# Tobacco Control and Public Health in Eastern Europe

## Heavy smoking and severe dental caries in Indonesian men

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BACKGROUND: In Indonesia, the prevalence of dental caries is 85%–99% and 67.4% of males aged 15 years or older are current users of tobacco. The aim of this study was to examine the association between heavy smoking and severe dental caries.

METHODS: The authors used secondary data from Basic Health Research 2007. Respondents were Indonesian males aged 45–54 years (n = 34 534). Decay, Missing, Filled Teeth (DMFT) value was used to define severe dental caries with 31.4% of respondents having DMFT value ≥ 8, the cutoff point of severe dental caries in this study. In addition, the enumerators recorded socio-demographic characteristics (age, socio-economic status, education, and job), tooth brushing and smoking behavior of respondents. Chi-square test was used to compare the prevalence of severe dental caries between heavy smokers (defined as Brinkman Index or BI ≥ 400) and never smokers (BI = 0). The multivariable logistic regression model was used to estimate adjusted association between heavy smoking and dental caries severity.

RESULTS: The prevalence of severe dental caries among never smokers, light smokers (BI 1–399) and heavy smokers was 24.9%, 32.5%, and 38.7% respectively (p < 0.005). Compared to never smokers, the adjusted ORs of having severe dental caries among light smokers and heavy smokers were 1.45 (95% CI: 1.37–1.53) and 1.70 (95% CI: 1.59–1.81), respectively.

CONCLUSIONS: Smoking is a risk factor of severe dental caries in Indonesian men with dose-and-response association revealed between the exposure and the outcome. Indonesian dentists, individually and collectively, have to participate in smoking prevention and control more actively.

KEYWORDS: heavy smoking; severe dental caries; Indonesian men; Basic Health Research 2007.

## BACKGROUND

Dental caries is the most prevalent oral disease and is a major concern of dental health profession (Moses, Rangeeth & Gurunathan, 2011). On the global map of the spatial distribution of caries among people aged 12 years old, Indonesia belongs to the third or 'low' quartile (1.10 to 1.80) (Moreira, 2012). Though the mean Decay, Missing, Filled Teeth (DMFT) value of Indonesian people at the age of 12 is relatively low, dental caries is a major problem among the oral diseases in Indonesia with a preva-lence of 85%–99% in 2007 (Agtini, 2009). Dental caries can affect anyone at any age. If untreated, it can lead to pain and discomfort, and finally loss of teeth (Gupta, Gupta, Singh, 2014). Cariogenic bacteria and their by-products that diffuse through the dentin tubules are the most frequent cause of pulp inflammation (Soden, Botero, Hanks, & Nör, 2009). Periapical lesions develop as sequelae to pulp disease (Fernandes & Ataide, 2010).

If left untreated, this odontogenic infection may cause maxillary rhinosinusitis (Hoskison, Daniel, Rowson, & Jones, 2012), masticatory space (Schuknecht, Stergiou & Graetz, 2008), or buccal space abscess (Srinivas, Sumanth, & Chopra, 2009).

Dental caries and odontogenic infections can range in severity from mild buccal space infection to a severe, life-threatening multi-space infection (Gregoire, 2010). That is why the improvement of oral health may have a positive impact on the general health of the population and may diminish mortality (Padilha, Hilgert, Hugo, Bós & Ferrucci, 2008).

Dental caries is a multi-factorial disease that is affected by physical and biological factors, lifestyle and behavior, and social status (Tanaka, Miyake, Sasaki & Hirota, 2012). Dental caries risk factors can be divided into three groups: (1) personal factors, (2) oral environmental factors, and (3) factors that directly contribute to caries development. Personal factors include socio-demographic status, income, dental insurance coverage, knowledge, attitudes, oral health literacy, behavior (oral hygiene and smoking), and education (Higham, 2009).

One of the common ways to measure the level of dental health is by counting the total number of teeth decay (D), teeth extracted or missing (M) because of dental caries, and teeth that have been filled (F) (Gordan *et al.*, 2011). Decayed, Missing, Filled (DMF) index is a key measure for the experience of dental caries in the epidemiology of dental disease (Chukwumah *et al.*, 2012; Wellapuli & Amarasena, 2012; De Clerk *et al.*, 2012).

In Indonesia, 67.4% of men aged 15 years and older were cigarette smokers in 2011 (Ministry of Health Rep. of Indonesia, 2012). Indonesia is the third largest tobacco consumer in the world after China and India (Djutaharta, Thabrany, Sung, Ong & Hu, 2012). In 2013, an average Indonesian aged ten years and older consumed 12.3 cigarettes per day (Badan Litbang Kesehatan, Kemenkes R.I., 2013).

However, given the lack of tobacco control policies similar to ones implemented in other countries, tobacco use has not yet been recognized a leading health issue in Indonesia. Although the USA FDA has prohibited import, sales, distribution, and marketing of Indonesian clove cigarettes in order to protect the health of US young generation from harmful effects of tobacco use (U.S. FDA, 2014; U.S. FDA, 2013), *Badan Pengawasan Obat dan Makanan* (Indonesian FDA) did not do anything similar to protect its own population. While Thailand has become a pioneering country to prohibit tobacco import in order to protect Thai's public health (Frankel, 1996), in Indonesia, there was a tendency of increasing tobacco import from 1990 to 2011 (Wiyono and Ahsan, 2015).

While Brunei Darussalam has induced strong control of tobacco supply by implementing restrictions on tobacco import (Constitution of Brunei Darussalam, 2005), Indonesian president Joko Widodo has allowed Philip Morris – a giant transnational tobacco company – to increase investment in Indonesia (Thabrany, 2015). It is obvious why the rapid reduction in the prevalence of tobacco smoking, which occurred in many other countries, including neighboring countries, did not occur in Indonesia.

In the USA, the Department of Health and Human Services (U.S. DHHS) aimed to enhance the role of health professionals, including dentists, in the control of tobacco epidemic. The enhancement of dentists' role in tobacco control was undertaken by means of increasing tobacco use screening in dental care settings and increasing tobacco cessation counseling in dental care settings. (U.S. DHHS, 2010).

Smoking causes a number of oral conditions such as tooth discoloration (staining), bad breath, and impaired wound healing process (Terrades, Clarke, Mullally, & Stevenson, 2009), periodontal diseases, oral pre-cancer and tumor development (Lamster & Eaves, 2011). In Italy, the prevalence of dental caries was higher in heavy smokers as compared to never smokers (Campus *et al.*, 2011). In Mexico and the U.S., greater exposure to tobacco was significantly associated with a more severe dental caries (DMFT) (Zinser, Irigoyen, Rivera, Maupomé, Pérez & Velázquez, 2008; Gordan, Mc Edward, Garvan, Ottenga & Harris, 2011).

Therefore, this study aimed to examine the relationship between tobacco use and dental caries in Indonesian men. The primary research question of the study was whether greater exposure to tobacco smoking was associated with severe dental caries. To answer the question, the authors used the data from Basic Health Research (BHR) 2007, the latest population survey which covered dental caries issues. Other factors which are known to be causally related to dental caries and data on which were collected in the BHR were controlled for in this study. These included the site of housing (rural or urban), education (graduate from high school or not), ground water condition (e.g. consuming water with low levels of Fluor), socio-economic status (whether a respondent belongs to the group of underprivileged or rich people), etc.

## METHODS

### Source of data

Basic Health Research 2007 (BHR 2007), a national health survey conducted by the National Institute of Health Research and Development, Ministry of Health of Republic of Indonesia, was the source of data for this study. Information on socio-demographic characteris-

tics, tooth brushing, smoking behavior, and dental caries experience (DMFT) was obtained by well-trained enumerators. The study involved Indonesian men aged 45–54 years. The study sample included 53,942 individuals.

## Recoding socioeconomic status

Data management officers of BHR 2007 have categorized socioeconomic status of BHR 2007 respondents into five categories as follows:

a. Quintile 1 (the poorest);

b. Quintile 2 (the poor);

c. Quintile 3 (moderate);

d. Quintile 4 (the rich);

e. Quintile 5 (the richest).

The authors have collapsed this division into two categories:

a. The rich – quintiles 3 to 5;

b. The underprivileged – quintiles 1 and 2.

## Dental caries criteria

Intraoral examination on dental caries was performed with the use of a mouth mirror. Respondents were asked to rinse their mouth before the intraoral examination. A respondent was categorized as having dental caries if the enumerator found decay (D), missing (M) and/or filling (F) in one or more of the teeth. Afterwards, the DMFT score was recorded by the enumerators.

## Cutoff point of severe dental caries in this study

Subjects with severe dental caries in a population are defined as those with the top 30% of the population DMFT values (Ditmyer, Dounis, Mobley & Schwarz, 2010). The cutoff point for severe dental caries in this study was defined according

to the method of Malmo University (Malmo University, n.d.) and Leake *et al.* (Leake, Jozzy & Uswak, 2008):

1. Respondents in the study sample were ranked according to their DMFT values.

2. Approximately one-third of the study sample with the highest DMFT scores were defined as those with severe dental caries.

3. From this calculation, the lowest DMFT value of study participants with severe dental caries equaled 8. That is why the operational definition of severe dental caries in this study is DMFT $\geq$ 8 (Figure 1).

## Classification of smoking exposure

Brinkman index (BI) is an index of smoking exposure and is calculated by multiplying the average number of cigarettes smoked per day by the duration of daily smok-
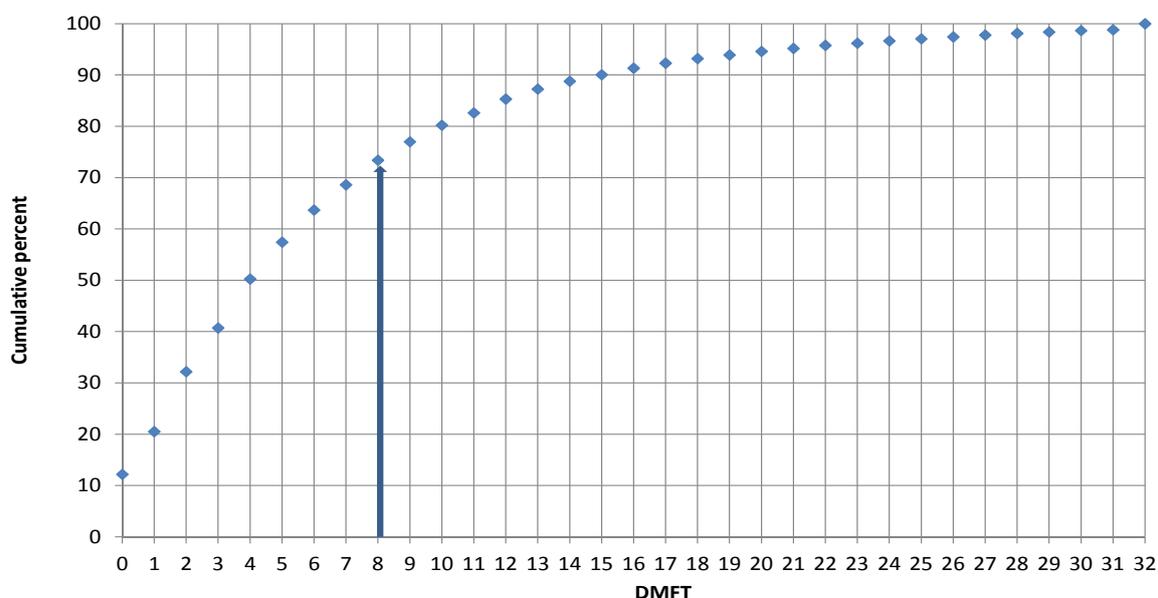


**Figure 1. DMFT value frequency distribution and severe dental caries cutoff point of Indonesian males aged 45–54 – Basic Health Research 2007.**

ing (in years) (Hamabe *et al.*, 2011). In this study, heavy smoking was defined as having BI≥400 (Hu, Sekine, Gaina, Wang & Kagamimori, 2007). Based on their smoking exposure, participants of this study were categorized into three groups: (1) never smokers (BI=0); (2) light smokers (BI 1–399); and (3) heavy smokers (BI≥400).

### Inclusion and exclusion criteria

Respondents were included in the analysis if data on DMFT indexes were available, and excluded if their smoking exposure (Brinkman index) could not be calculated (example: occasional smokers, former smokers, and regular smokers for whom there was no data on the duration of smoking). The final sample included 34,534 individuals.

### Statistical analysis

Chi-square test was used to examine the relationship between the outcome of interest – severe dental caries – and smoking exposure. Bivariate and multivariable logistic regression models were carried out to estimate unadjusted and adjusted associations between severe dental caries and heavy smoking on 5 percent significance level. Multivariable logistic regression also allowed estimation of adjusted ORs between the outcome of interest and other factors, which are known to be associated with dental caries. Thus, besides the main exposure variable, our final adjusted logistic regression model included the following covariates: ground water condition (whether the study participant lives in 'high-risk area' like in Bangka Island and South Kalimantan, or in the other provinces of Indonesia which are considered a 'safe area'), type of housing (ur-

ban or rural), age, education (in terms of the highest education level achieved by the respondent), main occupation, socioeconomic status, and tooth brushing frequency.

## RESULTS

### Univariate analysis

From a total of 34,534 respondents who were eligible, only 2.1% lived

**Table 1. Sociodemographic characteristics, dental caries severity, tooth brushing behavior and smoking exposure of study participants – Indonesian men aged 45–54 years – Basic Health Research, 2007**

|  | N | % |
|---|---|---|
| Ground water condition |  |  |
| (−)RH2AHLC/ LFC | 33,816 | 97.9 |
| (+)RH2AHLC/ LFC | 718 | 2.1 |
| Type of housing |  |  |
| Urban | 15,490 | 44.9 |
| Rural | 19,044 | 55.1 |
| Age (years) |  |  |
| 45–49 | 18,922 | 54.8 |
| 50–54 | 15,612 | 45.2 |
| Socioeconomic Status |  |  |
| Rich | 20,982 | 60.8 |
| Underprivileged | 13,552 | 39.2 |
| Education |  |  |
| SHS – graduated | 8,470 | 24.5 |
| SHS – did not graduate | 26,064 | 75.5 |
| Occupation |  |  |
| Army/ Police/ Gov/ Private Employees | 6,232 | 18.0 |
| Merchants | 8,963 | 26.0 |
| Laborers | 5,824 | 16.8 |
| Farmers/ Fishermen | 12,420 | 36.0 |
| Unemployed | 1,095 | 3.2 |
| Dental Caries Severity (DMFT) |  |  |
| Not severe (0–7) | 23,694 | 68,6 |
| Severe (≥ 8) | 10,840 | 31.4 |
| Tooth brushing frequency |  |  |
| At least once a day | 32,138 | 93.1 |
| Less than once a day | 2,396 | 6.9 |
| Smoking exposure (Brinkman index) |  |  |
| Never smokers (0) | 11,148 | 32.2 |
| Light smokers (1–399) | 15,978 | 46.3 |
| Heavy smokers (≥ 400) | 7,408 | 21.5 |
| Total | 34,534 | 100.0 |

(−) RH2AHLC/ LFC = Provinces where ground water was not Reported to have High Acidity and High Lead Concentration or Low Fluor Concentration

(+) RH2AHLC/ LFC = Provinces where ground water was Reported to Have High Acidity and High Lead Concentration or Low Fluoride Concentration)

in provinces with ground water reported to have high acidity and high lead concentration or low Fluor concentration (RHHA&HLC/LFC) (Table 1); 44.9% of respondents were living in urban areas; 54.8% were aged 45–49 years, while the rest 45.2% were 50–54 years old.

Based on the highest educational level achieved, the majority or 75.5% of respondents had education lower than Senior High School (SHS), and the rest 24.5% were graduates of SHS or other higher education institutions. The proportions of respondents based on their main occupation were as follows: (1) farmers or fishermen – 36%; (2) merchants – 26%; (3) army/police/government/private employee – 18.0%; (4) laborers – 16.8%; and (5) unemployed – 3.2%. From the point of view of socio-economic status, 60.7% of respondents were categorized as rich, and the rest 39.3% respondents were categorized as underprivileged. Severe dental caries (DMFT ≥ 8) was revealed in 31.4% of respondents. Tooth brushing at least once a day was reported by 93.1% of respondents and the rest 6.9% did so less often than once a day. The proportion of never smokers (BI = 0), light smokers (BI 1–399), and heavy smokers (BI ≥ 400) was 32.3%; 46.3%; and 21.4%, respectively.

### Bivariate analysis

Table 2 shows the results of bivariate analysis. The prevalence of severe dental caries in respondents who were never smokers, light smokers, and heavy smokers was 24.9%, 32.5%, and 38.7%, respectively (p<0.005).

### Multivariate Analysis

Table 3 shows the results of multivariate analysis with severe dental caries as the outcome of interest. As compared to never-smokers (BI=0), the adjusted OR of suffering from severe dental caries in light smokers (BI 1–399) was 1.45 (95% CI: 1.37–1.53), and in heavy smokers (BI≥400), the corresponding OR was 1.70 (95% CI: 1.59–1.81).

## DISCUSSION

### Main results and their comparison with published literature

This study found that the occurrence of severe dental caries was higher among those with greater smoking exposure. This is consistent with the finding of Campus *et al.* (2011) in Italy, which revealed that the prevalence of dental caries was higher in heavy smokers as compared to never smokers. The results of this study are also consistent with the finding of Zinser, Irigoyen, Rivera, Maupomé, Pérez & Velázquez (2008) in Mexico, as well as with the findings of Gordan, McEdward, Garvan, Ottenga & Harris (2011) in the USA. Both studies revealed that greater exposure to tobacco was significantly associated with a more severe dental caries expressed as DMFT value.

### Potential strengths and weaknesses of the study

This study has several advantages. First, the investigators had access to the data of Basic Health Research 2007, a nationwide community-based study that used a relatively large sample size. As known, larger sample sizes can provide greater precision in estimates

(Gonçalves, Paula, Ambrosano, Mialhe & Pereira, 2012; Kelsey, Whittemore, Evans & Thompson, 1996; DSS Research, 2015). Respondents of Basic Health Research 2007 were selected by the Central Bureau of Statistics in such a way that they would represent the population of Indonesia up to the district level.

Secondly, multivariable adjusted logistic regression model was carried out. This allowed estimating adjusted ORs between severe dental caries and heavy smoking, controlling for other covariates in the model.

However, this study had several limitations. First of all, dietary habits or, more precisely, the daily sugar intake covariate was not included in the logistic regression analysis. This was due to the lack of validity and reliability of the data on this matter in Indonesian Basic Health Survey 2007. Secondly, the main focus of this study was to assess the relationship between heavy smoking and dental caries severity regardless of the type of tobacco or cigarettes smoked by respondents. Thus, since the majority of Indonesian men consumed clove (kretek) cigarette, the results of this study could probably be applicable to Indonesian clove cigarette smokers. However, the authors admit that to find out whether heavy smoking might cause severe dental caries, a better study design is needed. One choice is to conduct a prospective cohort study.

### Further research

Based on the results of this study, additional research questions were generated. Specifically, further research is needed to find out what proportion of Indonesian dentists perform screening of smoking sta-

tus of their dental patients. Further on, there are no data on what percentage of Indonesian dentists perform smoking cessation counseling. Also, further research is recommended to find out whether giving additional lectures on this

matter to Indonesian dental students can help to increase the percentage of future Indonesian dentists who will perform smoking screening and smoking cessation counseling to their dental patients. Finally, further investigation is

needed to find out what behavior change approaches applied to dental practitioners in Indonesia can increase their participation in smoking screening and smoking cessation counseling.

**Table 2. Prevalence and crude odds ratios of severe dental caries (DMFT ≥ 8) in Indonesian men aged 45-54 years by socio-demographic characteristics, tooth brushing behavior and smoking intensity – Basic Health Research 2007**

| | N | DMFT < 8 (%) | ≥ 8 (%) | OR Estimate | p-value |
|---|---|---|---|---|---|
| Groundwater condition | | | | | |
| (–)RH2AHLC/ LFC | 33,816 | 69.0 | 31.0 | 1[a] | < 0.005 |
| (+)RH2AHLC/ LFC | 718 | 51.5 | 48.5 | 2.09 (1.80–2.42)[b] | |
| Site of housing* | | | | | |
| Urban | 15,490 | 71.5 | 28.5 | 1 | < 0.005 |
| Rural | 1944 | 66.3 | 33.7 | 1.28 (1.22–1.34) | |
| Age (years)* | | | | | |
| 45–49 | 18,922 | 74.4 | 25.6 | 1 | |
| 50–54 | 15,612 | 61.6 | 38.4 | 1.81 (1.72–1.89) | < 0.005 |
| Highest education * | | | | | |
| SHS – Graduated | 8,470 | 77.7 | 22.3 | 1 | < 0.005 |
| SHS – Did not graduate | 26,065 | 65.6 | 34.4 | 1.83 (1.73–1.94) | |
| Main Occupation * | | | | | |
| Army/Police/Gov/Private Employee | 6,232 | 78.0 | 22.0 | 1 | |
| Merchants | 8,962 | 69.5 | 30.5 | 1.56 (1,45–1.68) | |
| Laborers | 5,825 | 64.5 | 34.5 | 1.87 (1.73–2.03) | < 0.005 |
| Farmers/ Fishermen | 12,420 | 65.2 | 34.8 | 1.89 (1.77–2.03) | |
| Unemployed | 1,095 | 62.4 | 37.6 | 2.14 (1.87–2.45) | |
| Socio-Economic Status* | | | | | |
| Rich | 20,982 | 70.1 | 29.9 | 1 | < 0.005 |
| Underprivileged | 13,552 | 66.2 | 33.8 | 1.20 (1.14–1.25) | |
| Tooth Brushing Freq* | | | | | |
| Every day | 32,138 | 70.1 | 29.9 | 1 | < 0.005 |
| Not every day | 2,396 | 48.6 | 51.4 | 2.48 (2.28–2.70) | |
| Smoking intensity (BI)* | | | | | |
| Never smokers (0) | 11,148 | 75.1 | 24.9 | 1 | < 0.005 |
| Light smokers (1–399) | 15,978 | 67.5 | 32.5 | 1.45 (1.38–1.54) | |
| Heavy smokers (≥400) | 7,408 | 61.3 | 38.7 | 1.90 (1.78–2.03) | |

*Significantly different from its reference class, p < 0.005

[a] Reference group

[b] Numbers in parentheses are 95% confidence intervals (estimation achieved from logistic regression).

(–) RH2AHLC/ LFC = Provinces where ground water was not Reported to have High Acidity and High Lead Concentration or Low Fluor Concentration

(+) RH2AHLC/ LFC = Provinces where ground water was Reported to Have High Acidity and High Lead Concentration or Low Fluoride Concentration)

**Table 3. Adjusted odds ratios of severe dental caries (DMFT≥ 8) according to socio-demographic characteristics, tooth brushing behavior and smoking exposure in Indonesian men aged 45-54 years – Basic Health Research, 2007**

|  | B | S.E. | DF | P-value | Adjusted OR Estimate |
|---|---|---|---|---|---|
| Ground water condition* |  |  |  |  |  |
| (–)RH2AHLC/ LFC |  |  |  |  | 1[a] |
| (+)RH2AHLC/ LFC | 0.84 | 0.078 | 1 | <0.001 | 2.32 (1.99–2.71)[b] |
| Age (years)* |  |  |  |  |  |
| 45–49 |  |  |  |  | 1 |
| 50–54 | 0.56 | 0.024 | 1 | <0.001 | 1.74 (1.66–1.83) |
| Socioeconomic status* |  |  |  |  |  |
| Rich |  |  |  |  | 1 |
| Underprivileged | 0.05 | 0.025 | 1 | 0.039 | 1.05 (1.00–1.11) |
| Highest Education* |  |  |  |  |  |
| Graduated from SHS |  |  |  |  | 1 |
| Did not graduate from SHS | 0.33 | 0.037 | 1 | <0.001 | 1.39 (1.30–1.50) |
| Main occupation* |  |  |  |  |  |
| Army/ Police/ Gov./ Private Employee |  |  | 4 |  | 1 |
| Merchants | 0.21 | 0.043 | 1 | <0.001 | 1.24 (1.14–1.34) |
| Laborers | 0.26 | 0.049 | 1 | <0.001 | 1.30 (1.18–1.43) |
| Farmers/ Fishermen | 0.23 | 0.045 | 1 | <0.001 | 1.26 (1.15–1.37) |
| Unemployed | 0.44 | 0.074 | 1 | <0.001 | 1.56 (1.35–1.80) |
| Tooth brushing Freq. |  |  |  |  |  |
| Every day |  |  |  |  | 1 |
| Not every day | 0.75 | 0.044 | 1 | <0.001 | 2.11 (1.94–2.30) |
| Smoking exposure (BI) |  |  |  |  |  |
| Never smokers (0) |  |  | 2 |  | 1 |
| Light smokers (1–399) | 0.37 | 0.029 | 1 | <0.001 | 1.45 (1.37–1.53) |
| Heavy smokers (≥ 400) | 0.53 | 0.033 | 1 | <0.001 | 1.70 (1.59–1.81) |

*Significantly different from its reference group, p < 0.005

[a] Reference group

[b] Numbers in parentheses are 95% confidence intervals (estimation achieved from logistic regression).

(–) RH2AHLC/ LFC = Provinces where ground water was not Reported to Have High Acidity and High Lead Concentration or Low Fluor Concentration

(+) RH2AHLC/ LFC = Provinces where ground water was Reported to Have High Acidity and High Lead Concentration or Low Fluoride Concentration)

## CONCLUSIONS

This was a secondary analysis of cross-sectional data from Basic Health Survey 2007, a national health survey conducted by the National Institute of Health Research and Development, Ministry of Health Rep. of Indonesia. The aim of this study was to determine whether there was an association between heavy smoking and severe dental caries. The conducted analysis revealed that heavy smoking is associated with increased severe dental caries in Indonesian men.

**Implications for practice**

Indonesian dentists, individually and collectively (through Indonesian Dental Association) should be more intensively involved in accomplishment of tobacco control objectives. Together with other

health professional organizations, Indonesian dentists are supposed to contribute to the advancing of Indonesian nation from a smoking nation into a non-smoking one.

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## REFERENCES

Agtini, M. (2009, Sept). Pola status kesehatan gigi dan pemanfaatan pelayanan kesehatan gigi dan mulut di Indonesia pada Tahun 1990–2007. *Media Penelitian dan Pengembangan Kesehatan*. 19 (3), 144–53.

Badan Litbang Kesehatan, Kemenkes R.I. (2013). Pokok pokok Hasil Riskesdas Indonesia Tahun 2013. 31. Badan Litbang Kesehatan, Kemenkes R.I. (2013). Pokok pokok Hasil Riskesdas IJakarta: Badan Penelitian dan Pengembangan Kesehatan, Kemenkes R.I. Pp 11.

Campus, G., Cagetti, M. G., Senna, A., Blasi, G., Mascolo, A., Demarchi, P., *et al*. (2011, Apr). Does smoking increase risk for caries? A cross-sectional study in an Italian military academy. *Caries Res*. 45 (1), 40–6.

Chukwumah, N., Azodo, C., Adeghe, H., & Enabulele, J. (2012). Relating dental caries experience with body mass index among Nigerian primary school children: A cross-sectional survey. *J Educ Ethics Dent*. (2), 28–32.

Constitution of Brunei Darussalam. (2005, Jun 28). *Tobacco Order*. Retrieved Feb 12, 2015, from http://www.wipo.int: http://www.wipo.int/edocs/lexdocs/laws/en/bn/bn028en.pdf

Damyanov, N., Witter, D., Bronkhorst, E., & Creugers, N. (2012, Feb 24). Dental Status and Associated Factors in a Dentate Adult Population in Bulgaria: A Cross-Sectional Survey. *Int J Dent*, 1–11.

De Clerck, D., Leroy, R., Martens, L., Lesaffre, E., Garcia-Zattera, M., Vanden Broucke, S., et al. (2008). Factors associated with prevalence and severity of caries experience in preschool children. *Community Dent Oral Epidemiol*. 36 (2), 168–78.

Department of Health and Human Services. (2010). *Leading Health Indicators and Objectives - Tobacco Use*. Retrieved Mar 3, 2014, from http://www.healthypeople.gov: http://www.healthypeople.gov/2020/LHI/tobacco.aspx

Ditmyer, M., Dounis, G., Mobley, C., & Schwarz, E. (2010). A case-control study of determinants for high and low dental caries prevalence in Nevada youth. *BMC Oral Health*. 10 (24).

Djutaharta, T., Thabrany, H., Sung, H. Y., Ong, M. K., & Hu, T. W. (2012, March). Health-care Cost of Tobacco Related Diseases in Indonesia. In H. Thabrany, & P. Sarnantio, *Indonesia The Heaven for Cigarette Companies The Hell for the People* (pp. 61-86). Depok: Faculty of Public Health Universitas Indonesia.

DSS Research. (2015). *Statistical Power Calculator: Percentage, Two Sample*. Retrieved Mar 1, 2015, from https://www.dssresearch.com: https://www.dssresearch.com/KnowledgeCenter/toolkitcalculators/statisticalpowercalculators.aspx

Fernandes, M., & Ataide, I. (2010, Oct). Nonsurgical management of periapical lesions. *J Conserv Dent*. 13 (4), 240–5.

Frankel, G. (1996, Nov 18). Thailand Resists U.S. Brand Assault. Washington Post, p. A01

Gonçalves, J., Paula, J., Ambrosano, G., Mialhe, F., & Pereira, A. (2012 ). Cost Assessment of Epidemiologic Surveys in Dentistry. *Int J of Stat in Medical Research*. 1, 55–9.

Gordan, V. V., Mc Edward, D. L., Garvan, C. W., Ottenga, M. E., & Harris, P. A. (2011, Mar 14–19). *Association between patients' caries experience (DMFT) and demographic variables*. (Poster Session in International Association of Dental Research, 89th General Session and Exhibition. San Diego, California)

Gregoire, C. (2010). How are odontegenic infections best managed? *J Can Dent Assoc*, 76 (2), 114–6.

Gupta, P., Gupta, N., & Singh, H. (2014). Prevalence of Dental Caries in relation to Body Mass Index, Daily Sugar Intake, and Oral Hygiene Status in 12-Year-Old School Children in Mathura City: A Pilot Study. *Int J of Pediatr*, (2014): 1–5.

Hamabe, A., Uto, H., Imamura, Y., Kusano, K., Mawatari, S., Kumagai, K., et al. (2011). Impact of cigarette smoking on onset of nonalcoholic

fatty liver disease over a 10-year period. *J Gastroenterol*. 46 (6), 769–78.

Higham, S. (2009). *Caries Process and prevention strategies: The Agent. A Multi-factorial Disease*. Retrieved Sep 21, 2014, from http://www.dentalcare.com: http://www.dentalcare.com/en-US/dental-education/continuing-education/ce369/ce369.aspx?ModuleName=coursecontent&PartI

Hoskison, E., Daniel, M., Rowson, J. E., & Jones, N. (2012, Jan). Evidence of an increase in the incidence of odontogenic sinusitis over the last decade in the UK. *J Laryng & Oto*. 126 (1), 43–6.

Hu, L., Sekine, M., Gaina, A., Wang, H., & Kagamimori, S. (2007). Nested case-control study on associations between lung function, smoking and mortality in Japanese population. *Environ Health Prev Med*. 12 (6), 265–71.

Kelsey, J., Whittemore, A., Evans, A., & Thompson, W. (1996 ). *Methods in observasional epidemiology. Chapter 12: Methods of sampling and estimation of sample size*. New York: Oxford University Press. Pp. 311, 327–33.

Lamster, I., & Eaves, K. (2011). A model for dental practice in the 21st century. *AJPH*. 101 (10), 1825–30.

Leake, J., Jozzy, S., & Uswak, G. (2008, Jul/ Aug). Severe Dental Caries, Impacts and Determinants Among Children 2–6 Years of Age in Inuvik Region, Northwest Territories, Canada. *JCDA*.74 (6), 519 a–g.

Malmo University. (n.d.). *Oral Health Data Base - Significant Caries Index (SiC Index)*. Retrieved Sept 24, 2014, from http://www.mah.se: http://www.mah.se/CAPP/Methods-and-Indices/for-Caries-prevalence/Significant-Caries-Index/

Ministry of Health, Rep. of Indonesia. (2012). *Global Adult Tobacco Survey (GATS): Indonesia Report 2011 - Executive Summary*. Jakarta: MOH

RI in collaboration with BPS Statistics Indonesia, WHO SEARO and CDC Foundation.

Moreira, R. (2012, Feb 29). *Chapter. 8. Epidemiology of Dental Caries in the World*. in "Oral Health Care - Pediatric, Research, Epidemiology and Clinical Practices", Virdi, M.S. [Editor]. (InTech) Retrieved Mar 20, 2013, from http://cdn.intechopen.com: http://cdn.intechopen.com/pdfs/29340/InTech-Epidemiology_of_dental_caries_in_the_world.pdf

Moses, J. M., Rangeeth, B. N., & Gurunathan, D. (2011, Feb). Prevalence Of Dental Caries, Socio-Economic Status And Treatment needs of 15 years Old School Going Children Of Chidambaram. *J Clin and Diag Res*. 5 (1), 146–51.

Padilha, D. M., Hilgert, J. B., Hugo, F. N., Bós, Â. J., & Ferrucci, L. (2008). Number of teeth and mortality risk in the baltimore longitudinal study of aging. *J Geron*. 63A (7), 739–44.

Schuknecht, B., Stergiou, G., & Graetz, K. (2008, Sep). Masticator space abscess derived from odontogenic infection: imaging manifestation and pathways of extension depicted by CT and MR in 30 patients. *European Radiology*. 18 (9), 1972–9.

Soden, R., Botero, T., Hanks, C., & Nör, J. (2009, Sep). Angiogenic Signaling Triggered by Cariogenic Bacteria in Pulp Cells. *J Dent Res*. 88 (9), 835–40.

Srinivas, K., Sumanth, K., & Chopra, S. (Oct 2009). Ultrasonic evaluation of inflamatory swelling of buccal space. *Indian Journal of Dental Research*, 20 (4), 458–62.

Tanaka, K., Miyake, Y., Sasaki, S., & Hirota, Y. (2012). *Dairy products and calcium intake during pregnancy and dental caries in children*. Retrieved Apr 17, 2013, from http://www.nutritionj.com: http://www.nutritionj.com/content/11/1/33

Thabrany, H. (2015, November 30). *Presiden dan rokok (President and cigarettes) (in Indonesian language)*.

Retrieved Nov 17, 2016, from http://nasional.kompas.com: http://nasional.kompas.com/read/2015/11/30/18000031/Presiden.dan.Rokok?page=all

Terrades, M. C., Clarke, H., Mullally, B. H., & Stevenson, M. (2009). Patients' knowledge and views about the effects of smoking on their mouths and the involvement of their dentists in smoking cessation activities, *British Dent J*. 207 (E22). Retrieved Nov 1, 2013, from http://www.nature.com ml: http://www.nature.com/bdj/journal/v207/n11/full/sj.bdj.2009.1135.html U.S.

U.S. FDA. (2013, Mar 21 (last updated)). *Flavored tobacco*. Retrieved Feb 15, 2015, from http://www.fda.gov: http://www.fda.gov/TobaccoProducts/ProtectingKidsfromTobacco/FlavoredTobacco/default.htm

U.S. FDA. (2014, Sept 9 (last updated)). *Overview of the Family Smoking Prevention and Tobacco Control Act: Consumer Fact Sheet*. Retrieved Feb 15, 2015, from http://www.fda.gov: http://www.fda.gov/tobaccoproducts/guidancecomplianceregulatoryinformation/ucm246129.htm

Wellappuli, N., & Amarasena, N. (2012). Influence of family structure on dental caries experience of preschool children in Sri Lanka. *Caries Research*. 46 (3), 208–12.

Wiyono, N., & Ahsan, A. (2015). Chapter 4. Pertanian tembakau dan cengkeh (Tobacco and clove farming). In A. Ahsan, & N. Wiyono, *Bunga Rampai - Fakta Tembakau dan Permasalahannya (Tobacco and it's problems) (in Indonesian language)* (pp. 57–58). Jakarta: Tobacco Control Support Center - Ikatan Ahli Kesehatan Masyarakat Indonesia (Indonesian Public Health Association).

Zinser, V., Irigoyen, M., Rivera, G., Maupomé, G., Pérez, L., & Velázquez, C. (2008, Aug). Cigarette smoking and dental caries among professional truck drivers in Mexico. *Caries Res*. 42 (4), 255–62.