Comparison of Knowledge about Smoking and Passive Smoking and Urinary Cotinine Levels in Pregnant Women and their Partners in Mongolia: A Cross-sectional Study

Naoko Hikita\textsuperscript{a}, Megumi Haruna\textsuperscript{a}, Masayo Matsuzaki\textsuperscript{b}, Emi Sasagawa\textsuperscript{a}, Minoru Murata\textsuperscript{c}, Ariunaa Yura\textsuperscript{d}, and Otgontogoo Oidovsuren\textsuperscript{e}

Abstract

This study aimed to compare knowledge about smoking, including passive smoking, and urinary cotinine (UC) levels in pregnant women and their partners in Mongolia. The study was conducted between November 2015 and January 2016 in Darkhan-Uul Province, Mongolia. Pregnant women with less than 20 weeks’ gestation were recruited, and their partners were also invited to participate. Self-administered questionnaires and urine samples were used to collect data. Knowledge about smoking including passive smoking was measured using 14 questions. Data were analyzed using a Student’s $t$-test, a chi-squared test, a one-way analysis of variance, and the Tukey–Kramer method for post-hoc analysis. Correlations were measured by computing Pearson’s $r$ or Spearman’s $\rho$. A total of 508 pregnant women and 227 partners participated in this study; of these, 221 couples’ data were analyzed. Pregnant women’s scores on knowledge about smoking and passive smoking were significantly higher than those of their partners ($9.4 \pm 2.9$ and $8.7 \pm 3.1$, respectively; $p = 0.017$). Pregnant women’s and their partners’ scores were slightly correlated ($r = 0.163$, $p = 0.015$). Pregnant women’s and their partners’ UC levels were significantly correlated ($\rho = 0.250$, $p < 0.001$). This study is the first to examine knowledge about smoking and passive smoking and UC levels among pregnant women and their partners in Mongolia. Because pregnant women’s and their partners’ scores and UC levels were positively correlated, health education on the harm caused by smoking and passive smoking should be provided to both pregnant women and their partners.

Keywords: health education, smoking prevention, smoking, passive smoking, pregnant women

Background

In Mongolia, it has been reported that 48.0% of men and 6.9% of women are smokers, and 42.9% of people are exposed to secondhand smoke (SHS) at home (World Health Organization, 2009). Smoking and passive smoking are harmful to one’s health: they increase the risk or exacerbate the severity of cancer, respiratory diseases, and cardiovascular diseases (U.S. Department of Health and Human Services, 2014). Smoking and passive smoking during pregnancy harm the women and fetuses; maternal smoking increases risks for ectopic pregnancy, premature rupture of membranes, abruptio placenta, miscarriage, stillbirth, preterm birth, low birth weight, and so on (World Health Organization, 2013). Passive smoking during pregnancy...
has been shown to increase the risks of pre-eclampsia (Luo et al., 2014), foetal congenital malformation (Leonardi-Bee, Britton, & Venn, 2011; Salmasi, Grady, Jones, McDonald, & Knowledge Synthesis Group, 2010), stillbirth (Leonardi-Bee et al., 2011), small size for gestational age (Lee, Lee, Lee, Paek, & Lee, 2015; Leonardi-Bee, Smyth, Britton, & Coleman, 2008), infants’ low birthweight (Leonardi-Bee et al., 2008; Windham, Eaton, & Hopkins, 1999), and sudden infant death syndrome (US Surgeon General, 2006).

A previous study reported that persons with more knowledge of the effects of tobacco on health are associated with greater likelihood of tobacco cessation (Chow et al., 2017; Yang, Hammond, Driezen, Fong, & Jiang, 2010). Another study reported that employers with a higher level of knowledge of smoking are more likely to promote smoking cessation in the workplace (Wang et al., 2017), while pregnant women who have less knowledge about passive smoking are significantly more likely to be exposed to SHS (Norsa’adah & Salinah, 2014; Yang, Tong, Mao, & Hu, 2010). Considering these results, knowledge about smoking and passive smoking could be an important factor in improving people’s health outcomes, especially during pregnancy. This is because pregnancy is considered to be a “teachable moment,” which is the ideal time to modify and improve lifestyle or behavior (McBride, Emmons, & Lipkus, 2003).

In Mongolia, there has been no study investigating knowledge about smoking and passive smoking that has targeted pregnant women and their partners. To reduce passive smoking in pregnant women, it is necessary to involve their family members, especially their partners, because pregnant women are often exposed to smoke involuntarily. In fact, a previous study has reported that non-smoking pregnant women’s self-awareness of SHS exposure is not accurate, compared with the levels of exposure suggested by their urinary cotinine (UC) levels (Hikita et al., 2017); cotinine is the major metabolite of nicotine, a sensitive marker of passive smoking, and widely used to assess exposure to smoke (Benowitz, 1996; Wald et al., 1984). Thus, it would certainly be possible that pregnant women are exposed to smoke unknowingly.

If we can verify that knowledge about smoking and passive smoking is related to smoking behavior, we could suggest improving health education to reduce smoking and passive smoking during pregnancy. Therefore, we believe that investigating knowledge about smoking and passive smoking among pregnant women and their partners is important to understand their present situation. Furthermore, if we can verify that pregnant women are exposed to smoke from their partners, it would be important to involve their partners in the health education classes.

The aim of this study was to compare knowledge about smoking and passive smoking and UC levels in pregnant women and their partners in Mongolia.

**Methods**

**Study Design and Population**

This cross-sectional study was conducted between November 2015 and January 2016 in Darkhan-Uul Province, Mongolia. Pregnant women who presented with less than 20 weeks’ gestation were recruited by trained personnel at ten public health facilities when they attended antenatal health check-ups. Their partners were also asked to participate. Pregnant women who could not understand spoken Mongolian or had difficulty in participating were excluded.

Data collection was carried out by trained medical personnel using self-administered questionnaires and analysis of urine samples. If participants had difficulty answering the questionnaires due to low literacy levels, the trained medical personnel helped them.

**Questionnaire**

Socio-demographic data collected included age, educational attainment, employment status, monthly household income, number of family members, number of children living together, and information about the type of dwelling (detached house, condominium, ger [traditional tent-like home], or other). Participants were also asked to provide gestational age from the last menstrual period before the survey (as a re-confirmation), and their current smoking status (response options were daily, less than daily, not at all, and don’t know).

We asked a total of 14 questions about smoking and passive smoking, which were adapted from previous studies (Araki, Tanimoto, Fujii, Takato, & Yamaguchi, 1994; Nicholson, Borland, Couzos, Stevens, & Thomas, 2015), to measure participants’ knowledge. These consisted of eight True/False items and six Yes/No items, producing scores ranging from 0 to 14. The True/False items, with response options true, false, or don’t know, are shown in Appendix 1. The Yes/No items, with response options yes, no, or don’t know, are shown in Appendix 2. If participants skipped a question or selected don’t know, it was considered an incorrect answer, so these responses scored 0.
Biochemical Verification of Smoking Status

In this study, we collected urine samples to verify participants’ smoking status. Participants were asked to provide urine samples after completion of the questionnaires; the samples were kept at −20 °C until analysis.

UC levels were measured using a cotinine enzyme-linked immunosorbent assay kit (Calbiotech Inc., Spring Valley, CA, USA). We requested that all UC measurement be carried out at the GYALS Medical Center, LLC in Ulaanbaatar. Absorbance was assayed using the Microplate Reader MR-96A (Shenzhen Mindray Bio-Medical Electronics Co., Ltd., Shenzhen, China) at a wavelength of 450 nm. The lower and upper limits of quantification of the kit were set at 5 ng/ml and 100 ng/ml, respectively. The intra-assay coefficient of variation was 16%, while the inter-assay coefficient was 74%.

We determined the smoking status of participants according to their UC levels regardless of their self-report. Participants with UC levels >100 ng/ml were classified as “biochemically determined smokers,” (Lee, Kim, & Lee, 2014) with 5–100 ng/ml as “passive smokers,” and with <5 ng/ml as “non-smokers.” The cut-off between passive smokers and biochemically determined smokers was set at >100 ng/ml to exclude passive smokers because previous studies reported that non-smokers’ UC levels did not exceed 100 ng/ml (Biber et al., 1987; Haufroid & Lison, 1998). The cut-off of 5 ng/ml between non-smokers and passive smokers was determined in this study because a report by the US Surgeon General concluded that even minor exposure to tobacco smoke can be harmful to health (US Surgeon General, 2006). These criteria were adopted from a previous study so that the results could be compared (Hikita et al., 2017).

Statistical Analysis

We calculated descriptive statistics for all variables and used the chi-squared test and Student’s t-test to compare pregnant women’s and their partners’ characteristics. Pregnant women’s and their partners’ scores on knowledge about smoking and passive smoking were compared using the Student’s t-test. One-way analysis of variance, with the Tukey–Kramer method for post-hoc analysis, were performed to compare scores among three or more categories. Spearman’s rank-correlation coefficient and Pearson’s product moment correlation coefficient were used to assess the correlation. All data were analyzed using IBM SPSS Statistics 25.0 for Windows (IBM Corp., Armonk, NY, USA). Two-tailed p-values < 0.05 were considered statistically significant.

Results

Participants’ Characteristics and Smoking and Passive Smoking Knowledge Scores

A total of 508 pregnant women and 227 partners participated in this study. Of these, 15 women and three partners completed the questionnaires twice at different health facilities; therefore, we used only the responses from the questionnaires that were completed first. Furthermore, we were able to pair the responses of only 221 women with those of their partners. As such, data from 221 couples were analyzed. The questionnaire’s internal consistency, as measured with Cronbach’s alpha, was 0.721.

Table 1 shows the characteristics of 221 pairs of participants. Maternal age (mean ± SD) was 27.3 ± 5.8 years, and 120 (54.3%) pregnant women were university graduates, while partners were aged 28.6 ± 6.3 years, and 88 (39.8%) were university graduates. The number of children living at home was 1.4 ± 1.1, and the mean gestational age at recruitment was 13.1 ± 4.8 weeks.

According to participants’ self-reports, of the pregnant women, two (0.9%) were daily smokers, nine (4.1%) were nondaily smokers, 201 (90.9%) were non-smokers, and nine (4.1%) did not answer; of their partners, 96 (43.4%) were daily smokers, 38 (17.2%) were nondaily smokers, 84 (38.0%) were non-smokers, and three (1.4%) did not answer. According to participants’ UC levels, 23 (10.4%) pregnant women were biochemically determined smokers, 88 (39.8%) were passive smokers, and 110 (49.8%) were non-smokers; 142 (64.2%) partners were biochemically determined smokers, 32 (14.5%) were passive smokers, 45 (20.4%) were non-smokers, and two (0.9%) partners’ UC levels were not available.

The mean (±SD) score for knowledge about smoking and passive smoking among pregnant women was 9.4 (±2.9), while the mean score among their partners was 8.7 (±3.1), and pregnant women’s scores were significantly higher than those of partners (p = 0.017). Furthermore, pregnant women’s scores were significantly correlated with those of their partners (Pearson’s r = 0.163, p = 0.015; data not shown).

Comparison of Scores on Knowledge about Smoking and Passive Smoking by Characteristics

Table 2 shows comparison of scores on knowledge about smoking and passive smoking by characteristics. The scores of pregnant women significantly differed according to the levels of
Table 1  Characteristics of Participants (n = 221 Couples)

|                        | Pregnant women | Partners | p   |
|------------------------|----------------|----------|-----|
|                        | Mean ± SD or n (%) | Mean ± SD or n (%) |     |
| Age (years)            | 27.3 ± 5.8     | 28.6 ± 6.3 | 0.027 |
| Educational attainment |                |          |     |
| ≤ Lower secondary school | 18 (8.1)     | 27 (12.2) |     |
| ≥ Upper secondary school | 81 (36.7)     | 105 (47.5) |     |
| ≥ University           | 120 (54.3)     | 88 (39.8) |     |
| Missing                | 2 (0.9)        | 1 (0.5)  |     |
| Employment status      |                |          | <0.001a |
| Employed               | 89 (40.3)      | 117 (52.9) |     |
| Self-employed          | 29 (13.1)      | 42 (19.0) |     |
| Nomad                  | 6 (2.7)        | 9 (4.1)  |     |
| Unemployed             | 94 (42.5)      | 49 (22.2) |     |
| Others                 | 0 (0.0)        | 1 (0.4)  |     |
| Missing                | 3 (1.4)        | 3 (1.4)  |     |
| Monthly household incomeb |            |          |     |
| ≤ T400,000             | 64 (29.0)      | NA       |     |
| ≥ T410,000–800,000     | 105 (47.5)     |          |     |
| ≥ T810,000             | 42 (19.0)      |          |     |
| Missing                | 10 (4.5)       |          |     |
| Type of dwelling       |                |          |     |
| Detached house         | 57 (25.8)      | NA       |     |
| Condominium            | 113 (51.1)     |          |     |
| Ger                    | 38 (17.2)      |          |     |
| Others                 | 9 (4.1)        |          |     |
| Missing                | 4 (1.8)        |          |     |
| Number of family membersc |           |          | NA  |
| Number of children living togetherd | 1.4 ± 1.1 |          |     |
| Gestational age at recruitment | 13.1 ± 4.8 |          |     |
| Self-reported smoking status |         |          | <0.001a |
| Non-smoker             | 201 (90.9)     | 84 (38.0) |     |
| Nondaily smoker        | 9 (4.1)        | 38 (17.2) |     |
| Daily smoker           | 2 (0.9)        | 96 (43.4) |     |
| Missing                | 9 (4.1)        | 3 (1.4)  |     |
| UC determined smoking status |        |          | <0.001a |
| <5 ng/ml (non-smokers) | 110 (49.8)     | 45 (20.4) |     |
| 5–100 ng/ml (passive smokers) | 88 (39.8) | 32 (14.5) |     |
| >100 ng/ml (biochemically determined smokers) | 23 (10.4) | 142 (64.2) |     |
| Missing                | 0 (0.0)        | 2 (0.9)  |     |
| Score of knowledge     | 9.4 ± 2.9      | 8.7 ± 3.1 | 0.017 |

SD: standard deviation. Student’s t-test was used for analysis.

a Chi-squared test was used for analysis. Missing data was excluded from analysis.

b T20,000 = US$10.

c Missing for 9 participants.

d Missing for 24 participants.
educational attainment ($p<0.001$), and those of pregnant women who had graduated from university were significantly higher than those of women who had only graduated from upper secondary school ($10.2 \pm 2.5$ and $8.5 \pm 3.1$, respectively; $p<0.001$); this pattern was not observed among men. Furthermore, the scores of pregnant women significantly differed according to the self-reported smoking status ($p=0.002$), and those of pregnant women who identified as non-smokers were significantly higher than those of women who did not report their smoking status ($9.6 \pm 2.7$ and $8.9 \pm 3.5$, respectively; $p=0.001$). When the scores were separately analyzed in terms of active or passive smoking questions, significant differences were not seen between pregnant women who identified as non-smokers and those who self-reported that they were smokers (data not shown).

**Correlation between Pregnant Women’s and their Partners’ UC Levels**

Table 3 shows the correlation between pregnant women’s and their partners’ UC levels. Two partners’ UC data were not available; thus, data of 219 pairs of participants were analyzed. Among pregnant women whose UC levels were $5–100$ ng/ml, 71.3% of partners had UC levels $>100$ ng/ml, while among pregnant women whose UC levels were $>100$ ng/ml, 82.6% of partners had UC levels $>100$ ng/ml. Though the correlation coefficient was small, it is still significantly correlated (Spearman’s $r$ was $0.250$, $p<0.001$).

**Correlation between Pregnant Women’s UC levels and Partners’ Knowledge**

Table 4 shows the correlation between pregnant women’s UC levels and partners’ scores on knowledge about smoking and passive smoking. The scores of partners whose pregnant wives’ UC levels were $<5$ ng/ml were significantly higher than those of partners whose pregnant wives’ UC levels were $>100$ ng/ml ($9.1 \pm 3.2$ and $7.5 \pm 3.3$, respectively; $p=0.049$). However, a correlation between pregnant women’s knowledge scores and their partners’ UC levels was not observed (data not shown).
Table 3 Correlation between Pregnant Women’s and their Partners’ Urinary Cotinine (UC) Concentration Levels (n = 219 Couples)\(^a\)

| Partners’ UC concentration | \(p\) | \(n\) | (%) | \(n\) | (%) | \(n\) | (%) |
|-----------------------------|-------|-------|------|-------|------|-------|------|
| <5 ng/ml (n = 45)           |       | 37    | (33.9)| 11    | (10.1)| 61    | (56.0)|
| 5–100 ng/ml (n = 32)        | <0.001| 8     | (9.2)| 17    | (19.5)| 62    | (71.3)|
| >100 ng/ml (n = 142)        |       | 0     | (0.0)| 4     | (17.4)| 19    | (82.6)|

Chi-squared test was used for analysis.
\(^a\) 2 partners’ UC data were not available, and thus 219 couples of participants’ data were analyzed.

Spearman’s rank-correlation coefficient \(= 0.250 (p < 0.001)\).

Table 4 Correlation between Pregnant Women’s Urinary Cotinine (UC) Concentration Levels and their Partners’ Scores on Knowledge about Smoking and Passive Smoking (n = 221 Couples)

| Partners’ score on knowledge | \(p\) | \(n\) | Mean ± SD |
|-----------------------------|-------|-------|-----------|
| <5 ng/ml                    |       | 110   | 9.1 ± 3.2\(^a\) |
| 5–100 ng/ml                 |       | 88    | 8.5 ± 2.8 |
| >100 ng/ml                  |       | 23    | 7.5 ± 3.3\(^a\) |

One-way analysis of variance was used for analysis.
\(^a\) Significant difference was seen between these two groups. \(p = 0.049\). Tukey–Kramer method.

Spearman’s rank-correlation coefficient \(= –0.180 (p = 0.007)\).

Discussion

This study is the first to examine knowledge about smoking and passive smoking and UC levels among pregnant women and their partners in Mongolia. Pregnant women’s scores on knowledge on this topic were significantly higher than those of their partners. Furthermore, pregnant women’s scores and their partners’ scores were positively correlated. The scores of pregnant women who had graduated from university were significantly higher than those of pregnant women who had only graduated from upper secondary school. Pregnant women’s UC levels were positively correlated with their partners’ UC levels, while the knowledge scores of partners whose pregnant wives’ UC levels were <5 ng/ml were significantly higher than those of partners whose pregnant wives’ UC levels were >100 ng/ml.

Comparison and Correlation of Knowledge about Smoking and Passive Smoking

In this study, 54.3% pregnant women and 39.8% of their partners had graduated from university. In Mongolia, women’s educational attainment is generally higher than that of men (Batsukh, Altankhuuyag, & Osorgarav, 2013; Burn & Oidov, 2001), and it has been reported that 76.5% women have been enrolled in tertiary education (United Nations Educational, Scientific and Cultural Organization, 2018), and the ratio of female to male students in tertiary education is 1.4:1 (Batsukh et al., 2013). Thus, the educational level of our participants was lower than that of the general population in Mongolia, though the ratio of female to male graduates among our participants approximately reflected the national ratio.

In this study, pregnant women’s scores on knowledge about smoking were significantly higher than those of their partners. This might be due to the difference in educational levels. Furthermore, pregnant women who had graduated from university had significantly higher knowledge scores than did women who had only graduated from upper secondary school, while this pattern was not observed among men. Previous studies have reported that people with higher educational attainment obtain higher scores on knowledge on this topic (Demaio, Nehme, Ogtontuya,
were positively correlated with their partners' UC concentration levels. In addition, when the scores were analyzed, the internal consistency of the questionnaire was acceptable. In previous studies (Araki et al., 1994; Nicholson et al., 2015), and their Cronbach’s alpha was 0.721; thus, the internal consistency of the questionnaire was acceptable. In addition, when the scores were analyzed, no significant differences were found between those pregnant women who self-reported that they smoked and those who self-reported that they did not smoke.

**Correlation between Pregnant Women’s and their Partners’ UC Concentration Levels**

In this study, pregnant women’s UC levels were positively correlated with their partners’ UC levels. This suggests that pregnant women might be exposed to smoke from their partners. A previous study reported that pregnant women whose partners smoke were at a higher risk of SHS (Aurrekoetxea et al., 2014). However, since the correlation coefficient was small in this study, the possibility that pregnant women were exposed to smoke from people other than their partners could not be denied. Furthermore, in Mongolia, smoking in public areas such as restaurants, bars, hotels, buses, and workplaces is prohibited by law; thus, smokers tend to smoke outside and at their home. In any case, it is still essential to provide health education for pregnant women and their partners, as well as other household members, on the harm caused by smoking and passive smoking.

The knowledge scores of partners whose pregnant wives’ UC levels were >100 ng/ml were significantly lower than those of partners whose pregnant wives’ UC levels were <5 ng/ml. This result indicates that partners of pregnant wives who were biochemically determined smokers did not have enough knowledge about smoking and passive smoking to allow them to avoid its harmful effects. However, the converse result was not observed, which indicates that even if pregnant women had high levels of knowledge, it did not change their partners’ smoking behavior.

Pregnancy is a good time for women and their partners to become motivated to protect their own health and that of their fetus—in other words, it can be considered a “teachable moment” (DiClemente, Dolan-Mullen, & Windsor, 2000; McBride et al., 2003). Therefore, teaching pregnant women, their partners, and other household members about the harm of smoking and passive smoking during pregnancy is very important for increasing awareness of their own and their children’s health. Furthermore, medical personnel should promote reduction in exposure and offer smoking cessation support (World Health Organization, 2013).

**Strengths and Limitations**

Above all, this is the first study to have measured pregnant women’s and their partners’ knowledge about smoking and passive smoking in Mongolia. Furthermore, this study revealed that pregnant women’s and their partners’ UC levels were positively correlated. Using biological markers such as UC in middle-income countries is somewhat difficult due to the lack of funds and measurement instruments and insufficient infrastructure. Thus, these results are extremely valuable.

Despite this strength, there are several limitations as well. First, we used only 14 items to
measure participants’ knowledge about smoking and passive smoking. There were no significant differences in knowledge scores among partners according to socio-demographic differences. This might be due to the small number of questions or insufficient sensitivity of those questions. However, Cronbach’s alpha was 0.721; thus, the internal consistency of the questionnaire was acceptable. Second, because our sample was not reflective of the general population in Mongolia (educational levels of our participants were lower than those of the general population), the results cannot be generalized to the entire Mongolian population. Third, our data analysis was limited, and we could not adjust for some confounding factors. Fourth, the intra- and inter-plate assay percent coefficient of variation were fairly high, indicating that the results must be cautiously interpreted. However, as we treated UC concentration as categorical data, most inaccuracies were unlikely to affect the outcomes of the analysis.

Regarding the clinical implications of this study, our results suggest that because pregnant women’s UC levels were correlated with their partners’ UC levels, health education on the harm caused by smoking and passive smoking during pregnancy should be provided not only for pregnant women but also for their partners.

Conclusions

This study was the first to examine knowledge about smoking and passive smoking among pregnant women and their partners in Mongolia. Scores on knowledge on this topic differed significantly between pregnant women and their partners. The scores of pregnant women who had graduated from university were significantly higher than those of women who had only graduated from upper secondary school, while such a difference was not observed among their partners. Because pregnant women’s and their partners’ UC levels were positively correlated, it is suggested that pregnant women might be exposed to smoke from their partners; thus, health education on the harm caused to their health by smoking and passive smoking should be provided for both pregnant women and their partners. In addition, individual- or group-based interventions for pregnant women with the goal of enhancing knowledge regarding the harms, susceptibility, severity of exposure to SHS, and benefits of avoiding SHS could be also effective (Chi, Sha, Yip, Chen, & Chen, 2016). Future research investigating the effects of health education on the harm caused by smoking and passive smoking for pregnant women and their partners should be conducted.

Ethical Approval and Consent to Participate

This study was approved by the Research Ethics Committee of the Graduate School of Medicine at the University of Tokyo, Japan (No. 10934), and the Ethical Review Board of the Ministry of Health, Mongolia (No. 06, 19 November 2015). Participants were informed of the purpose and details of this study and that the results of this study would be kept confidential. Participation was emphasized as voluntary, and written informed consent was obtained from all participants. This study’s protocol complied with the principles of the Declaration of Helsinki (World Medical Association, 2013).

Acknowledgments

We thank Battsergul Buyannemekh at the Mongolian Health Agency and Erdenetulga Buyandalai at Darkhan-Uul General Hospital for their coordination.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest concerning the research, authorship, or publication of this article.

Funding

This study was conducted using funds from the Japan International Cooperation Agency (JICA) Partnership Program and Research Assistant Program from the Graduate School of Medicine at the University of Tokyo.

References

Araki, T., Tanimoto, M., Fujii, M., Takato, J., & Yamaguchi, T. (1994). A study on the smoking habits of female students: Female students in a certain junior college in Okayama Prefecture. Journal of Chu-goku Junior College, 25, 1–12.

Aurrekoetxea, J. J., Murcia, M., Rebagliato, M., Fernández-Somoano, A., Castilla, A. M., Guxens, M., … Santa-Marina, L. (2014). Factors associated with second-hand smoke exposure in non-smoking pregnant women in Spain: Self-reported exposure and urinary cotinine levels. The Science of the Total Environment, 470–471, 1189–1196. https://doi.org/10.1016/j.scitotenv.2013.10.110

Batsukh, B., Altankhuyag, G., & Osorgarav, I. (2013). Achieving the millennium development goals—Fifth national progress report 2013. Government of Mongolia.

Benowitz, N. L. (1996). Cotinine as a biomarker of environmental tobacco smoke exposure. Epidemiologic
Demaio, A. R., Nehme, J., Otgontuya, D., Meyrowitsch, D., Chow, C. K., Corsi, D. J., Gilmore, A. B., Kruger, A., Igum-Burn, N., & Oidov, O. (2001). Women in Mongolia—Mapping attitudes and practices study. Toxicology Letters, 35(1):45–52. https://doi.org/10.1016/0378-4274(87)90084-1

Burn, N., & Oidov, O. (2001). Women in Mongolia—Mapping progress under transition. United Nations Development Fund for Women.

Chi, Y. C., Sha, F., Yip, P. S., Chen, J. L., & Chen, Y. Y. (2016). Randomized comparison of group versus individual educational interventions for pregnant women to reduce their secondhand smoke exposure. Medicine, 95(40):e5072. https://doi.org/10.1097/MD.0000000000005072

Chow, C. K., Corsi, D. J., Gilmore, A. B., Kruger, A., Igumbor, E., Chifamba, J., … Yusuf, S. (2017). Tobacco control environment: Cross-sectional survey of policy implementation, social acceptability, knowledge of tobacco health harms and relationship to quit ratio in 17 low-income, middle-income and high-income countries. BMJ Open, 7(3):e013817. https://doi.org/10.1136/bmjopen-2016-013817

Demiao, A. R., Nehme, J., Otgontuya, D., Meyrowitsch, D. W., & Enkhtuya, P. (2014). Tobacco smoking in Mongolia: Findings of a national knowledge, attitudes and practices study. BMC Public Health, 14:213. https://doi.org/10.1186/1471-2458-14-213

DiClemente, C. C., Dolan-Mullen, P., & Windsor, R. A. (2000). The process of pregnancy smoking cessation: Implications for interventions. Tobacco Control, 9(Suppl 3):iii16–iii21. https://doi.org/10.1136/tc.9.suppl_3.iii16

Haufroid, V., & Lison, D. (1998). Urinary cotinine as a tobacco-smoke exposure index: A minireview. International Archives of Occupational and Environmental Health, 71(3):162–168. https://doi.org/10.1007/s004200050

Hikita, N., Haruna, M., Matsuzaki, M., Sasagawa, E., Murata, M., Oidovsuren, O., … Yura, A. (2017). Prevalence and risk factors of secondhand smoke (SHS) exposure among pregnant women in Mongolia. Scientific Reports, 7(1):16426. https://doi.org/10.1038/s41598-017-16443-4

Lee, D. R., Kim, H. S., & Lee, J. (2014). The characteristics of false respondents on a self-reported smoking survey of Korean women: Korean National Health and Nutrition Examination Survey, 2008. Korean Journal of Family Medicine, 35(1):28–34. https://doi.org/10.4082/kjfm.2014.35.1.28

Lee, J., Lee, D. R., Lee, D. H., Paek, Y. J., & Lee, W. C. (2015). Influence of maternal environmental tobacco smoke exposure assessed by hair nicotine levels on birth weight. Asian Pacific Journal of Cancer Prevention, 16(7):3029–3034. https://doi.org/10.7314/APJCP.2015.16.7.3029

Leonardi-Bee, J., Britton, J., & Venn, A. (2011). Secondhand smoke and adverse fetal outcomes in nonsmoking pregnant women: A meta-analysis. Pediatrics, 127(4):734–741. https://doi.org/10.1542/peds.2010-3041

Leonardi-Bee, J., Smyth, A., Britton, J., & Coleman, T. (2008). Environmental tobacco smoke and fetal health: Systematic review and meta-analysis. Archives of Disease in Childhood. Fetal and Neonatal Edition, 93(5):F351–F361. https://doi.org/10.1136/adc.2007.133553

Luo, Z. C., Julien, P., Wei, S. Q., Audibert, F., Smith, G. N., Fraser, W. D., … MIROS Study Group. (2014). Plasma cotinine indicates an increased risk of pre-eclampsia in previous and passive smokers. American Journal of Obstetrics and Gynecology, 210(3):e232–e5. https://doi.org/10.1016/j.ajog.2013.09.041

McBride, C. M., Emmons, K. M., & Lipkus, I. M. (2003). Understanding the potential of teachable moments: The case of smoking cessation. Health Education Research, 18(2):156–170. https://doi.org/10.1093/her/18.2.156

Nicholson, A. K., Borland, R., Couzos, S., Stevens, M., & Thomas, D. P. (2015). Smoking-related knowledge and health risk beliefs in a national sample of Aboriginal and Torres Strait Islander people. The Medical Journal of Australia, 202(10):S45–S50. https://doi.org/10.5942/mja14.00877

Nors’a'adah, B., & Salinah, O. (2014). The effect of secondhand smoke exposure during pregnancy on the newborn weight in Malaysia. The Malaysian Journal of Medical Sciences, 21(2):44–53.

Salmasi, G., Grady, R., Jones, J., McDonald, S. D., & Knowledge Synthesis Group. (2010). Environmental tobacco smoke exposure and perinatal outcomes: A systematic review and meta-analyses. Acta Obstetricia et Gynecologica Scandinavica, 89(4):423–441. https://doi.org/10.3109/00016340903505748

Sansone, G. C., Raute, L. J., Fong, G. T., Pednekar, M. S., Quah, A. C., Bansal-Travers, M., … Sinha, D. N. (2012). Knowledge of health effects and intentions to quit among smokers in India: Findings from the Tobacco Control Policy (TCP) India pilot survey. International Journal of Environmental Research and Public Health, 9(2):564–578. https://doi.org/10.3390/ijerph9020564

United Nations Educational, Scientific and Cultural Organization. (2018). UNESCO Institute of Statistics, Mongolia. Retrieved from http://uis.unesco.org/country/MN

U.S. Department of Health and Human Services. (2014). The health consequences of smoking—50 years of progress: A report of the Surgeon General. Centers for Disease Control and Prevention, Coordinating Center for Health Promotion, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health.
US Surgeon General. (2006). *The health consequences of involuntary exposure to tobacco smoke: A report of the Surgeon General*. Centers for Disease Control and Prevention, Coordinating Center for Health Promotion, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health.

Wald, N. J., Boreham, J., Bailey, A., Ritchie, C., Haddow, J. E., & Knight, G. (1984). Urinary cotinine as marker of breathing other people’s tobacco smoke. *Lancet, 1* (8370):230–231. [https://doi.org/10.1016/S0140-6736(84)92156-1](https://doi.org/10.1016/S0140-6736(84)92156-1)

Wang, M. P., Li, W. H. C., Suen, Y. N., Cheung, K. C., Lau, O. S., Lam, T. H., … Chan, S. S. C. (2017). Association between employer’s knowledge and attitude towards smoking cessation and voluntary promotion in workplace: A survey study. *Tobacco Induced Diseases, 15*:44. [https://doi.org/10.1186/s12971-017-0149-4](https://doi.org/10.1186/s12971-017-0149-4)

Windham, G. C., Eaton, A., & Hopkins, B. (1999). Evidence for an association between environmental tobacco smoke exposure and birthweight: A meta-analysis and new data. *Paediatric and Perinatal Epidemiology, 13*(1):35–57. [https://doi.org/10.1046/j.1365-3016.1999.00150.x](https://doi.org/10.1046/j.1365-3016.1999.00150.x)

World Health Organization. (2009). *Mongolian STEPS survey on the prevalence of noncommunicable disease and injury risk factors—2009*. Manila: World Health Organization. Retrieved from [http://www.who.int/iris/handle/10665/206919](http://www.who.int/iris/handle/10665/206919)

World Health Organization. (2013). *WHO recommendations for the prevention and management of tobacco use and second-hand smoke exposure in pregnancy*. World Health Organization. Retrieved from [http://www.who.int/iris/handle/10665/94555](http://www.who.int/iris/handle/10665/94555)

World Medical Association. (2013). *World Medical Association Declaration of Helsinki: Ethical principles for medical research involving human subjects*. *JAMA, 310*(20):2191–2194. [https://doi.org/10.1001/jama.2013.281053](https://doi.org/10.1001/jama.2013.281053)

Yang, J., Hammond, D., Driezen, P., Fong, G. T., & Jiang, Y. (2010). Health knowledge and perception of risks among Chinese smokers and non-smokers: Findings from the Wave 1 ITC China Survey. *i(Suppl 2):i18–i23*. [https://doi.org/10.1136/tc.2009.029710](https://doi.org/10.1136/tc.2009.029710)

Yang, L., Tong, E. K., Mao, Z., & Hu, T. W. (2010). Exposure to secondhand smoke and associated factors among non-smoking pregnant women with smoking husbands in Sichuan province, China. *Acta Obstetricia et Gynecologica Scandinavica, 89*(4):549–557. [https://doi.org/10.3109/00016341003713851](https://doi.org/10.3109/00016341003713851)

---

### Appendix 1 True/False Questions about Smoking and Passive Smoking

| Items                                                                 | Correct answer, n (%) |
|---------------------------------------------------------------------|-----------------------|
| **Pregnant women**                                                  | **Partners**          |
| 1. Smoking doesn’t cause infertility.                               | 109 (49.3)            | 101 (45.7) |
| 2. Smoking during pregnancy increases the risk of miscarriage, premature birth, or stillbirth. | 197 (89.1)            | 185 (83.7) |
| 3. Smoking during pregnancy doesn’t relate to the birth of children with disability directly. | 127 (57.5)            | 119 (53.8) |
| 4. Toxicity from secondhand smoke is weaker than that from mainstream smoke. | 132 (59.7)            | 123 (55.7) |
| 5. If there is a smoker in the family, it is possible that you may have lung cancer. | 165 (74.7)            | 152 (68.8) |
| 6. Smoke from tobacco is not the cause of air pollution.            | 144 (65.2)            | 116 (52.5) |
| 7. Some nutrients such as vitamins are not affected by smoking.     | 136 (61.5)            | 127 (57.5) |
| 8. The earlier smoking initiation age is, the higher mortality rate will be. | 182 (82.4)            | 168 (76.0) |

### Appendix 2 Yes/No Questions about Smoking and Passive Smoking

| Items                                                                 | Correct answer, n (%) |
|---------------------------------------------------------------------|-----------------------|
| **Pregnant women**                                                  | **Partners**          |
| 1. Does smoking cause lung cancer?                                  | 186 (84.2)            | 182 (82.4) |
| 2. Does smoking cause heart disease?                                | 160 (72.4)            | 154 (69.7) |
| 3. Does smoking worsen diabetes?                                    | 131 (59.3)            | 120 (54.3) |
| 4. Does smoking cause low birthweight?                              | 155 (70.1)            | 144 (65.2) |
| 5. Does smoking cause asthma in children from secondhand smoke?    | 150 (67.9)            | 124 (56.1) |
| 6. Does smoking cause sudden infant death syndrome (SIDS) in children from secondhand smoke? | 99 (44.8)              | 107 (48.4) |