population. Further studies are needed to clarify the direct and indirect effects of unmet needs for dental treatment on an individual's oral health status by investigating critical variables of the causal pathways among perceived dental needs, dental care utilization, and oral health status.

Key Words: Dental care, Dental health surveys, DMF index, Health services needs and demand, Oral health

Introduction

Although it is widely accepted that there are socioeco-

nomie inequalities in oral health status^{1,2)}, the importance of dental attendance has been emphasized since decreased utilization of dental care services and lack of access to dental

treatments have more negative consequences on oral health status than socioeconomic disadvantage itself³⁾. Dental service utilization acts as a mediator in the relationship between individual's socioeconomic status and oral health consequences⁴⁾. Interestingly, it has been suggested that determinants of health are different from determinants of health inequalities.

Dental care utilization has been associated with perceived need for dental care in a number of cross-sectional and longitudinal studies^{5,6)}. Additionally, it has been suggested that the perceived need for dental treatments plays a key role in whether people in general will seek dental care services⁷⁾. In particular, unmet dental care needs may be the main factor contributing to poor oral health since oral health problems such as dental caries or periodontal diseases will not get better, if they are not treated⁸⁾.

In previous studies, unmet needs for dental treatments were defined as the condition of being in need of dental care but unable to receive appropriate services, and several factors such as dental insurance, income, language skill and ethnicity were found to be main contributors to unmet dental care needs⁹⁻¹²⁾. The primary predictors of unmet needs for dental treatments were identified as lack of dental insurance and low income¹³⁾, and cost in accessing dental cares¹²⁾. These factors are closely related to each other and act as a barrier to achieving good oral health.

From the year of 2000, the Korean Ministry of Health and Welfare started to survey dentate status and attitudes toward oral health among the Korean population at the intervals of 3 years. Unmet dental care needs have been investigated since 2006. However, information on unmet dental care needs for the adult population was not included in the KNOHS 2010, 2012, and 2015.

Until now, several studies have considered patients' perceived dental needs to identify the potential factors leading to unmet dental care needs^{14,15)} and to assess their influences on dental care utilization¹⁶⁾ and oral health related quality of life¹⁷⁾. Few studies have evaluated the effect of patients' perceived unmet dental care needs on oral health status among the adult Korean population. Therefore, this study aimed to demonstrate the prevalence of and the reasons for unmet dental care needs, and evaluate the association between unmet needs for dental treatments and DMFT scores by using a national representative sample from the adult Korean population.

Materials and Methods

1. Study population

The KNOHS 2006 employed the stratified cluster sampling method and surveyed 15,777 persons as a representative sample of the Korean population. The sample design of the KNOHS 2006 is described in detail elsewhere¹⁸⁾. 4,546 subjects aged ≥ 18 years were selected from the dataset of the KNOHS 2006 and 3,883 records with information on unmet needs for dental treatments, the DMFT scores and participants' characteristics such as biological and socioeconomic factors, oral health-related behaviors and dental care use were finally analyzed. Eight trained dentists examined the decayed (DT), missing (MT), or filled teeth (FT) according to the World Health Organization epidemiological survey guidelines¹⁹⁾. Participants' individual characteristics were collected by using standardized questionnaires. The study protocol was approved by the Institutional Review Board of Kyungpook National University in Daegu (approval number: 2016-0068), and performed in accordance with ethical principles of the Helsinki declaration. All participants provided written informed consent.

2. Data collection

Unmet dental need were evaluated by using the following questions: "During the past 12 months, was there any time when you needed dental care but did not receive it?" and "What is the main reason why you did not receive dental care?" The following options were provided as the reasons for unmet dental needs: economic problems, living far from the dental clinic, unable to take time off from work, difficulty with mobility owing to poor health, childcare, low priority, and fear. These seven reasons for unmet dental care needs were classified into four categories: low priority, economic problems, restrictions due to personal factors (i.e., difficulty with mobility, child care, and fear), and restrictions due to social factors (i.e., lives far from the dental clinic and unable to take time off from work).

3. Statistical analyses

Data analyses were performed by using SAS 9.4 (SAS Institute Inc., Cary, NC, USA). Sample weights were used to account for the national complex sampling design. To identify the characteristics of the study population and the prevalence of and the reasons for unmet dental needs, unweighted number, weighted percent, and *P*-value were estimated from Surveyfreq procedures. The average DMFT scores and each of their components such as DT, MT, and FT depending on

the prevalence of and the reasons for unmet dental needs were estimated with weighted mean and weighted standard deviations by using Surveymeans procedures. The first null hypothesis was that oral health status will not differ subjects with unmet needs for dental treatments to those without unmet needs for dental treatments. The second null hypothesis was that oral health status will not be different according to

the reasons for unmet dental needs. To assess the association between unmet needs for dental treatments and the DMFT scores, four linear regression models were built: the model 1 presented the crude association; the model 2 was adjusted by age; the model 3 was adjusted by education and income as well as age; and the model 4 was adjusted by all confounders together such as age, education, income, daily tooth brush-

Table 1. Characteristics of subjects with or without unmet needs for dental care utilization

	Total (n=3,883)	Unmet dental needs (n=1,378)	Met dental needs (n=2,505)	P-value
Biological factor				
Age group				0.47
18-29	467 (23.0)	163 (22.5)	304 (23.2)	
30-39	925 (25.2)	339 (26.5)	586 (24.5)	
40-49	722 (21.2)	256 (21.1)	466 (21.3)	
50-59	610 (14.5)	230 (15.2)	380 (14.2)	
60-69	635 (10.0)	209 (8.8)	153 (10.6)	
≥70	524 (6.1)	181 (5.9)	343 (6.2)	
Sex				0.06
Male	1,410 (47.1)	471 (44.7)	939 (48.4)	
Female	2,473 (52.9)	907 (55.3)	1,566 (51.6)	
Socioeconomic factor				
Education (years)				0.61
None	322 (4.4)	118 (4.1)	204 (4.6)	
1-9	735 (12.0)	260 (11.9)	475 (12.1)	
10-12	1,750 (46.3)	631 (47.6)	1,119 (45.5)	
>12	1,076 (37.3)	369 (36.4)	707 (37.8)	
Monthly household income [†]				0.01*
Low	966 (18.8)	361 (19.6)	605 (18.3)	
Middle-low	971 (26.2)	368 (28.7)	603 (24.9)	
Middle-high	975 (28.8)	358 (29.9)	617 (28.2)	
High	971 (26.2)	291 (21.8)	680 (28.6)	
Residence				0.01*
Metropolis	1,545 (48.2)	542 (48.4)	1,003 (48.1)	
City	1,839 (36.6)	690 (38.9)	1,149 (35.3)	
Rural	499 (15.2)	146 (12.7)	353 (16.6)	
Oral health-related behaviors				
Frequency of tooth brushing (times/day)				0.19
0	48 (0.8)	16 (0.8)	32 (0.8)	
1	456 (10.2)	167 (10.8)	289 (9.8)	
2	1,937 (50.1)	714 (52.0)	1,223 (49.1)	
3+	1,442 (38.9)	481 (36.3)	961 (40.3)	
Experience with smoking				0.03*
Yes	729 (25.1)	279 (27.7)	450 (23.7)	
No	3,154 (74.9)	1,099 (72.3)	2,055 (76.3)	
Use of dental care service				
Recent dental checkups (years)				0.01*
<1	1,570 (40.9)	426 (31.6)	1,144 (46.0)	
1-2	830 (21.5)	341 (26.0)	489 (19.0)	
>2	1,483 (37.6)	611 (42.4)	872 (35.0)	
Purpose of the recent dental visit (n=1,445)				0.01*
Prevention	263 (20.5)	50 (14.0)	213 (23.0)	
Treatment	1,182 (79.5)	352 (96.0)	830 (77.0)	

n (%) n=unweighted number, %=weighted percent. *significant P-values.

[†]Cutoff points for low (\$1,090), middle-low (\$2,246), and middle-high (\$3,575), \$1 United States dollar=925.8 Korean Won in 2006.

ing frequency, and the time of last dental visit. The regression coefficients and *P*-values were calculated using by Surveyreg procedures.

Results

Table 1 shows the characteristics of the study population with or without unmet needs for dental treatments. The average age of the population was 42.5 years (a range, 18-91 years). The prevalence rate of unmet needs for dental treatments was 34.7% (*n*=1,378). There is a greater chance of having unmet dental care needs in all income groups except for

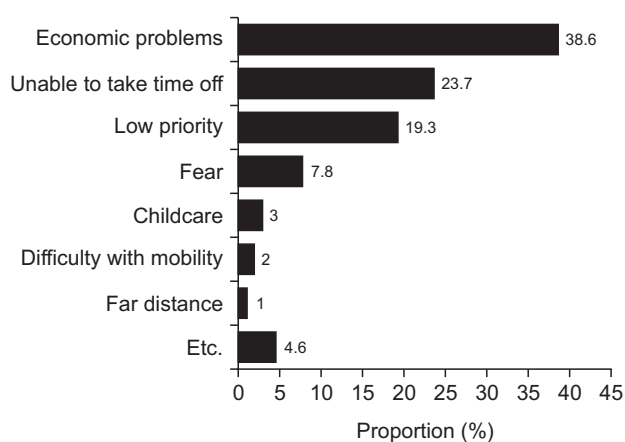


Fig. 1. The reasons for unmet dental needs (*n*=1,378; weighted percent).

the highest one ($P<0.01$). Subjects with unmet dental care needs were located in the city, yet those without unmet dental care needs were prominent in a rural area ($P<0.01$). Smokers were dissatisfied with their dental treatment needs than their counterparts ($P<0.05$). Subjects whose purpose of the recent dental visits was a treatment were more likely to have unmet needs for dental treatments ($P<0.01$) (Table 1).

The reasons for unmet dental care needs were as follows: economic problems (38.6%), the inability to take time off from work or school (23.7%), a low priority (19.3%), and fear (7.8%) (Fig. 1).

The first null hypothesis was rejected. The average DMFT scores were higher in the participants with unmet needs for dental treatments (7.57) than in those without unmet needs for dental treatments, with a marginal significance (7.17, $P=0.05$). The average number of DT was significantly higher in the group with unmet needs (1.00) than in the group without unmet needs (0.39), whereas the average number of FT was lower in the former (4.13) than in the latter (4.54, $P\leq 0.01$) (Table 2).

The proportions of subjects who reported a low priority, economic problem, restrictions due to personal factors, and restrictions due to social factors as the reasons for unmet dental needs were 20.3%, 40.3%, 26.0%, and 13.4%, respectively. The second null hypothesis was also rejected. The average DMFT scores were significantly different depending on the reasons for unmet dental needs ($P<0.01$), and subjects with

Table 2. Oral health status of the participants with or without unmet dental needs

	Total (<i>n</i> =3,883)	Unmet dental needs (<i>n</i> =1,378)	Met dental needs (<i>n</i> =2,505)	<i>P</i> -value
DMFT	7.31±0.10	7.57±0.17	7.17±0.13	0.05*
DT	0.60±0.02	1.00±0.06	0.39±0.02	<0.01*
MT	2.30±0.06	2.43±0.10	2.23±0.08	0.23
FT	4.40±0.08	4.13±0.14	4.54±0.10	0.01*

Data are presented as weighted mean±standard deviation, *significant *P*-values, DMFT, decayed, missing, or filled teeth; DT, decayed teeth; MT, missing teeth; FT, filled teeth.

Table 3. Oral health status of the study population depending on the reason for unmet dental needs

	Total (<i>n</i> =1,335)	Low priority (<i>n</i> =260)	Economic problem (<i>n</i> =621)	Restriction due to personal factors [†] (<i>n</i> =277)	Restriction due to social factors [‡] (<i>n</i> =177)	<i>P</i> -value
DMFT	7.27±0.22	6.30±0.32	9.07±0.30	6.48±0.31	7.29±0.50	<0.01*
DT	1.01±0.11	0.68±0.09	0.98±0.09	1.17±0.14	1.27±0.21	0.02*
MT	2.17±0.18	1.57±0.15	3.83±0.20	1.47±0.14	1.95±0.26	<0.01*
FT	4.09±0.30	4.04±0.29	4.25±0.23	3.84±0.27	4.06±0.42	0.73

Data are presented as weighted mean±standard deviation, *significant *P*-values, DMFT, decayed, missing, or filled teeth; DT, decayed teeth; MT, missing teeth; FT, filled teeth.

[†]Restrictions on personal factors included difficulty in mobility, childcare, and fear.

[‡]Restrictions on social factors included living far from the dental clinic and the inability to take time off from work.

Table 4. Regression coefficients for an association between unmet dental needs and the DMFT scores

	Model 1		Model 2		Model 3		Model 4	
	β (SE)	<i>P</i> -value	β (SE)	<i>P</i> -value	β (SE)	<i>P</i> -value	β (SE)	<i>P</i> -value
DMFT	0.39 (0.21)	0.07	0.42 (0.21)	0.04*	0.43 (0.21)	0.04*	0.59 (0.21)	0.01*
DT	0.61(0.06)	0.01*	0.60 (0.06)	0.01*	0.58 (0.06)	0.01*	0.58 (0.06)	0.01*
MT	0.19 (0.13)	0.14	0.24 (0.11)	0.02*	0.24 (0.10)	0.02*	0.27 (0.10)	0.01*
FT	-0.40 (0.17)	0.02*	-0.42 (0.17)	0.01*	-0.39 (0.17)	0.02*	-0.26 (0.17)	0.14

β , estimated regression coefficient; SE, standard error; *significant *P*-values, DMFT, decayed, missing, or filled teeth.

Model 1: crude association.

Model 2: adjusted for age.

Model 3: adjusted for age, education level, and income.

Model 4: adjusted for age, education level, income, the frequency of daily tooth brushing, and the timing of the recent dental visit.

an economic problem had the highest DMFT score. The number of DT was significantly higher in participants with restrictions due to social factors (1.27), yet this was lower in participants who considered dental treatment a low priority (0.68, $P<0.05$). The MT and FT scores were remarkably high in respondents who had an economic problem. However, only the MT scores were statistically significant ($P<0.01$) (Table 3).

Table 4 shows the estimated regression coefficients for the association between unmet needs for dental treatments and the DMFT scores. In the crude association, individuals with unmet needs for dental treatments were likely to have DMFT scores that were 0.39 higher than those without unmet needs for dental treatments. The former was likely to have 0.61 higher DT, 0.19 higher MT, and 0.40 lower FT scores than the latter, but the regression coefficients were only significant for the DT and FT scores (model 1). The regression coefficients of each DMFT component changed after adjusting for age; in particular, the coefficient for MT scores increased from 0.19 to 0.24 ($P<0.05$, model 2). The coefficient for FT scores also increased after controlling for the level of education and monthly income (model 3). In the final regression model that included oral health-related behaviors such as the frequency of daily tooth brushing and the timing of the most recent dental visit, subjects with unmet needs for dental treatments were likely to have 0.58 higher DT and 0.27 higher MT scores, yet they were likely to have 0.26 lower FT scores than those without unmet needs for dental treatments. After adjusting for all confounding variables, the coefficients of the components of the DMFT index increased except for DT scores. However, the coefficients were only significant for the DT, MT, and DMFT scores (model 4).

Discussion

According to previous studies, the prevalence rates of

unmet needs for dental treatments vary from about 20% to 32%^{12,13}. National studies have confirmed the various consequences of unmet dental care needs; e.g., 19% of Korean adolescents reported having unmet needs for dental treatments²⁰ and 37% of Korean adults reported having unmet needs for dental treatments²¹. Jeon et al.²¹ aimed to determine the factors affecting dental care utilization among Koreans by analyzing the National Health and Nutrition Examination Survey (2007 to 2009) (KNHANES IV). The use of a different dataset may have led to the difference in the prevalence of unmet needs for dental treatments, although both of the surveys represented the Korean national population. Results from a Tanzanian study reported that 43% of those with unmet needs for dental treatments received problem-oriented dental care⁷. Moreover, the cost of dental treatments has been identified as a barrier to obtaining health care services²². In our analyses, the prevalence of unmet needs for dental treatments was lower in the Korean population (34.7%) than in the Tanzanian population. Both studies commonly reported a disadvantaged economic status as a main reason for unmet dental needs.

The present study confirmed that the average DMFT scores were higher in subjects with unmet needs for dental treatments than in their counterparts. The main difference in the DT scores between the two groups led to a significant difference in the DMFT index. After adjusting for all confounding variables, individuals with unmet needs for dental treatments had significantly high DT and MT indexes. A longitudinal study of Hong Kong residents²³ showed that dental visitation was associated with a perceived need for dental fillings, not the baseline number of DT. Additionally, results from studies in developed and developing countries^{7,17,24-26} showed that pain relief is one of the main reasons for self-reported treatment. Consequently, limited access to oral health services are often associated with teeth being left untreated, which results in subsequent extraction of these teeth because of pain or

discomfort²⁷⁾; this is consistent with the results of the present study, which showed that the DT index was significantly different between individuals with and without unmet needs for dental treatments.

The highest MT scores were observed in individuals with economic problems, which accounted for the largest proportion of the difference in the DMFT scores according to the reason for unmet dental needs. Financial limitations limit access to health care services and contribute to health inequalities. Although people with socioeconomic disadvantages had a need for dental care, were not afraid to undergo dental treatment, and had the time to access dental treatment, they did not do so due to their economic limitations³⁾. Moreover, persons with a perceived need for dental treatment and poor oral health may avoid dental visits because they fear the cost of dental treatment, are anxious about the pain associated with treatment, or are concerned about criticism from dentists because of their poor oral condition²⁸⁾. Heft et al.¹⁴⁾ reported that those who seek only problem-oriented care and those who are unable to afford an unexpected \$500 dental bill, report a greater perceived need for care and greater current need for care. Interestingly, Baldani et al.²⁹⁾ reported that children whose caregivers responded that their child has oral health problems were likely to never have visited a dental clinic. Delayed dental care contributes to lost time, which can be important for treating natural teeth for preservation, which results in poorer oral conditions, as this was indicated by the increased MT index among people with a disadvantaged economic status in our study.

Indeed, 1,445 participants who had visited a dental clinic within 1 year responded to the question that asked about the purpose of their last dental visit (i.e., prevention or treatment). It is likely that important information needed to interpret the current results is missing since the dataset missed the remaining respondents who did not answer the question about the purpose of their last dental visit (n=2,438). Nevertheless, only 14% of 402 subjects with unmet needs for dental treatments had recently visited a dental clinic for the purpose of prevention, whereas 23% of 1,043 subjects without unmet needs for dental treatments visited a dentist for the same purpose. These results indicate that some of the study population who had experienced unmet needs for dental treatments may have regarded dental care as being necessary to receive problem-oriented treatment compared to their counterparts.

To our knowledge, this study is the first trial to focus on unmet needs for dental cares and their association on the DMFT scores by using a large national sample of Korean

adults. The main problem with this cross-sectional study was that information on individuals' perceived dental care needs collected at the time of the survey may be insufficient for explaining their oral health status. Moreover, our method of evaluating unmet dental care needs may be insufficient since only one question was used to assess this factor. Clarifying the frequency of unmet needs for dental treatments of subjects during the study period would make it possible to more accurately estimate the oral health outcomes caused by unmet needs for dental treatments. Anderson's behavioral model³⁰⁾ demonstrated that the perceived needs for dental treatment directly and indirectly affect an individual's oral health status. Thus, it is necessary to clarify the direct and indirect effects of unmet needs for dental treatments on an individual's oral health status by investigating critical variables on causal pathways among perceived dental needs, dental care utilization, and oral health status.

Further studies are needed to compensate for the limitations of this study in regard to information on unmet needs for dental treatments. The authors hope that the present method of assessing unmet needs for dental treatments may help develop questionnaires for measuring the needs for dental treatment accurately, and determine the causal effect of unmet needs for dental treatments on individuals' oral health status.

Conclusions

The prevalence of unmet needs for dental treatments was 34.7% among the adult Korean population. The primary reason for unmet dental needs was economic burden (38.6%). After controlling for all confounding factors, Individuals with unmet needs for dental treatments were likely to have 0.58 more decayed teeth and 0.27 more missing teeth than those without unmet needs for dental treatments in Korean adults. The findings of the present study indicate that unmet needs for dental treatments are significantly related to poor oral health status and unmet dental care needs can be one of the independent risk indicators for oral health status.

References

1. Locker D. Deprivation and oral health: a review. *Community Dent Oral Epidemiol* 2000;28:161-169.
2. Choi HN, Lee CH, Kim YS, Lee MG, Shin SC. Interrelation of the children's decayed tooth actual condition and social environment factor of Asian various nations. *Int J Clin Prev Dent* 2008;4:96-111.
3. Wamala S, Merlo J, Bostrom G. Inequity in access to dental care services explains current socioeconomic disparities in oral health: the Swedish National Surveys of Public Health 2004-2005. *J Epidemiol*

- Community Health 2006;60:1027-1033.
4. Donaldson AN, Everitt B, Newton T, Steele J, Sherriff M, Bower E. The effects of social class and dental attendance on oral health. *J Dent Res* 2008;87:60-64.
 5. Gilbert GH, Shelton BJ, Chavers LS, Bradford EH, Jr. The paradox of dental need in a population-based study of dentate adults. *Med Care* 2003;41:119-134.
 6. Gilbert GH, Heft MW, Duncan RP, Ringelberg ML. Perceived need for dental care in dentate older adults. *Int Dent J* 1994;44:145-152.
 7. Astrom AN, Kida IA. Perceived dental treatment need among older Tanzanian adults - a cross-sectional study. *BMC oral health* 2007;7:9.
 8. Vargas CM, Ronzio CR. Relationship between children's dental needs and dental care utilization: United States, 1988-1994. *Am J Public Health* 2002;92:1816-1821.
 9. Kim HY, Lee SW, Cho SI, Patton LL, Ku Y. Associations between missing teeth with unmet needs and socioeconomic status among South Korean dentate government employees. *J Public Health Dent* 2007;67:174-178.
 10. Lee SY, Kim CW, Kang JH, Seo NK. Unmet healthcare needs depending on employment status. *Health Policy* 2015;119:899-906.
 11. Jang Y, Yoon H, Park NS, Chiriboga DA, Kim MT. Dental care utilization and unmet dental needs in older Korean Americans. *J Aging Health* 2014;26:1047-1059.
 12. Malecki K, Wisk LE, Walsh M, McWilliams C, Eggers S, Olson M. Oral health equity and unmet dental care needs in a population-based sample: findings from the Survey of the Health of Wisconsin. *Am J Public Health* 2015;105 Suppl 3:S466-474.
 13. Calvasina P, Muntaner C, Quinonez C. Factors associated with unmet dental care needs in Canadian immigrants: an analysis of the longitudinal survey of immigrants to Canada. *BMC oral health* 2014;14:145.
 14. Heft MW, Gilbert GH, Shelton BJ, Duncan RP. Relationship of dental status, sociodemographic status, and oral symptoms to perceived need for dental care. *Community Dent Oral Epidemiol* 2003;31:351-360.
 15. Mosha HJ, Scheutz F. Perceived need and use of oral health services among adolescents and adults in Tanzania. *Community Dent Oral Epidemiol* 1993;21:129-132.
 16. Tennstedt SL, Brambilla DL, Jette AM, McGuire SM. Understanding dental service use by older adults: sociobehavioral factors vs need. *J Public Health Dent* 1994;54:211-219.
 17. Seirawan H, Sundaresan S, Mulligan R. Oral health-related quality of life and perceived dental needs in the United States. *J Public Health Dent* 2011;71:194-201.
 18. Ministry of Health & Welfare. 2006 Korean National Oral Health Survey: III. Abridgement. Seoul:Ministry of Health & Welfare;2007:6-9.
 19. World Health Organization. Oral health surveys: basic methods. 4th ed. Geneva: World Health Organization. World Health Organization;1997.
 20. Ahn E, Han J. Measure of unmet dental care needs among Korean adolescent. *J Dent Hyg Sci* 2015;15:91-97.
 21. Jeon J, Chung W, Kim N. Determinants for dental service utilization among Koreans. *J Korean Acad Oral Health* 2011;35:441-449.
 22. Sahn DE, Younger SD, Genicot G. The demand for health care services in rural Tanzania. *Oxford Bulletin of Economics and Statistics* 2003;65:241-260.
 23. Lo E, Schwarz E. Determinants for dental visit behavior among Hong Kong Chinese in a longitudinal study. *J Public Health Dent* 1998;58:220-227.
 24. Slaughter A, Taylor L. Perceptions of dental care need among African - American elders: implications for health promotion. *Spec Care Dent* 2005;25:158-163.
 25. Phommavongsa N, Senesombath S, Lim JH, Kim NY, Park WR, Na EJ, et.al. Dental survey of Vientiane city children in Laos. *Int J Clin Prev Dent* 2015;11:33-38.
 26. Yun SW, Shin SC, Chang YS, Kim HK, Sohn SJ, Kim JK, et.al. A survey of dental caries in Mongolia in 2014. *Int J Clin Prev Dent* 2014;10:165-178.
 27. Petersen PE, Bourgeois D, Ogawa H, Estupinan-Day S, Ndiaye C. The global burden of oral diseases and risks to oral health. *Bulletin of the World Health Organization* 2005;83:661-669.
 28. Muirhead V, Quinonez C, Figueiredo R, Locker D. Predictors of dental care utilization among working poor Canadians. *Community Dent Oral Epidemiol* 2009;37:199-208.
 29. Baldani MH, Mendes YB, Lawder JA, de Lara AP, Rodrigues MM, Antunes JL. Inequalities in dental services utilization among Brazilian low-income children: the role of individual determinants. *J Public Health Dent* 2011;71:46-53.
 30. Andersen RM, Davidson PL. Ethnicity, aging, and oral health outcomes: a conceptual framework. *Adv Dent Res* 1997;11:203-209.