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Effectiveness of social media for weight reduction on overweight undergraduate students in Thailand

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Abstract

Purpose – Addressing overweight in the population is an important public health challenge. Use of social media such as Facebook has been proposed as a platform to deliver weight loss interventions to influence behavior change to tackle obesity. The purpose of this paper is to compare the effectiveness of weight loss education and support interventions delivered through online social media (experimental group) vs conventional method (control group).

Design/methodology/approach – The six-month experimental study comprised of a four-month intervention and a two-month follow up from May 2016 to October 2016. All faculties in a university were randomly selected into the experimental or control group. Then, undergraduate students (n = 66) were randomly recruited from each faculty into the corresponding groups (experimental group = 33 and control group = 33). Both groups received health education and support services through either Facebook or the offline support system. The mean differences of main outcomes including body mass index (BMI) and waist to height ratio (WHtR) between groups at baseline and fourth month and baseline and sixth month were compared using t-test.

Findings – The results show those in the experimental group had significantly better outcomes in term of BMI and WHtR at the end of four-month intervention with the mean difference (95% CI) at 0.7 (0.1, 1.3) and 0.01 (0.00, 0.01), respectively. The differences at the end of the study, however, became insignificant.

Originality/value – The health education and support services through Facebook can be used in a weight loss promotion program for BMI and WHtR reduction. On a larger scale to replace conventional programs, a long-term continuous measure is needed.

Keywords Obesity, Social media, Facebook, Overweight, Weight loss, Weight reduction, Thailand

Paper type Research paper

Introduction

The Asia-Pacific region has almost half of the world’s population. The countries in the region are diverse in socio-cultural backgrounds and differ in economics and technologies. Increased economic development in many countries in this region has contributed to an increase in the prevalence of obesity[1]. Based on a study of the global trend of body mass index (BMI), overweight, obesity and obesity statistics from the years 1975 to 2016 analyzed 2,416
studies from 128.9m people and showed BMI in children and adolescents had increased in many high-income countries with a significant increase in parts of Asia[2]. Obesity is an increasing major global health problem, and every year, a large and increasing number of the obese population die or suffer from various medical complications[3]. The trend of self-health care in the modern age is dependent on health information and the internet is a major information source that could play a role as a medium for healthy lifestyle improvements[4]. Thailand is one of the countries with the highest obesity epidemic in Asia, ahead of other richer countries like Singapore, Korea and Japan[5].

Social media is gaining popularity globally and it has been used for health promotion and disease prevention. A systematic review of the effectiveness of online social network health behavior interventions by Maher et al[6] showed limited evidence. The interventions were defined as behavioral change interventions for health improvement such as weight control, smoking control and drinking control. Some studies showed encouraging results such as a decrease in the study samples’ weight. Another systematic review study looking at the role of social media on obesity by Patel et al[7] found that the use of social media, especially Facebook for social support for chronic diseases such as obesity, is likely to improve patient care. From our search of PubMed, Scopus and Cochrane databases from 2005 to 2014 using Overweight, Obesity and Social Media as the keywords, there were two relevant articles that met the criteria on the social media effectiveness on obesity or overweight populace. The studies[8, 9] were small and the study population were mostly Caucasians from the USA. The interventions used in the two studies were quite specific to the American lifestyle that may not be relatable to Thai or Asian population.

In order to understand the effectiveness of social media on the Thai obese populace more research is needed. In Thailand, there were about 4m people who use Facebook regularly and the growth of Facebook users was ranked as the world’s second highest (11 percent)[10]. It is among the first choice of media channels among the Thai population and a large number of people reportedly accessed health information from Facebook before finding information elsewhere[11]. Facebook has been used for health issue research purposes[12] but information on its effectiveness has been limited.

Given the significant interest in the national policy on the use of social media for health outcomes, this study intended to shed light on the debate over the benefit of such technology on the obesity and overweight situation, which is a public health concern that continues to increase in Thailand[5]. It is argued that social media activities require low budgets and can be more effective in comparison to old traditional solutions[6]. This study provided an aspect from an Asian (Thai) viewpoint and applied methods from previous research[8, 9] to provide outcomes. The objective of this study is to compare the effectiveness of weight loss education and support interventions delivered to university students through online social media (experimental group) vs conventional methods (control group). The findings from this study can help policymakers and public health practitioners in Thailand and abroad design and support policy implementation both in the public and private sectors.

Methods
The six-month experimental study comprised of a four-month intervention period and a two-month follow up. The study compared the effects of weight loss interventions on overweight people through social media technology in the experimental group and through conventional methods in the control group. The target population was undergraduate students at a university in Phitsanulok Province in Thailand. Multistage sampling was used when recruiting the 66 students as study samples from all 16 faculties at the university. All faculties in the university were randomly selected into either the experimental or control group. Then, we randomly recruited the volunteers from each faculty into the corresponding
groups, resulting in 33 samples in each group. The sample size was calculated using the formula to calculate sample size for continuous data, using data on mean weight in the treatment and control groups and their standard deviations in the calculation[13], with a design factor multiplier of 1.5 to compensate for the stratified sampling approach used.

All volunteers acknowledged the detail and the purpose of the research and signed the consent form voluntarily. A set of research tools including a nutrition and exercise curriculum, a basic information questionnaire, a knowledge attitude practice (KAP) assessment form and a satisfaction questionnaire were developed and revised by experts. The exercise demonstration videos were also created by the experts to simplify the understanding of the audience in the experimental group.

The basic information questionnaire had 21 questions to capture general characteristics of the volunteers including age, sex and education performance. A KAP assessment form was used to assess the knowledge, attitude and practice related to the nutrition and exercise activities of the volunteers. The KAP sections have 20, 10 and 15 items per section, respectively. The knowledge section used multiple-choice questions while the other two sections used rating scale questions, each item ranging from 1 to 5 (attitude section; 5: strongly agree, 4: agree, 3: neutral, 2: disagree, 1: strongly disagree; and practice section; 5: every day, 4: a few times a week, 3: a few times a month, 2: a few times a year, 1: never). The satisfaction questionnaire consisted of four sections, namely, project process, experts, project activities and project quality sections, with 5, 2, 3 and 5 items per section, respectively. The times in all section used a rating scale with the score from 1 to 5 (5: very satisfied, 4: satisfied, 3: neutral, 2: unsatisfied, 1: very unsatisfied).

The KAP assessment form was assessed for its level of validity using the index of item-objective congruence (IOC). It was also piloted and revised to ensure up to date validity. The value of IOC is 0.89. The Cronbach’s $\alpha$ of the KAP assessment form was also assessed for reliability and was at 0.93.

At baseline, volunteers were measured for height, weight and waist circumference by a certified nurse. Before the start of the research project, the nurse was repeatedly trained on the standardized waist circumference measurement method based on the method used by the Faculty of Medicine, Khon Kaen University and WHO. A standard measuring tape was used to measure a volunteer’s waist at the middle position of the waist between the lower edge of the last palpable rib and the top of the iliac crest. The nurse would ensure that the tape did not compress the skin but was snug around the waist and was parallel to the floor[14, 15].

Volunteers filled out a baseline assessment form and a KAP test. Subjects who were overweight or obese with BMI equal to or greater than 23 kg/m² without disease that cause weight gain were included. They had to also confirm their ability to use and access the internet daily. Those taking medicines or supplements to lose weight or participating in other weight loss programs were excluded from the study.

**Interventions**

**The experimental group**

Volunteers were invited to join a Facebook private group created by the researchers. The research team then sent a message to each participant’s Facebook inbox to set a monthly weight loss goal. Health messages were published on the Facebook group’s page regularly. These included nutrition education messages from a nutritionist (four times a week in the morning), exercise education messages and exercise videos from an exercise expert (four times a week in the afternoon), questions about nutrition and exercise were posted twice a week and figures encouraging weight loss were posted once a week. The volunteers could consult with the nutritionist and the exercise expert who also joined the Facebook group and they could respond to the activities of the group. The volunteers reported their daily body weight using the scale provided by the project. Every month, the
data on the volunteers' weight were assessed to set a new weight goal. At the fourth-month and sixth-month points, the volunteers’ weight, height, waist circumference, KAP score and satisfaction scores were measured.

The control group
The volunteers in the control group received the same intervention as in the experimental group. The only difference was that the information on nutrition and exercise was provided via printed manuals instead of online with the Facebook group. The research team set a monthly weight loss goal and sent the goal to the volunteers in print. The volunteers were required to read the nutrition and exercise manual books, to report their daily weight, and monthly, to submit a paper form to consult with the nutritionist and exercise expert by sending the paper form via postal mail or leaving the paper form in a received box at the University Student Affairs Division. The volunteers received a reply from the experts via the postal mail.

Ethical considerations
This research protocol was reviewed and approved by the Institutional Review Board (IRB), Faculty of Medicine, Chulalongkorn University, IRB Number 346/58. All volunteers provided written informed consent before joining the program.

Data collection
At baseline, the volunteers were measured for weight, height, waist circumference, knowledge, attitude and practice with a KAP test form and completed the basic information questionnaire. In the fourth month (at the end of the intervention period) and in the sixth month (at the end of the follow-up period), the volunteers underwent the same physical measurement and completed the KAP test. They were also evaluated on their satisfaction with the program. All data were secured from unauthorized access. A list of interventions and data collection processes is shown in Figure 1.

Data analysis and statistics
Descriptive statistics were used to analyze baseline demographics. The differences in the mean level of the main outcomes of interest between the intervention and the control groups were compared using t-test statistics, including BMI and waist to height ratio (WHtR). The comparison between baseline and fourth month, and baseline and sixth month between groups was also tested. The summary scores for K, A and P sections and the summary satisfaction scores were calculated using a simple summation of all item scores in related categories, assuming equal weight. The trend of KAP and satisfaction scores was measured at baseline, fourth month, and six month to compare the improvement of both groups. The participant’s activities data such as number of comments, consultations, questions, answers, posts, visiting counts and daily weight self-reports from both groups were analyzed by count, percentage, mean and standard deviation. Drop-out rates were collected (if any) and analyzed for the cause of withdrawal.

Results
There were no dropouts in both the experimental and control groups at the end of the study. The findings on descriptive statistics of baseline data to determine the difference between the two groups prior to the experiment are shown in Table I. This includes the baseline characteristics of the samples on age, grade point average (GPA), monthly income, BMI, WHtR (continuous data) and the ratio of each sex and academic year (category data).

At baseline, there were no statistically significant differences in characteristics between the groups except monthly income. The main measurements of interest such as BMI and WHtR were not different between groups.
For the volunteers’ activity, the incidences of the Facebook group visiting online, by clicking, commenting, posting in the experimental group were 221 times per person visiting (98.6 percent), 189 times per person clicking (84.4 percent), 97 times commenting and 26 times posting. The number of consultations in the experimental group was 76 times and
the number in the control group was 34 times. The average number of occasions, the experimental and control groups answered questions were 20 times/person (62.1 percent) and 16 times/person (48.5 percent), respectively. The number of days that the experimental group reported their weight was 108 days per/person (96.3 percent) and 112 days per/person in the control group (100 percent) (Table II).

There was no statistically significant difference in KAP between groups. However, the change in knowledge factor ($K$) from baseline (first) to sixth month (third) was significantly different between groups at $p$-value of 0.03, with mean difference (95% CI) of 1.7 (0.2, 3.3).

**BMI**

The mean difference of BMI comparison between baseline (first) and fourth month (second) was $1.1 \pm 1.0$ and $0.4 \pm 1.4$ for the experimental and control groups, respectively. The difference between the two groups was 0.7 (95% CI from 0.1 to 1.3) and was statistically significant at $p$-value of 0.02.

The comparison between baseline (first) and sixth month (third) period showed the mean difference and standard deviation of the experimental and control groups at $0.5 \pm 0.9$ and $0.1 \pm 1.4$, respectively. These results on BMI data are shown in Table III.

### Table II.

| Group          | Period     | Knowledge ($K$)   | Attitude ($A$) | Practice ($P$) | Combined KAP         |
|----------------|------------|------------------|----------------|----------------|----------------------|
|                |            | Mean diff. (95% CI) | Mean diff. (95% CI) | Mean diff. (95% CI) | Mean diff. (95% CI) |
| Experimental   | 4-month change | [2.2 (1.1–3.4)] | [1.1 (−0.3–2.4)] | [6.5 (2.6–10.4)] | [9.8 (5.5–14.1)] |
| Control group  | 1st–2nd    | [−5, 12]         | [−5, 9]         | [−22, 24]       | [−18, 31]           |
| Experimental   | 6-month change | [2.7* (1.5–3.9)] | [0.1 (−2.0–2.2)] | [5.8 (3.4–8.2)] | [8.7 (5.0–12.3)] |
| Control group  | 1st–3rd    | [−3, 11]         | [−8, 5]         | [−9, 31]        | [−7, 34]            |

**Note:** $*p < 0.05$

### Table III.

| Variables | Group          | 1st Mean ± SD | 2nd Mean ± SD | 3rd Mean ± SD |
|-----------|----------------|---------------|---------------|---------------|
| BMI       | Experimental   | 30.6 ± 4.5    | 29.5 ± 4.5    | 30.1 ± 4.3    |
|           | Control group  | 30.3 ± 5.2    | 30.0 ± 5.0    | 30.2 ± 4.9    |

**Note:** CI, Confidence interval. $*p < 0.05$; $**p < 0.01$
The mean difference of WHtR compared between baseline (first) and fourth month (second) was $0.01 \pm 0.01$ and $0.00 \pm 0.01$ for the experimental and control groups, respectively. The difference between the two groups is $0.01$ (95% CI from 0.00 to 0.01) and was statistically significant at $p$-value of 0.01.

The comparison between baseline (first) and sixth month (third) periods showed the mean difference and standard deviation of the experimental and control groups at $0.01 \pm 0.01$ and $0.00 \pm 0.01$. These results on WHtR data are shown in Table III.

The results of the satisfaction score in the experimental and control groups were both categorized at a very good level of 87 and 85 percent, respectively. Daily weight self-reporting in the experimental and control groups was 96 and 100 percent, respectively.

Discussion

The results of BMI and WHtR reduction in the experimental group were statistically and significantly different in the first four months in comparison with the control group that supported the social cognitive theory[16–18], the fundamental theory in determining the intervention factors in this research that consisted of personal factors, environmental factors and behavioral factors. In addition, the frequency of stimulation from Facebook in the experimental group was daily, while the control group using manual books might be less stimulated relying on self-motivation. The results also supported previous literary reviews that found social media had the potential to be a medium for promoting healthy behaviors[19]. The knowledge gained from this study demonstrated that it is possible to use Facebook as a medium for intervention transfer to promote weight loss. It supports the result of previous research[7] showing that social media use, significantly promoted weight loss among volunteers. The experimental and control groups had the same basic activities, but they were different in terms of being online or offline. However, the experimental or online group had certain specific activities due to the nature of Facebook such as posting, commenting, sharing and liking. The experimental group had a significantly higher number of consultation activities with the experts than the control group. This might be because the experimental group could always consult with the experts immediately online. They received a response within 24 h by experts who were also members of the group. The control group had more limitations because they needed to write on a paper form for consultation making the response process lengthier and less immediate.

Facebook is a very popular social media platform compared to other social media[20]. This study shows that Facebook could be an alternative tool for solving public health issues. Online social media is generally cheaper to implement but further cost-effective analysis is needed to confirm this.

Regarding acceptance and participation, the intervention in this study, which was given to the undergraduate students, was well received as evidenced by the results of the satisfaction score, daily weight self-reporting and zero drop-out rate. The success of this aspect might be due to the setting of the project, which was on campus and was organized in cooperation with the University Student Affairs Division which helped most volunteers to cooperate in the project with ease.

The result of KAP showed that only the Knowledge factor ($K$) found a statistically significant difference in the sixth month between groups. There are many potential explanations for this result. First, there may be some limitations in the measurement of $A$ and $P$ using the self-reported questionnaire. The measurement tool is perhaps not sensitive enough to the change. Second, there could be many factors influencing behavioral change that cannot be simply explained using $K$, $A$, $P$ measurements[21, 22].
Bias that might appear in the project such as contamination bias where the volunteers might be sharing information between groups, and co-intervention bias where the research team might add what the volunteers did not actually receive from the other group, had been limited where possible. The research team created a volunteer understanding of the objectives and processes before the project commenced and the project was designed to provide intervention to the groups separately. In addition, the interaction of the research team toward the volunteers in both groups was equal.

In terms of sustainability, the effect of the reduction in both BMI and WHtR was seen during the intervention period (the first four months) in the experimental group, but there was no difference during the entire six months. In the long run, there could be many factors that are complex and that influence the change of BMI and WHtR that cannot be clearly explained in behavioral science[23].

This study has a number of limitations. The duration of the trial was held during the school break and each physical measurement appointment was held during the semester to collect the data. During the school break, when most students did not stay at the university or nearby, it was, therefore, necessary to choose a mutually appropriate time for the activities. If the project could have been held during both school semester time and school break time, a more pronounced change in behavior and weight loss might have been observed. Moreover, Facebook had some limitations on its use. Facebook could not record the duration of a member’s activity in the group and the number of logins to the group directly. However, Facebook did record enough data to be measured. The restriction on Facebook was trivial and could be substituted by alternate measurement methods. Internet assessment for the experimental group showed that sometimes, volunteers could not join the Facebook group every day for various reasons such as traveling, poor internet reception, etc. However, there were no volunteers who could not access the internet for long periods of time.

The application of this research needs to be tailored to fit the target population in other groups and additional research should be done in parallel. Those who will apply these results such as government agencies, university administrators and health promoters will have to consider this information. Furthermore, the use of Facebook is likely to be a low-cost alternative tool for solving public health issues that will be beneficial to public health. This might reduce the budgets of old conventional methods of losing weight which take a relatively higher investment. However, cost-effective analyses will also need to be studied in more detail.

Conclusion
The study results prove that health education and support services through Facebook can be effectively used for weight reduction among students at a public university in Thailand. However, additional studies are needed to understand the mechanisms of action and the sustainability of the results in the long run. The application of this research needs to be tailored to fit each population group, and additional research should be done before it is implemented in other population.

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Effectiveness of social media
Intimate partner violence and utilization of reproductive and maternal health services in Cambodia

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Abstract

Purpose – The purpose of this paper is to explore an association between women experience lifetime intimate partner violence (IPV) and women decision making with utilization of reproductive and maternal health services in Cambodia.

Design/methodology/approach – An analysis of secondary data of Cambodia Demographic and Health Survey (CDHS) 2014. The total number of sample size was 1,539 married women who had birth in the last five years prior to the time of interview and completed the domestic violence module in the CDHS 2014 questionnaire. χ² test and binary logistic regression were performed in this study.

Findings – Results give an evidence that emotional violence had significant impact on receiving sufficient antenatal care (ANC) (OR: 0.7, 95%CI: 0.43–0.86) while physical violence had significant association with deliver with skilled birth attendance (SBA) (OR: 0.5, 95%CI: 0.27–0.79). Further, women’s participation in household decision making played as important factor in enabling women revive sufficient ANC (OR: 1.7, 95%CI: 1.19–2.29), and utilization of modern contraceptive method (OR: 1.5, 95% CI: 1.09–1.97).

Originality/value – This study provides significant finding on the impact of IPV and women’s decision making on reproductive and maternal health in Cambodia. Result has drawn an attention to policy makers, related ministries and stakeholder to promulgate and effectiveness of policies and program implementation within the country.

Keywords Intimate partner violence, Reproductive and maternal health services, Women decision making, Cambodia

Paper type Research paper

Introduction

The Royal Government of Cambodia has made a strong commitment to protect women’s rights and promote gender equality by promoting several national policies[1] and has ratified international conventions to respond to gender-based violence[2]. However, gender inequality is still considered an issue as Cambodia was ranked 116th among 160 countries globally in the Gender Inequality Index[3]. Inequality between men and women is a major cause of gender-based violence, and women are more likely to become a victim especially from their intimate partners. Data from a national survey implied that over 30 percent of Cambodian women had experienced intimate partner violence (IPV) in any or all forms in their lifetime[4]. Violence against women is a major public health problem globally. Women who are victims of violence suffer various negative health consequences including sexual and reproductive health[5]. In Cambodia, the national evidence shows that 4 percent of Cambodian women experience physical abuse during their pregnancy and reported having...
miscarriages and abortions[6]. Access to maternal health services still also remains an issue. Generally, pregnant women and their newborn babies are still unable to fully access the required maternal health services to ensure their wellbeing. An analysis of national surveys indicated that 40 percent of Cambodian women did not receive all three types of maternal health services including antenatal care (ANC) during pregnancy, delivery using skilled birth attendant (SBA) help and postnatal care (PNC) after delivery[7]. The country still has one of the highest levels of maternal mortality compared to neighboring countries in the Southeast Asian region[8].

IPV has various impacts on women’s reproductive and maternal health. IPV can cause various negative health consequences such as poor maternal and infant health outcomes for both mother and child[9]. Studies found that women who experienced psychological abuse had a higher risk of postnatal depression and had a poorer mental health-related quality of life[10]. Sexual violence was associated with an increased number and duration of pregnancy-related physical symptoms which may cause women major discomfort and can severely affect their wellbeing during pregnancy[11]. Women with a history of experiencing physical violence had a higher risk of the premature rupturing of membranes and low birth weight for their children [12]. In terms of their reproductive health, women victims of IPV are more likely to have unwanted pregnancies and are unable to decide on the use of a contraceptive method[13, 14]. They are also less likely to utilize sufficient ANC and did not deliver with the help of SBA[15].

There have been several very useful studies conducted to try to understand women’s issues in Cambodia. However, most of these focus on the issue of violence and women’s health separately, while the study of the association between IPV and women’s reproductive health has attracted less attention. This study aims to explore an association between women with experience of IPV during their lifetime, and women’s decision making regarding the utilization of reproductive and maternal health services in Cambodia.

Methodology

Study design and sample selection

This quantitative research study analyzes the secondary data of the Cambodia Demographic and Health Survey (CDHS) 2014 which was the latest survey conducted in Cambodia. CDHS 2014 represents the information on population and health issues of Cambodian women and men aged between 15–49 years old nationally. To measure the utilization of reproductive and maternal health services, this study selected married women who had given birth in the last five years prior to the time of interview and completed the domestic violence module in the CDHS 2014 questionnaire. The total number of the sample size was 1,539 married women.

Variables

Outcome variable. This study selected five outcome variables to reflect the reproductive and maternal health services including: use of modern contraceptive methods (such as the pill, IUD, injections, diaphragm, condom, female sterilization, male sterilization, implants, female condom) which are categorized as YES for the use of a modern contraceptive and NO for not using any method or use of traditional methods and folkloric methods. The number of ANC visits were categorized as insufficient (< 4 times) and sufficient (≥ 4 times). Delivery at a health facility was categorized as “institutional delivery” against a “delivery at home”. Institutional delivery included delivering in public or private hospitals or clinics and NGO clinics. PNC was categorized as YES for those who received any postnatal check-up after delivery and NO for those who did not receive any postnatal check-up after delivery. Delivery with SBA refers to women who delivered with the help of a doctor, health professional, nurse and/or midwife.
Explanatory variable. There are two major explanatory variables for this study: IPV which refers to women who experience physical, emotional and sexual violence by their partner during their lifetime and Women’s participation in household decision making refers to decisions on women’s own health, decisions on large household purchases and decisions on visiting family/friends. Women gave three possible answers: making decisions alone, joint decision making with husband, and husband/others making decisions without wife/women’s input. We categorized these answers into two categories. “YES” refers to the women’s response to make any decision alone and any joint decisions with husband, and “NO” for any decision made by husband/others with no women’s input. Attitudes toward IPV was measured based on the women’s agreement with any justification for the husband hitting or beating his wife. The justifications were: goes outside without telling husband, neglects children, argues with husband, refuses to have sex with husband and burns the food. Women who responded and agreed with all five statements were coded as YES, while those who agreed with less than the five statements were coded as NO. Other socio-demographic variables included age, place of residence, educational level and wealth index.

Data analysis
Data were analyzed using statistical software STATA version 14. Three analyses were applied in this study. The first analysis employed descriptive statistics as univariate analyses to examine the frequencies of outcome variables and explanatory variables. Secondly, this study applied chi-square ($\chi^2$) test as a bivariate analysis to study the difference in the prevalence of socio-demographic variables among women who experienced IPV and women who did not experience IPV. In the final analysis, we applied binary logistic regression as a multivariate analysis to access the association between explanatory variables and the utilization of reproductive and maternal health services. Odds Ratio (OR) was used to interpret the strength of association between independent and dependent variables.

Ethical consideration
This study used data CDHS 2014 downloaded from the Demographic and Health Survey (DHS). This dataset can be accessed subsequent to registration, authorization and after providing information about the guidelines and the conditions of using the data. Procedures and questionnaires used for the CDHS 2014 were reviewed and approved by the ICF Institutional Review Board[16]. This DHS maintained strict standards for protecting the privacy and confidentiality of respondents during data collection and data processing. All respondents were given an informed consent form at the start of individual interviews. Therefore, no further ethical approval was necessary since this study was based on public use data which was anonymous and had no identifiable information on the survey respondents.

Results
Socio-demographic characteristic
A total of 1,539 women participated in this study. Of those, the majority aged between 25 and 29 years and 30–34 years (30.3 and 29.0 percent). More than half of the total sample lived in rural areas (76.1 percent). Most of them had attended primary school and 43.4 percent of them had a poor wealth index. This study also found that 86 percent of women had participated in household decision making and 52.6 percent agreed the act of IPV. For women who experienced lifetime IPV, data showed that 13.4 percent of women experienced physical violence, 4.1 percent experienced sexual violence and 19.1 percent experienced emotional violence (Table I).

Figure 1 present the percentage of married women utilize reproductive and maternal health services. More than 50 percent of selected women had access to maternal health
| Variables                        | Frequency | %    |
|---------------------------------|-----------|------|
| **Age (years)**                 |           |      |
| 15–19                           | 46        | 2.9  |
| 20–24                           | 320       | 20.7 |
| 25–29                           | 486       | 30.3 |
| 30–34                           | 447       | 28.0 |
| 35–49                           | 260       | 16.9 |
| **Place of residence**          |           |      |
| Urban                           | 367       | 23.8 |
| Rural                           | 1,172     | 76.1 |
| **Educational level**           |           |      |
| No education                    | 205       | 13.3 |
| Primary school                  | 770       | 50.0 |
| Secondary and higher            | 564       | 36.6 |
| **Wealth Index**                |           |      |
| Poor                            | 669       | 43.4 |
| Middle                          | 259       | 16.8 |
| Rich                            | 611       | 39.7 |
| **Women’s participation in household decision making** | | |
| Yes                             | 1,325     | 86.1 |
| No                              | 214       | 13.9 |
| **Women’s attitude toward IPV** |           |      |
| Agree                           | 810       | 52.6 |
| Disagree                        | 729       | 47.3 |
| **Women experienced physical violence** | | |
| Yes                             | 206       | 13.4 |
| No                              | 1,333     | 86.6 |
| **Women experienced sexual violence** | | |
| Yes                             | 63        | 4.1  |
| No                              | 1,476     | 95.9 |
| **Women experienced emotional violence** | | |
| Yes                             | 304       | 19.7 |
| No                              | 1,235     | 80.2 |

**Note:** $n = 1,539$

Table I. Distribution of socio-demographic characteristic, attitude toward IPV and women experiencing IPV, CDHS 2014

Figure 1. Percentage of women’s use of reproductive and maternal health services by type
services, including sufficient ANC (74.1 percent), delivery at a health facility (83.4 percent), delivery with SBA (88.2 percent), and received PNC (88.3 percent). While only 48.0 percent reported the use of modern contraceptive methods.

Prevalence of women experiencing IPV

Women reporting the experience of emotional, physical and sexual violence were significantly higher amongst the older age group (35–49 years), who had no education, were amongst the poor wealth index, did not participate in household decision making and agreed with acts of IPV. These associations are statistically significant at a high level ($p \leq 0.001$ to $p \leq 0.05$) (Table II).

Results of multivariate analysis

Table III explains the association of women’s experience of IPV, women’s participation in household decision making, women’s attitude toward IPV and selected socio-demographic characteristics with utilization of modern contraceptive methods and attending sufficient ANC.

The use of modern contraceptive methods can be statistically associated with women’s participation in household decision making and the women’s educational level. Women who participated in household decision making were 1.5 times more likely to use modern contraceptive methods (95%CI: 1.09–1.97). Interestingly, women who completed secondary and higher education were 30% less likely to use modern contraceptive methods (95%CI: 0.48–0.99). IPV and other socio-demographic factors were not associated with the use of modern contraceptive methods.

| Variables                          | Emotional                  | Physical                  | Sexual                    |
|------------------------------------|----------------------------|----------------------------|---------------------------|
|                                    | No (%) Yes (%)             | No (%) Yes (%)             | No (%) Yes (%)            |
| Age (years)                        | $\chi^2 = 22.78^{***}$     | $\chi^2 = 25.19^{***}$    | $\chi^2 = 6.38$           |
| 15–19                              | 78.3 21.7                  | 89.1 10.9                  | 95.7 4.3                  |
| 20–24                              | 82.8 17.2                  | 90.0 10.0                  | 96.9 3.1                  |
| 25–29                              | 85.4 14.6                  | 90.6 9.4                   | 97.2 2.8                  |
| 30–34                              | 78.3 21.7                  | 84.3 15.7                  | 95.1 4.9                  |
| 35–49                              | 71.5 28.5                  | 78.8 21.2                  | 93.8 6.2                  |
| Place of residence                 | $\chi^2 = 2.98$            | $\chi^2 = 0.53$            | $\chi^2 = 0.37$           |
| Urban                              | 83.4 16.6                  | 87.7 12.3                  | 96.5 3.5                  |
| Rural                              | 79.3 20.7                  | 86.3 13.7                  | 95.7 4.3                  |
| Education level                    | $\chi^2 = 37.01^{***}$     | $\chi^2 = 34.29^{***}$    | $\chi^2 = 7.70^{*}$       |
| No education                       | 73.7 26.3                  | 76.6 23.4                  | 92.7 7.3                  |
| Primary school                     | 76.1 23.9                  | 85.2 14.8                  | 95.8 4.2                  |
| Secondary and higher               | 88.3 11.7                  | 92.2 7.8                   | 97.2 2.8                  |
| Wealth Index                       | $\chi^2 = 28.56^{***}$     | $\chi^2 = 17.74^{***}$    | $\chi^2 = 7.93^{*}$       |
| Poor                               | 74.3 25.7                  | 82.8 17.2                  | 94.3 5.7                  |
| Middle                             | 81.9 18.1                  | 86.5 13.5                  | 96.5 3.5                  |
| Rich                               | 86.1 13.9                  | 90.8 9.2                   | 97.4 2.6                  |
| Women’s participation in household decision making | $\chi^2 = 2.61$ | $\chi^2 = 0.89$ | $\chi^2 = 3.80$ |
| No                                 | 76.2 23.8                  | 84.6 15.4                  | 93.5 6.5                  |
| Yes                                | 80.9 19.1                  | 86.9 13.1                  | 96.3 3.7                  |
| Women’s attitude toward IPV        | $\chi^2 = 23.74^{***}$     | $\chi^2 = 13.58^{***}$    | $\chi^2 = 1.56$           |
| Agree                              | 75.6 24.4                  | 83.6 16.4                  | 95.3 4.7                  |
| Disagree                           | 85.5 14.5                  | 90.0 10.0                  | 96.6 3.4                  |

Table II.
Prevalence of women who experienced IPV and women who did not experience IPV

Notes: *$p \leq 0.05$; **$p \leq 0.01$; ***$p \leq 0.001$
Receiving sufficient ANC (≥4 times) was statistically associated with women who experienced emotional violence, women who participated in household decision making, the age of the women, their educational level and wealth index. Women who experienced emotional violence were 30 percent less likely to attend sufficient ANC (95%CI: 0.43–0.86). Women who participated in decision making were almost 1.7 times more likely to have sufficient ANC (95%CI: 1.19–2.29), Women aged 25–29 were 2.1 times more likely (95%CI: 1.08–4.06) and women aged 30–34 were 2.3 times (95%CI: 1.17–4.46) more likely to receive sufficient ANC. Women who completed primary school were 1.9 times more likely to attend sufficient ANC (95%CI: 1.36–2.65), and women who completed secondary and higher education were 3 times more likely to receive sufficient ANC (95%CI: 1.99–4.45). Regarding the wealth index, women in the middle wealth index were 1.4 times more likely to visit an ANC facility (95%CI: 1.06–1.98) while women amongst the higher wealth index were two times more likely to have sufficient ANC (95%CI: 1.41–2.78).
Table IV presents the results of the binary logistic regression analysis. The analysis looked at the association of women’s experience IPV, women’s participation in household decision making, women’s attitude toward IPV and selected socio-demographic characteristic with attend institutional delivery, skilled birth attendance and attended PNC. Babies delivered at a health facility were statistically associated with some socio-demographic factors such as place of residence, educational level, and wealth index. Women who lived in rural areas were 60 percent less likely to deliver at a health facility (95% CI: 0.20–0.66). Women who attended only primary school were 1.7 times more likely to have an institutional delivery (95% CI: 1.19–2.44), while women who attended secondary or higher education were 2.8 times more likely to deliver at a health facility (95% CI: 1.75–4.57). Regarding the wealth index, women in the middle wealth index were 2.4 times more likely to deliver at a health facility (95% CI: 1.59–3.71) and women in the richer wealth index were

| Variables                                | Institutional delivery | Deliver with SBA | Received PNC |
|------------------------------------------|-----------------------|------------------|--------------|
|                                          | OR 95% CI             | OR 95% CI        | OR 95% CI    |
| **Women experienced emotional violence** |                       |                  |              |
| No (ref.)                                | 1.0                   | 0.68–1.58        | 1.2          |
| Yes                                      | 1.2                   | 0.74–1.99        | 1.1          |
|                                          | 0.7                   | 0.42–1.10        | 0.5**        |
| **Women experienced physical violence**  |                       |                  |              |
| No (ref.)                                | 0.7                   | 0.42–1.10        | 0.5**        |
| Yes                                      | 1.2                   | 0.60–2.38        | 1.1          |
|                                          | 1.1                   | 0.74–1.68        | 1.0          |
| **Women experienced sexual violence**    |                       |                  |              |
| No (ref.)                                | 1.1                   | 0.74–1.68        | 1.0          |
| Yes                                      | 1.2                   | 0.60–2.38        | 1.1          |
| **Women’s participation in household decision making** |       |                  |              |
| No (ref.)                                | 1.1                   | 0.74–1.68        | 1.0          |
| Yes                                      | 1.2                   | 0.60–2.38        | 1.1          |
| **Women’s attitude toward IPV**          |                       |                  |              |
| Agree (ref.)                             | 1.0                   | 0.76–1.36        | 1.2          |
| Disagree                                 | 1.1                   | 0.74–1.68        | 1.0          |
| **Age (years)**                          |                       |                  |              |
| 15–19 (ref.)                             | 1.0                   | 0.76–1.36        | 1.2          |
| 20–24                                    | 1.1                   | 0.44–2.69        | 1.7          |
| 25–29                                    | 0.9                   | 0.38–2.25        | 1.4          |
| 30–34                                    | 0.9                   | 0.38–2.28        | 1.7          |
| 35+                                      | 0.5                   | 0.22–1.32        | 0.9          |
| **Place of residence**                   |                       |                  |              |
| Rural                                    | 0.4***                | 0.20–0.66        | 0.5          |
| **Educational level**                    |                       |                  |              |
| No education (ref.)                      |                       |                  |              |
| Primary school                           | 1.7**                 | 1.19–2.44        | 2.1***       |
| Secondary and higher                     | 2.8***                | 1.75–4.57        | 5.1***       |
| Wealth Index                             | 2.8***                | 1.75–4.57        | 5.1***       |
| **Poor (ref.)**                          |                       |                  |              |
| Middle                                   | 2.4***                | 1.59–3.71        | 2.8***       |
| Rich                                     | 3.6***                | 2.31–5.68        | 7.5***       |
| **Wealth Index**                         |                       |                  |              |
| Middle                                   | 2.4***                | 1.59–3.71        | 2.8***       |
| Rich                                     | 3.6***                | 2.31–5.68        | 7.5***       |

**Notes:** ref., Reference. *p ≤ 0.05; **p ≤ 0.01; ***p ≤ 0.001
3.6 times more likely to have an institutional delivery (95%CI: 2.31–6.00). No IPV factors and women’s participation in household decision making was found to have a significant association with institutional delivery.

Women who delivered with the help of SBA were found to have significant associations with women who experienced physical violence, their educational level, and the wealth index. Results showed that women who experienced physical violence were 50 percent less likely to deliver with SBA (95%CI: 0.27–0.79). Women who completed primary education were 2.1 times more likely to deliver with SBA (95%CI: 1.45–3.14) and women who completed secondary and higher education were 5.1 times more likely to delivery with SBA (95%CI: 2.74–9.38). At the same time, women in the middle wealth index were 2.8 times more likely to attend SBA (95%CI: 1.69–4.78) and women in the rich wealth index were 7.5 times more likely to deliver with SBA (95%CI: 3.77–14.91). No women’s participation in household decision-making factors was found to have significant association with deliveries using the help of SBA.

Women who received PNC were found to have a significant association with women’s educational levels and wealth index. Results implied that women who attended primary school were 1.8 times more likely to have PNC (95%CI: 1.23–2.71) while women who attended secondary and higher education were 4.1 times more likely to have received PNC (95%CI: 2.33–7.12). Women in the rich wealth index were 2.5 times more likely to have attended PNC (95%CI: 1.49–4.06). No IPV factors and women’s participation in household decision making were found to have significant association with receiving PNC (Table IV).

Discussion

This study is based on CDHS 2014 which examined the impact of IPV on the utilization of reproductive and maternal services in Cambodia. A significant finding from this study indicated that IPV has a strong impact on the utilization of reproductive and maternal health services. Results show that women who experienced emotional violence were less likely to receive sufficient ANC. Simultaneously, women who experienced physical violence were less likely to deliver using SBA professionals. This result is in line with findings from other countries such as Ethiopia and Kenya[17,18]. Two separate studies have stressed that women who experienced IPV before pregnancy and before delivery were more likely to have low birth weight infants and experience of stillbirth[19,20]. Therefore, IPV does not only impact on women’s health but raises a barrier for them to access the required maternal health services and impacts upon the health of their newborn babies as well.

Further important results from this study highlight women’s participation in household decision making and the utilization of reproductive and maternal health services. Women who are authorized to make decisions alone or make joint decisions with their husbands were more likely to use modern contraceptive methods and receive sufficient ANC for their maternal health. These findings show that when women can make their own decisions or are involved in decision making on maternity issues, they are also able to make decisions related to their own fertility as well[21]. Women who have decision making power have the autonomy to seek out maternal health services and gain access to sufficient maternal health care for their own pregnancy and health[22].

Besides those major explanatory variables, some socio-demographic factors such as place of residence, women’s educational levels, age of the women and place on the wealth index also showed significant association with the utilization of maternal health services.

Results from this study confirmed that rural women were less likely to deliver at a health facility compared to urban women. Health seeking behaviors would be the best explanation...
to support this finding. Most Rural communities prefer to seek health services from indigenous practitioners as their priority and usually would not go to health facilities unless they experienced a failure of treatment from indigenous practitioners[23]. This decision indicates that local people have low regard and distrust of the public health facilities, whilst some were not even aware of the services available to them. In terms of supply, unequal distribution of health services and infrastructure between urban and rural areas, and a limited health workforce might also be a cause that contributes to the choice of delivering in a health facility[24].

This study also confirmed that educated women were more likely to utilize all the required maternal health services such as receiving sufficient ANC, delivery at a health facility, delivery with SBA professionals and receiving PNC after delivery. Education has long been regarded as one of the most powerful tools for enhancing women’s health[25]. Regarding this factor, one study highlighted the very strong influencing power of a woman’s educational level. The author of this study also revealed that women able to deliver the child at a Health facility still showed a higher maternal mortality level if they were women with a lower educational level[26]. Another study from Peru also stressed the same issue that women’s education has a great impact on maternal mortality [27]. Therefore, it can be shown that education plays an essential role in enhancing women’s health.

Even though many studies have acknowledged education and the use of modern contraceptive methods, an interesting finding arising from this study showed that women with a higher educational level were less likely to use a modern contraceptive method. This result seems to go against many major findings, but it is explainable. One qualitative study from Sri Lanka also found the same result that a lower level of modern contraceptive use was prevalent among women with a higher education qualification. The same study states that educated women who do not wish to have a baby tend to choose traditional methods over modern methods because they have a better understanding of how to record their ovulatory cycle and have very good cooperation from their husbands for the effective use of traditional methods[28]. The implication of this study does not discredit education, as education on options does not always mean using contraceptive methods, but it does influence women’s knowledge about their own fertility. When women can understand and manage their ovulatory cycle, the choice of using contraceptive methods (either modern or traditional) does not matter so much. However, education still has a significant involvement in women’s reproductive health.

The age of women was only found to have a significant association with ANC in this study. Women aged between 25 to 34 years old were more likely to receive sufficient ANC compared to the younger or older age group. As it also happens in some other countries, research from Uganda and Nepal also found the same results which are in line with our study[29, 30]. Regarding this finding, there are a lot of controversial discussions about the age of women and when they seek maternal health support. A study in Ethiopia indicated that women at a younger age (15–19 years old) are more likely to receive sufficient ANC compared to an older age group[31]. Therefore, an association between the age of women and sufficient ANC is not consistent.

As expected, wealthier women are more likely to utilize sufficient maternal health services including sufficient ANC, institutional delivery, and delivery with SAB help and adequate PNC. Among other socio-demographic factors, the wealth index stands as a leading factor that is significantly associated with maternal health services. This study was found to have similar results with similar research globally[32–34].

Another interesting finding from this study was that more than half the women who agreed with acts of IPV were more likely to have experienced IPV. The social and cultural contexts of Cambodia is one of hegemonic masculinities where society accepts violence
against women and IPV as a cultural norm[35]. This result highlights the impact of cultural norms on IPV and marks a significant and much-needed spotlight showing the level of gender inequality in Cambodia.

Conclusion
Gender inequality still exists among the Cambodian population and is considered a root cause of IPV. Women still experience IPV and women’s participation in household decision making had a significant contribution to the utilization of reproductive and maternal health services. Therefore, the government should help promote and strictly implement existing policies that support gender equality. This will help citizens have a better understanding of gender issues and help to prevent IPV in the community. Moreover, continuing to promote women’s education enables them to join the labor force with equal decent living wages so they have access to economic benefits that especially empower their household decision making.

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Work-environmental determinants of mass fainting illness among textile factory workers

Development of a screening instrument

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Abstract

Purpose – The purpose of this paper is to develop a brief screening instrument to identify risk factors of factory workers experiencing mass fainting illness (MFI) due to work-environmental determinants.

Design/methodology/approach – A factory-based cross-sectional study was conducted among 740 workers in October 2017 and was completed with face-to-face interviews. Data analyses included univariate logistic regression, backward stepwise linear regression and multiple logistic regression. Sum scores on significant items and receiver operator characteristic curves were used to compute potential cut-off points and the sensitivity and specificity rates.

Findings – Significant work-environmental factors were identified as working at very high speeds, having less influence on the choice of working partners, perceived high temperature at work, having less opportunity to do their best at work, and concern about losing a job in the next six months. In developing a screening instrument, a 6.5 cut-off point that corresponded to 99.6 percent sensitivity and 92.2 percent specificity was identified.

Originality/value – The study concludes that this MFI-instrument could potentially be used to prevent MFI. By understanding the policy implications, the government body, employers, workers, development partners and stakeholders should work toward preventing MFI. Implementing a preventive measure is therefore warranted due to the health education impact.

Keywords Factory workers, Mass fainting illness, MFI instrument, Sensitivity and specificity, Work-environmental determinants, Cambodia

Paper type Research paper

Introduction

Fainting (or syncope) is a form of unconsciousness due to temporary insufficient cerebral circulation and can occur repeatedly as a consequence of psychological determinants at work, such as life-threatening or very stressful conditions[1]. Mass fainting illness (MFI),
previously known as mass psychogenic illness (MPI) or mass hysteria, has frequently been identified in many settings where large groups of people gather, such as factories, schools, towns/villages, family groups, institutions and hospitals[2–5]. A combination of psychosocial factors and environmental determinants in occupational settings can act as precipitating factors, causing physical symptoms, even fainting from two or more workers working closely within an intragroup and intergroup, without organic pathogens being identified[6–9]. Researchers have found no agreement with risk factors explaining this phenomenon. There are two main reasons for syncope in the medical context, including psychogenic disorders due to life-threatening or very stressful situations[1], and occupational settings, somatoform disorders often occur, accounting for mild to severe physical symptoms but no cause has been identified[10]. Most researchers agree that episodes triggering MPI or mass hysteria are due to existing stressors at work, consisting of two syndromes, mass anxiety manifested by repeated exposure of acute anxiety frequently seen in schoolchildren and mass motor often triggered in groups but found at any age, with existing risk factors in the work environment[11, 12]. A toxic environment has been found in several studies, which is generated by-products, such as chemical odors or gases that may immediately trigger MPI[13, 14]. Previous studies identifying the risks of MPI in which the environmental measurements were confirmed found that no high threshold exposure existed in work environments[15–17]. Additionally, a joint ILO/WHO theory explained that triggering events may result from interacting combinations of risk factors, such as individual capability, working conditions, working environments, including monotonous work, physical stress, personal relations and management practice at work, plus external work factors[18]. Several job stress models discerned that various risk factors found in the workplace might cause adverse health effects. For example, the job demands-job control model underlying the job characteristics and work environments showed that the health outcome (MPI) resulted from unmet working demands (i.e. work overload or time pressure) and poor decision latitude (low job control at work or low social support). Other job stress models have similar concepts, such as the National Institute for Occupational Safety and Health and Person-Environment fit model, in which job characteristics and persons are broken down due to physiological changes. Additionally, job stressors[19], including job demands (workload and job control), organizational factors (workers’ role, management practice at work, job security and interpersonal relations) and physical stress (from noise, fire and burns from heat), can be influenced by existing factors, such as individual and context factors, leading to health consequences, such as psychological, physiological and behavioral problems[20]. Psychosocial factors include not only existing work-environmental factors, such as job content, work organization and management plus organizational and environmental conditions, but also external work factors (domestic demands) and individual characteristics (personality and attitudes). If prolonged, factors such as psychological and physical illnesses also induced stress[21]. The Job Content Questionnaire noted that a high level of stress at work would result from unmet needs between the demands of a job and control over the job, which could lead to psychological strain and physical illness[22]. A study on job stress predicting mental strain found high job demands and low job control and low job satisfaction to be important factors[23]. Monotonous tasks, including repetition known as psychosocial work factors, also contributed to health outcomes[24] or psychosocial health complaints, such as headaches, overall fatigue, stomach ache, sleep disturbances, anxiety, muscle strain and even fainting.

In Cambodia, MPI has received an increased attention due to its repeated occurrence among workers throughout factory settings in the country. Most workers have reported forms of MPI, such as dizziness, headache, nausea, hyperventilation and weakness. This illness manifests in intragroup and intergroup settings of workers and may occur once or twice a day and/or the following consecutive days. According to the National Social
Security Fund, from 2015 to 2017, the number of factories and workers that had experienced MFI was 32, 18 and 22 and 1806, 1160 and 1603, respectively, in which garment and footwear factories were observed as high risk. A reliable prediction method for MFI has been difficult to produce, but in this study, the validated questionnaire was freely available from the previous study and was modified and used to determine factors predicting MFI. In occupational settings, the working conditions are consistent with psychosocial factors in terms of identical factors[19]. As an essential evaluation of a screening instrument that is related to health conditions, a receiver operating characteristic (ROC) curve is a pure index of diagnostic accuracy in which a test’s ability to highlight a difference between illness and non-illness was applied[25, 26]. In the ROC curve, however, a graph is constructed by plotting sensitivity (representing a true positive) and 1 minus specificity (representing a false positive). A complete range of potential cut-off scores would be accepted and preferably discriminate between the misclassification of disease as non-illness (false negative) and healthy individuals as illness (false positive). The present study developed a concise screening instrument to identify factors predicting MFI regarding work-environmental determinants and determines a potential cut-off point and sensitivity and specificity rates.

Materials and methods
Study design and participants
The factory-based cross-sectional study was conducted among factory workers in October 2017 using face-to-face interviews. The factory workers’ ages ranged from 17 to 52 years and were employed in factories that agreed to participate in the study by signing an informed consent form and included workers with MFI who were affected at least one or more times within the last six months. Those who were absent from work on the day of data collection and refused to participate were excluded from the study.

The sample size was calculated using an expected MFI of 8 percent with a 23 percent allowable error and 1.7 precision. A total of 740 workers (659 women, 81 men) were recruited from 4 factories with 36 workers in each operative section (5/12 working operative sections were at high risk of exposure to common health hazards in the workplace). This study reviewed the case of eight factories that had experienced MFI, located in the capital city of Phnom Penh and two provinces in Cambodia. Of these, four factories were recruited into the study settings and were in three different locations: two factories (one garment and one footwear) in Kandal, one garment factory in Kampong Speu and one garment factory in Phnom Penh City. A convenient sampling method was used to recruit the study settings. A two-stage cluster sampling with probability proportional to size was used to recruit workers in each factory into the study population[27].

Measurements
Workers’ characteristics included age, gender, material status, education, monthly income, family member’s dependent on income, occupations, working duration, previous work history in a factory setting, number of working hours per week, employment contracts, smoking, absence from work and the reasons, and body mass index. Other variables concerning the presence of long-term effects were influenced by the impact of work on workers’ health, such as gastritis/stomachache, insomnia, emotional disturbance, back pain/arthritis, lung disease, heart disease, high blood pressure and kidney illness. In this part of the questionnaire, the questions were “Yes-No” and “multiple choice” type questions.

Work-environmental determinants are defined as an interacting combination among/between the job stressors underlying individual factors and contextual factors that may lead to health consequences or physical health illnesses. This term is synonymous with psychosocial work factors regarding working conditions. There are five subscales
consisting of job intensity (2 items), job control ability (7 items), physical work environments (17 items), psychological well-being (5 items) and job satisfaction (8 items). A response format in each question is rated on a five-point Likert scale of 1 (almost always) to 5 (almost never). The scoring of each factor was computed from a total score in each item and then split into two groups: scoring below average or equal to the lowest score was coded as a high-risk condition while low-risk conditions were coded with scores above average. All items in each subscale were computed as Cronbach’s $\alpha$, which was used to measure the internal consistency of the reliability. The overall score was 0.763 (Table I).

MFI (or workers with MFI) refers to workers who have experience of worsening health conditions and experienced unconsciousness (unable to move) or dizziness, at least one time

| MFIQ subscales | Items                                                                 | Cronbach’s $\alpha$ |
|----------------|-----------------------------------------------------------------------|---------------------|
| Job intensity  | 1. Working at very high speed                                          | 0.699               |
|                | 2. Working to tight deadlines                                          |                     |
| Job controls and supports | 3. You can get assistance from coworkers if you ask for it | 0.602               |
|                | 4. You can get assistance from your supervisors if you ask for it      |                     |
|                | 5. You can get external assistance if you ask for it                   |                     |
|                | 6. You influence the choice of your working partners                   |                     |
|                | 7. You can take your break when you need                               |                     |
|                | 8. You have enough time to get the job done                            |                     |
|                | 9. You are free to decide when taking a holiday or days off             |                     |
| Physical work environments | 10. Tiring or painful position                                         | 0.812               |
|                | 11. Carrying or moving heavy loads                                     |                     |
|                | 12. Standing or walking                                                |                     |
|                | 13. Repetitive hand or arm movements                                   |                     |
|                | 14. Having vibrations from hand tools, machinery, etc.                |                     |
|                | 15. Noise so loud that you would have to raise your voice to talk to people |                 |
|                | 16. The high temperature which makes you perspire even when not working|                     |
|                | 17. Low temperature whether indoors or outdoors                        |                     |
|                | 18. Experience breathing in smoke, fume, dust, toxic agents or strange odor |                |
|                | 19. Breathing in solvents and thinners                                 |                     |
|                | 20. Handling or being in skin contact with chemical products or substances |               |
|                | 21. Dangerous equipment                                                |                     |
|                | 22. Dangerous work methods                                             |                     |
|                | 23. Things placed or stored dangerously                                |                     |
|                | 24. Fire and burns from heat                                           |                     |
|                | 25. Electric shock                                                     |                     |
|                | 26. Dirty or poor maintenance                                          |                     |
| Psychological well-being | 27. At work, you have an opportunity to do what you do best        | 0.629               |
|                | 28. You can apply your ideas in your work                              |                     |
|                | 29. You have the feeling of doing useful work                          |                     |
|                | 30. You find your job intellectually demanding                         |                     |
|                | 31. You find your job emotionally demanding                            |                     |
| Job satisfaction | 32. I might lose my job in the next six months                        | 0.685               |
|                | 33. I am well paid for the work I do                                   |                     |
|                | 34. My job offers good prospects for career advancement               |                     |
|                | 35. I feel myself at home in this factory                              |                     |
|                | 36. At work, I have the opportunity to learn and grow                 |                     |
|                | 37. I have very good friends at work                                   |                     |
|                | 38. Satisfaction with working conditions                               |                     |
|                | 39. Satisfaction with working environments                            |                     |
| Overall        |                                                                        | 0.763               |

Note: MFIQ: Mass Fainting Illness Questionnaire

Table I. Baseline items of MFIQ subscale in relation to work-environmental determinants
within the previous six months prior to the interview. Those who did not report any of the MFI forms were considered healthy workers.

The questionnaire, which was called the MFI questionnaire, was modified based on a validated questionnaire, which is freely available from a previous study[28]. The questionnaire was also prepared bilingually in English and the Khmer languages.

Ethical consideration
Ethics approval was provided by Thammasat University Ethics Committee (COA No. 330/2560) and obtained from the National Ethics Committee for Health Research in Cambodia (Code No. 080 NECHR).

Statistical analysis
Workers who reported MFI due to work-environmental determinants were compared to those who did not report any form of MFI. Descriptive data analyses, such as count, percent, mean, median, mode and standard deviation, were used to describe each variable. For the development of the screening instrument, statistical analyses were subsequently performed. For the logistic regression analysis, the association between items in each subscale was considered as the baseline as having MFI within the last six months. All significant items in these univariate analyses (χ² test; p-values < 0.05) were selected for further analysis along with the multivariate logistic regression. Backward stepwise linear regression was aimed at reducing items that were correlated with an increased risk of MFI. All significant items were selected, and the scores were summed for each item for further analysis. A receiver operator characteristic (ROC) analysis was computed to determine the cut-off value that corresponded to the rate of sensitivity and specificity, which was used for predicting factors of MFI. In this study, however, missing data were omitted. The statistical analysis was performed using the Statistical Package for Social Science (IBM SPSS Statistic 23 License Authorization).

Results
Among 740 factory workers, 89 percent were female workers, and 31.8 percent had experienced an MFI incident within the last six months. The study also showed that the average age of factory workers was 26 years (SD = 6.20). Most workers had completed lower education, such as primary school (45.9 percent) and secondary school (40.8 percent). The majority (47.7 percent) were in sewing operations, and 66.3 percent of those employed had a fixed-term contract. Additionally, 75.5 percent reported some absences from work, while 60.5 percent had illness within the past 12 months (Table II).

For the data analysis, the univariate logistic regression analysis was applied for selected baseline items associated with increased risk of MFI due to work-environmental determinants. Significant predictive factors of MFI were as follows: workers working at very high speeds, receiving less assistance from coworkers, perceiving less influence on the choice of working partners, perceiving exposure to vibration from hand tools and machinery, perceiving high temperatures at work, perceiving low temperatures at work, having to breathe in smoke and strange odors, perceiving fire and burns from heat, having less opportunity to do their best at work, allowing less application of their ideas at work, perceiving a concern of losing their job within the next six months, and perceiving low satisfaction with working conditions (Table IV).

Second, backward stepwise linear regression was used to analyze the suppressor effects of factors that were used to predict MFI. Many items were correlated with MFI that were related to work-environmental determinants. Factors correlated with MFI included workers receiving assistance from coworkers, perceiving the influence on choice of working partners,
|                      | Total | MFI (%) | Non-MFI (%) |
|----------------------|-------|---------|-------------|
| Factory workers      | 740   | 100.0   | 505         |
| **Age (years)**      |       |         |             |
| 17–20                | 130   | 17.7    | 28          |
| 21–25                | 258   | 35.1    | 93          |
| 26–30                | 156   | 21.2    | 53          |
| 31–35                | 125   | 17.0    | 37          |
| > 35+                | 66    | 9.0     | 22          |
| **Mean = 26.53, SD = 6.20, Min. = 17, Max. = 52** |       |         |             |
| **Gender**           |       |         |             |
| Female               | 658   | 89.0    | 433         |
| Male                 | 81    | 11.0    | 71          |
| **Marital status**   |       |         |             |
| Single               | 281   | 38.0    | 194         |
| Married/divorced/widowed | 459 | 62.0    | 311         |
| **Education**        |       |         |             |
| No education         | 30    | 4.1     | 21          |
| Primary school       | 337   | 45.9    | 220         |
| Secondary school     | 300   | 40.8    | 211         |
| High school/college or higher | 68 | 9.3     | 51          |
| **Mean = 187.95, SD = 24.81, Min. = 100, Max. = 290** |       |         |             |
| **Monthly income (USD)** |     |         |             |
| < 200                | 599   | 80.9    | 419         |
| > 200                | 141   | 19.1    | 87          |
| **Number of working hours per week** |       |         |             |
| 48                   | 592   | 80.0    | 421         |
| > 48                 | 148   | 20.0    | 84          |
| **Mean = 50.14, SD = 4.43, Min. = 40, Max. = 78** |       |         |             |
| **Types of occupation** |   |         |             |
| Sewing               | 353   | 47.7    | 218         |
| Cutting              | 109   | 14.7    | 77          |
| Assembly line work   | 81    | 10.9    | 61          |
| QCs                  | 80    | 10.8    | 52          |
| Packaging            | 48    | 6.5     | 39          |
| Supervisors          | 56    | 7.5     | 42          |
| Ironing              | 43    | 5.8     | 37          |
| **Employment contracts** |  |         |             |
| Fixed-term contract  | 487   | 66.3    | 341         |
| Temporary contract   | 247   | 33.4    | 159         |
| **Worked in a factory before** |     |         |             |
| No                   | 231   | 31.3    | 178         |
| Yes                  | 508   | 68.7    | 326         |
| **Absence from work in the past 12 months** |       |         |             |
| No                   | 181   | 24.5    | 143         |
| Yes                  | 558   | 75.5    | 361         |
| **Illness in the past 12 months** |       |         |             |
| No                   | 292   | 39.5    | 232         |
| Yes                  | 448   | 60.5    | 273         |

Table II: Descriptive statistics of 740 factory workers with MFI.
perceiving high temperature at work, having to breathe in smoke or strange odors, having an opportunity to do their best at work, perceiving a feeling of doing useful work, perceiving losing their job within the next six months, being paid well for their job, and perceiving satisfaction with working conditions and working environments (Table III).

Table IV presents the factors associated with MFI. Multivariate logistic regression analyses were performed, in which selected significant items from the univariate analyses were identified ($\chi^2$-test, $p$-value < 0.05). Predictive factors of MFI included working at very high speeds, perceiving less influence on the choice of working partners, perceiving a high temperature at work, having less opportunity to do their best at work and having a concern for losing a job in the next six months. Fourth, sum scores were found for the significant items from the data that were computed by multiplying and adding the scores, ranging from 5 to 21.

The screening instrument was assessed to discriminate between workers who had MFI and those who did not have MFI that had been influenced by work-environmental determinants. The ability of this screening instrument to discriminate among these health conditions and determine potential cut-off thresholds that correspond to the sensitivity and specificity rates with their confident interval was tested (Table V). An ROC curve could preferably highlight the highest cut-off point that predicts MFI. By definition[25], an AUC of 0.5 means that affected-MFI and non-affected-MFI cannot be distinguished, and an AUC of 1.0 indicates perfect discrimination among the two groups. We used 6.5 as a potential cut-off point, which corresponded to a sensitivity rate of 99.6 percent and a specificity rate of 92.2 percent. The area under the curve (AUC) was 0.615 (95% CI: 0.572–0.658), and the data are shown in detail in Figure 1.

Discussion
This study found factors that were associated with MFI, such as working at very high speeds, perceiving less influence on the choice of working partners, perceiving high temperature at work, having less opportunity to do their best at work (e.g. all handling tasks among textile factory workers are performed to expedite speedily and are dependent on their supervisors) and perceiving concern for losing a job in the next six months. These factors were used to develop a screening instrument. Only a 6.5 cut-off point determined the high sensitivity and specificity rate that is distinctly used for identifying predicting factors of MFI. In this screening instrument, 39 items were modified from validated questions that are freely available from a previous study recognized for its reliability.

In our study, however, methodological features and some limitations are present. First, information about the predictive factors of MFI due to work-environmental determinants was identified throughout the interviewing process and whilst measuring workers' perception. However, the objective data as a baseline were determined by workers who had

| $b$     | SE(b) | 95% CI       |
|---------|-------|--------------|
| Received assistance from co-workers if asking for it | 0.04*** | 0.02 | (0.01, 0.07) |
| Influenced the choice of your working partners | 0.07*** | 0.02 | (0.03, 0.10) |
| Perceived high temperature at work | 0.08*** | 0.01 | (0.05, 0.11) |
| Breathing in smoke, fume, dust, toxic agents or strange odor, etc. | 0.04*** | 0.01 | (0.01, 0.06) |
| Having an opportunity to do their best at work | 0.04*** | 0.01 | (0.02, 0.07) |
| Have feeling of doing useful work | −0.02* | 0.01 | (−0.04, −0.00) |
| Perceived lost job in the next six months | −0.04*** | 0.01 | (−0.07, −0.01) |
| Perceived well paid for the job done | −0.03*** | 0.02 | (−0.12, −0.05) |
| Satisfaction with working conditions | −0.17*** | 0.04 | (−0.24, −0.10) |
| Satisfaction with working environments | 0.11*** | 0.04 | (0.03, 0.18) |

Table III. Work-environmental determinants correlated with MFI

Notes: $n = 740$. *$p < 0.05$, ***$p < 0.001$
MFI and those who did not have MFI. Workers were diagnosed with MFI by the ICD-10 guideline (e.g. somatoform disorders), which is rather subjective. Second, factors predicting MFI are caused by a single risk factor unless diverse factors, known as work-environmental determinants, could be clearly observed from factory to factory or from country to country. Third, factory byproducts, such as toxic environments, existed (e.g. smoke or smelling odors) that are more likely to trigger an episode of MFI. In this study, a questionnaire was used to assess factors that predicted MFI, so the results would draw less attention from the

| Work-environmental determinants | Crude analysis | Adjusted analysis |
|-------------------------------|---------------|-------------------|
|                               | cOR<sup>a</sup> 95% CI OR | aOR<sup>b</sup> 95% CI OR |
| Working at very high speed    |               |                   |
| High                          | Ref.          |                   |
| Low                           | 2.19          | (1.23-3.93)       | 1.98 (1.10-3.9) |
| Perceived assistance from co-workers |               |                   |
| High                          | Ref.          |                   |
| Low                           | 1.44          | (1.06-1.97)       | 1.17 (0.84-1.64) |
| Influencing the choice of working partners |               |                   |
| High                          | Ref.          |                   |
| Low                           | 1.97          | (1.36-2.86)       | 1.64 (1.03-2.61) |
| Perceived vibrations from hand tools, machinery |               |                   |
| High                          | Ref.          |                   |
| Low                           | 1.44          | (1.02-2.02)       | 1.21 (0.85-1.72) |
| Perceived high temperature at work |               |                   |
| High                          | Ref.          |                   |
| Low                           | 1.98          | (1.44-2.72)       | 2.16 (1.39-3.35) |
| Perceived low temperature at work |               |                   |
| High                          | Ref.          |                   |
| Low                           | 1.41          | (1.04-1.93)       | 0.91 (0.62-1.33) |
| Breathing in smoke, fume, dust, toxic agents or strange odor |               |                   |
| High                          | Ref.          |                   |
| Low                           | 1.64          | (1.20-2.25)       | 1.26 (0.87-1.81) |
| Perceived fire and burns from heat |               |                   |
| High                          | Ref.          |                   |
| Low                           | 1.98          | (1.23-3.20)       | 1.62 (0.99-2.67) |
| Having an opportunity to do their best at work |               |                   |
| High                          | Ref.          |                   |
| Low                           | 1.77          | (1.29-2.44)       | 1.64 (1.14-2.38) |
| Applying their own ideas at work |               |                   |
| High                          | Ref.          |                   |
| Low                           | 1.42          | (1.01-1.99)       | 1.04 (0.70-1.55) |
| Perceived loss of job in the next six months |               |                   |
| High                          | Ref.          |                   |
| Low                           | 1.74          | (1.22-2.49)       | 1.62 (1.10-2.40) |
| Satisfaction with working conditions |               |                   |
| High                          | Ref.          |                   |
| Low                           | 2.93          | (1.01-8.55)       | 0.37 (0.13-1.10) |

Notes: n = 740. <sup>a</sup>Crude estimate OR; <sup>b</sup>adjusted estimated OR (adjusted for factors with p-values < 0.05 of the χ²-test)
public’s perspective. However, numerous past studies have conducted environmental measurements, but threshold exposure levels may not have been considered, and the other tests did not find ample air-born contaminants[6, 15, 29]. Fourth, the cut-off point in developing screening instruments frequently determines the sensitivity and specificity rates. If the cut-off point is remarkable, the number of false negatives and false positives is restricted. Additionally, the screening instrument is directed at workers underlying health conditions. If the result had a low sensitivity and specificity rate, the misclassification among those groups would have determined affected MFI or vice versa. However, no such cut-off threshold value was found in developing the screening instrument. Therefore, the study suggests that the testing MFI instrument has practical usability and efficient performance that can be used not only in this study setting but could also be applied in other

| Table V. | Cut-off points | Sensitivity (CI) | Specificity (CI) |
|----------|----------------|-----------------|-----------------|
| 6.5      | 99.6 (98.8–100.0) | 92.2 (89.8–94.6) |                |
| 7.5      | 97.0 (94.8–99.2) | 89.5 (86.8–92.2) |                |
| 8.5      | 91.0 (87.3–94.7) | 82.2 (78.5–85.9) |                |
| 9.5      | 84.1 (79.0–89.2) | 72.7 (68.2–77.2) |                |
| 10.5     | 76.8 (70.7–82.9) | 62.4 (57.1–67.7) |                |
| 11.5     | 67.8 (60.5–75.1) | 51.7 (45.6–57.8) |                |
| 12.5     | 52.8 (44.0–61.6) | 32.7 (25.4–40.0) |                |

Notes: Receiver operator characteristic (ROC) curve for the development of the screening instrument for identifying factors predicting MFI as result of the area under the curve (AUC) of 0.615 (95% CI: 0.572–0.658); by definition, an AUC of 0.5 shows no discrimination above chance and an AUC of 1.0 shows perfect discrimination
similar patterns of work characteristics. The sensitivity rate is extremely high, and the specificity is slightly low. However, if this screening instrument is available, it could be used towards effective interventions.

**Conclusion**

There are factors helping us to predict MFI occurrences, and a screening instrument used for identifying risk factors of MFI was developed. If this screening instrument is available, its practical use can work towards helping to prevent MFI. Based on the policy implications, the government, employers, development partners and other stakeholders should work towards identifying the common work-environmental determinants as a step towards improving the situation. The study suggests that further study in other settings will increase the effectiveness and validation of this screening instrument.

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Effect of probiotic consumption on increasing the CD4+ T cell counts among Iranian patients living with HIV

A double-blind randomized clinical trial

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Abstract

Purpose – During the ART era, persistent immune activation remains a significant challenge in people living with HIV (PLWH). Microbial translocation play an essential role in this setting. Probiotics have several immunological benefits which can reverse this process. The purpose of this paper is to investigate the safety and efficacy of probiotics on CD4 counts among Iranian PLWH.

Design/methodology/approach – In total, 50 PLWH with CD4 counts above 350 cells/mm³ did not receive ART participated in a randomized, double-blind trial and underwent 24 weeks of treatment with either LactoCare® or placebo twice daily. CD4 counts of the patients were measured at baseline, 12 weeks and 24 later in the two groups. Side effects were measured monthly using a specific checklist.

Findings – The mean CD4 count of the patients showed a significant difference between the two groups after six months. Through six months follow up, the mean CD4 count of the patients showed a significant reduction as compared to the baseline in the placebo group; however, it did not show a significant difference in the probiotic group. Repeated Measures Anova test showed a significant effect for time × treatment interaction on the CD4 count during the trial course. No significant difference between the two groups concerning adverse events was reported.

Originality/value – It seems the use of probiotics in PLWH with a CD4 count above 350 cells/mm³ who are not receiving antiretroviral drugs is safe and can reduce the devastating process of CD4+ T cells in these patients.

Keywords HIV, Probiotic consumption, CD4 count, Iran

Introduction

In spite of three decades since the rise of the HIV infection in the USA, no curative treatment or effective vaccine has been discovered. With respect to newly antiretroviral therapy (ART), AIDS-related deaths fell from 1.9m in 2004 to 940,000 in 2017. It is
estimated that more than 36m people were infected by the end of 2017, reflecting the enormous burden of disease on the international community[1]. In Iran, by the beginning of 2018, a total of 36,571 people were diagnosed with HIV. However, the true figure is estimated to be much higher. Therefore, any attempts to understand the mechanisms of disease sustainability or progression as well as the strategies to contain and deal with the disease is essential[2].

The universal use of ART in the past decades has led to a change in the face of HIV infection from a deadly disease to a chronic one. Therefore, non-infectious complications such as cardiovascular disease, diabetes, metabolic syndrome, obesity and premature aging, all mediated by chronic inflammation, are more common in patients[3]. Immune system activation persists despite using ART. Growing evidence supports the findings that intestinal mucosa breakdown during SIV/HIV infections might lead to the release of microbial products into the bloodstream that stimulates the immune system. This phenomenon could be due to the structural, microbial and immunological changes in the intestine during the infection[4]. Low-level viremia and other simultaneous viral infections, such as cytomegalovirus (CMV) and hepatitis C virus (HCV), are also associated with inflammation persistence[5].

The shift in intestinal microbial flora is common in all HIV disease stages, regardless of the presence of opportunistic infection. In one study, the most frequent changes were found in the number of essential intestinal microorganisms, especially in bifidobacteria. Increased growth of pathogenic organisms, mainly Staphylococcus aureus, Candida and Klebsiella, was observed in 57.1 percent of the patients[6].

Normally, microbes and microbial products pass through phagocytosis in the lamina propria and mesenteric lymph nodes. The level of lipopolysaccharides (LPS) in HIV infected patients, especially in advanced stage (CD4 count < 200 cells/mm³), is significantly higher than non-infected patients, suggesting a higher rate of microbial translocation. Furthermore, there is a direct correlation between the level of LPS in plasma and the level of intrinsic and acquired immune system activity[7, 8].

LPS of gram-negative bacteria mediates C-C chemokine receptor Type 5 (CCR5) coreceptor overexpression and facilitates infection of the lamina propria CD4+ T cells (LP CD4 T) without simultaneously activating a large number of other T cells, hence ultimately lowering the LP CD4 T. This phenomenon could indicate a new mechanism that potentially links intestinal dysbiosis to mucosal pathogenesis of HIV[9].

On the other hand, a subgroup of T helper (TH) cells, TH17 cells and Interleukin (IL)-17 play a critical role in host immunity and protect the intestinal mucosal integrity. Therefore, their reduction during HIV infection along with the microbial products translocation through damaged mucosal epithelium provides immune stimulation and a poor long-term prognosis for people living with HIV (PLWH). Furthermore, ART treatment initiation could not improve the TH17 population in the intestinal mucous membrane completely[10].

Recently, Valiathan and Asthana revealed that an increase in circulatory TH17 (cTh17) had a reverse relation to the percentage and absolute count of CD4+ T cells and direct relation to microbial translocation and immune activation[11].

Probiotics are defined as living organisms that benefit the host when adequately administered. Commonly, lactobacillus or bifidobacterium species are used in various illnesses with promising results in some conditions, such as reducing the duration of acute infectious diarrhea, and the severity of infantile necrotizing enterocolitis, or as an alternative treatment for bacterial vaginosis[12]. During HIV infection, reduced intestinal CD4+ T cells and dendritic cells damage the intestine. In addition, ART side effects such as gastrointestinal (GI) symptoms like diarrhea impact on the quality of life and can even result in ceasing treatment. A novel hypothesis suggests that probiotics protect
the GI tract reducing diarrhea and postpone the HIV progression to AIDS for several years (Figure 1)[13].

Moreover, probiotics can reduce intestinal inflammation and permeability, increase mucosal immunity response, balance the T helper cells response as well as increase Immunoglobulin A (IgA) polymer secretion (Figure 2)[15, 16].

It is also shown that probiotics can inhibit the HIV-1 pseudovirus in vitro through CD4 receptors expression on the lactobacillus cell surface, and increase CD4 counts[18].

Concerning the side effects of probiotics, there is a case report of lactobacillus acidophilus bacteremia that has been used as a probiotic in a patient with AIDS[19]. Another study showed an increased mortality rate in the probiotic group that received six different lactobacillus species and bifidobacterium, with a total of 10 CPU daily dose, for infectious complications of acute pancreatitis. There were also reports of bacteremia, endocarditis and liver abscess caused by lactobacillus species (including L.hamnosus GG) particularly in patients with small intestinal syndrome, central venous catheter, intestinal feeding tubes, or severe underlying disease[20].

However, it seems that the use of these agents, especially lactobacillus species, is safe and well-tolerated in patients without AIDS, although the number of studies and tested species is limited[15, 21].

Therefore, for the first time in Iran, we investigated the safety and efficacy of probiotics on CD4 + T cell counts among Iranian patients living with HIV.

Materials and methods
Participants
In total, 50 patients out of a total of 207 HIV infected patients (male and female), who were referred to the voluntary counseling and testing (VCT) center at Imam Khomeini Hospital in Tehran, Iran were selected to participate in this trial between February 2016 to October 2017. To participate, eligible patients had to be aged 18 to 65 years old with CD4 count

Notes: Pro- and prebiotics may ameliorate the HIV-induced intestinal problems through effects on the microbiota and its metabolism, on various cells of the immune system (as represented by the arrow pointing at the sampling DC), and on intestinal epithelial cells (IEC)

Source: Reproduced from Hummelen et al. in 2010 [14], with permission
greater than 350 cells/mm$^3$ who did not receive any ART. Those selected had to attend and complete a 24-week randomized, double-blind and placebo-controlled trial (Figure 3).

**Random allocation**

Following simple randomization with a computerized random number generator, eligible patients received either a probiotic (LactoCare®, Zist Takhmir Pharmaceutical Company, Tehran, Iran) or a placebo (provided by Zist Takhmir Pharmaceutical Company, Tehran, Iran) capsule twice daily for 24 weeks (allocation ratio 1:1). A third-party assignment was used for the allocation concealment. The probiotic and placebo capsules were identical regarding their size, shape, color, texture and odor. The patients and investigators were blinded to the treatment assignment.

**Measurements and procedures**

The CD4 count was measured using the Partec kit (Partec GmbH, Münster, Germany) for all participants at baseline, 12 and 24 weeks. The primary outcome was the assessment of
probiotic safety and efficacy to increase CD4 count compared to placebo in PLWH who were not treated with ART using general linear model repeated measures. Side effects were measured monthly during the study using a specific checklist. In addition, participants were warned to immediately alert the researchers to any unexpected symptom during the duration of the study.

This trial was a proof of concept study; however, we assumed a significant difference of 15 on the CD4 count, an SD of 10, a two-sided significance level of 0.05, a power of 80 percent based on a previous study[22], and a loss to follow up rate 20 percent. Thus the sample size was calculated 50 (25 patients in each arm).

**Ethical considerations**

The authors considered the declaration of Helsinki and subsequent revisions and obtained written informed consent from all patients before participation in the study. Participants knew they could leave the study when they wanted without any interruption in their standard care. The study protocol was approved by the institutional review board of Tehran University of Medical Sciences.

**Statistical analysis**

All patient data were decoded and analyzed. Quantitative and qualitative variables were reported as mean ± SD and number (%). Baseline, at 12 weeks and at 24 weeks CD4 count were compared between the two groups using an independent t-test. The independent t-test was also used to compare the reduction in CD4 count from baseline to each time point in both groups. Anova’s repeated-measure analysis was used to compare the CD4 count between the two groups during the trial course. Qualitative variables were analyzed using Fisher’s exact test. All tests

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Figure 3. The flow of participants through study
were in two domains and a \( p \)-value less than 0.05 was considered statistically significant. All statistical analyses were performed with the statistical package of social science (SPSS) software (version 22; IBM Company, Armonk, New York, USA). The graphs of repeated-measure tests were drawn with Sigma plot (version 12; Systat Software Inc., San Jose, California, USA).

Results

Demographic characteristics

Baseline demographic characteristics of the participants, as well as their baseline CD4 count, were not significantly different between the two groups (Table I).

Outcomes

There was no significant difference in the baseline CD4 count between the probiotic and the placebo groups (710.2 \( \pm \) 143.37 vs 694.4 \( \pm \) 213.80, respectively, mean difference (MD) (95% confidence interval) = \(-15.8 \ (\ -119.32 \ to \ 87.72)\), \( t = -0.37\), \( p = 0.7\)). The mean CD4 count was not significantly different at weeks 24 compared to the baseline in the probiotic group and it remained relatively constant in contrast to the probiotic group. In the probiotic group, the independent \( t \)-test showed no significant difference regarding the mean CD4 count from baseline to weeks 12 in the probiotic group compared to the placebo group (\( p = 0.06\)), but after 24 weeks the mean CD4 count in the placebo group was significantly lower than the probiotic group (\( p = 0.001\)). The mean CD4 count in the probiotic group on week 12 dropped significantly (\( p = 0.04\)) compared to the baseline. At week 24, the mean CD4 count in the probiotic group increased substantially (\( p = 0.02\)) from week 12; however, compared to the beginning of the trial, this was not statistically significant (\( p = 0.7\)) (Table II).

In the probiotic group, the independent analysis showed that the change from baseline to week 24 in the CD4 count was significantly different to the other group (\( p = 0.001\)) and also,

| Table I. | Placebo group \((n = 25)\) | Probiotic group \((n = 25)\) | \(p\)-value |
|----------|--------------------------|-----------------------------|-------------|
| Age (years) (mean \( \pm \) SD) | 35.68 \( \pm \) 7.77 | 34.76 \( \pm \) 6.86 | 0.9 |
| Sex: M: F n (%) | 10 (40.0), 15 (60.0) | 11 (44.0), 14 (56.0) | 0.7 |
| Educational level | | | |
| Illiterate | 1 (4.0) | 0 (0) | 0.2 |
| Diploma | 10 (40.0) | 5 (20.0) | |
| Under the diploma | 9 (36.0) | 8 (32.0) | |
| Master's degree and higher | 4 (16.0) | 11 (44.0) | |
| PhD | 1 (4.0) | 1 (4.0) | |
| Table II. | | | |
| Comparison of mean CD4 count between the two groups using the independent \( t \)-test, Tehran, 2016–2017 | | | |
| Baseline | Week 12 | Week 24 | \(p\)-value |
| Probiotic | 710.2 \( \pm \) 143.37 | 687.4 \( \pm \) 144.56 | 718.0 \( \pm \) 136.13 | 0.001 |
| Placebo | 694.4 \( \pm \) 213.80 | 607.7 \( \pm \) 148.87 | 537.7 \( \pm \) 143.78 | 0.387 |
the increased CD4 count percent from baseline to week 24 was greater in the probiotic group during study ($p < 0.001$) (Table III).

ANOVA repeated measurement analysis demonstrated significant effect for time x treatment interaction on the CD4 count from the beginning of the study to 24 weeks $p < 0.05$ (Figure 4).

The mean CD4 count in the placebo group at baseline, week 12, and week 24 in patients who acquired HIV infection via intravenous (I.V) drug transmission route was $633.5 \pm 138.4$, $593.2 \pm 194.6$ and $540.6 \pm 131.7$ cells/mm$^3$, respectively. This variable in the sexual transmission route was $726.6 \pm 171.4$, $635.1 \pm 109.7$ and $513.5 \pm 116.6$ cells/mm$^3$, respectively ($p$-value in each part was $p = 0.1$, $p = 0.3$ and $p = 0.1$, sequentially).

The mean CD4 count in the probiotic group at baseline, week 12 and week 24 in patients who acquired HIV infection via I.V drug transmission route was $617 \pm 117.8$, $635.5 \pm 136.8$ and $684.2 \pm 118.2$ cells/mm$^3$, respectively. This variable was in the sexual transmission route $773.4 \pm 128.6$, $724.3 \pm 146.2$ and $742.8 \pm 146.1$ cells/mm$^3$, sequentially ($p$-value in each part was $p = 0.1$, $p = 0.2$ and $p = 0.4$, respectively).

Evidently, the I.V drug and sexual transmission routes and the comparison of mean CD4 count between the placebo and probiotic groups did not show any significant difference during each time point of the study (at baseline, week 12 and week 24 was $p = 0.1$, $p = 0.2$ and $p = 0.4$, respectively).

**Adverse effects**

No significant adverse events occurred between the two groups ($p = \text{ns}$). Additionally, no mortalities were recorded (Table IV).

### Table III

|                          | Placebo group | Probiotic group |
|--------------------------|---------------|-----------------|
| Increase of CD4 count percent from baseline to week 12 | 4 (20.0) | 19 (79.2) |
| Increase of CD4 count percent from baseline to week 24 | 0 (0) | 16 (66.7) |

**Figure 4.**
Repeated measure for comparison of two study groups on the CD4 count
Discussion

This double-blind randomized clinical trial showed that for PLWH, one probiotic capsule consumed twice daily for 6 months significantly prevented CD4 count reduction compared to the placebo group. Since the baseline clinical characteristics in both probiotic and placebo groups were not significantly different, this effect in the treatment group can be attributed to the improvement of the immune system caused by probiotic consumption. As the side effects were not significantly different in the two groups, it could be concluded that probiotic use was well tolerated, and no significant complications were observed in this study.

For HIV patients, in addition to the intestinal lymphoid tissue (GALT) infection, a major lymphocyte reservoir in the body, the accumulation of other triggered CD4+ T cells in the intestine as a consequence of the microbial translocation leads to an increase in infected CD4+ T cells and subsequently increased viral load as well as progression of the infection[23]. Several studies showed probiotics could play a role in interrupting this faulty cycle. Probiotic products such as probiotic yogurt are readily available and inexpensive. Furthermore, food fermentation mediated by probiotics can effectively lead to the essential fatty acids release in repairing the intestinal mucosal wall and improving the barrier between pathogenic and beneficial microorganisms. In addition to CD4 count improvement, probiotics can alleviate common ART side effects associated with low compliance such as GI upse[23].

Our study was in line with the review of Miller et al[23] in which 13 studies were analyzed to evaluate the effect of probiotic consumption on the CD4 count of HIV infected patients between 2004 and 2015. Ten studies showed a statistically significant increase or stability in the CD4 count. Therefore, the authors concluded that probiotics have a potential role in enhancing the immune system of HIV infected adults and children.

In the present study, although the mean CD4 count of patients in the probiotic group after three months of the trial did not significantly increase compared to the placebo group; after six months of probiotic administration, the mean CD4 count was significantly higher than the placebo group. Considering the nature of HIV infection, it was expected that through the first three months of the trial, the mean CD4 count dropped off significantly in the probiotic and placebo groups. Surprisingly, this trend reversed in the probiotic group compared to the placebo group in the remaining follow up period. The emergence of the probiotic effect might illustrate this phenomenon. Therefore, probiotics administration longer than three months as an adjunct therapy might decelerate HIV progression. Heiser et al[24] showed probiotic consumption for three months improved diarrhea associated with ART, but it was not effective in preserving the CD4 count. The latter finding could be due to a relatively shorter duration of taking probiotics. Gonzalez-Hernandez et al[25] also demonstrated that the CD4 count increased significantly only in the symbiotic group compared to the probiotic or placebo groups during a short period of 16 weeks therapy. Symbiotics are a combination of probiotics and prebiotics which contain no digestible fiber compounds stimulating the growth of probiotic microorganisms.

Although it was shown that the loss of lactobacillus species in vaginal flora could increase the risk of HIV acquisition from an HIV infected woman, we observed no impact of probiotic consumption on the mean CD4 count concerning HIV acquisition via the sexual contact vs IV drug use. This suggests that HIV interacts with the human gut microbiota ignoring the route of transmission[26].

| Table IV. |  |  |  |
| --- | --- | --- | --- |
| Prevalence of adverse events in the trial groups, Tehran, 2016–2017 | Placebo group (%) | Probiotic group (%) | p-value |
| Mild diarrhea | 1 (4.0%) | 2 (8.0%) | 0.9 |
| Weight gain | 1 (4.0%) | 6 (24.0%) | 0.1 |
| None | 23 (92.0%) | 17 (68.0%) | – |
In our study, the side effects of probiotic consumption, including sepsis and gastrointestinal symptoms, were not statistically significant in the two groups. Of course, none of the participants had the risk factors for bacteremia associated with Lactobacillus species, such as CD4 counts below 50 cells/mm³, alcoholic liver disease, gastrointestinal disorder (active infection, malignancy and recent surgery) which Haghighat et al.[19] purposed. Likewise, Carter et al.[27], did not find any bacteremia or fungemia associated with probiotic consumption in the analysis of 39 studies.

We used LactoCare® containing lactobacillus and bifidobacterium species as well as Streptococcus thermophilus in this trial. In the literature, lactobacillus or Bifidus species administration was associated with a moderate increase in the mean CD4 count in all papers where their primary outcome was the CD4 count. However, the use of Saccharomyces boulardii was not helpful in one study[27].

To the best of our knowledge, this is the first study to evaluate the immune-boosting benefit of probiotics on Iranian PLWH. While in the majority of papers analyzed in the previous review papers treatment duration was less than six months[21, 24], we followed up patients for 6 months preparing a more accurate comparison between the probiotic and placebo group. In addition, a double-blind, randomized, placebo-controlled trial design provided a reliable comparison of probiotic effects on CD4 count. However, the limitations of this study included its relatively small sample size, lack of inflammatory factors evaluation such as erythrocyte sedimentation rate (ESR), C – reactive protein (CRP), IL-1β, IL-6, TNF-α, and other markers related to bacterial translocation such as CD14, LPS, plasma 16SrRNA and bacteria in feces. Unfortunately, we could not measure the HIV viral load in the plasma due to a lack of financial support.

In conclusion, probiotic consumption twice daily amongst HIV-infected patients with a CD4 count greater than 350 cells/mm³ who are not receiving antiretroviral drugs is safe and well-tolerated. It also might preserve CD4+ T cell populations in these patients and slow progression of the disease. Further studies with larger sample sizes in patients receiving ART by different probiotic strains in combination with prebiotics are warranted.

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System dynamics analysis of
dental caries status among Thai
adults and elderly

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Abstract

Purpose – The purpose of this paper is to estimate the changes of dental caries status among Thai adults and elderly under the different policy options using system dynamics modeling.

Design/methodology/approach – A multi-sector system dynamics model was developed to capture the dynamic interrelationship between dental caries status changes and oral health behavior – including self-care, dental care utilization and sugar consumption. Data used to populate the model was obtained from the Thai national oral health survey in 2000, 2006, 2012 and Thailand Official Statistics Registration. Three policy scenarios were experimented in the model: health promotion policy, dental personnel policy and affordable dental care service policy.

Findings – Dental caries experiences among Thai adults and elderly were projected to increase from now to 2040, as the elderly population increases. Among all policies experimented herein, the combined policies of health promotion, increased affordability and capacity of dental health service were found to produce the highest improvement in dental caries status with 3.7 percent reduction of population with high decayed, missing and filled teeth (DMFT) and 5.2 percent increase in population with very low DMFT.

Originality/value – This study is the first comprehensive simulation model that attempts to explore the dynamic interrelationship among dental caries experiences and behavioral factors that impact on oral health outcomes. In addition, the simulation model herein offers a framework for policy experimentation that provides policymakers with additional insights to inform health policy planning.

Keywords Elderly, Adult, Dental caries, System dynamics analysis, Thailand

Paper type Research paper

Introduction

Dental caries is a major public health problem among the adults and the elderly, particularly in developing countries of a nation’s population. In Thailand, the prevalence of dental caries among the population aged 15 years, 35–44 years and 60–74 years increased from 62.1 to
62.7, 85.6 to 91.8 and 95.6 to 98.5 percent between 2000 and 2017[1]. Within this increase, untreated dental caries instances were listed at 40.1 percent (15 years), 43.3 percent (35–44 years) and 52.6 percent (60–74 years) in the 2017 National Oral Health Survey[1]. The presence of dental caries has been found to significantly diminish the oral health-related quality of life of Thais in all age groups[2]. Symptoms of dental caries can cause physical discomfort, psychological stress[3], negative impact on daily activities and a decrease in work productivity[4]. Furthermore, untreated dental caries can eventually lead to edentulism, which limits the ability to chew and may lead to nutritional deficiency and poor physical health[5].

Based on the 2017 Thai Health and Welfare Survey, the proportion of the Thai population who visited a dentist within the past year has increased from 7.4 in 2006 to 9.6 percent in 2017[6]. However, the dental utilization rate is still very low compared to the treatment needs among adults and the elderly[1, 6]. These groups tend to seek dental treatment when the symptoms become more severe[1]. Therefore, treatment for these groups often includes tooth extractions and other complicated and lengthy procedures[1].

The etiology of dental caries is the interaction of multiple factors including the host, oral micro-flora, fermentable sugar in the diet and the length of time an individual is exposed to these factors. Despite individual predispositions to dental caries, other indirect factors such as social, behavioral and environmental factors can increase one’s susceptibility to dental caries and their progression[7–9]. In particular, high quantities and frequent sugar consumption are major causes of dental caries[10]. Sugar consumption in Thailand has increased significantly in the past decades from 12.7 kg per person per year in 1983 to 38.2 kg/person/year in 2015[11, 12].

Considering the multiple factors involved in the progression of dental caries and the complex interrelationships among these factors over time[13, 14], addressing changes in dental caries status requires a method that captures these interrelationships and dynamics in a systematic approach. System dynamics is one such methodology[15, 16]. This method has been applied to public health issues such as the outbreak of influenza[17], obesity[18], AIDS and sexually transmitted infections[19]. It has previously been used to analyze oral health problems such as the dental services system in the Netherlands[20], oral health problems of the elderly in urban areas in the USA[21] and manpower needs for dental care in Thailand[22].

Several approaches have been used to improve the prevalence of dental caries in the population worldwide[23]. The WHO Global Oral Health program has adopted oral health promotion which is integrated with the common risk-factors approach (hygiene and diet) as the best means to promote oral health and reduce oral diseases[23]. A systematic review found that an oral health promotion program focusing on daily brushing with fluoride toothpaste effectively reduces dental caries[24]. In Thailand, oral health promotion is integrated within the national dental health policies to help enable the holistic healthcare system to focus on lifestyle changes such as sugar consumption, smoking cessation and tooth brushing with fluoride toothpaste[25]. Furthermore, the use of dental care services was one of the factors affecting the oral health of the population[26]. Baker[27] found that the type of dental services, treatment costs and income of the individual predicted dental treatment needs, which in turn could predict oral health behavior and dental services used. The supply of trained dental personnel was found to be a predictor for dental services utilization for adults in both urban and rural areas[28]. In Thailand, the use of dental services among the elderly was found to be related to attitudes toward oral health conditions, access to dental services, accompanying persons, income and general health conditions[29].

With dental caries, the interrelated factors can adapt to change over time such as with life span and population structures. Although the dental caries problem affects the whole population, the factors related to the development of disease and the dynamics of oral health
behaviors in children are different from adults and the elderly[30]. There is also a cause for concern as the proportion of elderly individuals in Thailand is projected to increase steadily from 13.2 in 2010 to 19.1 percent in 2020 and is estimated to increase further to 32.1 percent in 2040[31]. Oral health problems are also projected to increase[32]. An analysis of determinants affecting oral health shows that these groups are important for understanding the future demands required to adequately plan for dental health services and policy at the population level.

Accompanying this demographic shift is an increased risk of chronic diseases as people age, which can affect the ability to maintain oral hygiene and can lead to certain oral conditions related to the patients' oral mucosa, salivary gland, periodontal tissue and teeth[32, 33]. Moreover, the interaction of related factors may be nonlinear and involve reverse relationships. For example, sugar consumption, self-care and dental treatment can cause a change in a person's dental caries status that can also affect behavior as well. Most traditional studies using epidemiological approaches have analyzed the factors that affect oral health in separate parts. These studies may be limited because they fail to show the dynamic, nonlinear and feedback relationships and may not reflect the impact of other unintended consequences of the problems[14]. The aim of this study was to estimate the changes in dental caries status among Thai adults and elderly under the different policy options using system dynamics modeling.

Methods
This study forms part of a project which aims to analyze the impact of the sugar-sweetened beverage tax on dental caries outcomes in Thailand. This system dynamics modeling project included both qualitative and quantitative elements. The qualitative element was reported earlier elsewhere[34]. It used qualitative processes including extensive literature reviews, in-depth interviews with stakeholders and data analyses, to map the causal relationships between dental caries outcomes, behavioral factors and the sugar-sweetened beverage tax and identified the main feedback loops driving the observed behavior[34].

This study, which formed part of the quantitative model, aimed to project the main outcomes including the number of the population with experience of dental caries in each severity group and the proportion of the population with untreated dental caries in each severity group. Based on the qualitative conceptual framework[34], the system dynamics model was developed using Vensim DSS version 6.4 (Ventana Inc). The model consisted of interacting sets of differential equations developed from a broad range of relevant empirical data to capture the interrelationship of key variables and oral health outcomes. Over the course of the model development process, oral health policy experts were consulted to verify the assumptions and outcome measures. After verification, the model was parameterized using a series of empirical data sets. When data were not available, estimates from experts were used. Finally, the model was simulated to generate the base case and a range of scenarios to project the main outcomes.

Ethical considerations
This study received ethical approval from the Research Ethics Committee of the Faculty of Medicine, Chulalongkorn University, IRB No. 503/59 on September 29, 2016.

Model structure
The quantitative model had three sectors: the population, the dental caries sector and the oral health behavior sector. The projection timeframe was from year 2000–2040. A brief overview of each sector is presented in the below sections.
**Population sector.** The population sector (Figure 1) modeled the population of Thailand accounting for the aging process of the Thai population and disaggregated the population by age – single year age cohorts and gender[35]. The population sector was calibrated using national statistical data[36].

**Dental caries sector.** The dental caries sector (Figure 2) disaggregates the Thai population 15 years and older into four dental caries statuses using the decayed, missing and filled teeth (DMFT) index[37]. The DMFT index is an aggregate score of the number of
teeth that are either decayed, missing or filled. The four dental caries statuses used in the dental caries model are very low DMFT, low DMFT, moderate DMFT and high DMFT; using standards set by the World Health Organization[38]. Each DMFT group was divided into “completely treated” and “untreated,” accounting for age and gender differences.

Transitions across dental caries treatment states are influenced by the treatment rate, which is derived from the oral health behavior sector. An increase in treatment rates increases the flow of individuals from untreated to treated dental caries status, whereas a reduction in dental treatment rates will increase the flow of individuals from treated to untreated dental caries status. The transition from low to high DMFT was estimated using available data, adjusting for the effect of oral health behavior. The dental caries prevalence from the Thai National Oral Health Survey in 2000–2001, 2006–2007 and 2012 were the main data sources. At the end of each year, members of the population who reached 15 years of age were moved from the Thai population model (Figure 1) into the dental caries model (Figure 2). The population of 15-year-old was then disaggregated into one of the four dental caries statuses. Subsequently, individuals in each of the dental caries age groups could transition from one dental caries status to another. In this model, dental caries status is assumed to be progressive and only movement from low to high dental caries statuses were allowed.

Oral health behavior sector. Three main factors were identified as key components in the oral health behavior sector including dental treatment rate, the proportion of self-care and sugar consumption (Figure 2). First, the dental treatment rate refers to the number of individuals receiving treatment. The change in treatment rate was influenced by accessibility to dental services, perceived need for dental care and affordability of dental care. Population per dental personnel (dentists and dental nurses) ratio was used as a measure of access to dental services. The supply of dental personnel is usually influenced by the intake of dental and dental nurse students and decreases via attrition. Data on dental personnel were obtained from the Thai Bureau of Dental Public Health, Ministry of Public Health year 2000–2015[37] to populate the model. It was assumed that increased access to dental care would increase the treatment rate.

A perceived need for dental care is assumed to be influenced by the affordability of dental services and oral health status. A proportion of the Thai population considered to be of low socioeconomic status (SES) experience problems with the out of pocket costs for accessing dental care, whereas high SES individuals are assumed to have no such accessibility issues. As the proportion of the population in the high SES group and high dental caries experience increases, the perceived need for dental services is assumed to increase. An increase in treatment rate was assumed to increase the transition between untreated to treated dental caries status (Figure 2).

The other factors in the oral health behavior sector (Figure 2) are sugar consumption and oral health self-care. To estimate the change in sugar consumption, current sugar consumption was compared to sugar consumption in the year 2010 to estimate relative sugar consumption. The self-care practice of oral health was modeled as a stock which changes over time. It is assumed that as health promotion programs increased, oral health awareness was assumed to also increase.

Data sources. Data from the Thailand Official Statistics Registration Systems, Department of Provincial Administration, The Ministry of Interior[36] were used in this model. Fertility rates were obtained from The World Bank Group[39] and mortality rates were obtained from the Thailand Public Health Statistics Report, Bureau of Policy and Strategy, Ministry of Public Health[40]. The Thai national oral health survey data from 2000 to 2001, 2006 to 2007 and 2012 were used to estimate the DMFT distribution, regular visit fraction, the perceived need for dental care and oral health self-care[41]. Average
sugar consumption for the Thai population was obtained from the Thailand Office of the Cane and Sugar Board, Ministry of Industry[12]. A list of model parameters is presented in the Appendix.

Model validation and sensitivity analysis
In order to verify the model’s validity, structure-based validation and behavior validation was conducted to ensure that the model was suitable for its purpose. When performing structure-based validation, the dimensional accuracy of the model equations and unit consistency of all variables were checked. The model boundary and assumptions were evaluated by the researchers and experts to ensure its realism and accuracy. On behavior validation, we compared simulated behavior of key outcomes variables – population, dental caries status, dental treatment status and sugar consumption – with available historical data. The results suggest that the simulated behavior compares favorably with data.

Sensitivity analysis was performed to observe how a change in key parameter values would affect the outcomes of interest. The list of parameters used in the sensitivity analysis is shown in the Appendix. Using multivariate sensitivity analysis, the values of each parameter were varied ±20 percent, using a uniform distribution. The model was run many times and a 95% confidence level for each run was used to show the credible interval including mean values.

Scenario analysis
For the purpose of this study, three scenarios in addition to the base-case were explored. These hypothetical scenarios were selected in response to the range of possibilities identified by stakeholders.

Base-case. The base-case scenario assumed that all model parameters and key variables remained unchanged over the simulation run. This simulation served as a reference point for comparing other scenarios.

Health promotion scenario. This scenario encompassed a set of policies aimed to increase oral health self-care and reduce sugar consumption through health promotion programs over the time period of 2018–2040.

Dental personnel intake and affordability scenario. This scenario assumes a gradual increase in the intake of dental students from 933 persons in 2018 to 1,200 persons by 2040. In addition, the proportion of the population considered able to afford dental care services was assumed to gradually increase from 40 percent in 2018 to 80 percent in 2040.

Combined scenario. This scenario is a combination of the health promotion scenario and dental personnel intake and affordability scenario. This scenario aimed to investigate the impact of simultaneously implementing both policy scenarios.

Results
The projected Thai population aged 15 and older by DMFT status is shown in Table I. For the base-case scenario, in 2010, of the 50.4m Thai population members aged 15 years and older, 38.6, 19.9, 16.7 and 24.8 percent had very low, low, moderate and high DMFT, respectively.

Under the health promotion scenario, by 2040 (Table I), the number of individuals with very low DMFT is projected to increase by 0.3m, while that for low, moderate and high DMFT is projected to decrease by 0.03m, 0.02m and 0.2m, compared to the base-case scenario. Compared to the base-case, under the health promotion scenario, the population with very low DMFT is projected to increase by 1.9 percent, while that for low, moderate and high is projected to decrease by 0.3, 0.2 and 1.1 percent, respectively.
**Table I. Projected numbers of population by dental caries status (millions)**

| Outcomes                      | 2010     | 2020     | 2030     | 2040     | % change 2020-2040 | % change to base-case |
|-------------------------------|----------|----------|----------|----------|---------------------|-----------------------|
| **Total population (15 years and older)** | 50.40    | 53.36    | 54.10    | 52.60    | 4.4                 |                       |
| **Base case**                 |          |          |          |          |                     |                       |
| Very low DMFT                 | 9.44 (19.35-19.53) | 17.70 (15.56-17.83) | 15.63 (15.46-15.79) | 13.39 (13.22-13.56) | -31.1               | -                     |
| Low DMFT                      | 10.03 (9.94-10.12) | 10.99 (10.87-11.11) | 10.77 (10.64-10.90) | 9.81 (9.68-9.94) | -2.2                | -                     |
| Moderate DMFT                 | 8.41 (8.34-8.48) | 9.57 (9.47-9.67) | 10.13 (10.02-10.24) | 9.89 (9.78-10.00) | 17.6                | -                     |
| High DMFT                     | 12.52 (12.47-12.57) | 15.1 (15.01-15.21) | 17.57 (17.41-17.72) | 19.50 (19.30-19.70) | 55.8                | -                     |
| **Health Promotion Program**  |          |          |          |          |                     |                       |
| Very low DMFT                 | 19.44 (19.35-19.53) | 17.35 (17.21-17.50) | 15.79 (15.63-15.95) | 13.65 (13.48-13.82) | -29.8               | 1.9*                  |
| Low DMFT                      | 10.03 (9.94-10.12) | 10.99 (10.87-11.12) | 10.74 (10.61-10.87) | 9.78 (9.65-9.91) | -2.5                | -0.3*                 |
| Moderate DMFT                 | 8.41 (8.34-8.48) | 9.56 (9.46-9.65) | 10.12 (10.00-10.23) | 9.87 (9.76-9.98) | 17.4                | -0.2*                 |
| High DMFT                     | 12.52 (12.47-12.57) | 15.06 (14.95-15.16) | 17.45 (17.30-17.61) | 19.29 (19.09-19.49) | 54.1                | -1.1*                 |
| **Dental personnel Intake and affordability** |          |          |          |          |                     |                       |
| Very low DMFT                 | 19.44 (19.35-19.53) | 17.70 (17.56-17.83) | 15.63 (15.47-15.79) | 13.40 (13.23-13.57) | -31.1               | 0.1*                  |
| Low DMFT                      | 10.03 (9.94-10.12) | 10.99 (10.87-11.11) | 10.77 (10.64-10.90) | 9.81 (9.68-9.94) | -2.2                | 0                     |
| Moderate DMFT                 | 8.41 (8.34-8.48) | 9.57 (9.47-9.67) | 10.13 (10.02-10.24) | 9.89 (9.78-10.01) | 17.6                | 0                     |
| High DMFT                     | 12.52 (12.47-12.57) | 15.11 (15.01-15.21) | 17.57 (17.41-17.73) | 19.49 (19.29-19.70) | 55.7                | -0.1*                 |
| **Combined scenario**         |          |          |          |          |                     |                       |
| Very low DMFT                 | 19.44 (19.35-19.53) | 17.77 (17.63-17.90) | 15.99 (15.83-16.16) | 14.09 (13.92-14.26) | -27.5               | 5.2*                  |
| Low DMFT                      | 10.03 (9.94-10.12) | 10.99 (10.87-11.11) | 10.76 (10.63-10.88) | 9.89 (9.76-10.02) | -1.4                | 0.8*                  |
| Moderate DMFT                 | 8.41 (8.34-8.48) | 9.56 (9.46-9.65) | 10.10 (9.94-10.20) | 9.85 (9.74-9.96) | 17.1                | -0.4*                 |
| High DMFT                     | 12.52 (12.47-12.57) | 15.05 (14.90-15.15) | 17.25 (17.09-17.40) | 18.77 (18.57-18.96) | 49.9                | -3.7*                 |

**Notes:** Numbers in parentheses refer to a 95% confidence level from the sensitivity analysis for each scenario. *Significant differences
Under the dental personnel intake and affordability scenario, the projections of population ratios in each DMFT group are similar to the base-case and health promotion program scenarios. By 2040, the change in the number of individuals in each DMFT does not show significant differences compared to the base-case scenario, with an exception of 0.1 percent increase observed among the population with very low DMFT and a decrease of 0.1 percent for the population with high DMFT (Table I).

Under the combined scenarios of the health promotion program, dental personnel intake and affordability scenarios, by 2040 (Table I), the individuals with very low and low DMFT are projected to increase by 0.7m and 0.08m, while those with moderate and high DMFT are projected to decrease by 0.05m and 0.7m. By 2040, the combined scenario showed significant differences in the number of individuals in each DMFT group compared to the base-case scenario. By comparing the base-case scenario with the scenario by 2040, the population with very low and low DMFT is projected to increase by 5.2 and 0.8 percent, respectively; while that for moderate and high DMFT is projected to decrease by 0.4 and 3.7 percent.

The proportion of the population with untreated dental caries, representing unmet dental care needs (Table II). In 2010, under the base-case scenario, the proportion of untreated individuals with very low, low, moderate and high DMFT was 63, 91, 92 and 90 percent. In 2040, the proportion of the population with untreated DMFT across all groups is set to decrease compared to 2010. By 2040, the largest percentage decrease of 3.1 percent was observed in the very low DMFT group. For the health promotion scenario, the proportion of the population with untreated caries in all DMFT groups decreased compared to the base-case scenario, with the highest improvement in untreated dental caries status at 9.2 percent observed among the high DMFT group compared to the base-case scenario at year 2040. Under the dental personnel intake and affordability scenario, a similar reduction across all DMFT groups was observed. In 2040, a modest reduction in DMFT status of 0.3 percent was observed among the very low and 0.1 percent for the low DMFT group.

| Outcomes                          | 2010 | 2020 | 2030 | 2040 | % change 2020–2040 | % change to base-case |
|-----------------------------------|------|------|------|------|--------------------|-----------------------|
| **Base-case**                     |      |      |      |      |                    |                       |
| Very low DMFT                     | 0.63 | 0.62 | 0.61 | 0.61 | −3.1               | −                     |
| Low DMFT                          | 0.91 | 0.90 | 0.89 | 0.89 | −1.7               | −                     |
| Moderate DMFT                     | 0.92 | 0.91 | 0.91 | 0.90 | −2.3               | −                     |
| High DMFT                         | 0.90 | 0.90 | 0.90 | 0.89 | −1.0               | −                     |
| **Health Promotion Program**      |      |      |      |      |                    |                       |
| Very low DMFT                     | 0.63 | 0.64 | 0.60 | 0.59 | −5.1               | −2.2                  |
| Low DMFT                          | 0.91 | 0.90 | 0.90 | 0.89 | −1.7               | −0.4                  |
| Moderate DMFT                     | 0.92 | 0.91 | 0.91 | 0.90 | −2.6               | −0.4                  |
| High DMFT                         | 0.90 | 0.90 | 0.83 | 0.81 | −10.1              | −9.2                  |
| **Dental personnel intake and affordability** |      |      |      |      |                    |                       |
| Very low DMFT                     | 0.63 | 0.62 | 0.61 | 0.61 | −3.4               | −0.3                  |
| Low DMFT                          | 0.91 | 0.90 | 0.90 | 0.89 | −1.8               | −0.1                  |
| Moderate DMFT                     | 0.92 | 0.91 | 0.91 | 0.90 | −2.3               | 0                     |
| High DMFT                         | 0.90 | 0.90 | 0.90 | 0.89 | −1.0               | −0.01                 |
| **Combined scenario**             |      |      |      |      |                    |                       |
| Very low DMFT                     | 0.63 | 0.62 | 0.59 | 0.57 | −8.6               | −5.7                  |
| Low DMFT                          | 0.91 | 0.90 | 0.89 | 0.88 | −3.0               | −1.4                  |
| Moderate DMFT                     | 0.92 | 0.92 | 0.91 | 0.90 | −2.4               | −0.2                  |
| High DMFT                         | 0.90 | 0.90 | 0.84 | 0.84 | −7.3               | −6.4                  |

Table II. Projected proportion of untreated dental caries population by DMFT group.
For the combined scenario, the untreated dental caries proportion in all groups is projected to reduce; with very low DMFT decreasing by 5.7 percent compared to the base-case; while that of high DMFT had a 6.4 percent reduction.

Discussion
To the best of our knowledge, this is the first comprehensive system dynamics model that attempts to explore the dynamics of dental caries status among Thai adults and the elderly under the potential policy interventions. Among those with dental caries, the proportion with untreated dental caries is expected to decrease slightly over the simulation time, however, more than half of the population aged 15 years and older will still have at least one untreated dental caries by the year 2040. The observed increase in dental caries could be explained by the increasing and aging population as well as low dental care service utilization among the population.

Amongst all policy scenarios, the combination of health promotion programs, increased affordability and capacity of dental health services were found to produce the highest improvement in dental caries status by a decrease in population with high DMFT along with an increase in population with very low DMFT. This result showed the additive effect of both positive oral health behaviors and the use of dental services. The model hypothesized that the health promotion program increased oral health awareness and self-care adherence; then it consequently slowed the incidence or progression of dental caries among the population. Evidence from several studies pointed to the positive impact of oral health education and health promotion programs on oral health behavior, such as tooth brushing/flossing and dental care utilization, as well as the attitudes toward oral health. Boles et al. also found that health promotion campaigns in the mass media could influence attitudes and behavior about sugary consumption within a population.

Surprisingly, the scenario of increasing 30 percent of dental students and 50 percent of the poverty line population who have financial access to dental treatment would produce only very small changes of the population with untreated dental caries from the base-case. This result might be due to the use of only dental personnel per population ratio as a proxy of capacity for dental health services and leaving other proxies that are not included in our model boundary such as distribution of dental personnel. The increase in dental students’ scenario in this study represented the real situation of the increase in new dental schools in recent years. However, the working position in the government sector has been limited and the trend of dentists working in the private sector has been increasing. The increase of dental personnel to population ratio may not translate into an increase of access to dental treatment, especially for the disadvantaged populace within the community. In addition, the increase in affordability for treatment cost showed only a small impact on the treatment rate in the Thai population because the essential dental treatment for low-income groups in Thailand had been subsidized by the universal health insurance scheme.

The findings suggested some public health policy implications. First, policymakers should explore interventions that increase oral health awareness among the population through health promotion programs aimed at reducing the incidence and prevalence of dental caries. Second, policymakers should engage other stakeholders in the healthcare system to find innovative ways of increasing affordability among low-income groups and help to educate the public about the value of dental care services for their general health. Finally, in order to improve the utilization of dental care services, access to dental care services should be increased to meet the oral health needs of the population. The policymakers should explore innovative ways to increase dental personnel and dental care services across both rural and urban areas of Thailand to decrease disparity in access.

The inherent strengths of this model are the comprehensive model boundaries adopted which include dental care services utilization, oral health behaviors of the population and its
impact on dental caries status among the Thai population 15 years and older. In addition, the ability of the simulation model to compare different alternative scenarios within the complex oral health system allows policymakers to explore the plausible impact of their policies in silico (computer simulation) before they are implemented in order to avoid unintended consequences. The main limitation of the model is the lack of comprehensive data to estimate important parameters that have the potential to change the observed results. Thus, moving forward, further work should be conducted to determine more accurate parameters.

**Conclusion**
This system dynamics model can be used to explore the relationship between the experience of suffering dental caries, dental service utilization and oral health behaviors in a systematic approach. Policymakers should consider alternative policy interventions that consider both preventive and curative strategies to improve dental caries status in Thailand. Furthermore, the model may be used as an additional tool to inform the types of policies that will prove to be most useful in improving oral health within the country.

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(The Appendix follows overleaf.)
Appendix

| Parameter sector | Initial value | Sources |
|------------------|---------------|---------|
| Population sector | | |
| Fraction female | 0.51 | Thailand Official Statistics Registration Systems, The Ministry of Interior |
| Total fertility rate | 0.043–0.047 | Census reports and data from national statistical offices |
| Age-specific mortality rate | 0.0015–0.058 | Bureau of Policy and Strategy, Ministry of Public Health |
| Net migration rate | 0.00058 | World bank |
| Dental caries sector | | |
| Age 15–34 | Age 35 and older | |
| Regular visit fraction very low DMFT [female] | 0.229 | 0.148 | National oral health survey data 2000; Bureau of Dental Health, Department of Health, Ministry of Public Health, Thailand |
| very low DMFT [male] | 0.191 | 0.170 | |
| low DMFT [female] | 0.306 | 0.357 | |
| low DMFT [male] | 0.308 | 0.385 | |
| moderate DMFT [female] | 0.521 | 0.643 | |
| moderate DMFT [male] | 0.462 | 0.333 | |
| high DMFT [female] | 0.571 | 0.332 | |
| high DMFT [male] | 0.583 | 0.215 | |
| Treated to untreated transition rate very low DMFT | 0.4 | 0.7 | Expert’s estimation with optimization |
| low DMFT | 0.78 | 0.58 | |
| moderate DMFT | 0.78 | 0.34 | |
| high DMFT | 0.7 | 0.75 | |
| VLowToLow transition rate | 0.063 (0.0504–0.0756) | Model calibration |
| LowToModerate transition rate | 0.066 (0.0528–0.0792) | |
| ModerateToHigh transition rate | 0.063 (0.0504–0.0756) | |
| Oral health behavior sector | | |
| Initial treatment rate VL | 0.384, I, 0.066, M 0.041, H 0.075 | National oral health survey data 2000; Ministry of Public Health, Thailand |
| Initial self-care adherence | 0.53 | |
| Initial perceived need for care VL | 0.584, L 0.071, M 0.733, H 0.681 | |
| Dental personnel student | Data from Report of dental personnel 2000–2015. Bureau of Dental Health, Department of Health, Ministry of Public Health, Thailand |
| Dental personnel | 2000–2015 | The Dental Council of Thailand |
| Attrition rate | 0.01 | Estimate by dental public health experts and model calibration |
| Elasticity of perception of need VLo, L 0.0, M 0.4, H 0.8 | 0.1 | |
| Elasticity of affordability | 0.1 | |
| Elasticity of sugar consumption | 0.6 (0.4–0.72) | |

Table AI. Model key parameters

Note: *Refer to parameters used for sensitivity analysis

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How do personality characteristics of risky pregnant women affect their prenatal distress levels?

A Turkey university hospital cross-sectional study

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Abstract

**Purpose** – The prenatal distress level of the pregnant woman is influenced by many variables. Personality characteristics are one of the most important of these variables. Knowing personality characteristics of pregnant women contributes to the personalization of care. The purpose of this paper is to identify the effect of personality characteristics of pregnant women at risk on the prenatal distress level.

**Design/methodology/approach** – A total of 438 women who were hospitalized based on a medical diagnosis associated with pregnancy were included in the study. The participants were administered the Personal Information Form, Cervantes Personality Scale and Revised Prenatal Distress Questionnaire. Data were evaluated using the SPSS 22.0 software program.

**Findings** – Of the pregnant women, 27.4 percent found their ability to cope with stress insufficient, and one-fifth of them found their social support insufficient. The pregnant women at risk with introverted, neurotic and inconsistent personality were found to have high levels of prenatal distress.

**Research limitations/implications** – This study was conducted on a group of Turkish pregnant women and cannot be generalized to other cultures. The data obtained from the research cannot be used to evaluate the psychological and physical disorders of the pregnant woman.

**Practical implications** – All health care professionals should evaluate women not only physically but also mentally and emotionally, beginning with the preconceptional period. They should determine the conditions that create distress and identify the personality characteristics that prevent from coping with stress. By using cognitive and behavioral techniques, pregnant women should be trained to gain skills on subjects such as risk perception and stress management, personality characteristics and coping, problem solving, psychological endurance and optimism. Caring initiatives should be personalized in line with personality characteristics of pregnant women. The care offered within this framework will contribute to the strengthening and development of the health of not only the women but also the family and society, and to the reduction of health care costs.

**Social implications** – Researchers have determined that pregnant women at risk with introverted, neurotic and inconsistent personality characteristics have higher distress levels. They have determined that these...
pregnant women find their ability to cope with stress more inadequate. It is vital to cope with stress during pregnancy due to its adverse effects on maternal/fetal/neonatal health. 

**Originality/value** – The prenatal distress level of the pregnant woman is influenced by many demographic (age, marital status and socioeconomic level), social (marital dissatisfaction, and lack of social support), personal (self-esteem, neuroticism and negative life experiences) and pregnancy-related (experiencing risky pregnancy, and previous pregnancy experiences) variables. Personality characteristics are one of the most important of these variables. This research is original because there are limited number of studies examining the effect of personality characteristics on prenatal distress level in the literature. And knowing the relationship between personality characteristics and distress by health professionals enables individualization of care. The care offered within this framework will contribute to the strengthening and development of the health of not only the women, but also the family and society, and to the decrease of health care costs.

**Keywords** Personality characteristics, Prenatal distress, Risky pregnancy, Turkey

**Paper type** Research paper

**Introduction**

Many of the physiological and psychosocial changes that occur during pregnancy result in each pregnancy being a potential risk[1]. Being “at risk” is the possibility of being faced with loss, injury or other harmful consequence that can result from danger. Risk in terms of pregnancy is the possible occurrence of some complications that are not expected to happen under normal conditions but may preexist or occur during pregnancy. A risky pregnancy is a condition that can arise during early or late stages of pregnancy, significantly increasing the risk of morbidity and mortality of the mother or fetus[2]. Many situations are considered within the scope of risky pregnancies, such as the woman having a systemic disease before pregnancy, diseases that emerge with pregnancy, hypertension caused by pregnancy, placenta anomalies, premature membrane rupture, intrauterine developmental retardation, cervical insufficiency and premature birth[3–6]. These risk situations experienced during pregnancy are the leading cause of morbidity and mortality among women of reproductive age in developing countries[4, 7]. Throughout the world, there is a risk factor to maternal/fetal health in 5–20 percent of all pregnancies. In Turkey, a high rate of 31.1 percent of pregnancies and 60.5 percent of births are included in a risk category[8].

Stress is often used to describe a mental state caused by excessive pressure. It is a state of imbalanced physiological or psychological conditions caused by stressors. To maintain the balance or to reduce such conditions, physiological changes occur, collectively called the stress response. With the stress response, people can change or adapt to stressful conditions. But when the stressful condition is not adapted to for a long period of time or if the stress is too intense, it may bring on distress. An acute or chronic stress condition can also be regarded as distress. Distress cannot be considered completely independent of stress as extreme stress leads to a state of distress. Concern, anxiety and stress are important components of distress[9–13]. Distress is found in contexts in which people have been subject to traumatic experiences and is uncomfortable, upsetting and closely linked to anxiety. Distress can be described as the inability to cope with stressful conditions, or a condition that is painful, either physically or mentally or both, and is observable in behavior. 

Prenatal distress is defined as the emotional reactions of pregnant women in terms of physical, mental and social changes, labor, parenthood and infant health that occur during pregnancy. There are many studies examining the prevalence of stress, anxiety and depression during pregnancy. In these studies, data are presented in the context of prenatal distress prevalence. Therefore, these variables should be taken into consideration when evaluating prenatal distress[14–26]. Pregnancy is a stressful and complex process for many women, even if there are no health problems diagnosed. A study of Schetter and Tanner shown that 78 percent of pregnant women are subject to low or intermediate levels of stress and 6 percent are subject to high levels of stress[9]. Many factors such as the lack of money,
lack of social support, smoking and substance abuse, relationship problems with spouse and negative body image may cause stress in pregnancy[14]. The stress experienced in risky pregnancies due to maternal or fetal problems is more pronounced and severe than normal pregnancies[10]. Intense stress and anxiety experienced during pregnancy adversely influences maternal/fetal health and pregnancy outcomes (such as preterm labor, abortion, low birth weight, intrauterine developmental retardation and a low APGAR score)[15–23]. Prenatal distress also increases the risk of depression. Gourounti, Karpathiotaki and Vlasmatsis reported that the prevalence of severe depression in pregnant women at high risk varies from 18 to 58 percent[24]. Prenatal depression is seen in about one-fifth of pregnant women who are hospitalized for long periods of time. Higher stress and anxiety levels in at risk pregnant women increase the probability of developing depression to a level that is higher than that of healthy pregnant women[25, 26]. The tendency of risky behavior increases in depressive pregnant women. It is also acknowledged that maternal depression has a regressive effect on the physiological, neurological and behavioral functions of the fetus/newborn[27].

The prenatal distress level of the pregnant woman is influenced by a number of factors. Changes in family and social life, availability of social support or tangible resources, age, marital status, socioeconomic status, antenatal care services, domestic violence, anxiety level, personality characteristics or pregnancy-related situations (experiencing risky pregnancy, and previous pregnancy experiences) can cause distress. Moreover, personality characteristics are one of the most important causes of prenatal distress[11–13, 28, 29]. Pregnant women’s emotional reactions may also differ in accordance with women’s personal characteristics[5]. Personality is composed of two basic parts – extroversion/introversion and emotional stability/neuroticism. People with extroverted personalities are open to collaboration, they do not have difficulty in communicating with other people and enjoy being in the community. People with an introverted personality are withdrawn, shy individuals who do not like social environments. People with an emotionally stable personality are comfortable, confident and patient, while those with a neurotic personality are anxious, frustrated, withdrawn and insecure[28–31]. Neuroticism is characterized by high sensitivity to stress including anxiety, fear, moodiness, worry, envy, frustration, jealousy and loneliness. Personality characteristics (neuroticism, introversion, extraversion) are, however, predictive of health outcomes in other fields potentially through biological, psychological and social mechanisms[28, 29, 31]. Personality characteristics have been linked to health outcomes in a number of studies, in particular for neuroticism and extraversion. For example, neuroticism is associated with increased risk of depression[32] and anxiety disorders whilst extraversion is believed to be protective against depression and social phobia[33]. When individuals face a situation that causes stress and increases anxiety, they create a coping strategy – consciously or unconsciously – that is based on personality characteristics. Individuals with extroverted, emotionally balanced, consistent and durable personality characteristics use problem-solving oriented strategies instead of emotion-oriented coping strategies[11].

Women who experience a risky pregnancy use different coping strategies against stressors they encounter during pregnancy. Ineffective coping strategies (such as eating, sleeping, crying, and hiding their feelings and disappointments) only reduce reactions to stressors instead of eliminating the stressors. However, in order to cope with the stress caused by a high-risk pregnancy, the pregnant woman and her family must both refer to the coping mechanisms they have used in the past and learn new coping mechanisms. It is extremely important to know the personality characteristics of the pregnant woman so that she can effectively cope with the distress caused by the risky pregnancy. Knowing the personality characteristics of pregnant women contributes to a better personalized support and care plan. By using personalized care initiatives, nurses and midwives working in perinatal clinics can support the personality development of the pregnant woman,
strengthen their ability to cope with stressors, reduce the perceived stress level and improve
the biopsychosocial health of the mother and the infant[2, 10, 34, 35]. The aim of this study
was to identify the effect of personality characteristics of pregnant women at risk on the
prenatal distress level.

Methods
Study design and sampling
This was a cross-sectional descriptive study and was carried out at a university hospital
between March 2017 and January 2018. The sampling included 438 pregnant women who
met the following criteria: women who were hospitalized due to a pregnancy-related health
problem, women with no recorded psychiatric illnesses, women who voluntarily agreed to
participate. The exclusion criteria included healthy pregnant women.

Research instrument
The participants were given a Personal Information Form, the Cervantes Personality Scale (CPS)
and Revised Prenatal Distress Questionnaire. The Personal Information Form consisted of 12
questions to determine certain sociodemographic and obstetric properties of the pregnant
woman. The CPS was developed by Castelo-Branco et al. to evaluate the personality
characteristics of women[36]. The scale was adapted into Turkish by Bal and Sahin[37]. Every
question on the scale was answered based on the individual’s own experience. The scale
consisted of a 20-item, six-point Likert-type questionnaire and had three sub-dimensions (ranging
from 0 to 5). Extroversion/introversion (min = 0, max = 35), emotional stability/neuroticism
(min = 0, max = 35) and consistency/inconsistency (min = 0, max = 30). As the mean scores
taken from the sub-dimensions decreased, extroverted, emotionally stable and consistent
personality characteristics were more prominent. In our study, the Cronbach’s $\alpha$ reliability
coefficient of the scale was found to be 0.85. A revised Prenatal Distress Questionnaire (NUPDQ)
was developed by Yali and Lobel to evaluate pregnancy-specific anxieties and concerns of
pregnant women[12, 13]. The scale was composed of a 17-item, three-point Likert-type and could
be used throughout the entire pregnancy (ranging from “not at all” (0) to “very much” (2)).
The pregnancy-specific distress score was obtained by summing the item scores of the scale. It
was possible to receive a minimum of 0 points and a maximum of 34 points from the scale.
The increase in the total score received from the scale was interpreted as an increased level of
prenatal distress perceived by pregnant women. The validity and reliability of the Turkish
version of the scale were tested by Yuksel et al.[38]. The Cronbach’s $\alpha$ value of the Turkish
version of the scale was 0.85. The scale consisted of four factors. However, it could also be used as
a single dimension. The Cronbach’s $\alpha$ value of the scale in this study was found to be 0.77.

Application of research
Data were collected by the research team using face-to-face interviews with pregnant
women. Before data collection tools were applied, a pilot study was performed on ten
pregnant women by the researchers. Thus, a common perspective was established among
researchers about the use of data collection tools. Risky pregnant women included in the
pilot application were not included in the sample.

Statistical analysis
Data were evaluated using the SPSS 22.0 software program. Frequencies were used for
the descriptive variables. The normalization of the data was examined by using the
Kolmogorov–Smirnov Test. For the data that met the parametric conditions, those with
two groups were analyzed using independent samples $t$-tests, and those with more than two
groups were analyzed using F-tests (ANOVAs). The relationships were determined using Pearson’s correlation coefficient, and the error level was taken as 0.05.

Ethical considerations
This study was approved by the author’s institution. In order to protect the rights of the women within the scope of the research, the ethical principles were met before collecting the research data: the “Informed Consent” principle involved explaining to the women the purpose of the study. The “Privacy and Protection of Privacy” principle was followed by informing participants that the information to be collected would be kept confidential, and the “Respect for Autonomy” principle by including those who wanted to participate voluntarily.

Results
Sociodemographic characteristics
The mean age of the pregnant women was 27.4 ± 5.2, and 90.4 percent of them were between the ages of 18 and 34. A total of 56.2 percent of the pregnant women had an education level of middle school or lower and 17.8 percent of the participants described their economic situation as poor. Of the pregnant women, 27.4 percent found their ability to cope with stress inadequate, and one-fifth of them found their social support systems insufficient. It was the first pregnancy of 10 percent of the pregnant women, 42 percent were in the second trimester and about two-thirds expressed fear and anxiety about pregnancy and the labor process. Of the pregnant women, 29.7 percent were hospitalized for eight days or more (Table I).

Obstetrics characteristics
In the obstetric histories of multigravida, there were stillbirths/losses of a fetus (4.6 percent), preterm births (4.1 percent) and spontaneous abortus (3 percent). A total of 9.6 percent of the pregnant women were ≥35 years old, and 13.7 percent were cigarette-smoking addicts. Considering the primary medical diagnoses of pregnant women, they were hospitalized for various reasons. Of them, 29.9 percent had bleeding in the first trimester (abortus/ectopic pregnancy/hydatidiform mole), 19.7 percent had risk of preterm birth and 10.1 percent had hypertensive problems (Table II).

Scale total scores
The mean total score received from the Prenatal Distress Scale by the pregnant women was found to be 22.98 ± 5.56 (min = 0, max = 34). The mean scores of the extroversion/introversion, emotional stability/neuroticism and consistency/inconsistency sub-dimensions of the CPS were found to be 16.08 ± 3.80, 20.59 ± 4.62 and 18.42 ± 5.82, respectively (Table III).

Scale total scores according to certain characteristics of the pregnant women
The mean total scores of the Prenatal Distress Scale were high in the pregnant women who were ≥35 years old, primigravida, hospitalized for ≥8 days, had a low economic status, experienced fear and anxiety about pregnancy/labor, and found their ability to cope with stress and their social support systems insufficient (p < 0.05). There was no statistically significant difference between the mean total scores of the Prenatal Distress Scale in terms of the educational status of the pregnant women, their place of residence and their gestational trimesters (p < 0.05). It was found that the pregnant women’s ages were significantly positively correlated with their PDS mean scores and negatively correlated with the number of pregnancies that they had (p < 0.05) (Table IV).

All three sub-dimension mean scores of the CPS were high in the pregnant women who were ≥35 years old, who found their ability to cope with stress and their social support
insufficient, and who were hospitalized for $\geq 8$ days ($p < 0.05$). The mean scores of the extroversion/introversion and consistency/inconsistency sub-dimensions were statistically significantly higher in the pregnant women who were middle school graduates or higher ($p < 0.05$). The mean scores of the extroversion/introversion and emotional stability/neuroticism sub-dimensions were statistically significantly higher in the multigravida participants ($p < 0.05$). The mean scores of the emotional stability/neuroticism and consistency/inconsistency sub-dimensions were high in pregnant women experiencing fear and anxiety related to pregnancy/labor ($p < 0.05$). None of the three sub-dimension mean scores of the CPS were statistically different in terms of the place of residence, perception of economic status and gestational trimester ($p < 0.05$) (Table V).

**Correlation according to scales total scores**
A statistically significant positive correlation was determined between the pregnant women’s PDS total scores and their CPS sub-dimension scores ($p < 0.05$). The pregnant women at risk with introverted, neurotic and inconsistent personalities were found to have high levels of distress (Table VI).
Discussion

Pregnancy is an event in life that creates stress for women, regardless of whether it is “less” or “more.” If a pregnancy is risky, the level of stress increases. The response to stress in risky pregnancies is closely related to many variables (such as the significance and type of stressful event, age, and past experiences). One of the most important of these variables is the personality characteristics of women. Previous research has investigated the relationship between personality characteristics and health outcomes. For example, mothers that score high for neuroticism may be more sensitive to the inherently stressful challenges of early motherhood and postpartum depression from lack of sleep or hormonal changes[39]. In addition, neuroticism and introversion have been reported to increase depression/anxiety disorders and substance use whilst extroversion has been reported to
cause a protective effect against depression and social phobia[40, 41]. This paper explored the association between maternal personality characteristics and prenatal distress on high-risk pregnant women.

We determined in this study that the pregnant women of ≥35 years of age had higher distress levels compared to those between the ages of 18 and 34 (Table IV). As is known, the age factor in pregnancy is very important for the mother and fetus. In advanced-age pregnancies (≥35), it is more common to encounter risky situations that have the potential to adversely affect maternal and fetal health. For this reason, the stress level may be higher among advanced-age pregnant women who are aware of the possible complications associated with pregnancy[42–44]. The pregnant women aged ≥35 years experienced more distress due to both the risk of possible complications of advanced-age pregnancy and the presence of the diagnosis of risky pregnancy.

| Characteristics                      | n  | PDS M (SD) | t/F  | p    |
|--------------------------------------|----|------------|------|------|
| **Sociodemographic characteristics** |    |            |      |      |
| Age (years)                          |    |            |      |      |
| 18–34                                | 396| 21.94 (5.11) | 2.278a | 0.002 |
| ≥35                                  | 42 | 23.10 (6.33)  |      |      |
| Educational level                    |    |            |      |      |
| Middle school and lower              | 246| 22.93 (5.73)  | 0.211a | 0.833 |
| High school and over                 | 192| 23.05 (5.35)  |      |      |
| Living place                         |    |            |      |      |
| Urban                                | 320| 22.90 (5.55)  | 0.490a | 0.624 |
| Rural                                | 118| 23.20 (5.60)  |      |      |
| Status of economical                 |    |            |      |      |
| Good                                 | 360| 23.86 (5.29)  | 7.409a | 0.007 |
| Bad                                  | 78 | 22.10 (6.68)  |      |      |
| Status of coping with stress         |    |            |      |      |
| I think it is sufficient              | 318| 20.48 (3.25)  | 0.442a | 0.002 |
| I think it is insufficient            | 120| 23.70 (4.80)  |      |      |
| Status of social support             |    |            |      |      |
| I think it is sufficient              | 348| 21.93 (5.50)  | 1.404a | 0.026 |
| I think it is insufficient            | 90 | 23.20 (5.82)  |      |      |
| Obstetrics characteristics           |    |            |      |      |
| Gravida                              |    |            |      |      |
| Primigravida                         | 44 | 24.02 (6.42)  | 1.430a | 0.043 |
| Multigravida                         | 394| 22.98 (5.46)  |      |      |
| Trimester                            |    |            |      |      |
| First trimester                      | 164| 22.46 (5.81)  | 1.489b | 0.227 |
| Second trimester                     | 184| 23.49 (5.39)  |      |      |
| Third trimester                      | 90 | 22.90 (5.49)  |      |      |
| Fear and anxiety related to pregnancy and childbirth |    |      |      |      |
| Yes                                  | 264| 23.14 (5.64)  | 1.491a | 0.048 |
| No                                   | 174| 21.88 (5.52)  |      |      |
| Hospitalization time (days)          |    |            |      |      |
| 1–7                                  | 308| 21.63 (3.69)  | 2.047a | 0.041 |
| ≥8                                   | 130| 23.82 (5.16)  |      |      |

Table IV.

Distribution of the PDS mean scores according to some characteristics of the pregnant women

Notes: n = 438. PDS, Prenatal Distress Scale; M, mean. aIndependent samples t-test; bone-way ANOVA; r, Pearson’s correlation coefficient
This study have suggested that primigravida has higher levels of stress compared to multigravidas (Table IV). Yuksel et al. demonstrated that nulligravida are more distressed than those in their second pregnancy[38]. Jeyanthi and Kavitha reported that there is a significant relationship between primigravida and multigravida with regard to anxiety[45]. However, there is no significant relationship between primigravida and multigravida with regard to stress levels. However, a number of researchers have stated that having a high number of children can lead to distress and depression during pregnancy[46, 47].

| Characteristics          | n | Extroversion/ introversion M (SD) | CPS Emotional stability/ neuroticism M (SD) | Consistency/ inconsistency M (SD) |
|--------------------------|---|----------------------------------|-------------------------------------------|----------------------------------|
| Sociodemographic         |   |                                  |                                           |                                  |
| characteristics         |   |                                  |                                           |                                  |
| Age (years)             |   |                                  |                                           |                                  |
| 18–34                   | 396| 16.02 (3.79)                    | 20.20 (4.43)                             | 18.13 (5.66)                     |
| ≥ 35                    | 42 | 17.26 (3.83)                    | 21.89 (5.10)                             | 19.18 (6.20)                     |
| Significance test        |   | 0.049                           | 0.042                                    | 0.027                            |
| Educational level       |   |                                  |                                           |                                  |
| Middle school and lower | 246| 16.26 (4.21)                    | 20.61 (4.65)                             | 19.65 (6.21)                     |
| High school and over    | 192| 15.95 (3.45)                    | 20.57 (4.60)                             | 17.24 (5.50)                     |
| Significance test        |   | 0.015                           | 0.440                                    | 0.009                            |
| Living place            |   |                                  |                                           |                                  |
| Urban                   | 320| 16.13 (3.71)                    | 20.43 (4.57)                             | 18.44 (5.79)                     |
| Rural                   | 118| 15.95 (4.06)                    | 21.04 (4.76)                             | 18.37 (5.59)                     |
| Significance test        |   | 0.294                           | 0.382                                    | 0.756                            |
| Status of economical    |   |                                  |                                           |                                  |
| Good                    | 360| 15.83 (3.91)                    | 20.37 (5.01)                             | 18.78 (5.79)                     |
| Bad                     | 78 | 16.14 (3.78)                    | 20.64 (4.54)                             | 18.34 (5.83)                     |
| Significance test        |   | 0.286                           | 0.085                                    | 0.099                            |
| Status of coping with   |   |                                  |                                           |                                  |
| stress                  |   |                                  |                                           |                                  |
| I think it is sufficient | 318| 14.02 (2.26)                    | 18.00 (2.23)                             | 17.16 (3.49)                     |
| I think it is insufficient | 120 | 17.60 (3.40)                  | 21.00 (3.01)                             | 19.10 (5.20)                     |
| Significance test        |   | 0.004                           | 0.004                                    | 0.047                            |
| Status of social        |   |                                  |                                           |                                  |
| support                 |   |                                  |                                           |                                  |
| I think it is sufficient | 348| 15.23 (3.94)                    | 20.70 (4.65)                             | 17.13 (5.80)                     |
| I think it is insufficient | 90  | 17.52 (3.15)                  | 22.17 (4.50)                             | 19.00 (5.80)                     |
| Significance test        |   | 0.041                           | 0.020                                    | 0.043                            |
| Obstetrics characteristics| |                                  |                                           |                                  |
| Gravida                 |   |                                  |                                           |                                  |
| Primigravida            | 44 | 16.56 (3.76)                    | 20.54 (4.98)                             | 17.88 (5.87)                     |
| Multigravida            | 394| 17.03 (3.81)                    | 22.60 (4.59)                             | 18.48 (5.82)                     |
| Significance test        |   | 0.026                           | 0.006                                    | 0.645                            |
| Trimester               |   |                                  |                                           |                                  |
| First trimester         | 164| 16.48 (4.17)                    | 20.21 (4.64)                             | 18.12 (6.18)                     |
| Second trimester        | 184| 15.89 (3.64)                    | 21.17 (4.49)                             | 18.46 (5.73)                     |
| Third trimester         | 90 | 15.75 (3.38)                    | 20.10 (4.59)                             | 18.88 (5.34)                     |
| Significance test        |   | 0.228                           | 0.082                                    | 0.600                            |
| Fear and anxiety related to pregnancy and childbirth | | | | |
| Yes                     | 264| 16.10 (3.63)                    | 22.58 (4.59)                             | 19.56 (5.34)                     |
| No                      | 174| 16.07 (3.91)                    | 20.60 (4.65)                             | 17.57 (6.12)                     |
| Significance test        |   | 0.463                           | 0.006                                    | 0.021                            |
| Hospitalization time (days) | |                                  |                                           |                                  |
| 1–7                     | 308| 16.24 (3.99)                    | 20.39 (4.66)                             | 17.48 (5.71)                     |
| ≥ 8                     | 130| 17.73 (3.29)                    | 22.06 (4.50)                             | 19.29 (6.10)                     |
| Significance test        |   | 0.011                           | 0.008                                    | 0.014                            |

Notes: n = 438. CPS, Cervantes Personality Scale; M, mean. aIndependent samples t-test; bone-way ANOVA
Being primigravida and, at the same time, experiencing a risky pregnancy can cause women to experience a high level of stress. However, the increase in the number of children can increase the anxiety of pregnant women with regard to childcare.

Pregnant women at risk often receive medical treatment or supervision in the hospital. Prenatal hospitalization for high-risk pregnant women is associated with numerous stress factors, such as separation from the family and home, boredom, lack of activity, prolonged bed rest, tests and treatments, feelings of uncertainty, and lack of control[24]. Prolonging hospitalization is a stressor for pregnant women. In this study, we determined that pregnant women who were hospitalized for ≥8 days had higher levels of stress than the pregnant women hospitalized for a week (Table IV). Yuksel et al. demonstrated that pregnant women with a history of health-related problems during pregnancy had higher prenatal distress and women with a history of admissions to hospital during their current pregnancies were more distressed[38]. Conversely, the study by Byatt et al[27] found a statistically significant decrease in depression and anxiety scores throughout the course of the hospitalization. The results of the same study showed that 77 percent of women reported that they would or may benefit from a supportive psychotherapy group during their hospitalization[27]. In line with the data, it can be concluded that psychosocial activities and psychotherapy groups would reduce the stress levels of pregnant women who have to stay in hospital for a long time.

This study has suggested that pregnant women who have fear and anxiety related to pregnancy/labor have higher levels of distress (Table IV). Yuksel et al. demonstrated that pregnant women having fears or concerns about labor and delivery experienced higher prenatal distress[38]. The fear of labor, in particular, is an emotional stress factor affecting the maternal well-being of pregnant women during the pregnancy period. Such stress causes pregnant women to be more resentful and aggressive. Stress increases the blood flow to the uterus by also increasing the level of catecholamine, leading to the development of fetal hypoxia or preterm labor/labor with complications[48, 49]. Researchers have stated that the fear of labor is increased with young mothers, lack of social support, pre-existing psychosocial problems, negative obstetric experiences and lack of prenatal care[50, 51]. Based on the data, it can be concluded that it will be beneficial in reducing distress to support all pregnant women (especially those who have fear and anxiety about pregnancy/labor) accordingly during the period they are experiencing, meet their information/care needs and strengthen them in line with their personality characteristics. Nurses and midwives working in perinatal clinics can undertake important roles in helping to reduce stressful situations.

Social support is an important factor that contributes to reducing the risk perception of pregnant women and their ability to fight stress in line with their personality characteristics. The results of the study have suggested that pregnant women who think that the social support they receive is insufficient have higher levels of stress. Moreover, such pregnant women have more introverted, neurotic and inconsistent personality characteristics. Adequate social support contributes to the development of perinatal health, prevention of potential health problems, protection against the effects of stress and the use of effective coping strategies. The mental health of a mother to be is significantly

| Table VI. The correlations PDS and CPS total and sub-dimension scores |
|-----------------------------|-----------------------------|
|                             | PDS                        |
|                             | \( r^a \) | \( p \) |
| CPS                        | 0.214 | 0.000 |
| Extroversion/introversion   | 0.742 | 0.000 |
| Emotional stability/neuroticism | 0.134 | 0.005 |

Notes: CPS, Cervantes Personality Scale; PDS, Prenatal Distress Scale. \(^a\)Pearson’s correlation coefficient.
related to the quality of her relationship especially with her husband[52]. For this reason, in order to reduce distress, it is beneficial to determine social support requirements and strengthen support systems.

Conclusion
Researchers have determined that pregnant women at risk due to introverted, neurotic and inconsistent personality characteristics have higher distress levels. They have determined that these pregnant women find their ability to cope with stress impaired. Creating an effective holistic approach to health care is central to an improved quality of life. Health care is interpersonal in nature and health care professionals view the human being as a whole with physical, emotional, social and intellectual needs. In this context, it can be said that psychological health is as important as physical health and is vital to coping with stress during pregnancy due to its adverse effects on maternal/fetal/neonatal health. All health care professionals should evaluate women not only physically but also mentally and emotionally commencing with the pre-conception period. They should determine the conditions that create distress and identify the personality characteristics that prevent women from coping with stress. Cognitive-behavioral techniques are an effective method of coping with distress. In the first stage of therapy, thoughts, behaviors and situations that cause distress are evaluated. The purpose of the assessment is to identify internal and external conditions that create distress. Cognitive-behavioral techniques teach pregnant women strategies to help manage stress, to gain skills in subjects such as risk perception and stress management, personality characteristics and coping, problem solving, psychological endurance and optimism. Caring initiatives should be personalized in line with the personality characteristics of pregnant women. The care offered within this framework will contribute to the strengthening and development of the health of not only the pregnant women but also the family and wider society, and can lead to a reduction of health care costs.

Limitations
This study was conducted on a group of Turkish pregnant women and cannot be generalized for other cultures. The data obtained from the research cannot be used to evaluate the psychological and physical disorders of the pregnant woman involved.

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The impact of smoke from grilled fish on the hematological parameters of Indonesian grilled fish sellers

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Abstract
Purpose – Fish processing by grilling can produce emissions that contain toxic compounds that can have short- and long-term effects on human health. Another study reported that exposure to air pollutants is hematotoxic. The purpose of this paper is to determine the effect of smoke exposure on fish grill results on hematological parameters.
Design/methodology/approach – The subjects of this study were 90 grilled fish sellers, with 32 processed food sellers who did not sell grill food as a control. The hematological analysis was performed using the Hematology Analyzers KX300 instrument.
Findings – The results showed that the mean value of hematological parameters in the test group was higher than the control group except for the number of lymphocytes and mixed cell parameters.
Originality/value – The content of harmful compounds contained in fish grill smoke can increase hematological value in the blood of exposed individuals, which has the potential for health problems and disease progression.
Keywords Carbon monoxide, Grilled fish seller, Hematology profile
Paper type Short Report

Introduction
Grilled fish is a processed dish that is very popular in South East Asia, with Indonesia being no exception. The dish is prepared by grilling fish on charcoal or coals, which adds flavor, color and aroma to make it more enjoyable[1]. Food processing by grilling using charcoal can produce emissions such as particulate matter (PM), carbon monoxide (CO), polycyclic aromatic hydrocarbons (PAHs), nitrogen oxides (NO), sulfur dioxide, volatile organic compounds, heavy metals (fluoride, arsenic, lead, mercury and selenium) and other toxic compounds which can provide short-term and long-term effects on human health[2]. The smoke produced during the grilling process can also contribute to pollutants in the
atmosphere. These pollutants are known to cause adverse health effects by interacting with molecules that are important for the biochemical or physiological processes of the human body[3, 4]. Exposure to biomass burning smoke has been shown to have a detrimental effect on cardiovascular health[5, 6].

Carbon monoxide is the most abundant emission produced via food processing using charcoal[7]. In addition, CO can also be produced from motor vehicle emissions, smoking and other household appliances that use fuel[8]. Exposure to CO can replace oxygen to bind to hemoglobin (Hb), which results in a reduced amount of oxygen in the body (hypoxia) which can affect the biochemical processes in the body[9]. This exposure can cause tissue hypoxia and can stimulate the formation of red blood cells (RBC) and hemoglobin[10].

The second most abundant pollutant resulting from grilling fish using charcoal is PM. PM has been declared carcinogenic by the International Agency for Research on Cancer, including emissions from household fuels such as wood and charcoal[11]. PM exposure can induce the production of reactive oxygen species (ROS) which can activate pro-inflammatory and pro-thrombotic pathways, produce endothelial dysfunction, increase blood coagulation and the development of cardiovascular disease[12]. Hazardous emissions that are also produced are PAHs which are genotoxic and contain carcinogenic compounds for humans[3, 4]. PAH can further induce hemolytic anemia[13]. The content of heavy metals in grilling smoke can produce free radicals that cause oxidative stress in living cells and induce an inflammatory response[14].

A complete blood count is one of the easy screening methods to find out the hematotoxicity of pollutants in the air[15]. Research shows a relationship between hematological parameters and exposure to air pollution, although the results obtained are still not consistent. Air pollutants, especially PM, have a significantly negative correlation with Hb and RBC, and a significant positive relationship with white blood cells (WBC) and platelet counts[16]. In 2012, a study reported by the Central Pollution Control Board for healthy adult individuals in Delhi who were exposed to air pollution showed an increase in Hb, hematocrit (HCT), RBC, WBC, monocytes, basophils and platelets levels[17]. Hemoglobin and RBC levels in individuals exposed to CO have also been reported to increase[10]. The relationship between exposure to air pollutants with hematological parameters is still controversial, and there have not been many specific investigations for pollutants produced by charcoal. This study aimed to carry out hematological analysis including Hb, RBC, HCT, mean cell volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), WBC, lymphocytes, neutrophils, mixed cells, red cell distribution width (RDW) and thrombocytes in individuals exposed to air pollutants from smoked grilled fish using charcoal.

Materials and methods

Research subjects and participants

The subjects of the study were 90 grilled fish sellers who sold in the Pahandut and Jekan Raya sub-districts of Palangka Raya City, were male, aged between 20 and 50 years, had worked as fish grillers for more than a year, were in good health, had no history of chronic diseases, were not smoking, not consuming alcohol and were subjected to smoke exposure for at least 4 h per day. The control group selected was composed of 33 male food sellers who did not sell grilled food.

The inclusion criteria were that participants had to be basically healthy, not have a history of chronic illness, not smoke, not consume alcohol, not consume drugs or vitamins that could affect the number of blood cells and not use respiratory protective equipment while working.
The test group and control group were determined based on information obtained through questionnaires, which contained participant identity, work history, medical history, smoking habits, alcohol consumption and drugs or vitamins commonly consumed. Both groups came from environments that lacked air pollution from vehicles or from industries and did not use firewood as a cooking tool. Individuals who fulfilled the criteria completed informed consent forms for blood sampling.

**Blood sampling**
Blood samples were taken in aseptic conditions of 3 ml of the cubital fossa (vein) in the morning between 8 to 10 a.m. The blood was inserted into a lavender lid vacuum tube containing EDTA anticoagulant. All blood samples were sent to the laboratory and analyzed within 1 h from the time of sampling.

**Hematology examination**
Blood samples were taken to the Clinical Laboratory of the Universitas Muhammadiyah Palangka raya to analyze the examination parameters consisting of Hb, HCT, erythrocyte count, leukocyte count, leukocyte type (lymphocytes, neutrophils and mixed cells), platelet count, erythrocyte index (MCV, MCH and MCHC) and RDW using the Hematology Analyzers Sysmex KX300. Quality control was done using three levels of control material (low, normal and high).

**Statistical analysis**
The results of hematological parameters were recorded in mean ± SD. The normality of the data was analyzed using the Kolmogorov–Smirnov test. To test the differences between the study group and the control group, the independent sample t-test was used for normally distributed variables and Mann–Whitney’s U-test was used for abnormally distributed variables. The different tests based on the duration of smoke exposure in the study group used the ANOVA analysis method. Differences were considered significant with p < 0.05 in 95% CI.

**Ethical clearance**
This study passed the ethical review from the Health Research Ethics Committee of the Faculty of Medicine, Universitas Lambung Mangkurat Banjarmasin Indonesia numbered 821/KEPK.FK.UNLAM/EC/VII/2018. Before taking blood samples, respondents were asked to fill out informed consent as proof that respondents were willing, without coercion to be included as research samples.

**Results**
A total of 122 food traders consisting of 90 sellers of grilled food as the test group and 33 food traders who did not sell grilled food as the control group participated in this study. The average age of study group participants was 33.3±9.3 years, and the control group was 33.7±8.3 years, indicating no significant difference in the age of the two groups. We also characterized based on the working experience in the form of the duration of time (years) working as food vendors who worked with grilled food and those who did not work with grilled food. Based on result statistics, the average length of time working as a grilled food seller was 7.1±5.4 years, with the control group averaging 6.6±4.8 years in their food trade with no significant differences in length of work experience between the two groups. The characteristics and results of the hematological examination in the study group and control group are shown in Table I.
The hematological analysis showed that hematological parameters (hemoglobin, the number of erythrocytes, hematocrit, MCV, MCH, MCHC, leukocyte, platelet, RDW and neutrophil counts) had higher mean values in the study group than the control group. However, those who had a significant increase ($p < 0.05$) were found in the parameters of the number of erythrocytes, hematocrit, platelets, number of leukocytes and neutrophils, whereas for lymphocyte counts and mixes, these had lower mean values in the study group than the control group, and statistically, only lymphocyte counts were significantly decreased.

**Discussion**

This research was conducted on sellers of grilled food exposed to air pollutants caused by smoked fish processed by grilling. Analysis of hematological parameters showed a higher hematological value in the exposed group than controls for Hb level, RBC count, HCT, MCV, MCH, MCHC, platelet, WBC, lymphocytes, and neutrophils. Values for test and control represent mean ± standard deviation. $^*$Independent sample t-test. $^?$Mann-Whitney’s. $^*p < 0.05$

The hematological analysis showed that hematological parameters (hemoglobin, the number of erythrocytes, hematocrit, MCV, MCH, MCHC, leukocyte, platelet, RDW and neutrophil counts) had higher mean values in the study group than the control group. However, those who had a significant increase ($p < 0.05$) were found in the parameters of the number of erythrocytes, hematocrit, platelets, number of leukocytes and neutrophils, whereas for lymphocyte counts and mixes, these had lower mean values in the study group than the control group, and statistically, only lymphocyte counts were significantly decreased.

### Table I

| Characteristics | Test ($n = 90$) | Control ($n = 33$) | $p$-value |
|-----------------|----------------|-------------------|-----------|
| Age (years)     | 33.3 ± 9.3     | 33.7 ± 8.3        | 0.649     |
| Work experience (years) | 7.1 ± 5.4  | 6.6 ± 4.8         | 0.589     |
| Hb (g/dL)       | 15.2 ± 1.1     | 15.0 ± 0.9        | 0.389     |
| MCV (fL)        | 83.3 ± 5.4     | 82.8 ± 3.9        | 0.648     |
| MCH (pg)        | 28.5 ± 2.5     | 28.1 ± 1.9        | 0.376     |
| MCHC (mg/dL)    | 34.3 ± 1.4     | 34.0 ± 1.3        | 0.400     |
| RBC (10^3/μL)   | 5.4 ± 0.5      | 5.3 ± 0.3         | 0.023     |
| HCT (%)         | 45.2 ± 3.1     | 43.7 ± 2.4        | 0.008     |
| RDW (fL)        | 41.3 ± 2.3     | 41.2 ± 1.9        | 0.551     |
| PLT (10^3/μL)   | 298.3 ± 62.3   | 277.2 ± 41.2      | 0.032     |
| WBC (10^3/μL)   | 7.5 ± 1.3      | 6.5 ± 0.9         | 0.000     |
| Lym (%)         | 34.5 ± 7.9     | 38.0 ± 5.1        | 0.007     |
| Mxd (%)         | 9.4 ± 3.4      | 10.1 ± 3.2        | 0.286     |
| Neut (%)        | 56.0 ± 9.5     | 51.9 ± 5.1        | 0.006     |

**Notes:** Hb, hemoglobin; MCV, mean cell volume; MCH, mean corpuscular hemoglobin; MCHC, mean corpuscular hemoglobin concentration; RBC, red blood cell; HCT, hematocrit; RDW, red cell distribution width; PLT, platelet; WBC, white blood cell; Lym, lymphocytes; Mxd, mixed cell; Neut, neutrophils. Values for test and control represent mean ± standard deviation. $^*$Independent sample t-test. $^?$Mann-Whitney’s. $^*p < 0.05$
WBC, lymphocyte and platelet levels[21]. Inhalation of CO exposure can quickly enter the circulatory system and bind to Hb 200 times stronger than oxygen to form carboxyhemoglobin, thus disrupting the oxygen transportation system to tissues, which can cause hypoxia. The condition of hypoxic tissue is a stimulus for erythropoiesis and stimulates the production of erythropoietin to produce more RBC and Hb in blood circulation[22].

RDW is the amount of anisocytosis or variation in the size of RBC. The life of RBC is shorter in conditions of oxidative stress, which results in an increase in hemolysis and then an increase in RDW[23]. The results of this study indicate a higher RDW value in the test group than the control group, in line with previous studies which stated that there was an increase in RDW in CO poisoning patients[24]. RDW in smokers is also reported to increase and can be used as an indicator of inflammation activity[25]. Increased RDW can occur due to an increase in oxidative stress on RBC which results in damaged cells and disruption in tissue perfusion[26].

WBC counts can be used as a biomarker for endothelial damage. We found that fish traders who were exposed to grilled fish smoke had a higher WBC and neutrophil count than those who were not exposed. Carbon monoxide intoxication itself is associated with toxicity to WBC in the form of leukocytosis and neutrophilia[20,27,28]. The systemic inflammatory response is characterized by the release of WBC and platelets in the circulation. Several studies have shown that the WBC level is a good predictor of atherosclerosis and cardiovascular disease[29]. A high WBC amount in exposed subjects can show that they may be at higher risk of developing atherosclerosis and cardiovascular disease than traders who are not exposed to smoke[30].

Increased platelet counts in healthy adult individuals who are exposed to long-term air pollutants, especially PM, shows a detrimental effect on blood clots[31]. Other studies have shown a significant increase in platelet counts in CO poisoning patients. Excess carbon monoxide in the body can activate platelets to produce NO which can react with superoxide to produce peroxynitrite and other ROS[32]. ROS can affect platelet aggregation and blood

| Parameters                  | A (n = 34) | B (n = 23) | C (n = 17) | D (n = 16) | p-value |
|-----------------------------|-----------|-----------|-----------|-----------|---------|
| Age (years)                 | 32.7 ± 9.9| 34.6 ± 8.2| 31.5 ± 7.7| 34.5 ± 11.3| 0.345*  |
| Hb (g/dL)                   | 148 ± 0.9 | 151 ± 0.9 | 155 ± 1.3 | 158 ± 1.3 | 0.021*  |
| MCV (fL)                    | 82.8 ± 6.4| 82.6 ± 3.8| 84.1 ± 4.6| 84.5 ± 6.2 | 0.619*  |
| MCH (pg)                    | 28.5 ± 2.8| 28.3 ± 1.9| 28.4 ± 2.2| 29.0 ± 2.9 | 0.298   |
| MCHC (mg/dL)                | 34.4 ± 1.4| 34.2 ± 1.4| 34.0 ± 1.4| 34.2 ± 1.5 | 0.796   |
| HCT (%)                     | 44.5 ± 2.9| 44.8 ± 2.6| 46.0 ± 3.3| 46.2 ± 3.3 | 0.164   |
| RDW (fL)                    | 41.0 ± 1.9| 41.2 ± 1.8| 41.9 ± 2.0| 42.8 ± 2.9 | 0.052*  |
| WBC (10^3/μL)               | 7.2 ± 1.1 | 7.3 ± 1.1 | 7.7 ± 1.6 | 8.0 ± 1.5  | 0.049*  |
| Lym (%)                     | 36.4 ± 7.7| 34.9 ± 5.9| 34.5 ± 8.6| 29.5 ± 7.8 | 0.033*  |
| Mxd (%)                     | 10.5 ± 4.1| 8.9 ± 2.4 | 8.5 ± 3.3 | 8.8 ± 2.2  | 0.086*  |
| Neut (%)                    | 53.1 ± 9.9| 56.2 ± 6.2| 57.0 ± 10.9| 61.7 ± 8.0 | 0.025*  |

Notes: Hb, hemoglobin; MCV, mean cell volume; MCH, mean corpuscular hemoglobin; MCHC, mean corpuscular hemoglobin concentration; RBC, red blood cell; HCT, hematocrit; RDW, red cell distribution width; PLT, platelet; WBC, white blood cell; Lym, lymphocytes; Mxd, mixed cell; Neut, neutrophils. A: 5–6 h/day; B: 7–8 h/day; C: 9–10 h/day; D: > 10 h/day. Values for A, B, C, and D represent mean ± standard deviation. *ANOVA test. *p < 0.05
flow, contributing to endothelial damage. Besides, free radicals can increase platelet adhesion and cause changes in the fibrinolytic pathway[33].

In addition, it is also known that there is a significant increase in platelet index (MPV, PDW, P-LCR and PCT) in grilled fish traders, which is a biomarker of inflammation due to increased platelet activation[34]. The results of this study show that the content of hazardous compounds in grilled fish processing using charcoal can increase hematological values in the blood of exposed individuals, especially for parameters that lead to an inflammatory response. However, this study had some limitations. First, all test subjects were male and because there are several factors such as ranges of Hb and MCHC which are influenced by the gender of the test subjects, the results of this study could only describe conditions in male test subjects.

Conclusion
This research has succeeded in showing the impact of air pollution originating from smoked fish processing by grilling. Decrease in the value of lymphocytes and mixed cells accompanied by the increase of Hb, erythrocytes count, HCT, MCV, MCH, MCHC, leukocyte count, platelets, RDW and neutrophils values is caused by exposure to hazardous chemicals contained in grilled fish smoke which have the potential to lead to health problems and disease progression. Research similar to different observation objects must be carried out in order to ascertain the effects of exposure to air pollutants from other objects, especially with larger sample quantities.

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Sex in the city
Sexual risk behaviors and sexual harassment among female beer promoters in Chiang Mai province, Thailand

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Abstract
Purpose – The purpose of this paper is to determine the sexual risk behavior and sexual harassment among female beer promoters in Chiang Mai, Thailand and analyze the associations among demographic data, sexual activities, sexual orientation, attitudes and working conditions based on the level of sexual harassment.
Design/methodology/approach – This study is a cross-sectional study that approached 184 Thai female beer promoters in Chiang Mai by a snowball sampling technique. Data were collected through a self-administrative questionnaire to find demographic data, sexual activities, sexual orientation, attitudes, sexual risk behavior and sexual harassment while working as a beer promoter. Descriptive, Pearson’s $\chi^2$ and Fisher exact tests were performed to describe and determine the associations.
Findings – The findings highlight that sexual risk behaviors and sexual harassment are found among female beer promoters. In total, 62.5 percent of them ever had sexual intercourse and 25.2 percent did not use condom. For sexual harassment, most of respondents had experienced a medium level harassment especially verbal harassment (73.9 percent). It associated with currently student status ($p = 0.038$), having sexual intercourse experience ($p = 0.024$), and type of job ($p = 0.002$).
Originality/value – This paper explores the sexual risk behaviors and sexual harassment among female beer promoters in the northern part of Thailand, containing the information on how common are the types of sexual risk behavior and sexual harassment experiences among a specific and hard-to-reach population.
Keywords Sexual harassment, Beer promoters, Sexual risk behaviours

Introduction
Alcohol consumption varies significantly across the world. The latest report of World Health Organization found that Belarus is the highest alcohol consumer in the world (17.6 liters/person/year) follow by Moldova and Lithuania (16.8 and 15.5 liters/person/year, respectively). In Thailand, it is found that Thai people consume 8.3 liters/person/year of alcohol which is continuously increasing especially in terms of beer and spirit[1]. Alcohol consumption is a known risk factor for a number of health conditions and potential mortality cases such as infectious diseases, specifically risky sexual behavior and sexually transmitted infections, alcohol-related crime and incidents, alcohol-related road traffic death and mental health disorders[1].

As the Alcohol Beverage Control Act B.E. 2551 was launched, alcohol advertising has become illegal[2]. The beer companies and local establishments have found a new way of advertising and marketing brands of beer to customers by beer promoters[3, 4]. Many young women are hired due to their appearance and forced to wear close-fitting and
revealing clothes[5]. Satisfying customers is one of their job duties and necessary for maintaining income especially commission. Consequently, beer promoters face daily sexual harassment and frequent requests to drink with customers which probably lead to sexual risk behavior[6]. In the some societies, a beer promoter is defined as “indirect sex workers” and stigmatized as the group of “bad girl” due to their working conditions including selling beer and working at night[5]. Due to the lack of clear categorization among this group, it might be hard to determine the risks they suffer from currently available data and their vulnerability to sexual and reproductive health, which is a major public health challenge.

Sexual harassment is defined as unwelcome behavior that includes non-verbal or gestural, verbal and physical harassment[7]. In Thailand, in past 20 years, more than 40,000 women have had the experiences toward violence and sexual harassment[8], despite the existing of law prohibiting sexual harassment. Sexual harassment is also related to sexual risk behaviors by forced sex. Sexual risk behavior is defined as a behavior that increases the risk of negative health consequences by increasing a chance of sexually transmitted infection, HIV infection and chance of unintended pregnancy[9–11].

Chiang Mai province is situated in the north of Thailand and is well-known and attractive tourist place which include several types of traveling including travelling for nightlife. Moreover, people also migrate to the city for job opportunities especially in the service and entertainment sector due to which lead beer promoters can be found throughout Chiang Mai.

Although this population can be found throughout the country, there are little evidence-based research works about their sexual behavior and workplace harassment. Without the authoritative surveillance and accurate data regarding this group, it is hard to find out the accurate solution to solve the problems. Therefore, this study aimed to determine their sexual risk behavior and sexual harassment among female beer promoters in Chiang Mai, Thailand; analyze the associations among demographic data, sexual activities, sexual orientation, attitudes and working conditions based on the level of sexual harassment.

Methods
The cross-sectional descriptive survey was conducted from May to July 2018 in Chiang Mai, Thailand. Snowball sampling technique was used due to hard-to-reach population from four seeds as first-wave participants and asked to identify further recruits until reach settled sample which is 198, calculated by using W.G. Cochran[12] with 95 percent confidence level with estimated proportion from prior research, 2011 Cambodia Survey Female Entertainment Workers[13]. The study population consisted of Thai female beer promoters who were 18 years old or more. People who have worked for less than a month and were not willing to fulfill the questionnaire or participate and were excluded.

A structural questionnaire was used to determine demographic characteristics, sexual activities, attitudes, working conditions, sexual risk behaviors and sexual harassment and was modified using Brief Sexual Attitudes Scale, Youth Risk Behavior, Deployment Risk and Resilience Inventory-2, and Sexual Harassment Attitude Scale[14–16]. Sexual harassment consists of non-verbal harassment, including being stared, blocked and seeing sexual gestures; verbal harassment, including being called baby, asked to have sex with or sexual preferences and hearing whistling or sexual comments; and physical harassment, including being massaged, touched body or cloths, stroked, hugged and stood close. The frequency of sexual harassment was scored as 0 = never; 4 = always and was classified into three levels by using mean and standard deviation as follows:

(1) Low sexual harassment = point \( \leq \) mean – SD (\( \leq 6.04 \)).
Questionnaire was submitted to three experts for content validity testing, IOC score of which was 0.73. Pilot test was performed for 30 female beer promoters in Bangkok, Thailand who were not included in the final survey. The reliability value was calculated by using coefficient Cronbach's $\alpha$ that was 0.804. Data collection was conducted through a self-administrative questionnaire under supervision of researcher and two trained female research assistants. All the participants were informed about the purpose of the survey and data were collected after having received participants' consent.

Statistical analysis was performed using SPSS window software program version 22.0 (licensed for Chulalongkorn University). Descriptive statistics for continuous variables and categorical variables were used to describe the population characteristics. Pearson's $\chi^2$ and Fisher exact test were used to determine association between variables, and $p$-value less than 0.05 was considered significant. Ethical approval was obtained from the Ethics Review Committee for Research Involving Human Research Subjects, Health Sciences Group, Chulalongkorn University (No. 133/2016).

Results

A cross-sectional study was done to assess sociodemographic characteristics, sexual activities, sexual orientation, attitudes, working conditions, sexual risk behaviors and sexual harassment of female beer promoters in Chiang Mai. The calculated total sample size was 198 and there were 184 respondents with 92.9 percent of responded rate, excluding the respondents with unmatched criteria and who did not fulfill the questionnaire. The results obtained were divided into two parts including descriptive findings and bivariate findings.

Table I shows the sociodemographic characteristics of female beer promoters in Chiang Mai, Thailand. Participants' age ranged from 18 to 30 years with a mean age of 22.7 years (SD = 2.58). Most of beer promoters (91.3 percent) were single (no a marriage certificate); 8.2 percent of beer promoters were married (having a marriage certificate); 0.5 percent of beer promoters were divorced or separated with partners. All beer promoters were educated and most had the education of college graduate or high vocational certificate levels (86.4 percent). In total, 58.7 percent of them were still students, 59.8 percent of them were studying for a bachelor degree followed by high vocational certificate (32.7 percent) and non-formal education (7.5 percent). Half of the participants rated their income status as sufficient without saving income status (50.0 percent), sufficient with saving (39.1 percent) and insufficient (10.9 percent). There were 35.3 percent of respondents who lived alone followed by 27.7 percent living with friends, 21.2 percent with boyfriend or husband and 16.3 percent with their families.

Table II shows the sexual activity and sexual orientation of the respondents. In total, 62.5 percent of respondents had experienced sexual intercourse with the mean age of respondents at the time of first sex being 18.9 years. Interestingly, among people who had sexual intercourse, most of them had sexual contact with male (86.0 percent), whereas 14 percent had same sex relationship 7.0 percent having sexual contact with female and 7.0 percent having sexual contact with both in male and female. Most of female beer promoters were heterosexual (81.5 percent), 11.4 percent were lesbian, 3.8 percent were not sure and 3.3 percent were bisexual.

Furthermore, this study revealed that the 71.7 percent of female beer promoters had neutral attitude toward sexuality, 17.4 percent had positive attitude and 10.9 percent had negative attitude. In terms of attitude toward using a condom, the 72.8 percent of female beer promoters had neutral attitude, whereas 19.6 percent had negative attitude.
Concerning attitude toward emergency contraceptive pills, 69.5 percent of them had neutral attitude. There were the 81.0 percent of female beer promoters who had neutral attitude toward sexual harassment, whereas 8.7 percent had negative attitude and 10.3 percent had positive attitude.
Table III represents about the distribution of attitude level of female beer promoters in three levels including sexuality, using condom, emergency contraceptive pills and sexual harassment. The majority of female beer promoters had a neutral attitude in all aspects.

Table IV represents the working conditions of respondents. There were 78.3 percent of respondents who worked as part-time beer promoters with average job hours of 5.6 and average job days of 5.2. Restaurant was the dominant workplace among female beer promoter (47.8 percent) followed by club or bar (33.5 percent). In total, 48.4 percent of them got drunk with the clients; however, the majority of them never got drunk at their workplace (83.1 percent).

Among 115 female beer promoters who ever had sexual intercourse, there were 45.2 percent of them having three or more sexual partners during their lifetime. The majority of them had sexual intercourse with one person (91.3 percent) in past three months. More than a half of them ever had sex under the influence alcohol or drug in their lifetime (67.0 percent). A few respondents had voluntary sex with their client in their lifetime (9.6 percent), and only 0.3 percent of them had voluntary sex with their client in past three months. Concerning pregnancy prevention, the majority of them used a condom (74.8 percent) during their last sex; nevertheless, 20.0 percent of them had no protection (Table V).

| Sexual activity                                      | Frequency | Percentage |
|------------------------------------------------------|-----------|------------|
| Have you ever had sexual intercourse? (n = 184)       |           |            |
| No                                                   | 69        | 37.5       |
| Yes                                                  | 115       | 62.5       |
| Age at first sex (Mean ± SD) (18.9 ± 2.13), Min. = 14, Max. = 25 |           |            |
| With whom have you had sexual contact? (n = 115)     |           |            |
| Female                                               | 8         | 7.0        |
| Male                                                 | 99        | 86.0       |
| Both                                                 | 8         | 7.0        |

Table II. Distribution of sexual activity and sexual orientation of female beer promoters

| Sexual orientation (n = 184)                             | Frequency | Percentage |
|----------------------------------------------------------|-----------|------------|
| Heterosexual (straight)                                  | 150       | 81.5       |
| Lesbian                                                 | 21        | 11.4       |
| Bisexual                                                | 6         | 3.3        |
| Not sure                                                | 7         | 3.8        |

Table III. Distribution of attitude levels of female beer promoters in Chiang Mai province, Thailand

| Level of attitude toward                                | Frequency | Percentage |
|---------------------------------------------------------|-----------|------------|
| Sexuality                                               | (28.96 ± 3.01) |            |
| Negative attitude (≤25.95)                              | 20        | 10.9       |
| Neutral attitude (25.96–31.96)                          | 132       | 71.7       |
| Positive attitude (≥31.97)                              | 32        | 17.4       |
| Using condom                                            | (14.03 ± 2.03) |            |
| Negative attitude (≤12.0)                               | 36        | 19.6       |
| Neutral attitude (12.1–16.05)                           | 134       | 72.8       |
| Positive attitude (≥16.06)                              | 14        | 7.6        |
| Emergency contraceptive pills                           | (8.84 ± 1.61) |            |
| Negative attitude (≤7.23)                               | 29        | 15.8       |
| Neutral attitude (7.24–10.44)                           | 128       | 69.5       |
| Positive attitude (≥10.45)                              | 27        | 14.7       |
| Sexual harassment                                       | (19.84 ± 2.28) |            |
| Negative attitude (≤17.56)                              | 16        | 8.7        |
| Neutral attitude (17.57–22.11)                          | 149       | 81.0       |
| Positive attitude (≥22.12)                              | 19        | 10.3       |
From Table VI, more than half of female beer promoters had experienced medium level sexual harassment including non-verbal, verbal and physical sexual harassment (68.5, 73.9 and 68.5 percent, respectively). Interestingly, there were 17.9 percent of them have faced a high level of physical sexual harassment which is the most threatening type of sexual harassment.

The associations among sociodemographic characteristics, sexual activity, sexual orientation, attitudes and working conditions with the level of sexual harassment are shown in Table VI. The study found that months of employment (p < 0.033), living condition (p < 0.017) and emergency contraceptive pills attitude (p < 0.026) were associated with non-verbal sexual harassment. On the contrary, the level of verbal sexual harassment was associated with currently student status (p < 0.038), having sexual intercourse experience (p < 0.024), and type of job (p < 0.002). Furthermore, the association findings demonstrated education level, income status, having sexual intercourse experience, and type of job that can make female beer promoters face physical type of sexual harassment at p-value 0.001, 0.003, 0.002 and 0.048, respectively (see Table VII).

### Table IV. Working conditions of female beer promoters

| Working conditions (n = 184) | Frequency | Percentage |
|-----------------------------|-----------|------------|
| **Type of job**             |           |            |
| Part-time                   | 144       | 78.3       |
| Full-time                   | 40        | 21.7       |
| **Job hours (Mean ± SD)**   |           |            |
| 5.6 ± 0.69                  |           |            |
| **Job days (Mean ± SD)**    |           |            |
| 5.2 ± 0.80                  |           |            |
| **Type of workplace (multiple answers)** |   |   |
| Restaurant                  | 100       | 47.8       |
| Karaoke                     | 6         | 2.9        |
| Club/bar                    | 70        | 33.5       |
| Beer garden                 | 33        | 15.8       |
| **Drink with clients**      |           |            |
| No                          | 95        | 51.6       |
| Yes                         | 89        | 48.4       |
| **Frequency of drinking with clients (n = 89)** |   |   |
| Monthly or less             | 27        | 30.3       |
| 2–4 times/month             | 41        | 46.1       |
| 2–3 times/week              | 13        | 14.6       |
| 4 or more times/week        | 8         | 9.0        |
| **Get drunk from workplace (n = 89)** |   |   |
| No                          | 74        | 83.1       |
| Yes                         | 15        | 16.9       |

### Discussion

According to this study, sexual risk behaviors and sexual harassment experiences among female beer promoters in the northern part of Thailand were investigated. The study found that most of respondents were under the age of 25 years (83.7 percent) and single (91.3 percent) which is remarkably similar to Webber et al.’s study[4]. All of the respondents were educated; half of them were still students (58.7 percent) and mostly studying bachelor programs. This might be related to the age distribution of respondents as 45.7 percent of respondents ranged between the age of 18–22 years. Moreover, remaining of them had high vocational certificate and non-formal education level of education. Concerning the living condition, 35.3 percent of respondents were living alone...
### Table V.
Distribution of sexual behaviors of female beer promoters

| Question                                                                 | Frequency | Percentage |
|--------------------------------------------------------------------------|-----------|------------|
| **During your life, with how many people have you had sexual intercourse?** |           |            |
| 1 person                                                                 | 26        | 22.6       |
| 2 people                                                                 | 37        | 32.2       |
| 3 or more people                                                         | 52        | 45.2       |
| **During past 3 months, with how many people have you had sexual intercourse?** |           |            |
| 1 person                                                                 | 105       | 91.3       |
| 2 people                                                                 | 10        | 8.7        |
| **Have you ever drunk alcohol or use drugs before you had sexual intercourse in your lifetime?** |           |            |
| No                                                                      | 77        | 67.0       |
| Yes                                                                     | 38        | 33.0       |
| **Did you drink alcohol or use drugs before you had sexual intercourse in past 3 months?** |           |            |
| No                                                                      | 104       | 90.4       |
| Yes                                                                     | 11        | 9.6        |
| **Have you ever voluntary had sex with clients in your lifetime?**       |           |            |
| No                                                                      | 104       | 90.4       |
| Yes                                                                     | 11        | 9.6        |
| **Did you voluntary had sex with clients in past 3 months?**             |           |            |
| No                                                                      | 114       | 99.1       |
| Yes                                                                     | 1         | 0.9        |
| **Have you ever had sex with client for money or object in your lifetime?** |           |            |
| No                                                                      | 111       | 96.5       |
| Yes                                                                     | 4         | 3.5        |
| **Did you had sex with client for money or object in past 3 months?**    |           |            |
| No                                                                      | 115       | 100.0      |
| **The last time you had sexual intercourse, did your partner use a condom?** |           |            |
| No                                                                      | 29        | 25.2       |
| Yes                                                                     | 86        | 74.8       |

### Table VI.
Distribution of sexual harassment level of female beer promoters

| Question                                                                 | Frequency | Percentage |
|--------------------------------------------------------------------------|-----------|------------|
| **Sexual harassment (n = 184)**                                          |           |            |
| Non-verbal                                                               | (9.6 ± 3.51) |          |
| Low level (≤6.04)                                                        | 36        | 19.6       |
| Medium level (6.05–13.05)                                                | 126       | 68.5       |
| High level (≥13.06)                                                      | 22        | 11.9       |
| Verbal                                                                   | (8.2 ± 3.35) |          |
| Low level (≤4.83)                                                        | 23        | 12.5       |
| Medium level (4.84–11.52)                                                | 136       | 73.9       |
| High level (≥11.53)                                                      | 25        | 12.6       |
| Physical                                                                 | (5.1 ± 3.54) |          |
| Low level (≤1.59)                                                        | 25        | 13.6       |
| Medium level (1.60–8.66)                                                 | 126       | 68.5       |
| High level (≥8.67)                                                       | 33        | 17.9       |
who were likely to have sexual risk behaviors followed by 27.2 percent living with friend. Interestingly, 21.2 percent of respondents were living with boyfriend or husband, and only 8.2 percent of respondents replied that they were married by registering a marriage certificate. This inconsistence might be explained that some respondents might live with their boyfriend before marriage. However, this phenomenon cannot be explained clearly based on only information from the survey.

The present study found that 62.5 percent of the participants used to have sexual intercourse with mean age at the time of first sex being 18.9 years. In comparison, female entertainment workers in Cambodia reported higher numbers to sexual intercourse experience (91.9 percent) with the mean age at the time of first sex being 19.4 years [17]. One study in Chiang Mai among general population, reported higher mean age at first sex around 2 years [18]. Based on the sexual experience of the group, 45.2 percent had sexual intercourse with three or more people during their lifetime which was consistent to H. Yang et al.'s study [19]. Furthermore, the majority of respondents never had sex with their clients neither voluntarily nor beneficially that was similar to Webber study and H. Yang et al. study [19, 20]. There were 25.2 percent respondents who did not use a condom as a protection which consistent with 2011 Cambodia STI survey among female beer promoters [21] that 24.1 percent did not use the condom during sexual activity.

### Table VII. Association between sociodemographic characteristics, sexual activity, sexual orientation, attitudes and working conditions with the level of sexual harassment

| Independent variables | Level of sexual harassment |  |
|-----------------------|----------------------------|---|
|                       | Non-verbal χ² (sig.)       | Verbal χ² (sig.) | Physical χ² (sig.) |
| **Sociodemographic characteristics** |                           |               |                  |
| Age range              | 2.929 (0.570)              | 4.699 (0.327) | 0.542 (0.969) |
| Marital status         | 4.523 (0.340)              | 3.855 (0.484) | 2.302 (0.724) |
| Education level        | 5.728 (0.167)              | 8.140 (0.056) | 17.205 (0.001)|
| Currently student status | 3.386 (0.184)          | 4.868 (0.038) | 0.966 (0.617) |
| Having other occupation | 4.694 (0.096)             | 0.119 (0.942) | 3.960 (0.138) |
| Average income         | 5.585 (0.200)              | 3.341 (0.475) | 2.958 (0.564) |
| Income status          | 9.326 (0.046)              | 2.661 (0.618) | 15.626 (0.003)|
| Months of employment   | 4.536 (0.033)              | 1.683 (0.195) | 0.122 (0.726) |
| Living condition       | 15.511 (0.017)             | 7.946 (0.289) | 7.417 (0.284) |
| Hometown               | 1.882 (0.399)              | 0.931 (0.656) | 9.211 (0.124) |
| **Sexual activity and sexual orientation** |                   |               |                  |
| Have you ever had sexual intercourse? | 0.572 (0.751) | 7.429 (0.024) | 12.890 (0.002) |
| Sexual orientation     | 1.708 (0.968)              | 7.046 (0.226) | 5.267 (0.434) |
| **Level of attitude toward** |                           |               |                  |
| Sexuality              | 3.792 (0.401)              | 5.908 (0.146) | 4.690 (0.279) |
| Using condom           | 1.766 (0.794)              | 4.345 (0.346) | 5.248 (0.251) |
| Emergency contraceptive pills | 10.527 (0.026) | 3.683 (0.441) | 4.370 (0.352) |
| Sexual harassment      | 1.810 (0.771)              | 1.027 (0.931) | 2.248 (0.682) |
| **Working conditions** |                           |               |                  |
| Type of job            | 3.890 (0.143)              | 11.997 (0.002) | 6.069 (0.048) |
| Job hours              | 4.881 (0.539)              | 1.614 (0.111) | 3.313 (0.776) |
| Job days               | 10.053 (0.225)             | 2.507 (0.113) | 13.275 (0.071) |
| Type of workplace      |                           |               |                  |
| Restaurant             | 0.901 (0.637)              | 0.134 (0.935) | 1.999 (0.368) |
| Karaoke                | 1.388 (0.536)              | 0.690 (1.000) | 1.388 (0.548) |
| Club/bar               | 0.454 (0.797)              | 0.889 (0.638) | 1.861 (0.304) |
| Beer garden            | 1.588 (0.452)              | 1.479 (0.487) | 0.706 (0.703) |
| Drink with clients     | 0.431 (0.806)              | 3.955 (0.138) | 0.836 (0.659) |

**Notes:** Fisher’s exact test, p < 0.05; Pearson χ², p < 0.05
In terms of attitude levels toward using a condom, 72.8 percent of female beer promoters had a neutral attitude about using condom, while 19.6 percent of them had a negative attitude. Most of female beer promoters had agreed that using condoms is an effective way to prevent HIV/AIDS. These results were consistent with Abhay Nirgude et al. study[22] that the majority of bar girls knew that the use of a condom can prevent them from HIV/AIDS. However, little more than half of respondents agreed that condoms make sex less enjoyable (53.8 percent). This finding showed that beyond the knowledge and awareness regarding protection during sexual intercourse, sexual pleasure remains essential for their sex life.

The study showed that most participants worked as part-time beer promoters (78.3 percent) which was inconsistent with Webber et al.’s study[20], while majority of respondents worked as full-time beer promoters (83 percent). This difference might be related to different study areas. Moreover, most respondents in this study were still a student or had other job. Most common workplace among beer promoters was restaurants (47.8 percent) and many respondents also used to drink with their clients (48.4 percent). Despite a few differences between studies, Webber’s study reported that 42.0 percent of Thai respondents ever had drunk with clients which is consistent[20].

The findings demonstrated that most respondents faced all types of sexual harassments while working as a beer promoter. Similar to the study in the USA, it was found that nearly 50 percent of women in the USA faced with sexual harassment in their work lives[23]. Moreover, the study by Webber et al.[20] revealed that workplace harassment was commonly found among beer promoters and alcohol was a major cause of the harassment. The majority of respondents had a medium level of sexual harassment experiences; however, numbers of sexual harassment experiences at a high level were also high. It might be related to low attention and unsuccessful campaigns regarding sexual harassment in Thailand. Moreover, many people also think that sexual harassment is a personal matter or personal perception which is hard to deal with. This was consistent with Cindy Bishop statement regarding less powerful #MeToo campaign in Thailand that “our society is quite conservative and for someone to come out and point a finger at someone who assaulted her is huge.”

Based on the results, associations between types of job and verbal sexual harassment and physical sexual harassment were found. The length of working time might be able to explain the difference between full-time and part-time job. Referring to A. Pina et al.’s study[24], it was revealed that the time length of exposure with strangers who were clients can lead sexual harassment. In addition, clients who drank alcohol tended to conduct improper behavior to other people.

There were possibly reasons for contradictory results of sexual harassment. First, the experience of sexual harassment depends on individual perception that is difficult to identify. Moreover, the respondents in this study were more likely to be the victims of sexual harassment and were in more vulnerable and insecure positions[25] and could not avoid the situation due to their job duties.

There were a few limitations of this study: first, non-probability snowball sampling technique cannot be representative of the population and could result in biasing recruitment toward respondents. Second, recall bias from self-administration. Third, all the data are quantitative data which cannot explain the entire phenomenon. Mixed method is recommended for in-depth information in further study.

Recommendations
The magnitude of sexual risk behaviors and sexual harassment should be revealed to the public as it is necessary to educated people in the society considering about these issues. The campaigns for women empowerment regarding knowledge and awareness of sexual
harassment, negotiation and life skills for female beer promoters should be created. In addition, the workplace should have a plan to guarantee the safety for female beer promoters in their workplace during working. Legal regulation and punishment should be strictly enforced to perpetrators in order to reduce sexual harassment occurrence and protect women's right.

Conclusion
This study was a cross-sectional survey based on sexual risk behaviors and sexual harassment among female beer promoters in Chiang Mai, Thailand. The study disclosed more than half of the respondents had sexual intercourse; 25.2 percent of them did not use a condom during last sexual intercourse. Regarding sexual harassment, it was found that most of the respondents had experienced sexual harassment including non-verbal, verbal and physical sexual harassment. Based on association results, the findings demonstrate that non-verbal sexual harassment associated with employment, living condition and emergency contraceptive pills attitude. Verbal sexual harassment was associated with current status of student, having sexual intercourse experience, and type of job, whereas physical sexual harassment was associated with the education level, income status, having sexual intercourse experience, and type of job.

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