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## Employment status and unmet dental care needs in South Korea: A population-based panel study

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4 Employment status and unmet dental care needs in South Korea: A  
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## Abstract

Objectives: This study was designed to evaluate whether employment status is associated with the experience of unmet dental care needs.

Methods: 4,620 workers were retrieved from the Korea Health Panel data (2010-2013) and potential relationships were explored among income level, employment change, and unmet dental care needs.

Results: 17.3% of 4,620 people said they had failed at least once to have a dental treatment or checkup despite the needs. Precarious workers and unemployed were more likely to experience unmet dental care needs caused by economic burden than permanent workers (OR: 1.36, 1.40, respectively). In addition, low-income group were more 4.46 times likely to experience unmet dental care needs caused by economic burden than those with the highest income.

Conclusion: This disparity means that precarious workers and unemployed are more likely to face barriers in obtaining needed health services. Given the insecure employment status of low income people, meeting their needs for health care is an important consideration.

Key Words: employment status, unmet dental care needs, income disparity

### Strengths and limitations of this study

#### 1. Strengths

- 1) This study is significant because it is the first study to examine the association of economic status on unmet dental care needs among adults in South Korea using longitudinal panel data.

#### 2. Limitations

- 1) We used self-reported questionnaires to identify subjects' experience of unmet dental care needs.
- 2) We did not control severity of dental care in our research.

## 1. Introduction

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8 Korea achieved universal health insurance coverage just 12 years after its national health  
9 insurance system was implemented <sup>1)</sup>. However, people with national health insurance still  
10 are paying rather high out-of-pocket (OOP) payments. The proportion of total medical  
11 spending financed by the public sector is only 56%, which is lower than the OECD average  
12 (73%), and is the fourth lowest OECD level of spending after Chile (46%), USA (48%), and  
13 Mexico (51%) <sup>2)</sup>. Relatively low coverage on health insurance may result in unmet needs and  
14 this phenomenon is more likely to occur in dental care which is higher than OOP payment of  
15 health care. Rate of unmet dental care needs that experience unmet needs is very high in  
16 South Korea. Previous study on unmet dental care needs in South Korea showed that  
17 response rate of unmet dental care needs 24.5% <sup>3)</sup>, Whereas study results of state of  
18 Wisconsin in US indicated that about 20.6% of total population experienced unmet dental  
19 care needs <sup>4)</sup>. In addition, Canadian study about immigrants living above 10 years in Canada  
20 showed that experience rate of unmet dental care needs 17.5% and the rate of 27 EU  
21 countries including Spain indicated 7.2% <sup>5-7)</sup>.

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31 The factors related to unmet health care needs among adults in previous studies are  
32 socioeconomic factors including income or education level and health status such as self-  
33 related health or mental health <sup>8-12)</sup>. In other words, low income or education groups are more  
34 likely to experience unmet health care needs than those with higher status. Although there are  
35 a few research of association between employment status and unmet needs, most of them  
36 examined unmet health care needs rather than dental care.

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The rate of unmet health care needs occurred by economic burden among reason of unmet  
needs was higher among temporary or day workers. There are pretty a number of unemployed  
and precarious workers in Korea. The employment rate is 64% and precarious workers which  
have been described as temporary or day worker account for 34.2% of the total waged  
workers in Korea <sup>13, 14)</sup>. Their wage is only 51.7% of that of regular workers and employment  
status of them is very insecure <sup>15)</sup>. In addition, a few people who have failed to get a regular  
job opt to begin their own business rather than to get precarious position. As a result, there  
were more men who were self-employed than men who were paid workers (66.6% vs. 59%)  
in the Korea that is more than two times compared to other countries <sup>16)</sup>. A number of self-

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4 employed people are exposed to danger of working poverty and belong to a low-income class.  
5 The income gap of them is comparatively serious compared to waged workers. There are  
6 fairly a number of unemployed, self-employed and precarious workers in Korea, and they are  
7 often expected to experience unmet needs for dental care.  
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10 This study aims to examine the impact of employment status on the experience of unmet  
11 dental care needs, using nationally representative panel data collected from 2010–2013.  
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## II. Methods

### *Data*

We utilized data from the Korea Health Panel (KHP) 3rd–6th (2010–2013 year), which is conducted by the Korea Institute for Health & Social Affairs and the National Health Insurance Corporation. The KHP is a nationally representative sample of Korean individuals and their families that include data on demographic and socioeconomic characteristics, health status, access to health care, and private health insurance status. The KHP uses a stratified multistage probability sampling design according to region and residence in order to select nationwide subjects from the 2005 Korea Census<sup>17)</sup>.

### *Study sample and design*

We excluded the 1<sup>st</sup>–2<sup>nd</sup> data of KHP (2008–2009 year) because the variable about unmet dental care needs did not be surveyed. This study included data from the 3<sup>rd</sup> wave in 2010. In the 3<sup>rd</sup> wave, 17,885 subjects completed the survey questionnaire. The baseline study subjects consisted of waged workers  $\geq 19$  years of age which did not experience unmet dental care needs. Subjects aged  $\geq 61$  years in 2010 were excluded so that all subjects in this study were  $< 65$  years old during the 3-year follow-up. After excluding subjects without follow-up or with any missing values, a total of 4,620 workers remained in this study. We defined employment status in first follow-up based on workers at baseline. If any one of workers at baseline loss his job in 2011, he is classified as unemployed. We considered change of employment status annually and examined the effect the employment status on the experience of unmet dental care needs during 2011 to 2013.

### *Dependent variable*

The dependent variable of this study is whether respondents had an unmet dental care needs or not, thus they were asked, “Have you failed to receive dental care services even if there was a need for treatment or checkup over the past one year?” Also, ‘economic burden’, ‘no time to spare’, and ‘others’ were added to result variables for those who had experienced unmet healthcare needs.

### *Independent variable*

Employment status was classified into four categories: full-time permanent, precarious, self-

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4 employed, or unemployed. The KHP classified individuals as full-time permanent workers if  
5 all four of the following conditions were satisfied: (i) they were directly hired by their  
6 employers (not subcontracted or dispatched workers or self-employed workers without  
7 employees); (ii) they were full-time workers (not part-time workers); (iii) there was no fixed  
8 term in their employment contract (not temporary workers); and (iv) there was a high  
9 probability of maintaining their current job (having relatively little job insecurity and not a  
10 day laborer). Other than full-time permanent workers, waged workers hired by their  
11 employers were classified as precarious workers. The self-employed were defined as workers  
12 who managed their own business regardless of scale or carried out professional matter on  
13 their own responsibility. For the purpose of comparability with previous East Asian studies  
14 and consideration of different classification of employment status between countries, the self-  
15 employed were treated as having a different employment status. The unemployed were  
16 defined as those who had been waged workers at baseline in 2010 but lost employment by the  
17 time of the survey.

#### 26 *Covariates*

28 In this study we used several covariates to control for demographic and socioeconomic  
29 characteristics and health status. Demographic characteristics included sex, age, marital status,  
30 and socioeconomic factors including education and income. The age groups were divided at  
31 10-year intervals for measurement. Marital status was categorized into three: 'Married,'  
32 'single,' and 'divorced or separated'. Educational levels were categorized into three: 'below  
33 elementary school,' 'middle or high school,' and 'above college'. Weighted total household  
34 income was divided into five: highest, high, middle, low, lowest. As a proxy for health status,  
35 we utilized self-rated health, stress, depression, disability, and chronic disease to control for  
36 the participant's health condition and health behavior, which can affect health care utilization.  
37 Finally, we used type of health insurance (national health insurance, medical aid) and  
38 existence of private insurance.

#### 47 *Statistical analysis*

49 The frequency with which unmet dental care needs was incurred overall after accounting  
50 for demographic, socioeconomic, and health status was determined by Chi-square test. To  
51 identify factors associated with unmet dental care needs and, in particular, to examine the  
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4 relationship between employment status and unmet dental care needs, we used the  
5 GLIMMIX procedure because subjects in our study are measured repeatedly over time. The  
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7 The odds ratio (OR) was calculated through the regression coefficient gained through the  
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9 GLIMMIX procedure and presented with a 95% confidence interval (95% CI). The SAS 9.3  
10 statistical package (Cary, NC, USA) was used for data analysis.  
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12 *Patient and Public Involvement statement*

13 Patients or Public were not involved in this study.  
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### III. Results

General characteristics at first follow-up (2011) of waged workers are shown in Table 1. 17.3% of 4,620 respondents aged between 20 and 61 said they had failed at least once to have a dental treatment or checkup despite the needs. People who have low education had a higher rate of unmet dental care needs compared to those who graduated college. Low-income group had a higher proportion of unmet dental care needs than higher income level. People who were divorced or separated had a higher rate of unmet dental care needs. People with negative self-related health and those having depression or stress were more likely to experience unmet dental care needs than those no having such diseases. People benefited from the medical aid program were more likely to experience unmet dental care needs than national health insurance. People who joined private insurance were less likely to experience unmet dental care needs than those who did not joined it. Precarious workers and self-employed were more likely to experience unmet dental care needs than full-time permanent workers. However, no significant relationship was observed between unmet dental care needs and sex, age, disability, chronic disease.

Table 2 shows self-reported reasons for unmet dental care needs according to employment status. Precarious workers and unemployed were more likely to experience unmet dental care needs caused by economic burden. Whereas, permanent workers were more likely to experience unmet dental care needs caused by no time to spare.

After applying multivariate models adjusted for several covariates, the results for factors associated with unmet dental care needs are shown in Table 3. People who did not graduate elementary school had a higher risk of unmet dental care needs compared to those who graduated college (Odds ratio (OR): 1.35, 95% CI: 1.11-1.64). Low-income group were more 1.77 times likely to experience unmet dental care needs than those with higher income. People with negative self-rated health were more 2.19 times likely to experience unmet dental care needs than positive self-related health and those having stress or depression were more likely to experience unmet dental care needs than those no having such diseases (OR: 1.90, 1.69, respectively). People who joined private insurance had a more 1.15 times likely to experience unmet dental care needs than those who did not join

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4 private insurance. Self-employed workers were more 1.18 times likely to experience unmet  
5 dental care needs than full-time permanent workers.  
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7 Table 4 shows factors associated with reason for unmet dental care needs according to  
8 employment status or income. In employment status, precarious workers and unemployed  
9 were more likely to experience unmet dental care needs caused by economic burden than  
10 permanent workers (OR: 1.36, 1.40, respectively). Whereas, precarious workers were less  
11 0.73 times likely to experience unmet dental care needs caused by no time to spare than  
12 permanent workers. In income level, low-income group were more 4.46 times likely to  
13 experience unmet dental care needs caused by economic burden than those with the highest  
14 income. Whereas, middle-income group were less 0.74 times likely to experience unmet  
15 dental care needs caused by no time to spare than the highest income class.  
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## IV. Discussion

This study showed that experience rate of unmet dental care needs among adults in South Korea is about 17.3%. This experience rate is higher 3~4 times compared to Europe countries and means relatively low access to dental care. The high experience rate results from very low health insurance coverage in dental care services. Dental care service consists of high non-insured payments which government do not support and the non-insured payments is higher than general health care services. 2010 national health insurance coverage rate is about 62.7% in South Korea (pharmacy 71.6%, clinic 65.6%, and hospital 60.5%), whereas coverage rate of dental clinic and hospital is about 35.5, 25.5%, respectively<sup>18)</sup>. In addition, the proportion of non-insured payment in OOP is about 43.2, 64.6%, respectively and this means much higher rate compared to other treatment services<sup>3)</sup>. Fortunately, Korean government implemented to insure implant treatment that was non-insured service among senior citizens and plans to expand coverage rate of younger people. Based on this benefit strengthen, we suggest consistent coverage expansion in dental care by considering characteristics of treatment items.

We examined that the factors affecting unmet dental care needs are education, income, self-rated health, depression, stress, private insurance, and employment status. Significant results of socioeconomic status including education, income level and health status such as self-rated health, depression, stress are not intended to be limited to dental care. In other words, these results are similar to previous studies using a variety of design or time<sup>19-27)</sup>.

Our research showed that people who joined private insurance had a more 1.15 times likely to experience unmet dental care needs than those who did not join private insurance. People who have higher income or education level is more likely to join private insurance and this phenomenon is similar in other countries which operate public health system with supportive private insurance<sup>28)</sup>. Although medical utilization of people joining private insurance is not higher than those uninsured by private insurance, it is possible to increase unmet needs by increasing health want. Unmet needs related to private insurance need to be examined in further study.

We examined difference of unmet dental care needs by employment status. Self-employed workers were more 1.18 times likely to experience unmet dental care needs than full-time

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4 permanent workers and this phenomenon may result from characteristics of self-employed  
5 workers in South Korea. A few people who have failed to get a regular job opt to start their  
6 own business rather than to have a non-regular position. Thus, self-employed people take up  
7 more than 30% in the labor market that is more than two times higher compared to other  
8 countries. A substantial number of self-employed people belong to a low-income class and  
9 are exposed to the danger of working poverty. The income gap of them is relatively grave  
10 compared to waged workers<sup>14</sup>.  
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12 We examined factors associated with reason for unmet dental care needs according to  
13 employment status or income. Precarious workers and unemployed were more likely to  
14 experience unmet dental care needs caused by economic burden than permanent workers and  
15 this result is similar to previous studies<sup>29,30</sup>. This phenomenon is related to the fact which  
16 monthly wage of precarious about 52.2% of full-time permanent workers. 2015 monthly  
17 wage of permanent workers is about US\$ 2,300 in South Korea, whereas the monthly wage  
18 of precarious workers is about US\$ 1,200. It is crucial issue that wage of precarious workers  
19 is lower than minimum cost of living and this disparity may affect to reduce access to dental  
20 care precarious workers as well as unemployed people. These results share context that low-  
21 income group were more 4.46 times likely to experience unmet dental care needs caused by  
22 economic burden than those with the highest income. However, unmet dental care needs  
23 caused by other reasons showed different direction of significant level. For example,  
24 precarious workers and unemployed were lower likely to experience unmet dental care needs  
25 caused by no time to spare than permanent workers. This phenomenon attributes to longer  
26 working hours of full-time permanent workers compared to precarious workers. Actually,  
27 2013 working hours of precarious workers account for about 75.5% of permanent workers.  
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29 This study is significant because it is the first study to examine the association of economic  
30 status on unmet dental care needs among adults in South Korea using longitudinal panel data.  
31 Although similar studies on this topic were conducted, all of them used cross-sectional design  
32 that possible inverse causality between employment status and unmet dental care needs are  
33 not reflected. This study's longitudinal design allows us to assess the stability and continuity  
34 of several attributes of a sample group by repeatedly observing the same participants. Another  
35 major strength of its longitudinal design is that cohort effects can be avoided because we  
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4 examined one group of individuals over time, rather than comparing several different groups  
5 that represent different ages and generations.  
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7 There were some limitations associated with our study. First, we used self-reported  
8 questionnaires to identify subjects' experience of unmet dental care needs. Nevertheless,  
9 some studies using subjective and objective methods have tended to give reasonably  
10 consistent results <sup>31</sup>). In addition, the follow-up period in the current study is relatively short  
11 compared with other studies. Second, we did not control severity of dental care in our  
12 research. Although severity of dental care including severe dental caries may affect medical  
13 access, we did not consider the factor in our model.  
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## V. Conclusions

Our research showed precarious workers and unemployed were more likely to experience unmet dental care needs caused by economic burden than full-time permanent workers. In addition, low-income group were more likely to experience unmet dental care needs caused by economic burden than those with the highest income. This disparity means that they are more likely to face barriers in obtaining needed health services. Given the insecure employment status of low income people, meeting their needs for health care is an important consideration.

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**Competing interests:** The authors declare that they have no competing interests.

**Authors' contributions:** JWC, YC, HJL, YJJ and ECP designed the study concept, wrote the protocol and collected the data. HJL and YJJ conducted the analyses. All authors helped to draft the manuscript, read and approve the final manuscript. All authors had full access to all data (including statistical reports and tables) in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis. JWC and ECP are the study guarantors.

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4 **Data sharing statement:** No additional data are available.  
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DOI: 10.1539/joh.14-0117-OA.

## 1. General characteristics at first follow-up (2011) of waged workers

Unit: N, %

Variables	Total	Unmet dental-care needs				p-value
		Yes		No		
Total	4,620	801	17.3	3,819	82.7	
Sex						0.675
Men	2,845	488	17.2	2,357	82.8	
Women	1,775	313	17.6	1,462	82.4	
Age						0.120
20–29	292	43	14.7	249	85.3	
30–39	1,034	167	16.2	867	83.8	
40–49	1,686	285	16.9	1,401	83.1	
≥50	1,608	306	19.0	1,302	81.0	
Education						<0.001
Below elementary school	346	84	24.3	262	75.7	
Middle or high school	2,231	408	18.3	1,823	81.7	
Above college	2,043	309	15.1	1,734	84.9	
Marital status						<0.001
Married	3,611	631	17.5	2,980	82.5	
Single	730	102	14.0	628	86.0	
Divorced or separated	279	68	24.4	211	75.6	
Income						<0.001
Q1 (Lowest)	204	51	25.0	153	75.0	
Q2	694	145	20.9	549	79.1	

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4	Q3	1,093	207	18.9	886	81.1	
5							
6	Q4	1,311	226	17.2	1,085	82.8	
7							
8	Q5 (Highest)	1,316	172	13.1	1,144	86.9	
9							
10	Self-rated health						<0.001
11							
12	Good	2,140	294	13.7	1,846	86.3	
13							
14	Normal	1,815	380	20.9	1,435	79.1	
15							
16	Bad	326	97	29.8	229	70.2	
17							
18							
19	Depression						<0.001
20							
21	Yes	251	88	35.1	163	64.9	
22							
23	No	4,030	683	16.9	3,347	83.1	
24							
25							
26	Stress						<0.001
27							
28	Always	363	118	32.5	245	67.5	
29							
30	Often	2,246	434	19.3	1,812	80.7	
31							
32	No	1,667	218	13.1	1,449	86.9	
33							
34	Type of health insurance						0.032
35							
36	National health insurance	4,531	778	17.2	3,753	82.8	
37							
38	Medical aid	89	23	25.8	66	74.2	
39							
40							
41	Private insurance						0.044
42							
43	Yes	3,953	659	16.7	3,294	83.3	
44							
45	No	657	132	20.1	525	79.9	
46							
47							
48	Employment status						<0.001
49							
50	Permanent	1,902	278	14.6	1,624	85.4	
51							
52	Precarious	1,221	237	19.4	984	80.6	
53							
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4	Self-employed	1,116	218	19.5	898	80.5
5						
6	Unemployed	381	68	17.8	313	82.2
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Table 2. Self-reported reasons for unmet dental-care needs according to employment status

Unit: N, %

Variable	Reason for unmet need						
	Total	Economic burden	No time to spare	Others <sup>b</sup>			
Total	801	415	51.8	209	26.1	177	22.1
Permanent	278	98	35.3	106	38.1	74	26.6
Precarious	237	158	66.7	42	17.7	37	15.6
Self-employed	218	109	50.0	56	25.7	53	24.3
Unemployed <sup>a</sup>	68	50	73.5	5	7.4	13	19.1

<sup>a</sup>Unemployed group: unemployed, student, house worker, early retirement, sickness and injuries, others.

<sup>b</sup>Others: trivial symptoms, great distance from the health care facility, reduced mobility (difficult to visit for physical reasons), no one to babysit, lack of information as to where to go, no timely appointment, absence of a primary care physician, etc.

Table 3. Factors associated with unmet dental-care needs

Variables	Unmet dental-care needs		
	Adjusted OR	95% CI	
<b>Sex</b>			
Men	1.00		
Women	0.95	0.86	1.06
<b>Age</b>			
≥50	1.00		
40–49	1.03	0.92	1.16
30–39	1.11	0.95	1.29
20–29	1.10	0.82	1.48
<b>Education</b>			
Above college	1.00		
Middle or high school	1.07	0.96	1.19
Below elementary school	1.35	1.11	1.64
<b>Marital status</b>			
Married	1.00		
Single	1.17	0.98	1.41
Divorced or separated	0.79	0.67	1.03
<b>Self-rated health</b>			
Good	1.00		
Normal	1.76	1.59	1.94
Bad	2.19	1.86	2.59



## Depression

No	1.00		
Yes	1.69	1.42	2.01

## Stress

No	1.00		
Often	1.39	1.26	1.55
Always	1.90	1.61	2.24

## Income

Q5 (Highest)	1.00		
Q4	1.20	1.05	1.38
Q3	1.33	1.16	1.52
Q2	1.51	1.29	1.76
Q1 (Lowest)	1.77	1.41	2.22

## Type of health insurance

National health insurance	1.00		
Medical aid	1.17	0.86	1.60

## Private insurance

No	1.00		
Yes	1.15	1.01	1.32

## Employment status

Permanent	1.00		
Precarious	1.11	0.98	1.26
Self-employed	1.18	1.04	1.34

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4 Unemployed 1.09 0.92 1.30  
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6 *Note.* OR, odds ratio; CI, confidence interval.  
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Table 4. Factors associated with reason for unmet dental care needs according to employment status or income

Variables	Reason for unmet need					
	Economic burden		No time to spare		Others	
	OR <sup>a</sup>	95% CI	OR <sup>a</sup>	95% CI	OR <sup>a</sup>	95% CI
<b>Employment status</b>						
Permanent	1.00		1.00		1.00	
Precarious	1.36	1.14 1.61	0.83	0.67 1.04	1.03	0.79 1.34
Self-employed	1.18	0.99 1.41	1.12	0.91 1.37	1.44	0.13 1.83
Unemployed	1.40	1.16 1.76	0.42	0.28 0.64	1.55	1.12 2.15
<b>Income</b>						
Q5 (Highest)	1.00		1.00		1.00	
Q4	2.06	1.65 2.57	0.92	0.75 1.12	0.96	0.75 1.22
Q3	2.93	2.35 3.64	0.74	0.59 0.94	0.85	0.65 1.10
Q2	3.44	2.73 4.34	0.74	0.56 0.98	0.89	0.65 1.21
Q1 (Lowest)	4.46	3.33 5.99	0.67	0.40 1.14	0.58	0.32 1.04

Note. OR, odds ratio; CI, confidence interval.

<sup>a</sup>Adjusted for age, sex, education, marital status, disability, chronic disease, depression, stress, self-rated health, type of health insurance, private insurance

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**STROBE 2007 (v4) checklist of items to be included in reports of observational studies in epidemiology\***  
**Checklist for cohort, case-control, and cross-sectional studies (combined)**

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any pre-specified hypotheses	4
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	5
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5
Bias	9	Describe any efforts to address potential sources of bias	5
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	6
		(b) Describe any methods used to examine subgroups and interactions	6
		(c) Explain how missing data were addressed	6
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed	6

		<i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	6
<b>Results</b>			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	8
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8
		(b) Report category boundaries when continuous variables were categorized	
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10-11
Generalisability	21	Discuss the generalisability (external validity) of the study results	10-11
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	13

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

# BMJ Open

## Employment status and unmet dental care needs in South Korea: A population-based panel study

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<b>Primary Subject Heading</b>:	Health services research
Secondary Subject Heading:	Occupational and environmental medicine
Keywords:	employment status, unmet dental care needs, income disparity

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4                   Employment status and unmet dental care needs in South Korea: A  
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6   population-based panel study  
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10                   Jae Woo Choi<sup>1</sup>, Young Choi<sup>2,3</sup>, Tae-Hoon Lee<sup>2,3</sup>, Hyo Jung Lee<sup>2,3</sup>, Yeong-Jun Ju<sup>2,3</sup>, Eun-Cheol Park<sup>3,4\*</sup>  
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39                   **Key Words:** employment status, unmet dental care needs, income disparity  
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41                   **Word Count:** 3,127(excluding title page, references, figures)  
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## Abstract

Objectives: This study was designed to evaluate whether employment status is associated with the experience of unmet dental care needs.

Methods: 4,620 workers were retrieved from the Korea Health Panel data (2010-2013) and potential relationships were explored among income level, employment change, and unmet dental care needs.

Results: 17.3% of 4,620 people said they had failed at least once to have a dental treatment or checkup despite the needs. Precarious workers and unemployed were more likely to experience unmet dental care needs caused by economic burden than permanent workers (OR: 1.36, 1.40, respectively). In addition, low-income group were more 4.46 times likely to experience unmet dental care needs caused by economic burden than those with the highest income.

Conclusion: This disparity means that precarious workers and unemployed are more likely to face barriers in obtaining needed health services. Given the insecure employment status of low income people, meeting their needs for health care is an important consideration.

Key Words: employment status, unmet dental care needs, income disparity

### Strengths and limitations of this study

#### 1. Strengths

- 1) This study is significant because it is the first study to examine the association of economic status on unmet dental care needs among adults in South Korea using longitudinal panel data.

#### 2. Limitations

- 1) We used self-reported questionnaires to identify subjects' experience of unmet dental care needs.
- 2) We did not control severity of dental care in our research.



## 1. Introduction

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8 Korea achieved universal health insurance coverage just 12 years after its national health  
9 insurance system was implemented <sup>1)</sup>. However, people with national health insurance still  
10 are paying rather high out-of-pocket (OOP) payments. The proportion of total medical  
11 spending financed by the public sector is only 56%, which is lower than the OECD average  
12 (73%), and is the fourth lowest OECD level of spending after Chile (46%), USA (48%), and  
13 Mexico (51%) <sup>2)</sup>. Relatively low coverage on health insurance may result in unmet needs and  
14 this phenomenon is more likely to occur in dental care which is higher than OOP payment of  
15 health care. In Korea, benefit coverage of dental health services is low due to the relatively  
16 high medical expenses incurred by non-insured payment. Although Korean government has  
17 expanded coverage expansion policy for dental service, the level of out-of-payment is very  
18 high compared to other countries.

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26 Rate of unmet dental care needs that experience unmet needs is very high in South Korea.  
27 Previous study on unmet dental care needs in South Korea showed that response rate of  
28 unmet dental care needs 24.5% <sup>3)</sup>, Whereas study results of state of Wisconsin in US  
29 indicated that about 20.6% of total population experienced unmet dental care needs <sup>4)</sup>. In  
30 addition, Canadian study about immigrants living above 10 years in Canada showed that  
31 experience rate of unmet dental care needs 17.5% and the rate of 28 EU countries including  
32 Spain indicated 7.2% <sup>5-7)</sup>.

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37 The factors related to unmet health care needs among adults in previous studies are  
38 socioeconomic factors including income or education level and health status such as self-  
39 related health or mental health <sup>8-12)</sup>. In other words, low income or education groups are more  
40 likely to experience unmet health care needs than those with higher status. Although there are  
41 a few research of association between employment status and unmet needs, most of them  
42 examined unmet health care needs rather than dental care.

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47 This study aims to examine the impact of employment status on the experience of unmet  
48 dental care needs, using nationally representative panel data collected from 2010–2013.  
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## II. Methods

### *Study Model*

This study used the Anderson social behavioral model to analyze factors that affect unmet dental care needs. This model is widely used as a model for analyzing factors affecting unmet medical care. In the Anderson model, the factors that determine the individual's behavior related to the use of medical services are largely categorized as predisposing factors, enabling factors, and need factors, and their relevance to medical use is analyzed through regression analysis. Predisposing factors consist of social structure variables (sex, age, marital status), social structural variables (education level, occupation), and health Beliefs and attitudes. Enabling factors are the resources of individuals and communities that enable the use of medical care and include variables such as income, number of household members, type of health insurance, and whether to join private health insurance. Need factors are directly related to use of health services as disease factors related to the level of individual disability or illness. It mainly includes variables such as subjective health status, presence of chronic disease, and disability. In this study, the predisposing factors were sex, age, education level, marital status, employment status. Enabling factors were income level, type of health insurance, and private insurance. Needs factors were self-rated health, depression, and stress.

### *Data*

We utilized data from the Korea Health Panel (KHP) 3rd–6th (2010–2013 year), which is conducted by the Korea Institute for Health & Social Affairs and the National Health Insurance Corporation. The KHP is a nationally representative sample of Korean individuals and their families that include data on demographic and socioeconomic characteristics, health status, access to health care, and private health insurance status. The KHP uses a stratified multistage probability sampling design according to region and residence in order to select nationwide subjects from the 2005 Korea Census<sup>13)</sup>. This study received ethical approval from the institutional review board of Yonsei University Graduate School of Public Health.

### *Study sample and design*

We excluded the 1<sup>st</sup>–2<sup>nd</sup> data of KHP (2008–2009 year) because the variable about unmet dental care needs did not be surveyed. This study included data from the 3<sup>rd</sup> wave in

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4 2010. In the 3<sup>rd</sup> wave, 17,885 subjects completed the survey questionnaire. The baseline  
5 study subjects consisted of waged workers  $\geq 19$  years of age which did not experience unmet  
6 unmet dental care needs. Subjects aged  $\geq 61$  years in 2010 were excluded so that all subjects  
7 subjects in this study were  $< 65$  years old during the 3-year follow-up. After excluding  
8 subjects without follow-up or with any missing values, a total of 4,620 workers remained in  
9 this study. We defined employment status at first follow-up based on workers at baseline. If  
10 any workers at baseline lost their job in 2011, he is classified as unemployed. We considered  
11 change of employment status annually and examined the effect the employment status on the  
12 experience of unmet dental care needs during 2011 to 2013.

### 13 *Dependent variable*

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15 The dependent variable of this study is whether respondents had an unmet dental care  
16 needs or not, thus they were asked, "Have you failed to receive dental care services even if  
17 there was a need for treatment or checkup over the past one year?" Also, 'economic burden',  
18 'no time to spare', and 'others' were added to result variables for those who had experienced  
19 unmet healthcare needs.

### 20 *Independent variable*

21  
22 Employment status was classified into four categories: full-time permanent, precarious, self-  
23 employed, or unemployed. The KHP classified individuals as full-time permanent workers if  
24 all four of the following conditions were satisfied: (i) they were directly hired by their  
25 employers (not subcontracted or dispatched workers or self-employed workers without  
26 employees); (ii) they were full-time workers (not part-time workers); (iii) there was no fixed  
27 term in their employment contract (not temporary workers); and (iv) there was a high  
28 probability of maintaining their current job (having relatively little job insecurity and not a  
29 day laborer). Other than full-time permanent workers, waged workers hired by their  
30 employers were classified as precarious workers. The self-employed were defined as workers  
31 who managed their own business regardless of scale or carried out professional matter on  
32 their own responsibility. For the purpose of comparability with previous East Asian studies  
33 and consideration of different classification of employment status between countries, the self-  
34 employed were treated as having a different employment status. The unemployed were  
35 defined as those who had been waged workers at baseline in 2010 but lost employment by the  
36 time of the survey.

### *Covariates*

In this study we used several covariates to control for demographic and socioeconomic characteristics and health status. Demographic characteristics included sex, age, marital status, and socioeconomic factors including education and income. The age groups were divided at 10-year intervals for measurement. Marital status was categorized into three: 'Married,' 'single,' and 'divorced or separated'. Educational levels were categorized into three: 'below elementary school,' 'middle or high school,' and 'above college'. Weighted total household income was divided into five: highest, high, middle, low, lowest. As a proxy for health status, we utilized self-rated health, stress, depression, disability, and chronic disease to control for the participant's health condition and health behavior, which can affect health care utilization. Finally, we used type of health insurance (national health insurance, medical aid) and existence of private insurance.

### *Statistical analysis*

The frequency with which unmet dental care needs was incurred overall after accounting for demographic, socioeconomic, and health status was determined by Chi-square test. To identify factors associated with unmet dental care needs and, in particular, to examine the relationship between employment status and unmet dental care needs, we used the GLIMMIX procedure because subjects in our study are measured repeatedly over time. The odds ratio (OR) was calculated through the regression coefficient gained through the GLIMMIX procedure and presented with a 95% confidence interval (95% CI). The SAS 9.3 statistical package (Cary, NC, USA) was used for data analysis.

### *Patient and Public Involvement statement*

Patients or Public were not involved in this study.

### III. Results

This study utilized longitudinal data which is repeatedly measured and constructed for 24,616 people in 2008. First year (2010) response rate of data utilized by in this study is 80.6% and the main reasons for decreasing response rate are death, response refusal etc. Table 1 shows General characteristics at first follow-up (2011) of waged workers. 17.3% of 4,620 respondents aged between 20 and 61 said they had failed at least once to have a dental treatment or checkup despite the needs. People who have low education, low-income group, people who were divorced, people with negative self-related health and those having depression or stress people who joined private insurance scheme, precarious workers and self-employed were more likely to experience unmet dental care needs. However, no significant relationship was observed between unmet dental care needs and sex, age, disability, chronic disease, and type of health insurance.

Table 2 shows self-reported reasons for unmet dental care needs according to employment status. Precarious workers and unemployed were more likely to experience unmet dental care needs caused by economic burden. Whereas, permanent workers and self-employed were more likely to experience unmet dental care needs caused by no time to spare.

After applying multivariate models adjusted for several covariates, the results for factors associated with unmet dental care needs are shown in Table 3. People who did not graduate elementary school had a higher risk of unmet dental care needs compared to those who graduated college (Odds ratio (OR): 1.35, 95% CI: 1.11-1.64). Low-income group were more 1.77 times likely to experience unmet dental care needs than those with higher income. People with negative self-rated health were more 2.19 times likely to experience unmet dental care needs than positive self-related health and those having stress or depression were more likely to experience unmet dental care needs than those no having such diseases (OR: 1.90, 1.69, respectively). People who joined private insurance scheme had a more 1.15 times likely to experience unmet dental care needs than those who did not join private insurance. Self-employed workers were more 1.18 times likely to experience unmet dental care needs than full-time permanent workers.

Table 4 shows factors associated with reason for unmet dental care needs according to employment status or income. In employment status, precarious workers and unemployed

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4 were more likely to experience unmet dental care needs caused by economic burden than  
5 permanent workers (OR: 1.36, 1.40, respectively). Whereas, precarious workers were less  
6 0.73 times likely to experience unmet dental care needs caused by no time to spare than  
7 permanent workers. In income level, low-income group were more 4.46 times likely to  
8 experience unmet dental care needs caused by economic burden than those with the highest  
9 income. Whereas, middle-income group were less 0.74 times likely to experience unmet  
10 dental care needs caused by no time to spare than the highest income class.  
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#### IV. Discussion

This study showed that experience rate of unmet dental care needs among adults in South Korea is about 17.3%. This experience rate is higher 3~4 times compared to Europe countries and means relatively low access to dental care. The high experience rate results from very low health insurance coverage in dental care services. Dental care service consists of high non-insured payments which government do not support and the non-insured payments is higher than general health care services. 2010 national health insurance coverage rate is about 62.7% in South Korea (pharmacy 71.6%, clinic 65.6%, and hospital 60.5%), whereas coverage rate of dental clinic and hospital is about 35.5, 25.5%, respectively<sup>14)</sup>. In addition, the proportion of non-insured payment in OOP is about 43.2, 64.6%, respectively and this means much higher rate compared to other treatment services<sup>3)</sup>. Fortunately, Korean government implemented to insure implant treatment that was non-insured service among senior citizens and plans to expand coverage rate of younger people. Based on this benefit strengthen, we suggest consistent coverage expansion in dental care by considering characteristics of treatment items.

We examined that the factors affecting unmet dental care needs are education, income, self-rated health, depression, stress, private insurance, and employment status. Especially, there is no interaction employment status and income. In other words, income and employment status independently affect unmet dental needs. Significant results of socioeconomic status including education, income level and health status such as self-rated health, depression, stress are not intended to be limited to dental care. These results are similar to previous studies using a variety of design or time<sup>15-23)</sup>.

Our research showed that people who joined private insurance scheme were 1.15 times more likely to experience unmet dental care needs than those who did not join private insurance. People who have higher income or education level is more likely to join private insurance and this phenomenon is similar in other countries which operate public health system with supportive private insurance<sup>24)</sup>. Although medical utilization of people joining private insurance is not higher than those uninsured by private insurance, it is possible to increase unmet needs by increasing health want. Unmet needs related to private insurance need to be examined in further study.

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4 We examined difference of unmet dental care needs by employment status. Self-employed  
5 workers were more 1.18 times likely to experience unmet dental care needs than full-time  
6 permanent workers and this phenomenon may result from characteristics of self-employed  
7 workers in South Korea. A few people who have failed to get a regular job opt to start their  
8 own business rather than to have a non-regular position. Self-employed people take up more  
9 than 30% in the labor market in Korea. A substantial number of self-employed people belong  
10 to a low-income class and are exposed to the danger of working poverty. The income gap of  
11 them is relatively grave compared to waged workers<sup>25</sup>.

12  
13 We examined factors associated with reason for unmet dental care needs according to  
14 employment status or income. Precarious workers and unemployed were more likely to  
15 experience unmet dental care needs caused by economic burden than permanent workers and  
16 this result is similar to previous studies<sup>26, 27</sup>. This phenomenon is related to the fact which  
17 monthly wage of precarious about 52.2% of full-time permanent workers. 2015 monthly  
18 wage of permanent workers is about US\$ 2,300 in South Korea, whereas the monthly wage  
19 of precarious workers is about US\$ 1,200. It is crucial issue that wage of precarious workers  
20 is lower than minimum cost of living and this disparity may affect to reduce access to dental  
21 care precarious workers as well as unemployed people. These results share context that low-  
22 income group were 4.46 times more likely to experience unmet dental care needs caused by  
23 economic burden than those with the highest income. However, unmet dental care needs  
24 caused by other reasons showed different direction of significant level. For example,  
25 precarious workers and unemployed were lower likely to experience unmet dental care needs  
26 caused by no time to spare than permanent workers. This phenomenon attributes to longer  
27 working hours of full-time permanent workers compared to precarious workers. Actually,  
28 2013 working hours of precarious workers account for about 75.5% of permanent workers.

29  
30 This study is significant because it is the first study to examine the association of economic  
31 status on unmet dental care needs among adults in South Korea using longitudinal panel data.  
32 Although similar studies on this topic were conducted, all of them used cross-sectional design  
33 that possible inverse causality between employment status and unmet dental care needs are  
34 not reflected. This study's longitudinal design allows us to assess the stability and continuity  
35 of several attributes of a sample group by repeatedly observing the same participants. Another  
36 major strength of its longitudinal design is that cohort effects can be avoided because we  
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4 examined one group of individuals over time, rather than comparing several different groups  
5 that represent different ages and generations.  
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7 There were some limitations associated with our study. First, we used self-reported  
8 questionnaires to identify subjects' experience of unmet dental care needs. Nevertheless,  
9 some studies using subjective and objective methods have tended to give reasonably  
10 consistent results<sup>28</sup>). In addition, the follow-up period in the current study is relatively short  
11 compared with other studies. Second, we did not control severity of patient's dental status in  
12 our research. Although severity of dental status including severe dental caries may affect  
13 medical access, we did not consider the factor in our model. Third, temporal bias could exist  
14 in this study results. Finally, definition of unemployment in this study is different with the  
15 definition of International Labor Organization (actively seeking work). But, we cannot grasp  
16 whether they actively seek job or not due to data limitation.  
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## V. Conclusions

Our research showed precarious workers and unemployed were more likely to experience unmet dental care needs caused by economic burden than full-time permanent workers. In addition, low-income group were more likely to experience unmet dental care needs caused by economic burden than those with the highest income. This disparity means that they are more likely to face barriers in obtaining needed health services. Given the insecure employment status of low income people, meeting their needs for health care is an important consideration.

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**Authors' contributions:** JWC, YC, HJL, YJJ and ECP designed the study concept, wrote the protocol and collected the data. THL, HJL and YJJ conducted the analyses. All authors helped to draft the manuscript, read and approve the final manuscript. All authors had full access to all data (including statistical reports and tables) in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis. JWC and ECP are the study guarantors.

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**Data sharing statement:** No additional data are available.

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Table 1. General characteristics at first follow-up (2011) of waged workers Unit: N, %

Variables	Total	Unmet dental-care needs				Rao-Scott chi-square (p-value)
		Yes	No			
Total	4,620	801	17.3	3,819	82.7	
Sex						0.35(0.555)
Men	2,845	488	17.2	2,357	82.8	
Women	1,775	313	17.6	1,462	82.4	
Age						4.00(0.261)
20–29	292	43	14.7	249	85.3	
30–39	1,034	167	16.2	867	83.8	
40–49	1,686	285	16.9	1,401	83.1	
≥50	1,608	306	19.0	1,302	81.0	
Education						14.67(<0.001)
Below elementary school	346	84	24.3	262	75.7	
Middle or high school	2,231	408	18.3	1,823	81.7	
Above college	2,043	309	15.1	1,734	84.9	
Marital status						9.24(0.009)
Married	3,611	631	17.5	2,980	82.5	
Single	730	102	14.0	628	86.0	
Divorced or separated	279	68	24.4	211	75.6	
Income						27.92(<0.001)
Q1 (Lowest)	204	51	25.0	153	75.0	

Q2	694	145	20.9	549	79.1
Q3	1,093	207	18.9	886	81.1
Q4	1,311	226	17.2	1,085	82.8
Q5 (Highest)	1,316	172	13.1	1,144	86.9
Self-rated health					64.09(<0.001)
Good	2,140	294	13.7	1,846	86.3
Normal	1,815	380	20.9	1,435	79.1
Bad	326	97	29.8	229	70.2
Depression					58.40(<0.001)
Yes	251	88	35.1	163	64.9
No	4,030	683	16.9	3,347	83.1
Stress					73.09(<0.001)
Always	363	118	32.5	245	67.5
Often	2,246	434	19.3	1,812	80.7
No	1,667	218	13.1	1,449	86.9
Type of health insurance					3.25(0.072)
National health insurance	4,531	778	17.2	3,753	82.8
Medical aid	89	23	25.8	66	74.2
Private insurance					4.04(0.044)
Yes	3,953	659	16.7	3,294	83.3
No	657	132	20.1	525	79.9
Employment status					14.00(0.002)
Permanent	1,902	278	14.6	1,624	85.4



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Precarious	1,221	237	19.4	984	80.6
Self-employed	1,116	218	19.5	898	80.5
Unemployed	381	68	17.8	313	82.2

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Table 2. Self-reported reasons for unmet dental-care needs according to employment status

Unit: N, %

Variable	Reason for unmet need						
	Total	Economic burden	No time to spare	Others <sup>a</sup>			
Total	4,620	415	9.0	209	4.5	177	3.8
Permanent	1,902	98	5.2	106	5.6	74	3.9
Precarious	1,221	158	12.9	42	3.4	37	3.0
Self-employed	1,116	109	9.8	56	5.0	53	4.7
Unemployed	381	50	13.1	5	1.3	13	3.4

<sup>a</sup>Others: trivial symptoms, great distance from the health care facility, reduced mobility (difficult to visit for physical reasons), no one to babysit, lack of information as to where to go, no timely appointment, absence of a primary care physician, etc.

Table 3. Factors associated with unmet dental-care needs

Variables	Unmet dental-care needs		
	Adjusted OR	95% CI	
<b>Sex</b>			
Men	1.00		
Women	0.95	0.86	1.06
<b>Age</b>			
≥50	1.00		
40–49	1.03	0.92	1.16
30–39	1.11	0.95	1.29
20–29	1.10	0.82	1.48
<b>Education</b>			
Above college	1.00		
Middle or high school	1.07	0.96	1.19
Below elementary school	1.35	1.11	1.64
<b>Marital status</b>			
Married	1.00		
Single	1.17	0.98	1.41
Divorced or separated	0.79	0.67	1.03
<b>Self-rated health</b>			
Good	1.00		
Normal	1.76	1.59	1.94
Bad	2.19	1.86	2.59

## Depression

No	1.00		
Yes	1.69	1.42	2.01

## Stress

No	1.00		
Often	1.39	1.26	1.55
Always	1.90	1.61	2.24

## Income

Q5 (Highest)	1.00		
Q4	1.20	1.05	1.38
Q3	1.33	1.16	1.52
Q2	1.51	1.29	1.76
Q1 (Lowest)	1.77	1.41	2.22

## Type of health insurance

National health insurance	1.00		
Medical aid	1.17	0.86	1.60

## Private insurance

No	1.00		
Yes	1.15	1.01	1.32

## Employment status

Permanent	1.00		
Precarious	1.11	0.98	1.26
Self-employed	1.18	1.04	1.34

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Unemployed	1.09	0.92	1.30
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*Note.* OR, odds ratio; CI, confidence interval.

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Table 4. Factors associated with reason for unmet dental care needs according to employment status or income

Variables	Reason for unmet need					
	Economic burden		No time to spare		Others	
	OR <sup>a</sup>	95% CI	OR <sup>a</sup>	95% CI	OR <sup>a</sup>	95% CI
<b>Employment status</b>						
Permanent	1.00				1.00	
Precarious	1.36	1.14 1.61	0.83	0.67 1.04	1.03	0.79 1.34
Self-employed	1.18	0.99 1.41	1.12	0.91 1.37	1.44	0.13 1.83
Unemployed	1.40	1.16 1.76	0.42	0.28 0.64	1.55	1.12 2.15
<b>Income</b>						
Q5 (Highest)	1.00				1.00	
Q4	2.06	1.65 2.57	0.92	0.75 1.12	0.96	0.75 1.22
Q3	2.93	2.35 3.64	0.74	0.59 0.94	0.85	0.65 1.10
Q2	3.44	2.73 4.34	0.74	0.56 0.98	0.89	0.65 1.21
Q1 (Lowest)	4.46	3.33 5.99	0.67	0.40 1.14	0.58	0.32 1.04

Note. OR, odds ratio; CI, confidence interval.

<sup>a</sup>Adjusted for age, sex, education, marital status, disability, chronic disease, depression, stress, self-rated health, type of health insurance, private insurance

**STROBE 2007 (v4) checklist of items to be included in reports of observational studies in epidemiology\***  
**Checklist for cohort, case-control, and cross-sectional studies (combined)**

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any pre-specified hypotheses	4
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	5
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5
Bias	9	Describe any efforts to address potential sources of bias	5
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	6
		(b) Describe any methods used to examine subgroups and interactions	6
		(c) Explain how missing data were addressed	6
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed	6

		<i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	6
<b>Results</b>			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	8
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8
		(b) Report category boundaries when continuous variables were categorized	
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10-11
Generalisability	21	Discuss the generalisability (external validity) of the study results	10-11
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	13

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).



# BMJ Open

## Employment status and unmet dental care needs in South Korea: A population-based panel study

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4 Employment status and unmet dental care needs in South Korea: A  
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6 population-based panel study  
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10 Jae Woo Choi<sup>1</sup>, Young Choi<sup>2,3</sup>, Tae-Hoon Lee<sup>2,3</sup>, Hyo Jung Lee<sup>2,3</sup>, Yeong-Jun Ju<sup>2,3</sup>, Eun-Cheol Park<sup>3,4\*</sup>

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## Abstract

Objectives: This study was designed to evaluate whether employment status is associated with the experience of unmet dental care needs.

Methods: 4,620 workers were retrieved from the Korea Health Panel data (2010-2013) and potential relationships were explored among income level, employment change, and unmet dental care needs.

Results: 17.3% of 4,620 people said they had failed at least once to have a dental treatment or checkup despite the needs. Precarious workers and unemployed were more likely to experience unmet dental care needs caused by economic burden than permanent workers (OR: 1.36, 1.40, respectively). In addition, low-income group were more 4.46 times likely to experience unmet dental care needs caused by economic burden than those with the highest income.

Conclusion: This disparity means that precarious workers and unemployed are more likely to face barriers in obtaining needed health services. Given the insecure employment status of low income people, meeting their needs for health care is an important consideration.

Key Words: employment status, unmet dental care needs, income disparity

### Strengths and limitations of this study

#### 1. Strengths

- 1) This study is significant because it is the first study to examine the association of economic status on unmet dental care needs among adults in South Korea using longitudinal panel data.

#### 2. Limitations

- 1) We used self-reported questionnaires to identify subjects' experience of unmet dental care needs.
- 2) We did not control severity of dental care in our research.

## I . Introduction

Korea achieved universal health insurance coverage just 12 years after its national health insurance system was implemented <sup>1)</sup>. However, people with national health insurance still are paying rather high out-of-pocket (OOP) payments. The proportion of total medical spending financed by the public sector is only 56%, which is lower than the OECD average (73%), and is the fourth lowest OECD level of spending after Chile (46%), USA (48%), and Mexico (51%) <sup>2)</sup>. Relatively low coverage on health insurance may result in unmet needs and this phenomenon is more likely to occur in dental care which is higher than OOP payment of health care. In Korea, benefit coverage of dental health services is low due to the relatively high medical expenses incurred by non-insured payment. Although Korean government has expanded coverage expansion policy for dental service, the level of out-of-payment is very high compared to other countries.

Rate of unmet dental care needs that experience unmet needs is very high in South Korea. Previous study on unmet dental care needs in South Korea showed that response rate of unmet dental care needs 24.5% <sup>3)</sup>, Whereas study results of state of Wisconsin in US indicated that about 20.6% of total population experienced unmet dental care needs <sup>4)</sup>. In addition, Canadian study about immigrants living above 10 years in Canada showed that experience rate of unmet dental care needs 17.5% and the rate of 28 EU countries including Spain indicated 7.2% <sup>5-7)</sup>.

The factors related to unmet health care needs among adults in previous studies are socioeconomic factors including income or education level and health status such as self-related health or mental health <sup>8-12)</sup>. In other words, low income or education groups are more likely to experience unmet health care needs than those with higher status. Although there are a few research of association between employment status and unmet needs, most of them examined unmet health care needs rather than dental care.

This study aims to examine the impact of employment status on the experience of unmet dental care needs, using nationally representative panel data collected from 2010–2013.

## II . Methods

### *Study Model*

This study used the Anderson social behavioral model to analyze factors that affect unmet dental care needs. This model is widely used as a model for analyzing factors affecting unmet medical care. In the Anderson model, the factors that determine the individual's behavior related to the use of medical services are largely categorized as predisposing factors, enabling factors, and need factors, and their relevance to medical use is analyzed through regression analysis. Predisposing factors consist of social structure variables (sex, age, marital status), social structural variables (education level, occupation), and health Beliefs and attitudes. Enabling factors are the resources of individuals and communities that enable the use of medical care and include variables such as income, number of household members, type of health insurance, and whether to join private health insurance. Need factors are directly related to use of health services as disease factors related to the level of individual disability or illness. It mainly includes variables such as subjective health status, presence of chronic disease, and disability. In this study, the predisposing factors were sex, age, education level, marital status, employment status. Enabling factors were income level, type of health insurance, and private insurance. Needs factors were self-rated health, depression, and stress.

### *Data*

We utilized data from the Korea Health Panel (KHP) 3rd–6th (2010–2013 year), which is conducted by the Korea Institute for Health & Social Affairs and the National Health Insurance Corporation. The KHP is a nationally representative sample of Korean individuals and their families that include data on demographic and socioeconomic characteristics, health status, access to health care, and private health insurance status. The KHP uses a stratified multistage probability sampling design according to region and residence in order to select nationwide subjects from the 2005 Korea Census<sup>13)</sup>. This study received ethical approval from the institutional review board of Yonsei University Graduate School of Public Health.

### *Study sample and design*

We excluded the 1<sup>st</sup>–2<sup>nd</sup> data of KHP (2008–2009 year) because the variable about unmet dental care needs was not included in the survey. This study included data from the 4<sup>th</sup> wave

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4 in 2011. In the 4<sup>th</sup> wave (2011), 17,035 subjects completed the survey questionnaire. The  
5 study subjects consisted of waged workers  $\geq 19$  years of age and excluded those who did  
6 experience unmet dental care needs in 3<sup>rd</sup> wave (2010). Subjects aged  $\geq 62$  years in 2011 were  
7 excluded so that all subjects in this study were  $< 65$  years old during the 3-year follow-up.  
8 After excluding subjects without follow-up or with any missing values, a total of 4,620  
9 workers remained in this study. We defined employment status at baseline (2011) and if any  
10 workers in 2010 lost their jobs in baseline, they are classified as unemployed. We considered  
11 change of employment status annually and examined the effect the employment status on the  
12 experience of unmet dental care needs during 2011 to 2013.

### 13 *Dependent variable*

14 The dependent variable of this study is whether respondents had an unmet dental care  
15 needs or not, thus they were asked, "Have you failed to receive dental care services even if  
16 there was a need for treatment or checkup over the past one year?" Also, 'economic burden',  
17 'no time to spare', and 'others' were added to result variables for those who had experienced  
18 unmet healthcare needs.

### 19 *Independent variable*

20 Employment status was classified into four categories: full-time permanent, precarious, self-  
21 employed, or unemployed. The KHP classified individuals as full-time permanent workers if  
22 all four of the following conditions were satisfied: (i) they were directly hired by their  
23 employers (not subcontracted or dispatched workers or self-employed workers without  
24 employees); (ii) they were full-time workers (not part-time workers); (iii) there was no fixed  
25 term in their employment contract (not temporary workers); and (iv) there was a high  
26 probability of maintaining their current job (having relatively little job insecurity and not a  
27 day laborer). Other than full-time permanent workers, waged workers hired by their  
28 employers were classified as precarious workers. The self-employed were defined as workers  
29 who managed their own business regardless of scale or carried out professional matter on  
30 their own responsibility. For the purpose of comparability with previous East Asian studies  
31 and consideration of different classification of employment status between countries, the self-  
32 employed were treated as having a different employment status. The unemployed were  
33 defined as those who had been waged workers at baseline in 2010 but lost employment by the  
34 time of the survey.

### *Covariates*

In this study we used several covariates to control for demographic and socioeconomic characteristics and health status. Demographic characteristics included sex, age, marital status, and socioeconomic factors including education and income. The age groups were divided at 10-year intervals for measurement. Marital status was categorized into three: 'Married,' 'single,' and 'divorced or separated'. Educational levels were categorized into three: 'below elementary school,' 'middle or high school,' and 'above college'. Weighted total household income was divided into five: highest, high, middle, low, lowest. As a proxy for health status, we utilized self-rated health, stress, depression, disability, and chronic disease to control for the participant's health condition and health behavior, which can affect health care utilization. Finally, we used type of health insurance (national health insurance, medical aid) and existence of private insurance.

### *Statistical analysis*

The frequency with which unmet dental care needs was incurred overall after accounting for demographic, socioeconomic, and health status was determined by Rao-Scott Chi-square test. To identify factors associated with unmet dental care needs and, in particular, to examine the relationship between employment status and unmet dental care needs, we used the GLIMMIX procedure because subjects in our study are measured repeatedly over time. The odds ratio (OR) was calculated through the regression coefficient gained through the GLIMMIX procedure and presented with a 95% confidence interval (95% CI). The SAS 9.3 statistical package (Cary, NC, USA) was used for data analysis.

### *Patient and Public Involvement statement*

Patients or Public were not involved in this study.

### III. Results

This study utilized longitudinal data which is repeatedly measured and constructed for 24,616 people in 2008. First year (2010) response rate of data utilized by in this study is 80.6% and the main reasons for decreasing response rate are death, response refusal etc. Table 1 shows General characteristics at first follow-up (2011) of waged workers. 17.3% of 4,620 respondents aged between 20 and 61 said they had failed at least once to have a dental treatment or checkup despite the needs. People who have low education, low-income group, people who were divorced, people with negative self-related health and those having depression or stress people who joined private insurance scheme, precarious workers and self-employed were more likely to experience unmet dental care needs. However, no significant relationship was observed between unmet dental care needs and sex, age, disability, chronic disease, and type of health insurance.

Table 2 shows self-reported reasons for unmet dental care needs according to employment status. Precarious workers and unemployed were more likely to experience unmet dental care needs caused by economic burden. Whereas, permanent workers and self-employed were more likely to experience unmet dental care needs caused by having no time to spare.

After applying multivariate models adjusted for several covariates, the results for factors associated with unmet dental care needs are shown in Table 3. People who did not graduate elementary school had a higher risk of unmet dental care needs compared to those who graduated college (Odds ratio (OR): 1.35, 95% CI: 1.11-1.64). Low-income group were more 1.77 times likely to experience unmet dental care needs than those with higher income. People with negative self-rated health were more 2.19 times likely to experience unmet dental care needs than positive self-related health and those having stress or depression were more likely to experience unmet dental care needs than those no having such diseases (OR: 1.90, 1.69, respectively). People who joined private insurance scheme were 1.15 times more likely to experience unmet dental care needs than those who did not join private insurance. Self-employed workers were more 1.18 times likely to experience unmet dental care needs than full-time permanent workers.



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4 Table 4 shows factors associated with reason for unmet dental care needs according to  
5 employment status or income. In employment status, precarious workers and unemployed  
6 were more likely to experience unmet dental care needs caused by economic burden than  
7 permanent workers (OR: 1.36, 1.40, respectively). Whereas, precarious workers were 0.73  
8 times likely to experience unmet dental care needs caused by having no time to spare than  
9 permanent workers. In income level, low-income group were 4.46 times more likely to  
10 experience unmet dental care needs caused by economic burden than those with the highest  
11 income. Whereas, middle-income group were 0.74 times likely to experience unmet dental  
12 care needs caused by having no time to spare than the highest income class.  
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## IV. Discussion

This study showed that the rate of unmet dental care needs experienced by adults in South Korea is about 17.3%. This rate is higher 3~4 times compared to Europe countries and means relatively low access to dental care. The high rate results from very low health insurance coverage in dental care services. The non-insured payments which government does not support of dental care services is higher than general health care services. 2010 national health insurance coverage rate is about 62.7% in South Korea (pharmacy 71.6%, clinic 65.6%, and hospital 60.5%), whereas coverage rates of dental clinics and hospitals are about 35.5, 25.5%, respectively <sup>14)</sup>. In addition, the proportion of non-insured payment (numerator) in OOP (denominator) is about 43.2, 64.6%, respectively and this indicates a much higher rate compared to other treatment services <sup>3)</sup>. Fortunately, the Korean government has implemented a policy to insure implant treatments, which were previously not insured among senior citizens and plans to expand coverage rate of younger people. Based on this strengthening of benefit, we suggest consistent coverage expansion in dental care by considering characteristics of treatment items.

We identified the factors affecting unmet dental care needs to be education, income, self-rated health, depression, stress, private insurance, and employment status. In particular, there is no interaction between employment status and income. In other words, income and employment status independently affect unmet dental needs. The significant results linking socioeconomic status - including education and income level - to health status indicators - such as self-rated health, depression, stress - are not confined to dental care outcomes. These results are similar to previous studies using a variety of design or time <sup>15-23)</sup>.

Our research showed that people who joined private insurance scheme were 1.15 times more likely to experience unmet dental care needs than those who did not join private insurance. People who have higher levels of income or education are more likely to join private insurance and this phenomenon is similar in other countries which operate public health care system with supportive private insurance <sup>24)</sup>. Although medical utilization of people joining private insurance is not higher than those uninsured by private insurance, it is possible to increase unmet needs by relative high want for health. Unmet needs related to private

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4 insurance need to be examined in further study.

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6 We examined difference of unmet dental care needs by employment status. Self-employed  
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8 workers were more 1.18 times likely to experience unmet dental care needs than full-time  
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10 permanent workers and this phenomenon may result from characteristics of self-employed  
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12 workers in South Korea. A few people who have failed to get a regular job opt to start their  
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14 own business rather than to have a non-regular position. Self-employed people comprise  
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16 more than 30% of the labor market in Korea. A substantial number of self-employed people  
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18 belong to a low-income class and are exposed to the danger of working poverty <sup>25</sup>).

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20 We examined factors associated with reason for unmet dental care needs according to  
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22 employment status or income. Precarious workers and unemployed were more likely to  
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24 experience unmet dental care needs caused by economic burden than permanent workers and  
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26 this result is similar to previous studies <sup>26, 27</sup>). This phenomenon is related to the fact that the  
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28 monthly wages of precarious workers are about 52.2% of full-time permanent workers. In  
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30 2015, the average monthly wage of permanent workers was about US\$ 2,300 in South Korea,  
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32 whereas the monthly wage of precarious workers is about US\$ 1,200. It is a crucial issue is  
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34 that the average wage of precarious workers is lower than minimum cost of living and this  
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36 disparity may have the effect of reducing access to dental care by precarious workers as well  
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38 as unemployed people. A similar issue is that the low-income group was 4.46 times more  
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40 likely to experience unmet dental care needs caused by economic burden than those with the  
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42 highest income. However, unmet dental care needs caused by other reasons were also  
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44 significant, but in the opposite direction. For example, precarious workers and unemployed  
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46 were less likely to experience unmet dental care needs caused by having no time to spare than  
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48 permanent workers. This phenomenon may be attributable to their longer working hours of  
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50 full-time permanent workers compared to precarious workers. In fact, the average working  
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52 hours of precarious workers in 2013 were about 75.5% of those of permanent workers.

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54 This study is significant because it is the first study to examine the association of economic  
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56 status on unmet dental care needs among adults in South Korea using longitudinal panel data.  
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58 Although similar studies on this topic were conducted, all of them used cross-sectional design  
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60 that possible inverse causality between employment status and unmet dental care needs are  
not reflected. This study's longitudinal design allows us to assess the stability and continuity  
of several attributes of a sample group by repeatedly observing the same participants.

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4 Another major strength of its longitudinal design is that cohort effects can be avoided because  
5 we examined one group of individuals over time, rather than comparing several different  
6 groups that represent different ages and generations.  
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9 There were some limitations associated with our study. First, we used self-reported  
10 questionnaires to identify subjects' experience of unmet dental care needs. Nevertheless,  
11 some studies using subjective and objective methods have tended to give reasonably  
12 consistent results <sup>28</sup>). In addition, the follow-up period in the current study is relatively short  
13 compared with other studies. Second, we did not control severity of patient's dental status in  
14 our research. Although severity of dental status including severe dental caries may affect  
15 medical access, we did not consider the factor in our model. Third, temporal bias could exist  
16 in this study results. Finally, the definition of unemployment in this paper differs from that of  
17 the International Labour Organization (actively seeking work). But, the questions in the  
18 survey used do not separately identify those who are actively seeking work. Also,  
19 unemployed group in this study may include retirees, student, permanently sick and others  
20 not normally considered as part of the unemployed. But, we cannot grasp the information due  
21 to data limitation.  
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## V. Conclusions

Our research showed precarious workers and unemployed were more likely to experience unmet dental care needs caused by economic burden than full-time permanent workers. In addition, low-income group were more likely to experience unmet dental care needs caused by economic burden than those with the highest income. This disparity means that they are more likely to face barriers in obtaining needed health services. Given the insecure employment status of low income people, meeting their needs for health care is an important consideration.

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**Competing interests:** The authors declare that they have no competing interests.

**Authors' contributions:** JWC, YC, HJL, YJJ and ECP designed the study concept, wrote the protocol and collected the data. THL, HJL and YJJ conducted the analyses. All authors helped to draft the manuscript, read and approve the final manuscript. All authors had full access to all data (including statistical reports and tables) in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis. JWC and ECP are the study guarantors.

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**Data sharing statement:** No additional data are available.

For peer review only

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Table 1. General characteristics at first follow-up (2011) of waged workers Unit: N, %

Variables	Total	Unmet dental-care needs		Rao-Scott	
		Yes	No	chi-square (p-value)	
Total	4,620	801	17.3	3,819	82.7
Sex					0.35(0.555)
Men	2,845	488	17.2	2,357	82.8
Women	1,775	313	17.6	1,462	82.4
Age					4.00(0.261)
20–29	292	43	14.7	249	85.3
30–39	1,034	167	16.2	867	83.8
40–49	1,686	285	16.9	1,401	83.1
≥50	1,608	306	19.0	1,302	81.0
Education					14.67(<0.001)
Below elementary school	346	84	24.3	262	75.7
Middle or high school	2,231	408	18.3	1,823	81.7
Above college	2,043	309	15.1	1,734	84.9
Marital status					9.24(0.009)
Married	3,611	631	17.5	2,980	82.5
Single	730	102	14.0	628	86.0
Divorced or separated	279	68	24.4	211	75.6
Income					27.92(<0.001)
Q1 (Lowest)	204	51	25.0	153	75.0

Q2	694	145	20.9	549	79.1
Q3	1,093	207	18.9	886	81.1
Q4	1,311	226	17.2	1,085	82.8
Q5 (Highest)	1,316	172	13.1	1,144	86.9
Self-rated health					64.09(<0.001)
Good	2,140	294	13.7	1,846	86.3
Normal	1,815	380	20.9	1,435	79.1
Bad	326	97	29.8	229	70.2
Depression					58.40(<0.001)
Yes	251	88	35.1	163	64.9
No	4,030	683	16.9	3,347	83.1
Stress					73.09(<0.001)
Always	363	118	32.5	245	67.5
Often	2,246	434	19.3	1,812	80.7
No	1,667	218	13.1	1,449	86.9
Type of health insurance					3.25(0.072)
National health insurance	4,531	778	17.2	3,753	82.8
Medical aid	89	23	25.8	66	74.2
Private insurance					4.04(0.044)
Yes	3,953	659	16.7	3,294	83.3
No	657	132	20.1	525	79.9
Employment status					14.00(0.002)
Permanent	1,902	278	14.6	1,624	85.4

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4	Precarious	1,221	237	19.4	984	80.6
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6	Self-employed	1,116	218	19.5	898	80.5
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9	Unemployed	381	68	17.8	313	82.2
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Table 2. Self-reported reasons for unmet dental-care needs according to employment status

Unit: N, %

Variable	Reason for unmet need						
	Total	Economic burden	No time to spare	Others <sup>a</sup>			
Total	4,620	415	9.0	209	4.5	177	3.8
Permanent	1,902	98	5.2	106	5.6	74	3.9
Precarious	1,221	158	12.9	42	3.4	37	3.0
Self-employed	1,116	109	9.8	56	5.0	53	4.7
Unemployed	381	50	13.1	5	1.3	13	3.4

<sup>a</sup>Others: trivial symptoms, great distance from the health care facility, reduced mobility (difficult to visit for physical reasons), no one to babysit, lack of information as to where to go, no timely appointment, absence of a primary care physician, etc.

Table 3. Factors associated with unmet dental-care needs

Variables	Unmet dental-care needs		
	Adjusted OR	95% CI	
<b>Sex</b>			
Men	1.00		
Women	0.95	0.86	1.06
<b>Age</b>			
≥50	1.00		
40–49	1.03	0.92	1.16
30–39	1.11	0.95	1.29
20–29	1.10	0.82	1.48
<b>Education</b>			
Above college	1.00		
Middle or high school	1.07	0.96	1.19
Below elementary school	1.35	1.11	1.64
<b>Marital status</b>			
Married	1.00		
Single	1.17	0.98	1.41
Divorced or separated	0.79	0.67	1.03
<b>Self-rated health</b>			
Good	1.00		
Normal	1.76	1.59	1.94
Bad	2.19	1.86	2.59

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4 Depression

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7 No 1.00  
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9 Yes 1.69 1.42 2.01

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11 Stress

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13 No 1.00  
14  
15 Often 1.39 1.26 1.55  
16  
17 Always 1.90 1.61 2.24

18  
19  
20 Income

21  
22  
23 Q5 (Highest) 1.00  
24  
25 Q4 1.20 1.05 1.38  
26  
27 Q3 1.33 1.16 1.52  
28  
29 Q2 1.51 1.29 1.76  
30  
31 Q1 (Lowest) 1.77 1.41 2.22

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34 Type of health insurance

35  
36 National health insurance 1.00  
37  
38 Medical aid 1.17 0.86 1.60

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50 Permanent 1.00  
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4	Unemployed	1.09	0.92	1.30
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7 *Note.* OR, odds ratio; CI, confidence interval.

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Table 4. Factors associated with reason for unmet dental care needs according to employment status or income

Variables	Reason for unmet need								
	Economic burden			No time to spare			Others		
	OR <sup>a</sup>	95% CI		OR <sup>a</sup>	95% CI		OR <sup>a</sup>	95% CI	
Employment status									
Permanent	1.00			1.00			1.00		
Precarious	1.36	1.14	1.61	0.83	0.67	1.04	1.03	0.79	1.34
Self-employed	1.18	0.99	1.41	1.12	0.91	1.37	1.44	0.13	1.83
Unemployed	1.40	1.16	1.76	0.42	0.28	0.64	1.55	1.12	2.15
Income									
Q5 (Highest)	1.00			1.00			1.00		
Q4	2.06	1.65	2.57	0.92	0.75	1.12	0.96	0.75	1.22
Q3	2.93	2.35	3.64	0.74	0.59	0.94	0.85	0.65	1.10
Q2	3.44	2.73	4.34	0.74	0.56	0.98	0.89	0.65	1.21
Q1 (Lowest)	4.46	3.33	5.99	0.67	0.40	1.14	0.58	0.32	1.04

Note. OR, odds ratio; CI, confidence interval.

<sup>a</sup>Adjusted for age, sex, education, marital status, disability, chronic disease, depression, stress, self-rated health, type of health insurance, private insurance

**STROBE 2007 (v4) checklist of items to be included in reports of observational studies in epidemiology\***  
**Checklist for cohort, case-control, and cross-sectional studies (combined)**

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any pre-specified hypotheses	4
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	5
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5
Bias	9	Describe any efforts to address potential sources of bias	5
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	6
		(b) Describe any methods used to examine subgroups and interactions	6
		(c) Explain how missing data were addressed	6
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed	6

		<i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	6
<b>Results</b>			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	8
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8
		(b) Report category boundaries when continuous variables were categorized	
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10-11
Generalisability	21	Discuss the generalisability (external validity) of the study results	10-11
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	13

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

# BMJ Open

## Employment status and unmet dental care needs in South Korea: A population-based panel study

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<b>Primary Subject Heading</b>:	Health services research
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Keywords:	employment status, unmet dental care needs, income disparity

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Manuscripts

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10 Jae Woo Choi<sup>1</sup>, Young Choi<sup>2,3</sup>, Tae-Hoon Lee<sup>2,3</sup>, Hyo Jung Lee<sup>2,3</sup>, Yeong-Jun Ju<sup>2,3</sup>, Eun-Cheol Park<sup>3,4\*</sup>

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44 **Key Words:** employment status, unmet dental care needs, income disparity  
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## Abstract

Objectives: This study was designed to evaluate whether employment status is associated with the experience of unmet dental care needs.

Methods: 4,620 workers were retrieved from the Korea Health Panel data (2010-2013) and potential relationships were explored among income level, employment change, and unmet dental care needs.

Results: 17.3% of 4,620 people said they had failed at least once to have a dental treatment or checkup despite the needs. Precarious workers and unemployed were more likely to experience unmet dental care needs caused by economic burden than permanent workers (OR: 1.36, 1.40, respectively). In addition, low-income group were more 4.46 times likely to experience unmet dental care needs caused by economic burden than those with the highest income.

Conclusion: This disparity means that precarious workers and unemployed are more likely to face barriers in obtaining needed health services. Given the insecure employment status of low income people, meeting their needs for health care is an important consideration.

Key Words: employment status, unmet dental care needs, income disparity

### Strengths and limitations of this study

#### 1. Strengths

- 1) This study is significant because it is the first study to examine the association of economic status on unmet dental care needs among adults in South Korea using longitudinal panel data.

#### 2. Limitations

- 1) We used self-reported questionnaires to identify subjects' experience of unmet dental care needs.
- 2) We did not control severity of dental care in our research.

## I . Introduction

Korea achieved universal health insurance coverage just 12 years after its national health insurance system was implemented <sup>1)</sup>. However, people with national health insurance still are paying rather high out-of-pocket (OOP) payments. The proportion of total medical spending financed by the public sector is only 56%, which is lower than the OECD average (73%), and is the fourth lowest OECD level of spending after Chile (46%), USA (48%), and Mexico (51%) <sup>2)</sup>. Relatively low coverage on health insurance may result in unmet needs and this phenomenon is more likely to occur in dental care which is higher than OOP payment of health care. In Korea, benefit coverage of dental health services is low due to the relatively high medical expenses incurred by non-insured payment. Although Korean government has expanded coverage expansion policy for dental service, the level of out-of-payment is very high compared to other countries.

Rate of unmet dental care needs that experience unmet needs is very high in South Korea. Previous study on unmet dental care needs in South Korea showed that response rate of unmet dental care needs 24.5% <sup>3)</sup>, Whereas study results of state of Wisconsin in US indicated that about 20.6% of total population experienced unmet dental care needs <sup>4)</sup>. In addition, Canadian study about immigrants living above 10 years in Canada showed that experience rate of unmet dental care needs 17.5% and the rate of 28 EU countries including Spain indicated 7.2% <sup>5-7)</sup>.

The factors related to unmet health care needs among adults in previous studies are socioeconomic factors including income or education level and health status such as self-related health or mental health <sup>8-12)</sup>. In other words, low income or education groups are more likely to experience unmet health care needs than those with higher status. Although there are a few research of association between employment status and unmet needs, most of them examined unmet health care needs rather than dental care.

This study aims to examine the impact of employment status on the experience of unmet dental care needs, using nationally representative panel data collected from 2010–2013.

## II . Methods

### *Study Model*

This study used the Anderson social behavioral model to analyze factors that affect unmet dental care needs. This model is widely used as a model for analyzing factors affecting unmet medical care. In the Anderson model, the factors that determine the individual's behavior related to the use of medical services are largely categorized as predisposing factors, enabling factors, and need factors, and their relevance to medical use is analyzed through regression analysis. Predisposing factors consist of social structure variables (sex, age, marital status), social structural variables (education level, occupation), and health Beliefs and attitudes. Enabling factors are the resources of individuals and communities that enable the use of medical care and include variables such as income, number of household members, type of health insurance, and whether to join private health insurance. Need factors are directly related to use of health services as disease factors related to the level of individual disability or illness. It mainly includes variables such as subjective health status, presence of chronic disease, and disability. In this study, the predisposing factors were sex, age, education level, marital status, employment status. Enabling factors were income level, type of health insurance, and private insurance. Needs factors were self-rated health, depression, and stress.

### *Data*

We utilized data from the Korea Health Panel (KHP) 3rd–6th (2010–2013 year), which is conducted by the Korea Institute for Health & Social Affairs and the National Health Insurance Corporation. The KHP is a nationally representative sample of Korean individuals and their families that include data on demographic and socioeconomic characteristics, health status, access to health care, and private health insurance status. The KHP uses a stratified multistage probability sampling design according to region and residence in order to select nationwide subjects from the 2005 Korea Census<sup>13)</sup>. This study received ethical approval from the institutional review board of Yonsei University Graduate School of Public Health.

### *Study sample and design*

We excluded the 1<sup>st</sup>–2<sup>nd</sup> data of KHP (2008–2009 year) because the variable about unmet dental care needs was not included in the survey. This study included data from the 4<sup>th</sup> wave



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4 in 2011. In the 4<sup>th</sup> wave (2011), 17,035 subjects completed the survey questionnaire. The  
5 study subjects consisted of waged workers  $\geq 19$  years of age and excluded those who did  
6 experience unmet dental care needs and workers (permanent or precarious or self-employed)  
7 in 3<sup>rd</sup> wave (2010). Subjects aged  $\geq 62$  years in 2011 were excluded so that all subjects in this  
8 study were  $< 65$  years old during the 3-year follow-up. After excluding subjects without  
9 follow-up or with any missing values, a total of 4,620 workers remained in this study. We  
10 examined the effect the employment status on the experience of unmet dental care needs  
11 during 2011 to 2013.  
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#### 18 *Dependent variable*

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20 The dependent variable of this study is whether respondents had an unmet dental care  
21 needs or not, thus they were asked, "Have you failed to receive dental care services even if  
22 there was a need for treatment or checkup over the past one year?" Also, 'economic burden',  
23 'no time to spare', and 'others' were added to result variables for those who had experienced  
24 unmet healthcare needs.  
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#### 28 *Independent variable*

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30 Employment status was classified into four categories: full-time permanent, precarious, self-  
31 employed, or unemployed. The KHP classified individuals as full-time permanent workers if  
32 all four of the following conditions were satisfied: (i) they were directly hired by their  
33 employers (not subcontracted or dispatched workers or self-employed workers without  
34 employees); (ii) they were full-time workers (not part-time workers); (iii) there was no fixed  
35 term in their employment contract (not temporary workers); and (iv) there was a high  
36 probability of maintaining their current job (having relatively little job insecurity and not a  
37 day laborer). Other than full-time permanent workers, waged workers hired by their  
38 employers were classified as precarious workers. The self-employed were defined as workers  
39 who managed their own business regardless of scale or carried out professional matter on  
40 their own responsibility. For the purpose of comparability with previous East Asian studies  
41 and consideration of different classification of employment status between countries, the self-  
42 employed were treated as having a different employment status. The unemployed were  
43 defined as those who lost a job in 2011 among workers in 2010.  
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#### 54 *Covariates*

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56 In this study we used several covariates to control for demographic and socioeconomic  
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4 characteristics and health status. Demographic characteristics included sex, age, marital  
5 status, and socioeconomic factors including education and income. The age groups were  
6 divided at 10-year intervals for measurement. Marital status was categorized into three:  
7 'Married,' 'single,' and 'divorced or separated'. Educational levels were categorized into  
8 three: 'below elementary school,' 'middle or high school,' and 'above college'. Weighted  
9 total household income was divided into five: highest, high, middle, low, lowest. As a proxy  
10 for health status, we utilized self-rated health, stress, depression, disability, and chronic  
11 disease to control for the participant's health condition and health behavior, which can affect  
12 health care utilization. Finally, we used type of health insurance (national health insurance,  
13 medical aid) and existence of private insurance.  
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### 22 *Statistical analysis*

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24 The frequency with which unmet dental care needs was incurred overall after accounting  
25 for demographic, socioeconomic, and health status was determined by Rao-Scott Chi-square  
26 test. To identify factors associated with unmet dental care needs and, in particular, to examine  
27 the relationship between employment status and unmet dental care needs, we used the  
28 GLIMMIX procedure because subjects in our study are measured repeatedly over time. The  
29 odds ratio (OR) was calculated through the regression coefficient gained through the  
30 GLIMMIX procedure and presented with a 95% confidence interval (95% CI). The SAS 9.3  
31 statistical package (Cary, NC, USA) was used for data analysis.  
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### 37 *Patient and Public Involvement statement*

38 Patients or Public were not involved in this study.  
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### III. Results

This study utilized longitudinal data which is repeatedly measured and constructed for 24,616 people in 2008. First year (2010) response rate of data utilized by in this study is 80.6% and the main reasons for decreasing response rate are death, response refusal etc. Table 1 shows General characteristics at first follow-up (2011) of waged workers. 17.3% of 4,620 respondents aged between 20 and 61 said they had failed at least once to have a dental treatment or checkup despite the needs. People who have low education, low-income group, people who were divorced, people with negative self-related health and those having depression or stress people who joined private insurance scheme, precarious workers and self-employed were more likely to experience unmet dental care needs. However, no significant relationship was observed between unmet dental care needs and sex, age, disability, chronic disease, and type of health insurance.

Table 2 shows self-reported reasons for unmet dental care needs according to employment status. Precarious workers and unemployed were more likely to experience unmet dental care needs caused by economic burden. Whereas, permanent workers and self-employed were more likely to experience unmet dental care needs caused by having no time to spare.

After applying multivariate models adjusted for several covariates, the results for factors associated with unmet dental care needs are shown in Table 3. People who did not graduate elementary school had a higher risk of unmet dental care needs compared to those who graduated college (Odds ratio (OR): 1.35, 95% CI: 1.11-1.64). Low-income group were more 1.77 times likely to experience unmet dental care needs than those with higher income. People with negative self-rated health were more 2.19 times likely to experience unmet dental care needs than positive self-related health and those having stress or depression were more likely to experience unmet dental care needs than those no having such diseases (OR: 1.90, 1.69, respectively). People who joined private insurance scheme were 1.15 times more likely to experience unmet dental care needs than those who did not join private insurance. Self-employed workers were more 1.18 times likely to experience unmet dental care needs than full-time permanent workers.

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4 Table 4 shows factors associated with reason for unmet dental care needs according to  
5 employment status or income. In employment status, precarious workers and unemployed  
6 were more likely to experience unmet dental care needs caused by economic burden than  
7 permanent workers (OR: 1.36, 1.40, respectively). Whereas, precarious workers were 0.73  
8 times likely to experience unmet dental care needs caused by having no time to spare than  
9 permanent workers. In income level, low-income group were 4.46 times more likely to  
10 experience unmet dental care needs caused by economic burden than those with the highest  
11 income. Whereas, middle-income group were 0.74 times likely to experience unmet dental  
12 care needs caused by having no time to spare than the highest income class.  
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## IV. Discussion

This study showed that the rate of unmet dental care needs experienced by adults in South Korea is about 17.3%. This rate is higher 3~4 times compared to Europe countries and means relatively low access to dental care. The high rate results from very low health insurance coverage in dental care services. The non-insured payments which government does not support of dental care services is higher than general health care services. 2010 national health insurance coverage rate is about 62.7% in South Korea (pharmacy 71.6%, clinic 65.6%, and hospital 60.5%), whereas coverage rates of dental clinics and hospitals are about 35.5, 25.5%, respectively <sup>14)</sup>. In addition, the proportion of non-insured payment (numerator) in OOP (denominator) is about 43.2, 64.6%, respectively and this indicates a much higher rate compared to other treatment services <sup>3)</sup>. Fortunately, the Korean government has implemented a policy to insure implant treatments, which were previously not insured among senior citizens and plans to expand coverage rate of younger people. Based on this strengthening of benefit, we suggest consistent coverage expansion in dental care by considering characteristics of treatment items.

We identified the factors affecting unmet dental care needs to be education, income, self-rated health, depression, stress, private insurance, and employment status. In particular, there is no interaction between employment status and income. In other words, income and employment status independently affect unmet dental needs. The significant results linking socioeconomic status - including education and income level - to health status indicators - such as self-rated health, depression, stress - are not confined to dental care outcomes. These results are similar to previous studies using a variety of design or time <sup>15-23)</sup>.

Our research showed that people who joined private insurance scheme were 1.15 times more likely to experience unmet dental care needs than those who did not join private insurance. People who have higher levels of income or education are more likely to join private insurance and this phenomenon is similar in other countries which operate public health care system with supportive private insurance <sup>24)</sup>. Although medical utilization of people joining private insurance is not higher than those uninsured by private insurance, it is possible to increase unmet needs by relative high want for health. Unmet needs related to private

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4 insurance need to be examined in further study.

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6 We examined difference of unmet dental care needs by employment status. Self-employed  
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8 workers were more 1.18 times likely to experience unmet dental care needs than full-time  
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10 permanent workers and this phenomenon may result from characteristics of self-employed  
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12 workers in South Korea. A few people who have failed to get a regular job opt to start their  
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14 own business rather than to have a non-regular position. Self-employed people comprise  
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16 more than 30% of the labor market in Korea. A substantial number of self-employed people  
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18 belong to a low-income class and are exposed to the danger of working poverty <sup>25</sup>).

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20 We examined factors associated with reason for unmet dental care needs according to  
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22 employment status or income. Precarious workers and unemployed were more likely to  
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24 experience unmet dental care needs caused by economic burden than permanent workers and  
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26 this result is similar to previous studies <sup>26, 27</sup>). This phenomenon is related to the fact that the  
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28 monthly wages of precarious workers are about 52.2% of full-time permanent workers. In  
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30 2015, the average monthly wage of permanent workers was about US\$ 2,300 in South Korea,  
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32 whereas the monthly wage of precarious workers is about US\$ 1,200. It is a crucial issue is  
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34 that the average wage of precarious workers is lower than minimum cost of living and this  
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36 disparity may have the effect of reducing access to dental care by precarious workers as well  
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38 as unemployed people. A similar issue is that the low-income group was 4.46 times more  
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40 likely to experience unmet dental care needs caused by economic burden than those with the  
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42 highest income. However, unmet dental care needs caused by other reasons were also  
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44 significant, but in the opposite direction. For example, precarious workers and unemployed  
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46 were less likely to experience unmet dental care needs caused by having no time to spare than  
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48 permanent workers. This phenomenon may be attributable to their longer working hours of  
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50 full-time permanent workers compared to precarious workers. In fact, the average working  
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52 hours of precarious workers in 2013 were about 75.5% of those of permanent workers.

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54 This study is significant because it is the first study to examine the association of economic  
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56 status on unmet dental care needs among adults in South Korea using longitudinal panel data.  
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58 Although similar studies on this topic were conducted, all of them used cross-sectional design  
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60 that possible inverse causality between employment status and unmet dental care needs are  
not reflected. This study's longitudinal design allows us to assess the stability and continuity  
of several attributes of a sample group by repeatedly observing the same participants.

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4 Another major strength of its longitudinal design is that cohort effects can be avoided because  
5 we examined one group of individuals over time, rather than comparing several different  
6 groups that represent different ages and generations.  
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9 There were some limitations associated with our study. First, we used self-reported  
10 questionnaires to identify subjects' experience of unmet dental care needs. Nevertheless,  
11 some studies using subjective and objective methods have tended to give reasonably  
12 consistent results <sup>28</sup>). In addition, the follow-up period in the current study is relatively short  
13 compared with other studies. Second, we did not control severity of patient's dental status in  
14 our research. Although severity of dental status including severe dental caries may affect  
15 medical access, we did not consider the factor in our model. Third, temporal bias could exist  
16 in this study results. Finally, the definition of unemployment in this paper differs from that of  
17 the International Labour Organization (actively seeking work). Unemployed group in this  
18 study may include student, permanently sick and others not normally considered as part of  
19 the unemployed (out of work). But, we cannot grasp the information due to data limitation.  
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## V. Conclusions

Our research showed precarious workers and unemployed were more likely to experience unmet dental care needs caused by economic burden than full-time permanent workers. In addition, low-income group were more likely to experience unmet dental care needs caused by economic burden than those with the highest income. This disparity means that they are more likely to face barriers in obtaining needed health services. Given the insecure employment status of low income people, meeting their needs for health care is an important consideration.

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**Data sharing statement:** No additional data are available.

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Table 1. General characteristics at first follow-up (2011) of waged workers Unit: N, %

Variables	Total	Unmet dental-care needs		Rao-Scott	
		Yes	No	chi-square	(p-value)
Total	4,620	801	17.3	3,819	82.7
Sex					0.35(0.555)
Men	2,845	488	17.2	2,357	82.8
Women	1,775	313	17.6	1,462	82.4
Age					4.00(0.261)
20–29	292	43	14.7	249	85.3
30–39	1,034	167	16.2	867	83.8
40–49	1,686	285	16.9	1,401	83.1
≥50	1,608	306	19.0	1,302	81.0
Education					14.67(<0.001)
Below elementary school	346	84	24.3	262	75.7
Middle or high school	2,231	408	18.3	1,823	81.7
Above college	2,043	309	15.1	1,734	84.9
Marital status					9.24(0.009)
Married	3,611	631	17.5	2,980	82.5
Single	730	102	14.0	628	86.0
Divorced or separated	279	68	24.4	211	75.6
Income					27.92(<0.001)
Q1 (Lowest)	204	51	25.0	153	75.0

Q2	694	145	20.9	549	79.1
Q3	1,093	207	18.9	886	81.1
Q4	1,311	226	17.2	1,085	82.8
Q5 (Highest)	1,316	172	13.1	1,144	86.9
Self-rated health					64.09(<0.001)
Good	2,140	294	13.7	1,846	86.3
Normal	1,815	380	20.9	1,435	79.1
Bad	326	97	29.8	229	70.2
Depression					58.40(<0.001)
Yes	251	88	35.1	163	64.9
No	4,030	683	16.9	3,347	83.1
Stress					73.09(<0.001)
Always	363	118	32.5	245	67.5
Often	2,246	434	19.3	1,812	80.7
No	1,667	218	13.1	1,449	86.9
Type of health insurance					3.25(0.072)
National health insurance	4,531	778	17.2	3,753	82.8
Medical aid	89	23	25.8	66	74.2
Private insurance					4.04(0.044)
Yes	3,953	659	16.7	3,294	83.3
No	657	132	20.1	525	79.9
Employment status					14.00(0.002)
Permanent	1,902	278	14.6	1,624	85.4

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4	Precarious	1,221	237	19.4	984	80.6
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6	Self-employed	1,116	218	19.5	898	80.5
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9	Unemployed	381	68	17.8	313	82.2
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Table 2. Self-reported reasons for unmet dental-care needs according to employment status

Unit: N, %

Variable	Reason for unmet need						
	Total	Economic burden	No time to spare	Others <sup>a</sup>			
Total	4,620	415	9.0	209	4.5	177	3.8
Permanent	1,902	98	5.2	106	5.6	74	3.9
Precarious	1,221	158	12.9	42	3.4	37	3.0
Self-employed	1,116	109	9.8	56	5.0	53	4.7
Unemployed	381	50	13.1	5	1.3	13	3.4

<sup>a</sup>Others: trivial symptoms, great distance from the health care facility, reduced mobility (difficult to visit for physical reasons), no one to babysit, lack of information as to where to go, no timely appointment, absence of a primary care physician, etc.



Table 3. Factors associated with unmet dental-care needs

Variables	Unmet dental-care needs		
	Adjusted OR	95% CI	
<b>Sex</b>			
Men	1.00		
Women	0.95	0.86	1.06
<b>Age</b>			
≥50	1.00		
40–49	1.03	0.92	1.16
30–39	1.11	0.95	1.29
20–29	1.10	0.82	1.48
<b>Education</b>			
Above college	1.00		
Middle or high school	1.07	0.96	1.19
Below elementary school	1.35	1.11	1.64
<b>Marital status</b>			
Married	1.00		
Single	1.17	0.98	1.41
Divorced or separated	0.79	0.67	1.03
<b>Self-rated health</b>			
Good	1.00		
Normal	1.76	1.59	1.94
Bad	2.19	1.86	2.59

1  
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3  
4 Depression

5  
6  
7 No 1.00  
8  
9 Yes 1.69 1.42 2.01

10  
11 Stress

12  
13 No 1.00  
14  
15 Often 1.39 1.26 1.55  
16  
17 Always 1.90 1.61 2.24

18  
19  
20 Income

21  
22  
23 Q5 (Highest) 1.00  
24  
25 Q4 1.20 1.05 1.38  
26  
27 Q3 1.33 1.16 1.52  
28  
29 Q2 1.51 1.29 1.76  
30  
31 Q1 (Lowest) 1.77 1.41 2.22

32  
33  
34 Type of health insurance

35  
36 National health insurance 1.00  
37  
38 Medical aid 1.17 0.86 1.60

39  
40  
41 Private insurance

42  
43 No 1.00  
44  
45 Yes 1.15 1.01 1.32

46  
47  
48 Employment status

49  
50 Permanent 1.00  
51  
52 Precarious 1.11 0.98 1.26  
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54 Self-employed 1.18 1.04 1.34  
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4 Unemployed 1.09 0.92 1.30  
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7 *Note.* OR, odds ratio; CI, confidence interval.  
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Table 4. Factors associated with reason for unmet dental care needs according to employment status or income

Variables	Reason for unmet need								
	Economic burden			No time to spare			Others		
	OR <sup>a</sup>	95% CI		OR <sup>a</sup>	95% CI		OR <sup>a</sup>	95% CI	
<b>Employment status</b>									
Permanent	1.00			1.00			1.00		
Precarious	1.36	1.14	1.61	0.83	0.67	1.04	1.03	0.79	1.34
Self-employed	1.18	0.99	1.41	1.12	0.91	1.37	1.44	0.13	1.83
Unemployed	1.40	1.16	1.76	0.42	0.28	0.64	1.55	1.12	2.15
<b>Income</b>									
Q5 (Highest)	1.00			1.00			1.00		
Q4	2.06	1.65	2.57	0.92	0.75	1.12	0.96	0.75	1.22
Q3	2.93	2.35	3.64	0.74	0.59	0.94	0.85	0.65	1.10
Q2	3.44	2.73	4.34	0.74	0.56	0.98	0.89	0.65	1.21
Q1 (Lowest)	4.46	3.33	5.99	0.67	0.40	1.14	0.58	0.32	1.04

Note. OR, odds ratio; CI, confidence interval.

<sup>a</sup>Adjusted for age, sex, education, marital status, disability, chronic disease, depression, stress, self-rated health, type of health insurance, private insurance

**STROBE 2007 (v4) checklist of items to be included in reports of observational studies in epidemiology\***  
**Checklist for cohort, case-control, and cross-sectional studies (combined)**

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any pre-specified hypotheses	4
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	5
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5
Bias	9	Describe any efforts to address potential sources of bias	5
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	6
		(b) Describe any methods used to examine subgroups and interactions	6
		(c) Explain how missing data were addressed	6
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed	6

		<i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	6
<b>Results</b>			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	8
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8
		(b) Report category boundaries when continuous variables were categorized	
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10-11
Generalisability	21	Discuss the generalisability (external validity) of the study results	10-11
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	13

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

# BMJ Open

## Employment status and unmet dental care needs in South Korea: A population-based panel study

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6 population-based panel study  
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10 Jae Woo Choi<sup>1</sup>, Young Choi<sup>2</sup>, Tae-Hoon Lee<sup>3</sup>, Hyo Jung Lee<sup>4</sup>, Yeong Jun Ju<sup>2</sup>, Eun-Cheol Park<sup>5\*</sup>  
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55 **Key Words:** employment status, unmet dental care needs, income disparity  
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## Abstract

Objectives: This study was designed to evaluate whether employment status is associated with the experience of unmet dental care needs.

Methods: A total of 4,620 workers were retrieved from Korea Health Panel data (2010-2013), and potential relationships were explored among their income levels, changes in employment, and unmet dental care needs.

Results: Among the 4,620 workers, 17.3% said they had failed at least once to get dental treatment or checkup, despite their needs. Precarious workers and those not in employment were more likely to experience unmet dental care needs due to economic burden compared to permanent workers (OR: 1.36, 1.40, respectively). In addition, people in low-income group were 4.46 times more likely to experience unmet dental care needs caused by economic burden, compared to those with the highest income.

Conclusion: This disparity means that precarious workers and those not in employment are more likely to face barriers in obtaining needed health services. Given the insecure employment status of low income people, meeting their healthcare needs is an important consideration.

Key Words: employment status, unmet dental care needs, income disparity

### Strengths and limitations of this study

#### 1. Strengths

1) This was the first study to examine the association between economic status and unmet dental care needs among adults in South Korea using longitudinal panel data.

#### 2. Limitations

1) We used self-reported questionnaires to identify subjects' experience of unmet dental care needs.

2) We did not control severity of dental care in our research.

## I . Introduction

South Korea achieved universal health insurance coverage just 12 years after its national health insurance system was implemented <sup>1)</sup>. However, people with national health insurance are still paying rather high amount of out-of-pocket (OOP) payments. The proportion of total medical spending financed by the public sector in South Korea is only 56% of the country's population, which is lower than the OECD average (73%). Furthermore, South Korea had the fourth lowest level of spending out of OECD nations after Chile (46%), USA (48%), and Mexico (51%) <sup>2)</sup>. Relatively low coverage by health insurance may result in unmet needs, and this phenomenon is more likely to occur in dental care which often requires higher OOP payments than those for regular healthcare. In South Korea, the coverage benefit of dental care services is low due to the relatively high medical expenses incurred by non-insured payment. Although the South Korean government has expanded coverage expansion policy for dental service, the level of OOP payments is very high compared to those of other countries.

The rate of unmet dental care needs is very high in South Korea. A previous study on unmet dental care needs in South Korea showed that response rate of unmet dental care needs was 24.5% of the entire population<sup>3)</sup>, whereas results from another study performed in the U.S. state of Wisconsin indicated that about 20.6% of the total population experienced unmet dental care needs <sup>4)</sup>. In addition, a Canadian study on immigrants living more than 10 years in Canada showed that the experience rate of unmet dental care needs was 17.5%, and the rate of 28 EU countries, including Spain, was 7.2% <sup>5-7)</sup>.

The factors related to unmet healthcare needs among adults in previous studies were socioeconomic factors, such as income or education levels, and health status, including self-related health or mental health <sup>8-12)</sup>. In other words, low income or education groups were more likely to experience unmet healthcare needs than those with higher income or education status. Although there has been some studies that reported on the association between employment status and unmet needs, most of them examined unmet healthcare needs, rather than dental care.

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4 The current study aimed to examine the impact of employment status on the experience of  
5 unmet dental care needs, using nationally representative panel data collected from 2010–  
6 2013.  
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## 9 10 **II . Methods**

### 11 12 13 14 *Study model*

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16 This study used the Anderson social behavioral model to analyze factors that affect unmet  
17 dental care needs. This model is widely used as a model for analyzing factors that affect  
18 unmet medical care. In the Anderson model, the factors that determine an individual's  
19 behavior related to the use of medical services are largely categorized as predisposing factors,  
20 enabling factors, and need factors, and their relevance to medical use is analyzed through  
21 regression analysis. Predisposing factors consist of social structure variables (sex, age,  
22 marital status), social structural variables (education level, occupation), and health beliefs and  
23 attitudes. Enabling factors are the resources of individuals and communities that enable the  
24 use of medical care, and these include variables such as income, number of household  
25 members, type of health insurance, and existence of private health insurance. Need factors are  
26 directly related to the use of health services, and disease factors are related to the level of  
27 individual disability or illness. It mainly includes variables such as subjective health status,  
28 presence of chronic disease, and disability. In this study, the predisposing factors were sex,  
29 age, education level, marital status, and employment status. Enabling factors were income  
30 level, type of health insurance, and private insurance. Needs factors were self-rated health,  
31 depression, and stress.  
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### 45 46 *Data*

47 We utilized data from the Korea Health Panel (KHP) 3rd–6th (2010–2013 year), which was  
48 conducted by the Korea Institute for Health & Social Affairs and National Health Insurance  
49 Corporation. KHP is a nationally representative sample of South Korean individuals and their  
50 families, and it includes data on subjects' demographic and socioeconomic characteristics,  
51 health status, access to healthcare, and private health insurance status. KHP uses a stratified  
52 multistage probability sampling design according to region and residence, in order to select  
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4 nationwide subjects from the 2005 Korea Census<sup>13</sup>). This study received ethical approval  
5 from the institutional review board of Yonsei University Graduate School of Public Health.  
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### 9 *Study sample and design*

10 We excluded the 1<sup>st</sup>–2<sup>nd</sup> data of KHP (2008–2009 year), since the variable of unmet dental  
11 care needs was not included in the survey. This study included data from the 4<sup>th</sup> wave in  
12 2011. In the 4<sup>th</sup> wave (2011), a total of 17,035 subjects completed the survey questionnaire.  
13 The study subjects consisted of waged workers  $\geq 19$  years of age, and excluded those who did  
14 experience unmet dental care needs. Subjects aged  $\geq 62$  years in 2011 were also excluded to  
15 ensure that all subjects in this study were  $< 65$  years old during the 3-year follow-up. After  
16 excluding subjects without follow-up or those with any missing values, a total of 4,620  
17 workers remained in this study. We examined the effect employment status on the experience  
18 of unmet dental care needs from 2011 to 2013.  
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### 28 *Dependent variable*

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30 Dependent variable of this study was whether or not the respondents had an unmet dental  
31 care. Therefore, they were asked, “Did you ever fail to receive dental care services over the  
32 past year, even when there was a need for treatment or checkup?” Also, economic burden, no  
33 time to spare, and others were added as result variables for those who had experienced unmet  
34 healthcare needs.  
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### 40 *Independent variable*

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42 Employment status was classified into four categories: full-time permanent, precarious, self-  
43 employed, or those not in employment. KHP classified individuals as full-time permanent  
44 workers if all four of the following conditions were satisfied: (i) they were directly hired by  
45 their employers (not subcontracted or dispatched workers, or self-employed workers without  
46 employees); (ii) they were full-time workers (not part-time workers); (iii) there was no fixed  
47 term in their employment contract (not temporary workers); and (iv) there was a high  
48 probability of maintaining their current job (having relatively little job insecurity, and not a  
49 day laborer). Other than full-time permanent workers, waged workers hired by their  
50 employers were classified as precarious workers. Self-employed were defined as workers  
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4 who managed their own business regardless of scale, or carried out professional matter under  
5 their own responsibility. For the purpose of comparability with previous East Asian studies  
6 and consideration of different classification of employment status between countries, self-  
7 employed were treated as having a different employment status. Those not in employment  
8 were defined as those who stopped working in 2011 out of workers in 2010.  
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### 14 *Covariates*

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16 In this study, we used several covariates to control for demographic and socioeconomic  
17 characteristics, as well as health status. Demographic characteristics included sex, age,  
18 marital status, and socioeconomic factors, including education and income. The age groups  
19 were divided in 10-year intervals for measurement. Marital status was categorized into  
20 married, single, and divorced or separated. Educational levels were categorized into below  
21 elementary school, middle or high school, and above college. Weighted total household  
22 income was divided into five levels: highest, high, middle, low, and lowest. As a proxy for  
23 health status, we utilized self-rated health, stress, depression, disability, and chronic disease  
24 to control for the participant's health condition and health behavior that can affect healthcare  
25 utilization. Finally, we used type of health insurance (national health insurance, medical aid)  
26 and existence of private insurance.  
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### 37 *Statistical analysis*

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39 The overall frequency of situations where unmet dental care needs incurred, after  
40 accounting for demographic, socioeconomic, and health status, was determined by Rao-Scott  
41 Chi-square test. To identify factors associated with unmet dental care needs and, in particular,  
42 to examine the relationship between employment status and unmet dental care needs, we used  
43 the GLIMMIX procedure since subjects in our study were measured repeatedly over time.  
44 Odds ratio (OR) was calculated using the regression coefficient gained through the  
45 GLIMMIX procedure, and presented with a 95% confidence interval (95% CI). SAS 9.3  
46 statistical package (Cary, NC, USA) was used for data analysis.  
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### 54 *Patient and public involvement statement*

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56 Patients or the public were not involved in this study.  
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### III. Results

This study utilized longitudinal data that was repeatedly measured and constructed for 24,616 people in 2008. First-year (2010) response rate of data utilized in this study was 80.6%, and the main reasons for decreasing response rate were death, response refusal, etc. Table 1 shows general characteristics at first follow-up (2011) of waged workers. Out of 4,620 respondents aged between 20 and 61 years, 17.3% said they had failed at least once to have dental treatment or checkup, despite their needs. People who had low education, as well as the low-income group, people who were divorced, people with negative self-related health, and those with depression or stress who joined private insurance scheme, precarious workers, and self-employed were more likely to experience unmet dental care needs. However, no significant relationship was observed between unmet dental care needs and sex, age, disability, chronic disease, and type of health insurance.

Table 2 shows self-reported reasons for unmet dental care needs according to employment status. Precarious workers and those not in employment were more likely to experience unmet dental care needs caused by economic burden. On the other hand, permanent workers and self-employed were more likely to experience unmet dental care needs due to having no time to spare.

After applying multivariate models adjusted for several covariates, the results for factors associated with unmet dental care needs are shown in Table 3. People who did not graduate elementary school had a higher risk of unmet dental care needs compared to those who graduated from college (odds ratio (OR): 1.35, 95% CI: 1.11-1.64). Low-income group was 1.77 times more likely to experience unmet dental care needs than those with higher income. People with negative self-rated health were 2.19 times more likely to experience unmet dental care needs than those with positive self-related health, and people with stress or depression were more likely to experience unmet dental care needs than those who did not have such conditions (OR: 1.90, 1.69, respectively). People who joined private insurance scheme were 1.15 times more likely to experience unmet dental care needs than those who did not join private insurance. Self-employed workers were 1.18 times more likely to experience unmet dental care needs than full-time permanent workers.



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4 Table 4 shows the factors associated with reason for unmet dental care needs according to  
5 employment status or income. In employment status, precarious workers and those not in  
6 employment were more likely to experience unmet dental care needs caused by economic  
7 burden, compared to permanent workers (OR: 1.36, 1.40, respectively). On the other hand,  
8 precarious workers were 0.73 times more likely to experience unmet dental care needs due to  
9 having no time to spare, compared to permanent workers. In terms of income level, low-  
10 income group were 4.46 times more likely to experience unmet dental care needs caused by  
11 economic burden than those with the highest income. Meanwhile, middle-income group was  
12 0.74 times more likely to experience unmet dental care needs caused by having no time to  
13 spare, compared to the highest income class.  
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## IV. Discussion

This study showed that 17.3% of the South Korean population experienced unmet dental care needs. This rate is about 3~4 times higher than those of European countries, meaning people in South Korea have relatively low access to dental care. The high rate results from very low health insurance coverage in dental care services. Non-insured payments, which includes costs that the government does not support such as dental care services, is higher than payments for general healthcare services. In 2010, the national health insurance coverage rate was about 62.7% in South Korea (pharmacy 71.6%, clinic 65.6%, hospital 60.5%), whereas coverage rates of dental clinics and hospitals were about 35.5% and 25.5%, respectively<sup>14</sup>. In addition, the proportion of non-insured payment (numerator) in OOP (denominator) was about 43.2% and 64.6%, respectively, which was a much higher rate compared to other treatment services<sup>3</sup>. Fortunately, the South Korean government has implemented a policy to insure dental implant treatments, which were previously not insured among senior citizens, and plans to expand coverage rate for younger people as well. Based on such improvement of benefits, we suggest consistent coverage expansion in dental care by considering the characteristics of treatment criteria.

We identified the factors affecting unmet dental care needs as following: education, income, self-rated health, depression, stress, private insurance, and employment status. In particular, we found no interaction between employment status and income. In other words, income and employment status independently affect unmet dental needs. The significant results linking socioeconomic status, including education and income levels, to health status indicators, such as self-rated health, depression, and stress, were not confined to dental care outcomes. These results were similar to those of previous studies using various designs or study periods<sup>15-23</sup>.

Our research showed that people who joined private insurance scheme were 1.15 times more likely to experience unmet dental care needs than those who did not join private insurance. People who had higher levels of income or education were more likely to join private insurance, and this phenomenon was similar to other countries that operate public healthcare systems with supportive private insurance<sup>24</sup>. Although medical utilization of people joining private insurance was not higher compared to those not insured by private insurance, it is

possible to increase unmet needs by relatively high desire for healthcare. Unmet needs related to private insurance must be examined further in future research.

We examined the difference of unmet dental care needs by employment status. Self-employed workers were 1.18 times more likely to experience unmet dental care needs than full-time permanent workers, and this phenomenon may have resulted from characteristics of self-employed workers in South Korea. A few people who failed to get a regular job opted to start their own business rather than looking for a non-regular position. Self-employed people comprise more than 30% of the entire labor market in South Korea. A substantial number of self-employed people belong to low-income class, and they are exposed to the danger of working in poverty<sup>25</sup>).

We examined the factors associated with reason for unmet dental care needs according to employment status or income. Precarious workers and those not in employment were more likely to experience unmet dental care needs caused by economic burden than permanent workers, and this result was similar compared to previous studies<sup>26, 27</sup>). Such phenomenon is related to the fact that the monthly wages of precarious workers were about 52.2% of wages earned by full-time permanent workers. In 2015, the average monthly wage of permanent workers was about US\$2,300 in South Korea, whereas the monthly wage of precarious workers was about US\$1,200. It is a crucial issue is that the average wage of precarious workers is lower than minimum cost of living, and this disparity may have the effect of reducing access to dental care for precarious workers and those not in employment. A similar issue is that low-income group was 4.46 times more likely to experience unmet dental care needs due to economic burden than those with the highest income. Meanwhile, unmet dental care needs caused by other reasons were also significant, but in the opposite direction. For example, precarious workers and those not in employment were less likely to experience unmet dental care needs caused by having no time to spare than permanent workers. This phenomenon may be due to the longer working hours of full-time permanent workers compared to precarious workers. In fact, the average working hours of precarious workers in 2013 were about 75.5% of those of permanent workers.

This study is significant in that it was the first study to examine the association of economic status on unmet dental care needs among adults in South Korea using longitudinal panel data. Although similar studies on this topic have been conducted, all of them used cross-sectional

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4 design, and the possible inverse causality between employment status and unmet dental care  
5 needs were not reflected. This study's longitudinal design allowed us to assess the stability  
6 and continuity of several attributes of a sample group by repeatedly observing the same  
7 participants. Another major strength of this study's longitudinal design was that cohort  
8 effects can be avoided since we examined one group of individuals over time, rather than  
9 comparing several different groups that represent different ages and generations.  
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11 Our study also had some limitations. First, we used self-reported questionnaires to identify  
12 subjects' experience of unmet dental care needs. Nevertheless, some studies using subjective  
13 and objective methods tended to give reasonably consistent results<sup>28</sup>). In addition, the follow-  
14 up period in the current study was relatively short compared to other studies. Second, we did  
15 not control severity of patient's dental status in our research. Although severity of dental  
16 status may affect the subject's access to medical care, we did not consider this factor in our  
17 model. Third, temporal bias could exist in our study results.  
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## V. Conclusions

Our research showed that precarious workers and those not in employment were more likely to experience unmet dental care needs due to economic burden than full-time permanent workers. In addition, low-income group were more likely to experience unmet dental care needs caused by economic burden than those with the highest income. This disparity indicates that certain people are more likely to face barriers in obtaining the health services they need. Given the insecure employment status of low income people, meeting their needs for healthcare may be an important thing to consider.

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**Competing interests:** The authors declare to have no competing interests.

**Authors' contributions:** JWC, YC, HJL, YJJ and ECP designed the study concept, wrote the protocol and collected the data. THL, HJL and YJJ conducted the analyses. All authors helped to draft the manuscript, in addition to reading and approving the final manuscript. All authors had full access to all data (including statistical reports and tables) in the study, and can take responsibility for the integrity of data and the accuracy of data analysis. JWC and ECP were the study guarantors.

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**Data sharing statement:** No additional data are available.

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Table 1. General characteristics at first follow-up (2011) of waged workers Unit: N, %

Variables	Total	Unmet dental care needs		Rao-Scott	
		Yes	No	chi-square	(p-value)
Total	4,620	801	17.3	3,819	82.7
Sex					0.35(0.555)
Men	2,845	488	17.2	2,357	82.8
Women	1,775	313	17.6	1,462	82.4
Age (years)					4.00(0.261)
20–29	292	43	14.7	249	85.3
30–39	1,034	167	16.2	867	83.8
40–49	1,686	285	16.9	1,401	83.1
≥50	1,608	306	19.0	1,302	81.0
Education					14.67(<0.001)
Below elementary school	346	84	24.3	262	75.7
Middle or high school	2,231	408	18.3	1,823	81.7
Above college	2,043	309	15.1	1,734	84.9
Marital status					9.24(0.009)
Married	3,611	631	17.5	2,980	82.5
Single	730	102	14.0	628	86.0
Divorced or separated	279	68	24.4	211	75.6
Income					27.92(<0.001)
Q1 (Lowest)	204	51	25.0	153	75.0
Q2	694	145	20.9	549	79.1
Q3	1,093	207	18.9	886	81.1
Q4	1,311	226	17.2	1,085	82.8
Q5 (Highest)	1,316	172	13.1	1,144	86.9

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4	Self-rated health					64.09(<0.001)
5						
6	Good	2,140	294	13.7	1,846	86.3
7						
8	Normal	1,815	380	20.9	1,435	79.1
9						
10	Bad	326	97	29.8	229	70.2
11						
12	Depression					58.40(<0.001)
13						
14	Yes	251	88	35.1	163	64.9
15						
16	No	4,030	683	16.9	3,347	83.1
17						
18	Stress					73.09(<0.001)
19						
20	Always	363	118	32.5	245	67.5
21						
22	Often	2,246	434	19.3	1,812	80.7
23						
24	No	1,667	218	13.1	1,449	86.9
25						
26	Type of health insurance					3.25(0.072)
27						
28	National health insurance	4,531	778	17.2	3,753	82.8
29						
30	Medical aid	89	23	25.8	66	74.2
31						
32	Private insurance					4.04(0.044)
33						
34	Yes	3,953	659	16.7	3,294	83.3
35						
36	No	657	132	20.1	525	79.9
37						
38	Employment status					14.00(0.002)
39						
40	Permanent	1,902	278	14.6	1,624	85.4
41						
42	Precarious	1,221	237	19.4	984	80.6
43						
44	Self-employed	1,116	218	19.5	898	80.5
45						
46	Those not in employment	381	68	17.8	313	82.2
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Table 2. Self-reported reasons for unmet dental care needs according to employment status

Unit: N, %

Variable	Reason for unmet need						
	Total	Economic burden	No time to spare	Others <sup>a</sup>			
Total	4,620	415	9.0	209	4.5	177	3.8
Permanent	1,902	98	5.2	106	5.6	74	3.9
Precarious	1,221	158	12.9	42	3.4	37	3.0
Self-employed	1,116	109	9.8	56	5.0	53	4.7
Those not in employment	381	50	13.1	5	1.3	13	3.4

<sup>a</sup>Others: Trivial symptoms, great distance from healthcare facility, reduced mobility (difficult to visit for physical reasons), no one to babysit, lack of information as to where to go, no timely appointment, absence of a primary care physician, etc.

Table 3. Factors associated with unmet dental care needs

Variables	Unmet dental care needs		
	Adjusted OR	95% CI	
<b>Sex</b>			
Men	1.00		
Women	0.95	0.86	1.06
<b>Age (years)</b>			
≥50	1.00		
40–49	1.03	0.92	1.16
30–39	1.11	0.95	1.29
20–29	1.10	0.82	1.48
<b>Education</b>			
Above college	1.00		
Middle or high school	1.07	0.96	1.19
Below elementary school	1.35	1.11	1.64
<b>Marital status</b>			
Married	1.00		
Single	1.17	0.98	1.41
Divorced or separated	0.79	0.67	1.03
<b>Self-rated health</b>			
Good	1.00		
Normal	1.76	1.59	1.94
Bad	2.19	1.86	2.59

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4 Depression

5				
6	No	1.00		
7				
8	Yes	1.69	1.42	2.01
9				

10  
11 Stress

12				
13	No	1.00		
14				
15	Often	1.39	1.26	1.55
16				
17	Always	1.90	1.61	2.24
18				
19				

20  
21 Income

22				
23	Q5 (Highest)	1.00		
24				
25	Q4	1.20	1.05	1.38
26				
27	Q3	1.33	1.16	1.52
28				
29	Q2	1.51	1.29	1.76
30				
31	Q1 (Lowest)	1.77	1.41	2.22
32				
33				

34  
35 Type of health insurance

36				
37	National health insurance	1.00		
38				
39	Medical aid	1.17	0.86	1.60
40				

41  
42 Private insurance

43				
44	No	1.00		
45				
46	Yes	1.15	1.01	1.32
47				

48  
49 Employment status

50				
51	Permanent	1.00		
52				
53	Precarious	1.11	0.98	1.26
54				
55	Self-employed	1.18	1.04	1.34
56				
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4 Those not in employment 1.09 0.92 1.30  
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7 *Note:* OR, odds ratio; CI, confidence interval.  
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Table 4. Factors associated with reason for unmet dental care needs according to employment status or income

Variables	Reason for unmet need								
	Economic burden			No time to spare			Others		
	OR <sup>a</sup>	95% CI		OR <sup>a</sup>	95% CI		OR <sup>a</sup>	95% CI	
Employment status									
Permanent	1.00			1.00			1.00		
Precarious	1.36	1.14	1.61	0.83	0.67	1.04	1.03	0.79	1.34
Self-employed	1.18	0.99	1.41	1.12	0.91	1.37	1.44	0.13	1.83
Those not in employment	1.40	1.16	1.76	0.42	0.28	0.64	1.55	1.12	2.15
Income									
Q5 (Highest)	1.00			1.00			1.00		
Q4	2.06	1.65	2.57	0.92	0.75	1.12	0.96	0.75	1.22
Q3	2.93	2.35	3.64	0.74	0.59	0.94	0.85	0.65	1.10
Q2	3.44	2.73	4.34	0.74	0.56	0.98	0.89	0.65	1.21
Q1 (Lowest)	4.46	3.33	5.99	0.67	0.40	1.14	0.58	0.32	1.04

Note: OR, odds ratio; CI, confidence interval.

<sup>a</sup>Adjusted for age, sex, education, marital status, disability, chronic disease, depression, stress, self-rated health, type of health insurance, private insurance.

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**STROBE 2007 (v4) checklist of items to be included in reports of observational studies in epidemiology\***  
**Checklist for cohort, case-control, and cross-sectional studies (combined)**

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	3	State specific objectives, including any pre-specified hypotheses	4
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	5
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	5
Bias	9	Describe any efforts to address potential sources of bias	5
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	6
		(b) Describe any methods used to examine subgroups and interactions	6
		(c) Explain how missing data were addressed	6
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed	6

		<i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	6
<b>Results</b>			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	8
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8
		(b) Report category boundaries when continuous variables were categorized	
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	12
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10-11
Generalisability	21	Discuss the generalisability (external validity) of the study results	10-11
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	13

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).