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JERE REIJULA

The Impact of Tobacco Legislation on Restaurant Workers' Exposure to Tobacco Smoke in Finland

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THE IMPACT OF TOBACCO LEGISLATION ON RESTAURANT WORKERS' EXPOSURE TO TOBACCO SMOKE IN FINLAND

Jere Reijula

ACADEMIC DISSERTATION

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“Happiness comes when your work and words are of benefit to others.”

— Siddhartha Gautama

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LIST OF PUBLICATIONS

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I Reijula JP, Reijula KE. The impact of Finnish tobacco legislation on restaurant workers' exposure to tobacco smoke at work. Scand J Public Health. 2010 Nov;38(7):724-30. doi: 10.1177/1403494810379168.

II Reijula JP, Johnsson TS, Kaleva PS, Reijula KE. Exposure to tobacco smoke and prevalence of symptoms decreased among Finnish restaurant workers after the smoke-free law. Am J Ind Med. 2012 Jan;55(1):37-43. doi: 10.1002/ajim.21006.

III Reijula JP, Johnsson T, Kaleva S, Tuomi T, Reijula K. Total prohibition of smoking but not partial restriction effectively reduced exposure to tobacco smoke among restaurant workers in Finland. Int J Occup Med Environ Health. 2013 Oct;26(5):682-92.doi: 10.2478/s13382-013-0145-8.

IV Reijula JP, Kjaerheim K, Lynge E, Martinsen JI, Reijula K, Sparén P, Tryggvadottir L, Weiderpass E, Pukkala E. Cancer incidence among waiters – 45 years follow-up in five Nordic countries. Scand J Public Health. 2015 Mar;43(2):204-11. doi: 10.1177/1403494814565130.

The publications are referred to in the text by their Roman numerals.

ABBREVIATIONS

CI = confidence interval

ETS = environmental tobacco smoke

FEV1 = Forced Expiratory Volume in the first second

FINJEM = Finnish National Job-Exposure Matrix

FIOH = Finnish Institute of Occupational Health

HR = hazard ratio

IARC = International Agency for Research on Cancer

MS = mainstream smoke

NIOSH = National Institute of Occupational Safety and Health

NNN = N′-nitrosonornicotine

NNK = (methylnitrosamino)-1-(3-pyridyl)-1-butanone

NOCCA = Nordic Occupational Cancer Study

OR = odds ratio

PM = particulate matter

$PM_{2.5}$ = fine particles, i.e. particles with diameter of 2.5 micrometers or less

SHS = secondhand smoke

SIDS = sudden infant death syndrome

SIR = standardized incidence ratio

SS = sidestream smoke

TCA = Tobacco Control Act of 1976

TCAA = Tobacco Control Act Amendment in 1995

ABSTRACT

Exposure to tobacco smoke significantly increases the risk of several diseases including cancer, cardiovascular and pulmonary diseases. Prohibition of smoking in workplaces effectively protects workers against occupational exposure to secondhand smoke (SHS). However, Finnish restaurant employees have still been exposed to SHS at work until recent years. In 2000, a reform in tobacco legislation was launched in Finland according to which restaurants had to reserve non-smoking areas for their clients. Smoking restrictions proceeded gradually so that in 2007 a total ban on smoking was enacted in Finnish restaurants. In this study, nationwide survey data concerning occupational exposure to ETS in restaurants was used to assess the impact of tobacco legislation. Additionally, the risk of restaurant waiting personnel to develop cancer was evaluated in five Nordic countries.

AIM OF THE STUDY: The overall purpose of the present study was to assess the impact of tobacco legislation on the occupational exposure to tobacco smoke in Finnish restaurants. The aim was to compare the effects of partial restrictions and a total prohibition of smoking in reducing the exposure to SHS among restaurant workers. Another objective of the study was to evaluate the risk of restaurant workers to develop cancer compared to that of the general population.

MATERIAL AND METHODS: The present thesis collects the data concerning exposure to SHS in restaurant work using national questionnaire surveys conducted in 1999, 2001, 2003, 2007, 2009 and 2010 among Finnish restaurant workers (I, II and III). Each year the surveys were sent to an average of 3000 restaurant employees belonging to the Service Union United (PAM). Study I assessed the data collected with the first four questionnaires (1999-2007). In study II, the main focus was in the results of the questionnaires conducted before and after the launch of the smoke free tobacco legislation (i.e., 2007 and 2009). Study III included data from the questionnaires conducted in 2003, 2007, 2009 and 2010, respectively.

Exposure to SHS in restaurant work was assessed also by measuring indoor nicotine concentrations in some restaurants in three towns (Helsinki, Jyväskylä and Lappeenranta). The measurements were done in each year when the questionnaire surveys were carried out. Altogether 730 measurements were carried out between 2004 and 2010, approximately 60 measurements in each type of restaurant each year. The measurements were done with sampling devices that were placed for 4 hours in three different types of restaurants, i.e., dining

restaurants, pubs and nightclubs, and bar desks. The samples were then desorbed at 300°C and analyzed for nicotine thermodesorption-gas-chromatography-mass spectrometry. The measured nicotine concentrations represent average concentrations during the 4-hour period.

In order to assess the risk of cancer among restaurant workers, data were collected from the database of the Nordic Occupational Cancer (NOCCA) study. It consists of those 14.9 million persons aged 30-64 years who participated in any computerized census in the five Nordic countries, in 1990 or earlier. The study population consists of 2.0 million persons from Denmark, 3.4 million from Finland, 0.1 million from Iceland, 2.6 million from Norway and 6.8 million from Sweden. The longest follow up times were from 1961 to 2005. Among this study population, we focused on the group of waiters, comprising 16,134 males and 81,838 females. Altogether 3,100 cancer cases among male and 16,288 cancer cases among female waiters were found in study IV. Standardized incidence ratios (SIRs) for 35 common cancer sites were then calculated as ratios of the observed number and the expected number of cancer cases assuming that the cancer incidence among male and female waiters would be the same as found in the respective national populations. The numbers of excess cancer cases for each cancer site were calculated by subtracting the expected numbers of cancer cases from the observed ones.

RESULTS: The prevalence of restaurant workers who were not exposed to SHS at work increased from 34% to 54% during 1999-2007. The prevalence of those who reported more than 4 hours of exposure to tobacco smoke during their work shift decreased from 46% to 24%.

Between 2007 and 2009, the prevalence of restaurant workers who were not exposed to SHS at work increased from 54% to 82%. The highest increase was among workers in pubs and nightclubs (from 7% to 69%). The prevalence of restaurant workers who were exposed to SHS more than 4 hours a day at work decreased from 24% to 4%. Between 2007 and 2009, the prevalence of work-related respiratory symptoms decreased from 18% to 4% and that of eye symptoms from 23% to 6%.

The median nicotine concentration in restaurants decreased from 11.7 μg/m³ to 0.1 μg/m³ between 2004 and 2010. The highest decrease in median nicotine concentration was found in pubs, where the median nicotine concentration decreased from 16.1 μg/m³ to 0.1 μg/m³. The reported exposure to SHS (at least 1 hour per work shift) decreased from 59% to 11% during 2004-2010.

The cancer incidence among male and female waiters was higher than among the general population in the Nordic countries. During the study period (1961-2005), the overall risk of

cancer among male waiters was 1.46 (95% confidence interval 1.41-1.51) and among female waiters 1.09 (1.07-1.11). The highest SIRs were found in cancer sites that are related to alcohol consumption. The highest numbers of excess cases among male waiters were in lung cancer (n=282) and cancer of the pharynx (n=92). Among female waiters the highest numbers of excess cancer cases were in lung cancer (n=718) and in cancer of the cervical uterus (n=314).

CONCLUSION: The reform of Finnish tobacco legislation in 2000 that only partially prohibited smoking in restaurants until 2007 decreased occupational exposure to SHS but was not fully effective in protecting restaurant workers from exposure to SHS at work, whereas the total prohibition of smoking in 2007 significantly decreased restaurant workers' exposure to SHS. The total ban on smoking in restaurants also decreased the prevalence of work-related respiratory and eye symptoms among restaurant workers, which most likely was associated with the decrease of exposure to SHS at work. In the follow-up, the positive effects of the strict tobacco legislation remained intact. The risk of cancer among male and female waiters was higher than among the general population in the five Nordic countries. This may be explained by high prevalence of smoking, heavy occupational exposure to tobacco smoke and high alcohol consumption among the subjects.

TIIVISTELMÄ

Tupakansavulle altistuminen lisää merkittävästi riskiä sairastua esimerkiksi syöpään sekä sydän- verisuoni- ja keuhkosairauksiin. Tupakoinnin kieltäminen työpaikoilla on tehokkaasti suojannut työntekijöitä tupakansavulle altistumiselta. Ravintolatyöntekijät ovat yksi viimeisistä ammattiryhmistä, jotka ovat viime vuosiin saakka altistuneet tupakansavulle työssään Suomessa.

Vuonna 2000 Suomessa tuli voimaan ravintoloita koskeva tupakkalaki, jonka mukaan ravintoloiden tuli varata osa asiakastiloista tupakoimattomille asiakkaille. Siitä alkaen tupakointikielto on edennyt asteittain vuoteen 2007 saakka, minkä jälkeen tupakointi kiellettiin kokonaan ravintoloiden yhteisissä asiakastiloissa. Tässä väitöstutkimuksessa arvioitiin ravintoloita koskevan tupakkalain toteutumista ja vaikutuksia tupakansavulle altistumiseen ravintolatyössä valtakunnallisten kyselyjen ja tupakansavun pitoisuusmittausten avulla.

TAVOITE: Tutkimuksen keskeinen tavoite oli arvioida ravintoloita koskevan tupakkalain toteutumista ja sen vaikutuksia ravintolatyöntekijöiden altistumiseen tupakansavulle työssä. Tavoitteena oli lisäksi verrata osittaisen tupakointikiellon ja totaalikiellon eroja työntekijöiden tupakansavulle altistumisessa. Tutkimuksessa haluttiin myös arvioida ravintolatyöntekijöiden riskiä sairastua syöpään viidessä pohjoismaassa.

AINEISTO JA MENETELMÄT: Väitöskirjatutkimusta varten toteutettiin valtakunnalliset kyselytutkimukset vuosina 1999, 2001, 2003, 2007, 2009 ja 2010 (I, II ja III). Kysely lähetettiin vuosittain sellaiselle satunnaisesti valitulle ravintolatyöntekijäotokselle, jonka jäsenet kuuluivat Palvelualojen ammattiliitto PAM:iin. Osatyössä I koottiin tulokset neljästä kyselystä (v. 1999-2007) ja osatyössä II päähuomio kohdistui totaalikiellon vaikutusten arviointiin (vuosien 2007-2009 kyselyt). Osatyössä III vedettiin yhteen tulokset kyselyistä (v. 2003-2010) ja tupakansavun pitoisuusmittauksista ravintoloissa.

Tupakansavulle altistumista arvioitiin myös ravintoloissa tehdyillä sisäilman nikotiinipitoisuusmittauksilla kolmella paikkakunnalla (Helsinki, Jyväskylä ja Lappeenranta) samanaikaisesti ravintolatyöntekijöiden kyselytutkimusten kanssa. Vuosina 2004-2010 mittauksia tehtiin yhteensä 730, vuosittain keskimäärin noin 60 mittausta per ravintolatyyppi. Ilmanäytteiden keräysaika oli 4 tuntia ja keräykset tehtiin ravintoloissa, pubeissa ja yökerhoissa sekä baaritiskien alueella. Näytteistä analysoitiin nikotiinipitoisuus

kaasukromatografiamenetelmällä. Saatu nikotiinipitoisuus ilmoitettiin neljän tunnin keskipitoisuutena.

Ravintolatyöntekijöiden syöpäriskiä varten kerättiin tiedot viiden pohjoismaan yhteisestä Nordic Occupational Cancer eli NOCCA-aineistosta. Tietokannassa on yhteensä 14,9 miljoonaa henkilöä, jotka osallistuivat 30 - 64-vuotiaina mihin tahansa sähköisenä saatavilla olevaan väestölaskentaan vuosina 1960 - 1990. Aineistossa on 2 milj. tanskalaista, 3,4 milj. suomalaista, 0,1 milj. islantilaista, 2,6 milj. norjalaista ja 6,8 milj. ruotsalaista. Tästä aineistosta poimittiin tarjoilijat, yhteensä 16 134 mies- ja 81 838 naistarjoilijaa, joiden syöpäilmaantuvuutta seurattiin väestölaskennasta eteenpäin, pisimmillään 45 vuotta. Osatyössä IV on kuvattu yhteensä 3 100 syöpätapausta miehillä ja 16 288 syöpätapausta naisilla. Vakioitu ilmaantuvuussuhde (standardized incidence ratio, SIR) laskettiin todettujen ja odotettujen syöpätapausten suhteena 35 yleiselle syöpälajille. Ylimääräisten syöpätapausten määrä kullekin elinsyövälle laskettiin vähentämällä odotettujen syöpätapausten määrä todettujen tapausten määrästä.

TULOKSET: Tupakansavulle altistumattomien ravintolatyöntekijöiden määrä kasvoi 34 %:sta 54 %:iin vuosina 1999-2007. Tupakansavulle yli 4 tuntia työvuoron aikana altistuneiden määrä puolestaan laski 46 %:sta 24 %:iin samana ajanjaksona. Vuosina 2007-2009 tupakansavulle altistumattomien määrä kasvoi 54 %:sta 82 %:iin. Suurin kasvu (7 %:sta 69 %:iin) todettiin pubien ja yökerhojen työntekijöillä. Yli 4 tuntia tupakansavulle altistuneiden määrä laski 24 %:sta 4 %:iin samana ajanjaksona. Vuosina 2007-2009 ravintolatyöntekijöiden hengitystieoireiden esiintyvyys laski 18 %:sta 4 %:iin ja silmäoireiden 23 %:sta 6 %:iin.

Keskimääräinen nikotiinipitoisuus ravintoloiden sisäilmassa laski vuosina 2004-2010 tasosta 11.7 µg/m³ tasolle 0.1 µg/m³. Suurin lasku todettiin pubeissa (16.1 µg/m³:sta 0.1 µg/m³:iin). Vähintään tunnin ajan työssään tupakansavulle altistuneiden määrä laski tänä aikana 59 %:sta 11 %:iin.

Syövän kokonaisilmaantuvuus oli ravintolatyöntekijöillä suurempi kuin väestössä keskimäärin: SIR oli miestarjoilijoilla 1,46 (95 %:n luottamisväli CI 1,41-1,51) ja naistarjoilijoilla 1,09 (1,07-1,11). Suurimmat SIR-luvut havaittiin syövissä, jotka liittyvät alkoholin kulutukseen. Suurin ylimääräisten syöpätapausten määrä miestarjoilijoilla oli keuhkosyövässä (n=282) ja nielusyövässä (n=92). Naistarjoilijoilla oli 718 ylimääräistä keuhkosyöpää ja 314 kohdunkaulan syöpää.

PÄÄTELMÄT: Vuonna 2000 voimaan tullut ravintoloita koskeva tupakkalaki, joka aluksi kielsi tupakoinnin ravintoloissa vain osittain, vähensi altistumista tupakansavulle, mutta ei täysin suojannut ravintolatyöntekijöitä. Tupakoinnin kieltäminen kokonaan ravintoloissa vuodesta 2007 alkaen puolestaan vähensi altistumista tupakansavulle merkittävästi. Tupakoinnin totaalikielto vähensi merkittävästi myös työntekijöiden työperäistä hengitysteiden ja silmien oireilua, mikä todennäköisimmin liittyi vähentyneeseen tupakansavulle altistumiseen. Seuranta osoitti, että tiukka tupakkalaki pysyi tehokkaana vielä kolme vuotta kiellon tultua voimaan. Todettu tarjoilijoiden riski sairastua syöpään oli kohonnut muuhun väestöön verrattuna viidessä pohjoismaassa. Tämä voi johtua siitä, että tarjoilijat tupakoivat muuta väestöä yleisemmin, altistuvat työssään tupakansavulle ja käyttävät alkoholia muuta väestöä enemmän.

1 INTRODUCTION

Tobacco smoke is the leading cause of preventable deaths in the world (USDHHS 2010; Danaei et al. 2009). Besides actual tobacco smoking, also secondhand smoke (SHS) or environmental tobacco smoke (ETS) has been known to be harmful and carcinogenic to health at least since 1928 (Schönherr 1928). SHS, the term used throughout the study, has also been shown to affect the development and worsening of many major health problems in public health (Musk and de Klerk 2003; Jaakkola and Jaakkola 2012).

SHS is classified as a Group 1 carcinogen by The International Agency for Research on Cancer (IARC 2004) and an occupational carcinogen by The National Institute for Occupational Safety and Health (NIOSH). In 2011 it was estimated that SHS causes over 600 000 deaths globally each year (Öberg et al. 2011). This means SHS is the cause of 1 % of the deaths worldwide every year. In the US, since 1964, 2.5 million nonsmokers have died from exposure to SHS (USDHHS 2014). Moreover, SHS increases the prevalence of several diseases including respiratory and middle ear symptoms and asthma. SHS also causes decrement in pulmonary function and acts as a risk factor for lung cancer, SIDS, nasal sinus cancer and heart diseases (Steenland et al. 1996; IARC 2004; USDHHS 2006).

Comprehensive legislation helping to decrease SHS in the indoor air of workplaces and public places has been set in countries all over the world. However, in 2011 overall 93% of the world's population were still living in countries that had no smoke-free public health regulations (WHO 2009; Eriksen and Cerak 2008; McNabola and Gill 2009; Fontana et al. 2007; Jaakkola and Jaakkola 2006). Worldwide, 40% of children, 33% of male nonsmokers, and 35% of female nonsmokers were exposed to SHS in 2004 (Öberg et al. 2011).

For most adults, the primary sources for SHS are workplaces where smoking occurs, but also residences shared with one or more smokers are noteworthy (USDHHS 2014). Workplace exposure to SHS varies along with workplaces and smoking policies (Brownson et al. 2002). Also total bans on smoking have become common in many countries. Restaurants, however, have generally been the last occupational sites where smoking has not been prohibited. In addition, among different workplaces, the highest indoor nicotine concentrations are measured in restaurants and bars (USDHHS 2014).

Occupational exposure to SHS increases cancer risk significantly. In addition, it is known that wide-ranging smoking bans on smoking in workplaces reduce acute coronary events significantly (10-20%) from the first year after the ban onwards (IARC 2009).

In Finland, the first tobacco legislation was launched as Tobacco Control Act (TCA) in 1976. In its amendment (TCAA) in 1995 workplaces were included in the legislation with the exception, however, that restaurants were excluded from the tobacco act. According to Heloma et al. (2001) and Helakorpi (2008), the strict tobacco legislation was able to significantly decrease the exposure to SHS in Finnish workplaces in general. In 2000, restaurants were also included in the tobacco legislation, after which they initially became partially smoke-free. The legislation became stricter gradually, so that in 2001 50% of restaurant premises had to be smoke free. In 2007 a smoke-free legislation was launched and finally in 2009, all restaurants had to be smoke free, with the exception that separate smoking rooms were allowed.

In the present study, the impact of the Finnish tobacco legislation concerning restaurants is assessed through restaurant workers' exposure to SHS at work. The evaluation is based on questionnaire surveys and measuring nicotine in the indoor air of restaurants. In addition, the study evaluates the restaurant worker's risk to develop cancer in five Nordic countries and compares it to that of the general population.

2 REVIEW OF LITERATURE

2.1 Smoking trends in Finland and among restaurant workers

Since 1978, the prevalence of daily smoking among the general Finnish population has been decreasing (Figure 1). Between 1978 and 2013, the prevalence of daily smoking has decreased from 35% to 19% among men and from 17% to 13% among women. 16% of the 15-64-year-olds and 13% of the 14-18-year-olds are daily smokers (Kinnunen et al. 2013). On the other hand, the prevalence of never smokers has increased from 24% to 36% among men, but decreased from 54% to 45% among women during 1978-2013. For reference, figure 2 shows the trend of smoking prevalence worldwide.

Figure 1. Proportion of daily smokers (%) among 15-65 year olds by sex in 1980–2012. (Helldán et al. 2013)

Smoking has been more common among restaurant workers than the general population (Kauppinen et al. 2014). During 1978-1991, altogether 23-42% of female restaurant workers smoked daily, depending on the position and place of working (waiter, bar/café workers etc.). Among male restaurant workers, the prevalence was 44-56% during the same period. Between 1999 and 2010, the proportion of daily smokers decreased from 45% to 31% among male restaurant workers and from 32% to 25% among female restaurant workers.

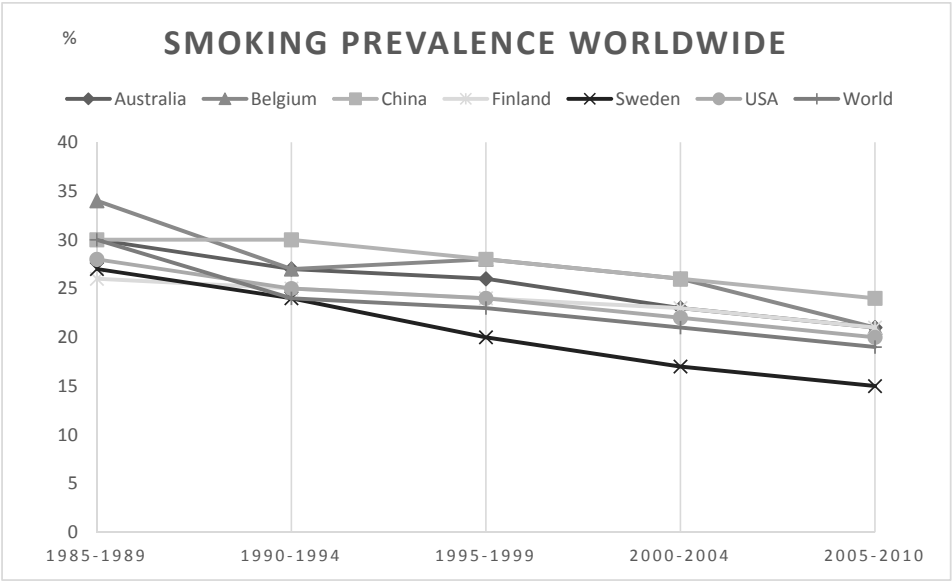

Figure 2. Prevalence of daily smoking in selected countries and worldwide, among persons 15 years or older through 1985-2010. (CBRC, Forey et al. 2011, Forey et al. 2013, Helldán et al. 2013, Ng et al. 2014, USDHHS 2014).

2.2 Health and exposure to SHS

Smoking tobacco has been known to be harmful to health at least since the beginning of the 20th century (USDHHS 2014), and during the last few decades more data on harmful health effects related to SHS has been collected.

At present there is scientific consensus on the harmful health effects of exposure to SHS (Samet 2008; USDHHS 2014). IARC has classified SHS as a group 1 carcinogen in 2012. NIOSH has concluded that SHS is an occupational carcinogen. Only smoke free places and eliminating smoking indoors fully protect nonsmokers from inhaling SHS (Samet 2008, USDHHS 2006). Separating smokers from nonsmokers, cleaning the air, and ventilating buildings cannot eliminate nonsmokers' exposure to SHS (USDHHS 2006).

2.2.1. Exposure to SHS in domestic and occupational settings

Exposure to SHS can take place in any indoor environment that people spend time in (IARC 2004). Worldwide, overall 40% of children, 33% of male nonsmokers, and 35% of female nonsmokers were exposed to SHS in 2004 (Öberg et al. 2011).

In Finland, exposure to SHS at work decreased significantly after the tobacco legislation concerning workplaces was launched in 1995 (Figure 3). In 1985-86, approximately 70% of male smokers and 25% of male nonsmokers were exposed to SHS at work for at least 1 hour per day (Tobacco statistics, Finland 2013). Among women, the prevalence of those who were exposed to SHS at work for 1 hour per day was 47% of smokers and 16% of nonsmokers, respectively.

In 2013, altogether 9% of men and 4% of women reported exposure to SHS at work in Finland. Respectively, 2% of men and 1 % of women other than smokers were exposed to SHS in workplace at least for one hour daily in the same year. 12% of male smokers and 5% of female smokers were exposed to SHS at least for one hour daily (Tobacco statistics, Finland 2014).

Figure 3. Proportion (%) of non-smoking 15-64year olds working outside home exposed to tobacco smoke at workplace daily in 1985–2011 (Helldán et al. 2013).

2.2.2 Contents of tobacco smoke

Tobacco smoke contains more than 4 000 chemical compounds from which at least 60 are known to be carcinogenic to humans (IARC 2004) including N-nitrosamines, polycyclic aromatic hydrocarbons, aromatic amines, aldehydes, phenols, benzene, nitro methane, ethylene oxide and polonium (Huang and Chen 2011).

SHS is a mixture of side stream smoke (SS) and mainstream smoke (MS) (USDHHS 2014), the two forms of smoke releasing from a burning cigarette. SS contains the smoke released from the burning end of a cigarette between puffs and MS the smoke exhaled by the smoker. There are qualitatively similar but quantitatively different contents in mainstream smoke compared to SS (IARC 2004). Some representative SS:MS ratios are: nicotine, 7.1; carbon monoxide, 4.8; ammonia, 455; formaldehyde, 36.5; acrolein, 18.6; benzo[a]pyrene, 16.0; N′-nitrosonornicotine (NNN), 0.43; (methylnitrosamino)-1-(3-pyridyl)-1-butanone (NNK), 0.40 (Jenkins et al. 2000; IARC, 2004).

Only recently has it been noticed that tobacco smoke in the indoor air clings to surface materials and can then later be released again into the air and extend the time of exposure to tobacco smoke (so called third hand smoke) (Kuschner et al. 2011).

The mechanisms of tobacco carcinogens to cause adverse health effects are only partly clear (Jyrkkiö et al. 2012). The most familiar route for tobacco smoke is cyclooxygenase pathway (COX) and its derivatives. Many contents of tobacco smoke increase the amount and the activity of COX-2 in the cells, and in many cancer cells an extra expression of COX-2 has been detected.

Like inhaled tobacco smoke also SHS is a mixture of more than 7,000 chemicals including many toxic ones, and about 70 that can cause cancer to humans (USDHHS 2014). These chemicals include formaldehyde, benzene, 1.3-butadiene, benzo[a]pyrene, butanone, vinyl chloride, arsenic, ammonia, hydrogen cyanide and many others (IARC, 2004; USDHHS 2006). SHS contains nicotine and in homes and workplaces where smoking is permitted the nicotine concentration in the air ranges on average from 2 to 10 $\mu g/m^3$ (IARC, 2004).

In the SHS, there are actually higher concentrations of many carcinogens than in the smoke actively inhaled into lungs by smokers (USDHHS, 2006). The concentrations of individual constituents in SHS can vary with time and environmental conditions. Table 1 lists some representative constituents and their concentration related to SHS (Jenkins et al. 2000; IARC 2004; USDHHS 2006).

Table 1. Constituents of SHS (Jenkins et al. 2000, USDHHS 2006).

Constituent	**Concentration**
Nicotine	10–100 μg/m^3
Carbon monoxide	5–20 ppm
Benzene	15–30 μg/m^3
Formaldehyde	100–140 μg/m^3
Acetaldehyde	200–300 μg/m^3
1,3-Butadiene	20–40 μg/m^3
Benzo[*a*]pyrene	0.37–1.7 ng/m^3
NNK	0.2–29.3 ng/m^3
NNN	0.7-23 ng/m^3

2.2.3 Health effects of smoking

Smoking is harmful to nearly every organ of the body and threatens a person's overall health (USDHHS 2014). Smoking is a risk factor for numerous diseases and almost every smoker suffers from bronchial irritation.

Smoking is the leading preventable cause of death in the world (USDHHS 2010; Danaei et al. 2009), and it is associated with increased mortality of 2-3 times that of lifelong nonsmokers (Mucha et al. 2006). In addition, male smokers lose an average of 13.2 years of life, and female smokers 14.5 years of life (CDC 2002). At least half of all smokers die earlier as a result of smoking (Doll et al. 2004; Thun et al. 1995). In Finland smoking is the cause of every fifth death, which means that approximately 5 000 Finns die prematurely from cigarette related diseases annually (Patja 2014).

Smoking is the major cause of lung, laryngeal and bladder cancer (Jyrkkiö et al. 2012) and increases the risk of many other types of cancer, including cancers of the cervix, kidney, ureter, lip, oral cavity, pharynx, esophagus, stomach, pancreas, liver, penis, colon, rectum, larynx and blood (acute myeloid leukemia) (USDHHS 2014; Sherman 1991).

Smoking can affect both the carcinogenesis and the nature of the cancer (Tsivian et al. 2011). Cancer can manifest itself more aggressively in smokers than in nonsmokers; smoking worsens the prognosis of a cancer patient and increases adverse effects of cancer treatments (Jyrkkiö et al. 2012). For example smokers with prostatic cancer are more likely to suffer from more aggressively acting cancer than nonsmokers (Tsivian et al. 2011). Also, renal cancer is spread more widely when diagnosed in smokers than nonsmokers. Furthermore, tobacco smoking worsens the effect of the treatment even when smoking is not the main cause of the cancer (Jyrkkiö et al. 2012). Cancer patients who continue to smoke also tend to suffer from more difficult pains than non-smoking patients (Ditre et al. 2011. Tobacco has harmful interactions with the drugs used for the treatment of cancer (Jyrkkiö et al. 2012).

Lung cancer is the most common cancer in the world and the leading cause of cancer deaths (Knuuttila 2013). In Finland, 1 600 male and 750 female patients are diagnosed with lung cancer annually (Patja 2014). Of lung cancers approximately 90% are caused by smoking (Patja 2014). The risk of a smoker getting lung cancer is 6-30 times higher than that of a lifelong nonsmoker (Pirie et al. 2013; Lee et al. 2012; Cataldo et al. 2010; Knuuttila et al. 2013). After giving up smoking the risk of getting lung cancer stays increased for approximately 30 years (Ebbert et al. 2003).

The risk of dying from lung cancer before age 85 is 22.1% for a male and 11.9% for a female current smoker, in the absence of competing causes of death. The corresponding estimates for lifelong nonsmokers are a 1.1% probability of dying from lung cancer before age 85 for a man of European descent, and a 0.8% probability for a woman of European descent (Thun et al. 2008).

Smoking has an evident relationship with renal cancer, even though the risk factors for renal cancer stay poorly recognized (Chow et al. 2010). Smoking lightly increases the risk of prostate cancer (Huncharek et al. 2011). The risk of prostate cancer related death among smokers is 1.4 times as high as that of lifelong nonsmokers (Kenfield et al. 2011). In Finland, about 450 tobacco-related bladder cancers are diagnosed annually (Jyrkkiö et al. 2012).

Regardless of the antiestrogenic effects of tobacco smoking, the breast cancer risk among longterm female smokers is 20-50% higher than among lifelong female nonsmokers (Luo et al. 2011). Smoking doesn't increase the risk of ovary cancer, but the prognosis of the cancer is worse than among nonsmokers (Ioffe et al. 2010).

Smoking can slightly predispose to intestinal cancer, and the prognosis of colonial cancer among a long-term smoker is worse (McCleary et al. 2010).

Smokers are at 50% greater risk of cardiovascular diseases than nonsmokers (Danaei et al. 2009; USDHHS 2014). Smoking also induces chronic obstructive pulmonary disease (COPD), and the risk of COPD among smokers is 10 to 12 times as high as that of nonsmokers (Sherman 1991; Devereux 2006; Danaei et al. 2009; Pirie et al. 2013). About 80% of deaths caused by COPD are related to smoking and smokers are 12 to 13 times more likely to die from COPD than nonsmokers (USDHHS 2014). There is also a linkage between smoking cigarettes and low levels of FEV1, increased respiratory symptoms and infections (Sherman 1991).

Smoking predicts increased absenteeism from work, and increased health care utilization and cost. In addition, smoking is related to an increased risk of infertility, miscarriage, preterm delivery, stillbirth, ectopic pregnancy, premature menopause, osteoporosis and impotence. Furthermore, smoking can affect the health of the teeth and gums and increase the risk of cataracts and age-related macular degeneration. Smoking increases (by 30-40%) the risk of developing type 2 diabetes and complicates the control of the disease. Smoking can also affect immune function and cause inflammations and rheumatoid arthritis (USDHHS 2014).

Smoking has been shown to worsen the symptoms of Crohn's disease (Cosnes et al. 1999) and smoking is also a risk factor for Alzheimer's disease (Cataldo et al. 2010). Finally, women are more likely to get diseases related to smoking than men (Mucha et al. 2006).

Smoking is the single largest cause of health inequality between socio-economic groups in Finland (Ministry of Social Affairs and Health 2014). Together with alcohol, smoking explains about half of the health inequalities in the Finnish population.

2.2.4 Health effects of exposure to SHS

SHS exposes people to carcinogenic, teratogenic, toxic and irritant agents of tobacco smoke because of others' smoking (Jaakkola and Jaakkola 2012). SHS contains many chemicals that can quickly irritate and damage the lining of the airways, and even a brief exposure can result in upper airway damages in healthy persons (USDHHS 2006).

SHS affects the development and worsening of many major health issues of public health among adults and children (Jaakkola and Jaakkola 2012). SHS is proved to be carcinogenic to

humans (Group 1) as well as the smoke inhaled by the smoker (IARC 2004) and therefore there is no risk-free level of SHS exposure (USDHHS 2014; Institute of Medicine 2009).

According to literature, the evidence on adverse effects of SHS exposure has grown substantially and a large number of meta-analyses have been performed, supporting broad causal conclusions (Samet 2008).

Since 1964, at least 2.5 million nonsmokers have died from exposure to SHS in the US (USDHHS 2014), and in 2004 passive smoking was the reason for 603,000 deaths and the loss of about 11 million years of life worldwide (Öberg et al. 2011). Of these deaths approximately 379,000 were from ischemic heart disease, 165,000 from lower respiratory infections, 36,900 from asthma, and 21,400 from lung cancer. Furthermore, of deaths caused by SHS exposure, 47% occurred in women, 28% in children, and 26% in men. In 25 countries in Europe more than 79,000 adults died in 2002 because of passive smoking and a total of just over 19,000 of these deaths were among nonsmokers (European Commission 2004). Women and children are carrying the biggest health burden of the SHS problem (Jaakkola and Jaakkola 2012).

As early as in 1986, the U.S. Surgeon General concluded that SHS causes lung cancer. Exposed nonsmokers' lung cancer risk is increased by 20-30% (USDHHS 2006) and in the United States SHS is the cause of lung cancer deaths in more than 7,300 cases per year among adult nonsmokers (USDHHS 2014). Since 1981, the connection between SHS and lung cancer has been studied in a series of studies internationally (USDHHS 1986; NRC 1986; California Environmental Protection Agency 1997; Hackshaw 1998; National Health and Medical Research Council 1997; Alberg and Samet 2003; Brennan et al. 2004; IARC 2004) with the same conclusion that SHS increases the relative risk of lung cancer in passive smokers significantly.

Among those women who are exposed to their partner's smoking, the lung cancer risk is over 20% higher than that of non-exposed women (USDHHS 2006). The risk for men whose partner is a smoker is 37% higher and for women and men together 29% higher. Work related passive smoking increases cancer risk significantly. In a meta-analysis of 22 studies evaluating SHS exposure at workplaces, the relative risk of lung cancer among those nonsmokers exposed to SHS was 1.24 (95 % CI 1.18-1.29) and among highly exposed 2.01 (95 % CI 1.33-2.60) when compared to non-exposed workers (Stayner et al. 2007).

In another study involving 10 European countries (European Prospective Investigation into Cancer and Nutrition, EPIC), it was estimated that the hazard ratio (HR) for lung cancer risk

was 1.34 (95% CI 0.85-2.13) among never smokers and ex-smokers who had been exposed to SHS at home and/or at work (Vineis et al. 2007). The greatest risk was the exposure at the workplace and the HR of workplace exposure to SHS was 1.65 (95% CI 1.04-2.63). According to this study, women were in the greatest risk and the HR for women was 2.13 (95% CI 1.6-3.4). In a Chinese study (Wen et al. 2006), an exposure to SHS at work significantly increased the risk of lung cancer mortality (HR 1.79, 95% CI 1.09-2.93).

Breathing SHS immediately affects the cardiovascular system of nonsmokers harmfully increasing the risk of heart attack especially among those suffering from heart disease (USDHHS 2014). Daily exposure to SHS duplicates the risk of coronary thrombosis among nonsmokers (Patja 2014).

SHS has adverse effects on the cardiovascular system and can cause cardiovascular disease (USDHHS 2006). US USDHHS (2006) estimates that the risk of getting a cardiovascular disease is 1.27 times higher among passive smokers than among non-exposed persons. SHS also worsens the symptoms of cardiovascular disease (Jaakkola 2002; USDHHS 2006). Each year between 2005 and 2009, approximately 34 000 deaths related to heart diseases among nonsmokers in the US were caused by exposure to SHS (USDHHS 2014).

According to studies even only 20 minutes' exposure to SHS increases the adherence of platelets and the coagulation of blood similarly as active smoking does among tobacco smokers (Jaakkola and Jaakkola 2002; USDHHS 2006). SHS causes endothelic dysfunctions and increases the fibrinogenic concentration of the plasma (Bonetti et al. 2011). Passive smoking also increases heart rate and blood pressure as well as the amount of carbon monoxide adhering to hemoglobin and arrhythmias among those suffering from stabile coronary heart disease. Epidemiological studies have shown that passive smoking increases the risk of atherosclerosis (Zou et al. 2009).

SHS also increases the risk of stroke by 20-30% and causes over 8,000 deaths from stroke in the US annually (USDHHS 2014). The risk of stroke seems to increase significantly after a rather small exposure daily (i.e. exposure to 5 cigarettes) (Oono et al. 2011).

The risk of breast cancer is 1.25 times higher among women exposed to SHS according to the meta-analysis by California Environmental Protection Agency (2005b). Before menopause (under 50 years) the same risk is even higher (1.68 times higher risk). Evidence of this is strong, although USDHHS (2006) indicated that more studies are needed.

Passive smoking causes acute respiratory symptoms such as nose symptoms, irritation of throat and cough (Jaakkola and Jaakkola 2002). Persons with allergies are more sensitive to symptoms of this kind and passive smoking also worsens allergies (Janson 2004). In a large case-control study the risk of invasive pneumococcal infection was over two times higher among passively smoking adults than among those not exposed (Nuorti et al. 2000).

According to studies SHS decreases pulmonary function lightly but significantly when measured with spirometer, and this decline adheres to the dose of SHS (Jaakkola and Jaakkola 2002; California EPA 2005b). The decrease of pulmonary function is bigger among asthmatics than non-asthmatics (Jaakkola and Jaakkola 2002). After smoke free legislation pulmonary function has significantly improved among passive smokers when compared to the time before the legislation, indicating less exposure to SHS (Eisner et al. 1998; Menzies et al. 2006). Thus, pulmonary function may be at least partly reversible.

There are multiple mechanisms by which SHS can cause chronic respiratory symptoms, asthma and COPD (Jaakkola and Jaakkola 2002; California EPA 2005b). Passive smoking at workplace or home almost doubles the risk of asthma (Jaakkola et al. 2003; California EPA 2005b; Jaakkola and Jaakkola 2006) and the risk is dose-related. Asthmatics also suffer from more symptoms and need more medication for their disease. Also, visits to hospital emergency room and need for hospital treatment are more typical of asthmatic patients exposed to SHS than of non-exposed ones (Jaakkola and Jaakkola 2002; California EPA 2005b).

On the strength of many studies the risk of COPD is higher because of exposure to SHS both at work and home (California EPA 2005b; Jaakkola and Jaakkola 2006). On the other hand, in the USA, a demographic study showed that a high exposure to SHS at home had to do with 1.55 times higher and at work with 1.36 times higher COPD risk compared to that of the non-exposed (Eisner et al. 2005).

Exposure to SHS of pregnant mothers leads to impaired fetal growth and may lead to organ system developmental disturbances, such as respiratory malfunction, and preterm delivery (Lødrup-Carlsen et al. 1997: Jaakkola et al. 2001). Among highly exposed pregnant women the risk of preterm delivery is found to be more than six times as high as the risk of non-exposed women (California EPA 2005b). In a meta-analysis the risk of preterm delivery among passively smoking women was estimated to be 1.57 times higher than among non-exposed women. Also prenatal and postnatal risk of asthma increases if the mother is exposed to SHS

(Jaakkola and Jaakkola 2006). Table 2 comprises a summary of the literature on health effects of SHS, concluded to have either an association or being the cause of a certain health hazard.

Table 2. The health effects of exposure to SHS (reciting Samet 2008).

Health effect	SG 1986	EPA 1992	Cal EPA 1997	UK 1998	WHO 1999	IARC 2004	CalEPA 2005	SG 2006
Increased prevalence of respiratory symptoms	+	+	++	++	++	++	++	++
Decrement in pulmonary function	+	+	+	+	-	++	+	++
Increased occurrence of acute respiratory illnesses	+	+	+	++	-	++	++	++
Increased occurrence of middle ear disease	-	+	++	++	++	++	++	++
Increased severity of asthma episodes/symptoms	-	-	++	++	-	++	++	++
Risk factor for new asthma	-	-	+	++	-		++	++
Risk factor for SIDS	-	-	-	++	+	++	++	++
Risk factor for lung cancer in adults	-	++	++	++	++	++	++	++
Risk factor for breast cancer for younger, primary premenopausal women	-	-	-	-	-	-	++	-
Risk factor for nasal sinus cancer	-	-	-	-	-	-	++	-
Risk factor for heart disease in adults	-	-	-	++	++	-	++	++

+ = association
++ = cause
- = not studied

SG=Surgeon General, EPA= US Environmental Protection Agency,
CalEPA= California Environmental Protection Agency, UK= United Kingdom Scientific Committee on Tobacco and Health

2.3 Work related exposure to SHS among restaurant workers

Restaurants and bars have been identified as workplaces with high level of SHS exposure (Edwards et al. 2006) and of all workplaces, the highest indoor nicotine concentrations are measured predominantly in restaurants and bars (USDHHS 2014). In addition, restaurants and bars are considered the places that are least likely to be incorporated in the smoking ban

policies. Thus being a waitress among female occupations seems to be hazardous (Siegel et al. 2005). Despite the strict legislations launched by many countries trying to restrict smoking in workplaces, workers in restaurants and bars are generally more often exposed to SHS than workers in other fields (Lopez et al. 2008).

In Finland exposure to SHS decreased significantly after the enforcement of the tobacco legislation in 1995 (Helldán et al. 2013). Furthermore, the exposure has continued to decrease after 1995 among nonsmokers. In 2013, 2% of other than daily smoking men and 1% of such women worked in a workplace where SHS existed at least for one hour per day. Of smokers 12% of men and 5% of women reported staying in workplaces with SHS at least for one hour daily.

In China, among different public places, smoking is most prevalent in restaurants (89%) (Jin et al. 2014). Another study conducted in Shanghai, China found that over 90% of restaurant workers were exposed to SHS at work with a median of 24.2 hours per week (Zheng et al. 2009).

In Lisbon, Portugal, a study reported significantly higher fine indoor air particles $PM_{2.5}$ in restaurants compared to other sites and also the urine cotinine concentrations of restaurant workers were significantly higher than of those who worked in canteens (Pacheco et al. 2012). A German study also found significantly high levels of SHS constituents such as polycyclic aromatic hydrocarbons (PAH), volatile organic compounds (VOC), aldehydes/ketones and cadmium in hospitality venues, such as bars, discotheques and restaurants (Bolte et al. 2008).

In Ireland, there was a great reduction in exposure to SHS among hospitality workers after a smoke-free legislation was launched in 2004. Self-reported exposure decreased from a median of 30 hours a week to 0 hours a week. Furthermore, a reduction of 83% in nicotine air concentration was found from 35.5 $\mu g/m^3$ to 5.95 $\mu g/m^3$ after the tobacco ban was launched. (Mulcahy et al. 2005). In New York (US), a smoke free law was launched in 2003, leading to a decrease in exposure to SHS among nonsmoking restaurant workers from 12.1 hours to 0.2 hours over four days of work. Among employees in non-hospitality workplaces and all other locations, the numbers were 2.4 hours and 0.6 hours, respectively (Farrelly et al. 2005).

Similar results (i.e. suggesting that hospitality workers' exposure to SHS at work was high before a smoke-free legislation and decreased significantly after a smoke-free legislation) have been found among hospitality workplaces in several countries or states worldwide, such as Argentina, Washington D.C (US), Minnesota (US), Canada, Belfast (Ireland), Scotland (UK)

and New Zealand (Jensen et al. 2010.; Pearson et al. 2009; Schoj et al. 2010, Bondy et al. 2009, Bannon et al. 2009, Ayres et al. 2009, Edwards et al. 2008)

2.4 Tobacco legislation

The WHO Framework Convention on Tobacco Control was launched through 2003 to 2005 (WHO FCTC 2003). It was established in response to the globalization of the tobacco epidemic, and with its 168 signatories from parties all over the world it is one of the most widely embraced treaties in the UN history. Specified in its articles, the main purpose of the FCTC is, by a great number of different measures, to protect and support public health by reducing the demand of tobacco and to prevent people from the harms of tobacco. On exposure to SHS, FCTC article number 8 concludes, "parties recognize that scientific evidence has unequivocally established that exposure to tobacco smoke causes death, disease and disability." Furthermore, "each Party shall adopt and implement in areas of existing national jurisdiction as determined by national law and actively promote at other jurisdictional levels the adoption and implementation of effective legislative, executive, administrative and/or other measures, providing for protection from exposure to tobacco smoke in indoor workplaces, public transport, indoor public places and, as appropriate, other public places."

Research evidence shows that smoking policies have been highly effective in reducing the exposure of nonsmokers to SHS at workplaces (offices, public sector workplaces, medical centers, restaurants) (Briss et al. 2000; Hopkins et al. 2001). In 2009 IARC summarized that there were 10–20% reduction in acute coronary events in the first year followed by different kinds of smoking bans in the workplaces. In addition, workplaces with smoking bans tend to show greater reduction in exposure to SHS than workplaces with mere smoking restrictions (Hopkins et al. 2001; Brownson et al. 2002).

According to Hammond (1999), in workplaces with smoking bans nicotine concentrations decreased to less than 1 $\mu g/m^3$. In comparison, in restaurants that allowed smoking the mean concentrations of indoor nicotine ranged from 3 to 8 $\mu g/m^3$.

The additional advantage of smoke-free laws in workplaces is the possible reduction of tobacco consumption among smokers and, moreover, a decrease in morbidity and mortality among

smokers (Eisner et al. 1998). A significant decrease in the number of smoked cigarettes has been detected after the total ban on smoking in workplaces (Fichtenberg and Glantz 2002). In addition, smokers who are employed in workplaces with total smoking bans are likely to smoke fewer cigarettes per day, are more likely to consider quitting and/or to quit compared to smokers in workplaces with no or weaker restrictions (Brownson et al. 2002).

2.4.1. Tobacco legislation globally and in the European Union

A number of countries around the world are trying to reduce the health risks and burden of the population by imposing smoke-free laws, restrictions and campaigns. However, there are still many developing countries that have not adopted anti-smoking policies at any level. In 2010 only 7.4% of the world population lived in jurisdictions where comprehensive smoke-free laws were in effect, and the enforcement of these laws was robust in only a few of the jurisdictions. (WHO 2009)

In Europe all 28 EU Member States have some kind of regulations to limit exposure to SHS. However, these regulations vary widely from country to country. Altogether 15 European countries (Finland, Sweden, Estonia, Latvia, Lithuania, Ireland, Belgium, France, Spain, Italy, Slovenia, Hungary, Bulgaria, Norway and Turkey)) are following the WHO's Framework Convention on Tobacco Control (FCTC) and thus the smoke-free law is strong and strongly enforced in these countries (Smoke free partnership 2014). Currently, more than 200 million European citizens are protected by good national smoke-free legislations.

However, there are many European countries (such as Denmark, Netherlands, Germany, Poland, Hungary, Greece, and Cyprus) that offer only limited protection. This means that many places may be smoke free but still don't provide full protection against SHS. In Greece and Cyprus the law seems to be poorly enforced. In Czech Republic, Austria and Romania there is no protection for workers against SHS; the laws are either weak or unenforced (Smoke free partnership 2014).

Table 3. Smoking restrictions in European Union countries (24), Norway and Turkey. Source: Smoke Free Partnership, 2014 Brussels Belgium.

Country	Bars and restaurants	Work places	Public transport	Date of implementation
Austria	-	-	++	2005
Belgium	++	+	++	2011
Bulgaria	-	-	½	2011
Cyprus	++*	-	++	2010
Czech Rep.	-	-	++	2010
Denmark	½	½	++	2007
Estonia	+	½	½	2007
Finland	+	+	++	2007
France	+	+	++	2008
Germany	½	½	++	2008
Greece	++*	++*	++	2010
Hungary	++	++	++	2012
Ireland	++	++	++	2004
Italy	+	+	++	2005
Latvia	++	½	½	2010
Lithuania	+	½	½	2007
Norway	++	+	++	2004
Poland	½	+*	++	2010
Portugal	½	½	++	2008
Slovakia	½*	½*	½	2009
Slovenia	+	½	++	2007
Spain	++	++*	++	2011
Sweden	+	½	++	2005
The Netherlands	½	½	++	2008
Turkey	++	++	++	2007
United Kingdom	++	++	++	2006-2007

++	Complete ban
+	Complete ban with ventilated rooms permitted under strict criteria
-	Weak, unenforced law or no ban
½	Incomplete ban
*	Problems with enforcement

2.4.2 Legislation concerning restaurants

Finland

Finland was the forerunner of tobacco policies in 1976 when the first act towards reducing tobacco smoking (693/1976) was passed. This tobacco law came into effect in 1977 and the following year advertising cigarettes was banned. Also, smoking in public places was restricted concurrently. According to studies the tobacco law from 1976 decreased smoking among the Finnish population (Helakorpi et al. 2004; Heloma et al. 2004). No essential changes were made to this law before 1994 but many workplaces had still voluntarily forbidden smoking in canteens. In 1994 the law was reformed so that workplaces had to be smoke-free from 1996 onwards. The implementation of the law in workplaces was monitored and the exposure to SHS reduced dramatically in just one year's follow up (Heloma et al. 2000).

However, since restaurants and bars were left outside the new tobacco law, the protection of the restaurant and bar employees remained neglected. In 2000, the first law considering restaurants still allowed smoking in 70% of customer premises, and after a transition period, in 2003, smoke free areas were extended to cover 50% of customer space. These laws didn't involve small restaurants. The Ministry of Social Affairs and Health decided to renew the act in 2005, and in 2006 the Finnish parliament approved the second amendment of the legislation. In 2007 smoking was prohibited in restaurants with a period of transition until 2009, with the exception that a restaurant could build a separate smoking room, where no service was allowed. The present Finnish Tobacco Act aims to eliminate the use of tobacco products by the end of the year 2040 (Ministry of Social Affairs and Health 2014).

From the beginning of 2001, employees exposed to SHS for 40 workdays a year and at least four hours a day had to be reported to a database maintained by the Finnish Institute of Occupational Health (FIOH) on employees exposed to carcinogens at work (Finlex 717/2001; 2§).

Other countries

Some of the data on legislation on restaurant smoking has already been presented earlier (see chapter 2.3). Positive results of legislation that prohibits smoking in workplaces are presented for example in California, where a smoking ban in bars and taverns decreased the prevalence of respiratory and sensory irritation symptoms among bartenders significantly (Eisner et al. 1998). In addition, the employees' pulmonary function improved after the smoke-free law. In

Scotland, there was a strong improvement in the health of bar staff only after three months of smoke-free work shifts (Menzies et al. 2006). In another survey carried out in Scotland (Semple et al. 2007) significant declines in exposure to SHS were also registered. These declines were assessed by measuring the cotinine concentration levels and self-reported exposure in bars before and after the smoke-free legislation.

Several other countries worldwide, such as Canada, Ireland, New Zealand, Norway and USA have also set legislation in order to protect workers against occupational exposure to SHS in restaurants. Their results show a significant and rapid reduction in exposure to SHS due to the total prohibition of smoking in bars and restaurants (Farrelly et al. 2005; Weber et al. 2003; Mulcahy et al. 2005). For instance, the first comprehensive smoke-free act in Ireland led to declines in all venues, including workplaces (62% to 14%), restaurants (85% to 3%), and bars/pubs (98% to 5%) (Fong et al. 2006). In Scotland, the average measured SHS levels in bars were reduced by approximately 90% compared to those before the total ban (Semple et al. 2007).

2.5 Assessing the exposure to tobacco smoke

The effectiveness of workplace smoking policies has been assessed by the differences or changes in perceived air quality in the workplace following a ban or restriction, and by the differences or changes in active measurements of nicotine vapor concentrations, metabolites, or levels of smoke particles.

The concentration of SHS in the air depends on the intensity of smoking, dilution by ventilation, and other smoke-removing processes (USDHHS 2006). Finally, the concentration of SHS in the indoor air can lead to doses that reach and harm target organs and cause harmful health effects. The strength of SHS depends on the number of smokers and the number of cigarettes smoked.

SHS is a fluctuating mixture with thousands of agents in it (USDHHS 2006). Some of these components are specific to SHS, such as nicotine and cotinine, but others may as well spring from additional sources and are therefore not specific to SHS. Therefore it is important to distinguish these confounding agents when assessing exposure specific to SHS.

Some of the most useful components of SHS can be measured in indoor air, like nicotine, for the purpose of research or assessment of public exposure to SHS. Other than those components measured in indoor air, also biomarkers, are valuable when assessing exposure to SHS. Biomarkers provide required index of the internal dose of SHS component or metabolite in exposed people.

2.5.1 Tobacco smoke and nicotine in indoor air

Indoor air nicotine is highly specific and considered a valid marker of SHS (Daisey 1999). In most environments nicotine in the air comes only from tobacco smoke, so there is no background concentration to take into account (USDHHS 2006). Nicotine is not only a highly specific and sensitive but also an inexpensive agent to measure and therefore commonly used for measuring SHS exposure in occupational and non-occupational environments (Leaderer and Hammond 1991; Marbury et al. 1993; Hammond 1999; Jenkins et al. 2000; Navas-Acien et al. 2004; Ott et al. 2006; USDHHS 2006).

There is only a little data available on measurements using other tobacco-specific markers of the indoor air than nicotine to assess the exposure to SHS. However, 3-ethenylpyridine, a pyrolysis product of nicotine degradation, has been suggested to be potentially even a better marker of SHS than nicotine, especially when used for group level monitoring (Jenkins et al. 1996; Rothberg et al. 1998; Scherer et al. 2000; Vainiotalo et al. 2001).

2.5.2 Biological monitoring

Exposure to SHS can also be assessed by measuring different biomarker(s) of tobacco smoke in biological specimens (Samet and Yang, 2001). Since people differ in their awareness of the extent and duration of SHS exposure, biomarkers are useful in verifying self-reports on exposure to SHS (USDHHS 2006).

When a biomarker is used as an indicator for exposure to SHS, it should be ensured that this marker is specific for involuntary smoking and has an appropriate half-life in the body. In addition, it must be measurable with high sensitivity, and it should be measurable in samples collected by noninvasive techniques. It should also be inexpensive to assay and it should either be an agent associated with health effects or strongly associated with such an agent, and be quantitatively related to a prior exposure to SHS (USDHHS 2006). Biomarkers have limitations concerning interindividual and intraindividual variability, analytical restrictions, and limitations on the exposure time frame that can be monitored.

There are multiple compounds that have been used as biomarkers for passive smoking including nicotine and its primary metabolite cotinine, CO in exhaled air, carboxyhemoglobin (the complex form of CO found in the blood), thiocyanate, polycyclic aromatic hydrocarbon (PAH) adducts in leukocyte DNA or plasma albumin, and hemoglobin adducts of tobacco-related aromatic amines such as 3-aminobiphenyl (3AB), 3-ethenylpyridine and 4AB (USDHHS 2006).

Nicotine is a highly tobacco-specific component of cigarette smoke that is present in abundant amounts (approximately 7 to 8 mg per cigarette) (IARC 2004). Nicotine can be readily measured in both active and involuntary smokers in a number of biologic materials including serum, urine, and saliva. Most of the nicotine emitted from a cigarette is found in side stream smoke (NRC 1986), which is the major contributor to SHS. Nonsmokers inhale nicotine, which is present as a gas during involuntary smoking. Some of the absorbed nicotine is excreted in

urine, but on average about 90 percent of the nicotine is further metabolized (Benowitz and Jacob 1994). Of this nicotine, about 70 to 80 percent is metabolized to cotinine (range: 60 to 90 percent). The half-life of nicotine is rather short (one to three hours), which limits the utility as a chronic exposure biomarker (Scherer et al. 1988; Benowitz et al. 1991).

As earlier mentioned, cotinine is a metabolite of nicotine and the most widely used biomarker of nicotine intake (Benowitz et al. 2009). Cotinine can be measured in blood, urine, saliva, hair, or nails with either radioimmunoassay or chromatography (USDHHS 2006). In the body cotinine is metabolized to other chemicals but its half-life is notably longer (16 to 18 hours) than that of nicotine which enables the measurement to be done long after the exposure.

The current optimal plasma cotinine cut-point to distinguish smokers from nonsmokers in the general US population is 3 ng x ml^{-1} (Benowitz et al. 2009). Some foods contain small amounts of nicotine, but for most persons cotinine level offers a highly specific indicator of exposure to SHS (Benowitz 1999).

2.5.3 Self-reported exposure

Indirect measures are generally obtained by survey questionnaires. These include self-reported exposure and descriptions of the source of second-hand tobacco smoke in relevant microenvironments, most often the home and workplace (Samet and Yang 2001). Self-reported exposure to SHS in vast enough quantities seems to be in correlation with the measured exposure to tobacco smoke (Heloma et al. 2000).

2.6 Work related cancer incidence among restaurant workers

Only a small number of studies on cancer in restaurant workers exist. Yet, restaurant workers are known to be at risk of heavy alcohol consumption (Broome and Bennet 2011), tobacco smoking or passive smoking (Kauppinen et al. 2014).

Alcohol (ethanol) is one of the ten most common health hazards among people increasing the risk of oral cavity, pharynx, larynx, oesophagus, liver, breast and colorectal cancer (Baan et al. 2007). Alcohol drinking and tobacco smoking together seem to multiplicatively increase the harmful effects of these two factors. Restaurant workers often work in shifts. Night shift work

is associated with increased cancer incidence and IARC has classified shift-work into class 2A, i.e. probably carcinogenic (Straif et al. 2007; Fritschi 2009).

Nordic Occupational Cancer (NOCCA) project presents important information about cancer incidence among waiters alongside other occupations (Pukkala et al. 2009). According to NOCCA, the highest overall risk of cancer among different occupations were observed among male waiters, beverage manufacture workers, tobacco manufacture workers, seamen, chimney sweeps, cooks and stewards. Male waiters also had the highest risk (SIR 1.49, 95% Cl 1.19-1.84) of unspecified cancer among different professions.

Lung cancer was the most common cancer among male waiters in Norway, and the risk of lung cancer was about 50% higher than among the general population (Andersen et al. 1989). Also the risks of other cancer sites relating to smoking were elevated. Waiters in Finland are known to smoke more frequently and use more alcohol than the general population (FINJEM). The main cause of lung cancer among waiters is tobacco smoking, exposure to SHS and these together.

2.7. Need for the present study

According to the previous literature, there is solid evidence that both smoking and exposure to SHS lead to adverse health effects in humans. In order to protect people against harmful outcomes related to tobacco smoke, strict tobacco legislation has proven effective. Especially involuntary exposure to SHS would most likely diminish under strict smoking regulation in locations where smoking is allowed, such as restaurants. Both Heloma et al. (2001) and Helakorpi et al. (2008) have shown that a strict smoke free legislation concerning Finnish workplaces reduces exposure to SHS at work. However, previous Finnish reports did not focus on the impact of tobacco legislation concerning restaurants. Moreover, to our knowledge, besides a relatively small study in Spain (Fernández et al. 2009), no reports exist where effects of partial restriction and total prohibition of smoking have been compared to each other.

In Finland, smoking has been prohibited in public places since 1978. After 1995, the spread of tobacco smoke has been prohibited totally inside the premises of workplaces as well. Only in 2000 were the client areas of restaurants included in Finnish tobacco legislation, after which also restaurant workers and clients have been under the cover of Tobacco Act. Due to the fact

that the Finnish Tobacco Act concerning restaurants was implemented only gradually, we were able to launch a nationwide survey to evaluate the impact of measures, which have been taken after 1999. Thus, at the Finnish Institute of Occupational Health a pre- and post-evaluation survey was planned and begun in restaurants and among restaurant workers in 1999, one year before the first step of Tobacco Act concerning restaurants. Since then, both questionnaire surveys and measurements of indoor air nicotine have been carried out annually until 2010 when the follow-up was finished. The present study describes the findings of the follow-up study and also evaluates the risk of restaurant workers to develop cancer compared to that of the general population.

3 AIMS OF THE STUDY

Tobacco Act concerning client areas in restaurants was launched in Finland in March 2000. According to the Act, the restrictions of smoking in restaurants were implemented gradually. The overall objective of the present study was to assess the impact of tobacco legislation on the occupational exposure to tobacco smoke in Finnish restaurants between 1999-2010, at the time when the restaurants were included in the Tobacco Act. In this study, we focused on the effects of the partial restriction and total prohibition of smoking on reducing the exposure to SHS. As occupational exposure to SHS has been common among restaurant workers, we also evaluated their risk to develop cancer compared to that of the general population.

The specific objectives of the present thesis were to

1. Assess the occupational exposure to SHS among restaurant workers before and after the Tobacco Act reform in 2000. (Study I)
2. Evaluate the effects of total prohibition of smoking in 2007 on the SHS exposure and work-related symptoms among restaurant workers. (Study II)
3. Compare the impact of partial and total prohibition of smoking in restaurants by using two methods (questionnaire surveys and monitoring of indoor air nicotine) in assessing restaurant workers' occupational exposure to SHS. (Study III)
4. Assess the risk of male and female waiters to develop cancer compared to that of the general population. (Study IV)

4 MATERIAL AND METHODS

4.1. Materials and procedures (I-IV)

Studies I, II and III are based on national questionnaire surveys that were conducted in 1999, 2001, 2003, 2007, 2009 and 2010 among Finnish restaurant workers in the whole of Finland. Detailed description of the surveys can be found in original articles I-III. Briefly, each year the surveys were sent to 3,000 randomly chosen restaurant workers that belonged to the national Service Union United (PAM). The total workforce in the hospitality industry in Finland in 2007 was on average 75,000 persons. Out of them approximately 55,000 belonged to the national labor union PAM. Out of the list of all members of the PAM only workers who participated in restaurant work daily were included in the present study. The study did not include members who were retired, unemployed or currently worked in a position other than restaurant-related. After this selection in the above target group, 30,000 members of the union were reached, of which every tenth were included in the present study ending up in 3,000 restaurant workers. Between 1999 and 2010 the response rate varied from 25 to 56% and the number of respondents was n=741-1,690. In 2001 and 2003, the questionnaires were re-sent to those who had not replied to them.

Study I assessed the data collected by using the first four questionnaires (1999-2007). The questionnaires were fielded before the smoke free legislation concerning restaurants was enacted. In study II, the main focus was in the survey data acquired before and after the launch of the smoke free tobacco legislation, namely in 2007 and 2009. Study III included survey data from 2003, 2007, 2009 and 2010. Measurements on indoor nicotine concentrations were made in the same years (see below).

The measurements of nicotine concentration in indoor air in restaurants were carried out in three cities in Finland (Helsinki, Jyväskylä and Lappeenranta) selecting three different types of restaurants in each city. The numbers and types of the restaurants are shown in Table 4. Category “pub” includes restaurants such as pubs, taverns and bars. Category “nightclubs” also includes night restaurants, such as discos. The third group is “dining restaurant”, in which food and eating are considered as the main purpose of visit. The measurements were conducted during 1999-2010. Of those, the ones conducted in the years 2004, 2006, 2008 and 2010, respectively, were included in Study III (dining restaurants 2004, 2006). The questionnaires used in the same study were conducted between 2003 and 2010.

The measurements were carried out through fall and winter seasons. During these seasons indoor air ventilation was solely based on mechanical ventilation and the heating was on, offering a possibility of an accurate comparison between the restaurants. In the results, waiters, who were working mainly in bar counter service were categorized as a different group than the rest of the waiters who did not work mainly in bar counter service.

Table 4 Number of measurements (n) in each type of restaurants

Year	Dining restaurant	Pubs	Nightclubs	Bar desks	All
2004	20	78	61	64	**223**
2006	24	71	64	67	**226**
2008	0	62	43	60	**165**
2010	0	53	30	33	**116**
All	**44**	**264**	**198**	**224**	**730**

Study IV assessed the risk of cancer among restaurant workers. The data was collected from the NOCCA registry. The registry comprises 14.9 million persons aged 30-64 who participated in any computerized census in 1990 or earlier, in five Nordic countries: Denmark, Finland, Iceland, Norway and Sweden. The follow up was made during the years 1961 to 2005. The study population consists of 2.0 million persons from Denmark, 3.4 million from Finland, 0.1 million from Iceland, 2.6 million from Norway and 6.8 million from Sweden.

The cancer incident cases were categorized by the study subjects' sex, age and occupation. Among this study population, a group of waiters was collected; 16,134 male and 81,838 female waiters. Altogether, there were 7,794 waiters from Denmark, 29,740 from Finland, 357 from Iceland, 22,293 from Norway and 37,788 from Sweden.

The participants entered the cohort if they were 30-64 years old on January 1st of the year after the first available census which they participated. Person years were counted until the date of emigration, death or to December 31st of the following years: in Denmark and Norway 2003, in Iceland 2004, in Finland and Sweden 2005.

Results are presented for 35 most common cancer sites. Altogether 3,100 cancer cases among male waiters and 16,288 among female waiters were included in study IV.

4.2 Measures (I-III)

The questionnaires, used in studies I, II and III, aimed to clarify the respondents' background information, occupational exposure to tobacco smoke, personal smoking habits and restrictions on smoking at workplace. Questions on symptoms and perceived symptoms related to exposure to SHS and were included in the last three questionnaires (2007-2010).

The questionnaires included questions such as "How many hours per day are you exposed to tobacco smoke at work?", "In what areas is smoking allowed in your workplace?", "Are there designated areas or tobacco rooms for smoking?", "If yes, does the smoke spread elsewhere?", "Is smoking allowed in break rooms?", "Has tobacco smoke in your workplace caused you respiratory or eye symptoms?". Further details of the questionnaire can be found in Appendix.

In study III, measurements of ventilation were made before each monitoring phase. The amount of air exiting and/or entering the premises and the volume and the area of the premises were measured. After this, in each restaurant, a monitoring (or sampling) device was placed in fixed positions in restaurants at three to five locations per establishment. These sampling devices were placed approximately at the height of the breathing zone of the waiter or a customer, i.e. between 1.4 and 1.7 meters from the ground. Monitoring devices were also placed on the waiters' work clothes in order to evaluate a single employee's rate of exposure to SHS. One of the devices was placed at the bar counter(s), one in a smoking section (not applicable after 2007) and one in the non-smoking area.

Each monitoring lasted for four hours and was carried out during peak hours, twice during the week and once during the weekend. The sampling device consisted of a sampling pump SKC Model 222 (SKC Inc, Eighty Four, PA, USA) collecting air at 100 $cm^3 x\ min^{-1}$ through a stainless steel tube (Part no. L4270123, Perkin Elmer, Norwalk, CT, USA) packed with 150 mg Tenax TA 35/60 mesh (Art 706216, Macherey-Nagel GmbH & Co. KG, Düeren, Germany). Further details of the sampling device and of the analysis have been described earlier (Rothberg et al. 1998, Johnsson et al. 2006).

To assess the cancer risk among waiters a standardized incidence ratio (SIR) was calculated in study IV The observed number of cancer cases and person years were stratified into eight 5-year attained age categories for each country and gender; 30-34, 35-39;…, 85+ years. The SIR was then calculated as ratio of the observed number and expected number of cancer cases. The

expected number was based on the number of person-years among waiters and respective cancer incidence rate in the national population of the same gender, age and period of observation. Further details of the SIR have been described earlier (Pukkala et al. 2009).

4.3 Statistical analyses

4.3.1 Questionnaire data (I-III)

In each questionnaire survey, the individual nominal scale answers of the data were examined through percentages, and cross- tabulating them according to, for example, sex, profession, age and possible position as a superior. Medians were calculated for variables that received a numeric value, and they were compared in different groups. In comparing the differences in the answers of the surveys, mainly binominal tests and x^2 -tests were used. The tests were analyzed using SAS Statistical software, version 9.1 (SAS Institute Inc, Cary, North Carolina, USA).

4.3.2 Measurement of nicotine in indoor air (III)

The air monitor consisted of a sampling pump collecting 100cm^3 x min^{-1} through a stainless steel tube packed with Tenax adsorbent. The samples were then desorbed at 300°C and analyzed for nicotine thermodesorption-gas-chromatography-mass spectrometry. The measured nicotine concentration represents the average concentration of the four-hour period. For calculations, 0.025 µg/m³ was used for samples below the limit of quantitation (0.05 µg/m³).

4.3.3 The Nordic Cancer Registry (NOCCA-data, IV)

The 95% confidence interval (CI) was defined for each SIR by assuming a Poisson distribution of the number of cases. The numbers of excess cancer cases for each cancer site were calculated by subtracting the expected numbers of cancer cases from the observed ones.

5 RESULTS

The present data collected by using nationwide questionnaire surveys and assessment of nicotine concentration in indoor air in restaurants show that from 1999 to 2006, before the smoke free tobacco act in 2004, exposure to SHS decreased among restaurant workers (Study I-III). However, still a significant number of restaurant workers were exposed to tobacco smoke in 2006. Only after the total prohibition of smoking in restaurants in 2007 did exposure to tobacco smoke decrease rapidly (Study II-III). According to the follow-up study, the positive impact of the total ban had remained in 2010 (Study III).

According to the data collected from the NOCCA-data (Study IV), restaurant workers have a significantly higher risk of getting cancer than the general population. Especially cancer sites related to alcohol and smoking are over represented among restaurant workers. Only two cancer sites, (cancer of the uterus and melanoma), seem to have lower SIR than the rest of the population.

5.1. Exposure to SHS before and after the launch of Tobacco Act in 2000 (Study I)

A Tobacco legislation concerning Finnish restaurants was launched in 2000. In 2000, smoking was only partially prohibited in restaurants. According to the present national questionnaire survey, the prevalence of restaurant workers who were not exposed to SHS increased from 34% to 54% during the study period in 1999-2007. On the other hand, during the same time the prevalence of those who reported more than four hours of exposure to tobacco smoke during their work shift decreased from 46% to 24%.

The most significant decrease in the reported exposure to SHS at work was found among waiters in dining restaurants of whom 15% reported no exposure in 1999 and 39% in 2007. At the same time the prevalence of waiters in dining restaurants who reported over four hours of exposure during their work day decreased from 73% to 43%.

The prevalence of daily smokers and the number of smoked cigarettes among restaurant workers remained unchanged; among all participants in the questionnaire survey 34% reported to be daily smokers in 1999 and 33% in 2007. The proportion of restrictions concerning

recreational facilities in restaurants, pubs and nightclubs increased in the study period. Smoking was not allowed in any social or break facilities in 40% of restaurants in 1999 and in 66% in 2007. In pubs and nightclubs, respective percentages were 12% in 1999 and 26% in 2007. The prevalence of restaurants which generally allowed smoking in their recreational facilities decreased from 12% to 5% during 1999-2007. In pubs and nightclubs, the respective percentages were 33% and 29%.

5.2. Exposure to SHS and work-related symptoms before and after the total prohibition of smoking (Study II)

A total prohibition of smoking in restaurants was launched in 2007. During the study period, between 2007 and 2009, the prevalence of restaurant workers who were not exposed to SHS at work increased from 54% to 82%. The highest increase was among workers in pubs and nightclubs of whom 7% were not exposed to SHS at work in 2007, and 69% in 2009. The prevalence of restaurant workers who were exposed to SHS more than four hours a day at work decreased from 24% to 4%. The highest decrease was also found among pub and nightclub workers, of whom the numbers were 72% in 2007 and 9% in 2009, respectively.

In 2007, overall 18% of restaurant workers reported work-related respiratory symptoms and 23% eye symptoms. In 2009, the prevalence of symptoms had decreased while 4% reported work-related respiratory symptoms and 6% eye symptoms. The most significant decrease in reported respiratory symptoms was detected among bartenders of whom 32% reported symptoms in 2007 and 6% in 2009. The highest decrease in reported eye symptoms was found among pub and nightclub workers of whom 41% reported symptoms in 2007 and 13% in 2009.

5.3. Assessing exposure to SHS by questionnaire surveys and measuring nicotine concentration in indoor air (Study III)

Exposure to SHS was assessed by measuring nicotine concentration in the indoor air in restaurants. A significant decrease in nicotine concentration was detected through the study period between 2004 and 2010. The median measured nicotine concentration was 11.7 μg/m³ in 2004, 5.0 μg/m³ in 2006, 0.2 μg/m³ in 2008, and 0.1 μg/m³ in 2010. The highest decrease in

median measured nicotine concentration was in pubs, where the median nicotine concentration was 16.1 µg/m³ in 2004 and 0.1 µg/m³ in 2010.

The reported exposure to tobacco smoke (at least 1 hour per work shift) decreased from 59% in 2004 to 11% in 2010. Among restaurant workers working in pubs in 2004, 71% reported more than 1 hour of exposure to SHS during a work shift, while in 2010 the respective figure was 18%.

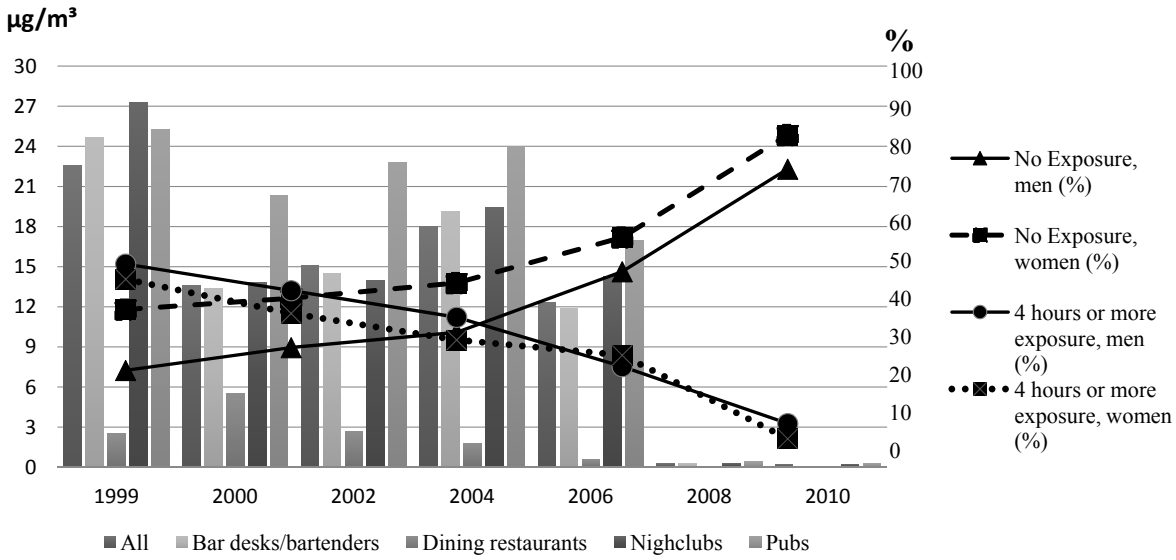

Figure 4. Nicotine concentrations measured from non-smoking restaurant workers' breathing zone during shift and reported exposure to tobacco smoke.

5.4. Cancer risk among waiters in the Nordic countries (Study IV)

According to the data collected from the NOCCA registry, the cancer incidence among waiters was higher than among the general population in the Nordic countries. There were altogether 19,388 cancer cases in the Nordic countries' waiters (n=97,972) during the study period (1961-2005). The overall risk of cancer among male waiters (16,134) was 1.46 (95% CI 1.41-1.51) and among female waiters (n=81,838) 1.09 (95% CI 1.07-1.11).

Compared to the general population, the highest risk of cancer among male waiters was in Denmark (SIR 1.73; 95% CI 1.62-1.84) and the lowest in Iceland (SIR 1.05; 95% CI 0.45-

2.07). The highest risk of cancer among female waiters was in Denmark (SIR 1.32; 95% CI 1.25-1.39) and the lowest in Finland (SIR 1.06; 95% CI 1.02-1.09).

The highest SIRs for male waiters were for cancers in the pharynx (6.11; 95% CI 5.02-7.37), oral cavity (4.91; 95% CI 3.81-6.24) and tongue (4.36; 95% CI 3.13-5.92), and for female waiters in larynx (2.17; 95% CI 1.63-2.82), oral cavity (1.96; 95% CI 1.60-2.34) and lung (1.89; 95% CI 1.80-1.99).

During 1961-2005, among all waiters, altogether 2,323 excess cancer cases (observed n minus expected n) were calculated (n_{male}=983, n_{female}=1,341). The highest number of excess cases among male waiters was in lung cancer (n=282) and cancer of the pharynx (n=92). Among female waiters the number of excess cancers were n=718 for lung cancer and n=314 for cancer of the cervical uterus.

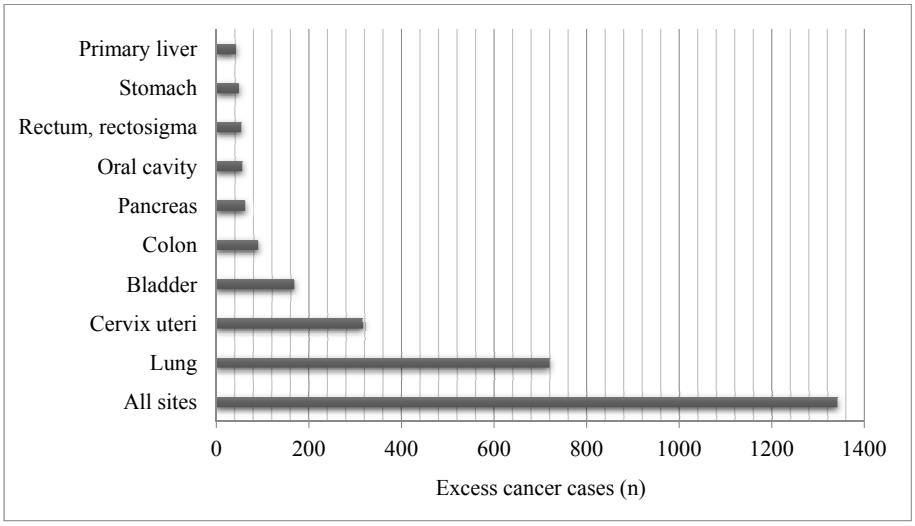

Figure 5. Female waiters - top excess cancer sites, all Nordic countries, 1961-2005

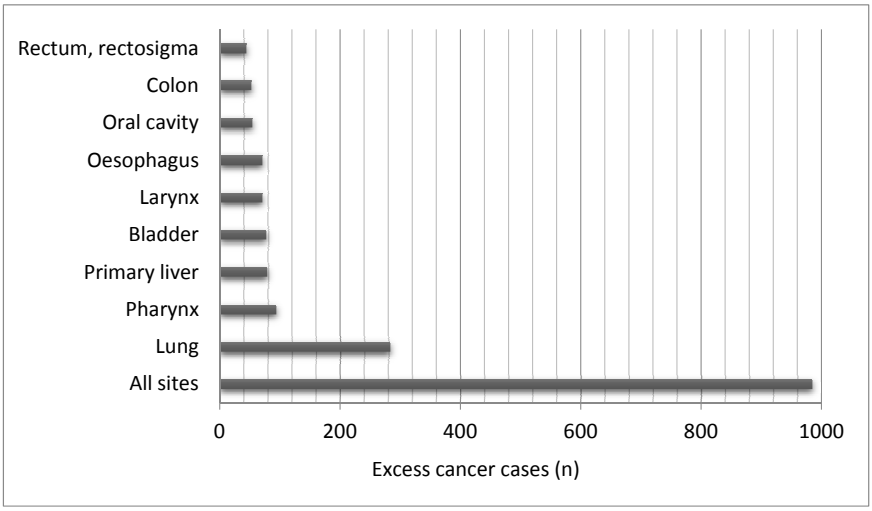

Figure 6. Male waiters - top excess cancer sites, all Nordic countries, 1961-2005

6 DISCUSSION

Before the reform of the Finnish tobacco legislation in 2000, restaurant workers were practically the only group of employees in Finland that was not protected by the smoke-free legislation launched in 1995. In 2000, restaurants were included in the tobacco act, but the implementation proceeded only gradually. Firstly, in 2000 at least 30% of the premises reserved for restaurant customers had to be smoke-free. Secondly, in 2001 at least 50% of the customer areas had to be smoke-free. Thirdly, in 2004 the Ministry of Social Affairs and Health decided to renew the tobacco act due to which the total prohibition of smoking in restaurants was launched in 2007. Even then, some of the restaurants still gained permission to continue with the previous legislation until 2009. After this, smoking has been prohibited in all restaurants in customer premises although separate smoking rooms with strict regulations are still allowed.

6.1. Exposure to SHS before and after the launch of Tobacco Act in 2000

Between 1999 and 2007, the prevalence of restaurant workers who reported no exposure to SHS increased from 34% to 54% while the prevalence of those who reported more than four hours of exposure to tobacco smoke during their work shift decreased from 46% to 24%. Thus, partial restriction of smoking decreased the exposure to SHS but was not effective enough to totally prohibit the exposure. This could also be found in measuring nicotine in indoor air in restaurants: the median nicotine concentration in present restaurants was 11.7 μg/m³ in 2004 and 5.0 μg/m³ in 2006. For comparison, the odor threshold for tobacco smoke in man varies between individuals but is on average at the level of 0,2-0,5 μg/m³ of nicotine in indoor air. This means that over four years after the launch of Tobacco Act, significant concentration of tobacco smoke could still be detected in the indoor air in restaurants.

Previous studies from other countries have clearly shown that the implementation of a smoke-free law can be an effective action to decrease work-related exposure to SHS (Farrelly et al. 2005, Weber et al. 2003, Mulcahy et al. 2005, Semple et al. 2007, Fong et al. 2006, Jensen et al. 2010, Pearson et al. 2009, Schoj et al. 2010, Bondy et al. 2009, Bannon et al. 2009, Ayres et al. 2009, Edwards et al. 2008). In accordance with them, the present study from Finnish experience also showed that once tobacco legislation is launched, exposure to work-related

SHS and the indoor nicotine concentration decreases. However, partial restriction was not effective enough in protecting exposure in restaurants. Thus, significant proportion of workers continued to inhale tobacco smoke during their work shifts until 2007 when total prohibition of smoking in restaurants was launched. The present results also suggest that the positive impact of total prohibition has remained in follow-up surveys.

6.2. Exposure to SHS and work-related symptoms before and after the total prohibition of smoking

Between 2007 and 2009, related to the total prohibition of smoking in restaurants, the prevalence of restaurant workers with no exposure to SHS at work increased from 54% to 82%. The increase was highest in pubs and nightclubs (from 7% to 69%). The prevalence of restaurant workers who were exposed to SHS more than four hours per work shift decreased from 24% to 4%. The highest decrease was found also among pub and nightclub workers (from 72% to 9%). Thus, total prohibition reduced the exposure to SHS in restaurants more effectively.

Exposure to SHS at work not only increases the risk to develop serious illnesses such as lung cancer and cardiovascular diseases but it also increases the prevalence of work-related symptoms among exposed workers. In the present study, between 2007 and 2009 the prevalence of work-related respiratory symptoms decreased from 18% to 4% and in eye symptoms from 23% to 6%. The most significant decrease in respiratory symptoms was detected among bartenders (from 32% to 6%) and in eye symptoms among pub and nightclub workers (from 41% to 13%).

In addition to over 50 carcinogens, tobacco smoke contains a complex mixture of chemicals including known irritants such as ammonia, formaldehyde, and sulfur dioxide, which have adverse health effects both in eyes and respiratory tract. Previous literature has mainly focused on SHS exposure and symptoms among children and patients with asthma (USDHHS 2014). According to controlled exposure experiments, acute SHS exposure affects lung function in adult asthmatics adversely (Eisner et al. 1998).

In recent literature, there are reports concerning the impact of tobacco legislation (Fichtenberg and Glantz 2002, Glantz 2008, Callinan et al. 2010, Jensen et al. 2010). However, only a few of them focus on work-related symptoms and especially immediate responses related to SHS

exposure on workers' health (e.g. Hahn et al. 2006, Ayres et al. 2009). In accordance with our studies, hospitality workers in Kentucky, USA, demonstrated significant declines both in the nicotine concentration in hair and respiratory symptoms after the strict smoking restriction in restaurants (Hahn et al. 2006). Also in Scotland, bar workers reported significantly fewer respiratory and sensory symptoms one year after their working environment became smoke-free (Ayers et al. 2009). An abundance of previous studies suggests that a launch of a smoke-free law decreases the number of sick leaves and the prevalence of respiratory diseases, and increases health in general (Larsson et al. 2008, Menzies et al. 2006, Cox et al. 2014).

6.3. Assessing exposure to SHS by questionnaire surveys and measuring nicotine concentration in indoor air

The present nationwide follow-up study assessed the impact of tobacco legislation consisting both partial and total prohibition of smoking in restaurants. The evaluation was carried out by using questionnaire surveys accompanied by measurements of indoor air nicotine concentrations in restaurants in three municipalities from different parts of the country. This gives a reliable estimation of the current situation in restaurant workers' exposure to SHS at work. It also evaluates the sustainability of the amended tobacco legislation.

By integrating the results of questionnaire surveys with the results of measured air samples it was possible to assess the exposure to tobacco smoke from two directions. By this setting we were able to get data not only from the duration of exposure and the number of workers affected by it but also an estimation of the inhaled concentration of tobacco smoke. This can help us to assess the severity of the exposure to SHS by comparing the reported time of the total exposure with the indoor air nicotine concentration collected from various types of restaurants (e.g. dining restaurants, pubs and nightclubs).

Previous studies have assessed the exposure to SHS at work by questionnaire surveys and measuring nicotine concentration in indoor air (Heloma et al. 2000). In accordance with our findings, they found a positive correlation between measured indoor nicotine concentration and self-reported exposure to tobacco smoke. In another study, self-reported exposure to SHS was found to be a valid and countable method for evaluating workers' exposure to tobacco smoke (Willemsen et al. 1997). Interestingly, the present study shows that nicotine concentrations

were the highest in restaurants where the highest prevalence of workers also reported the most exposure (over 4h work shift) to SHS.

6.4. Cancer risk among waiters in the Nordic countries

The statistics in Finland show that restaurant workers are more often regular smokers and tend to use more alcohol than the general population (Berg et al. 1992). In addition, the present study clearly showed that before strict tobacco legislation the waiters had also been heavily exposed to tobacco smoke at work. In correlation with these statistics, the present study found that waiters in Finland have an increased risk of cancer compared to the general population. Especially cancers related to smoking, exposure to SHS and alcohol consumption were significantly increased. Moreover, a large number of excess cancer cases (i.e. the number of cancer cases among waiters exceeding the expected number of cancer cases) were calculated. This suggests an etiology of environmental factors that could possibly be avoidable. The present study also works as a basis for future studies and emphasizes not only the role of occupational health but also preventive measures in general health care.

The present study found that the amendment of partial restrictions of smoking in restaurants in association with the improving of ventilation slightly decreased the restaurant workers' exposure to tobacco smoke. However, partial restrictions were insufficient in protecting restaurant workers from work-related SHS effectively. Thus, the present experience from Finnish restaurants strongly suggests not to aim for partial restrictions of smoking but to rather directly totally prohibit smoking in order to secure the health of restaurant workers and clients.

6.5. Methodological considerations

To my knowledge this is the first nationwide survey to assess the restaurant workers' occupational exposure to tobacco smoke in Finland. Moreover, the study provides an evaluation of the impact of the Finnish tobacco legislation concerning restaurants and the restaurant workers' risk of cancer. To achieve this, three main methods were used: national questionnaire follow-up surveys, monitoring indoor air nicotine concentration and analysing the NOCCA data consisting of information on restaurant workers´ cancer incidence. All this builds up a vast population allowing one accurately evaluate the progression of work-related

exposure to occupational SHS, the impact of tobacco legislation related to Finnish restaurants and waiters' risk of cancer.

The nationwide questionnaire surveys (n=3,000 each year) provide a comprehensive review of the current situation on restaurant workers' exposure to SHS at work. In addition, the self reported symptoms offer a personal view on the impact of a smoke free law on perceived symptoms. The six surveys conducted between 1999 and 2010 allowed us to assess the evolution of the impact of the Finnish tobacco legislation, which started as partial restrictions and resulted in making restaurants smoke free.

While the questionnaire surveys largely bring out a subjective estimation of exposure to SHS, the measurements on indoor air nicotine concentrations calculate the exact numbers of the indoor air of the restaurant workers' breathing zone, and thus provide more objective data on the same matter. These two methods of assessing exposure to SHS complement each other, as it was possible not only to get data on the duration of the exposure and the number of affected workers, but also obtain an estimation of the concentration of inhaled substance. In other words, the results in the questionnaire showed how many hours restaurant workers were exposed to SHS daily, while the measurements on the indoor air nicotine concentration showed the amount of indoor air impurity in various types of restaurants (e.g. restaurants, pubs and nightclubs). This helped in assessing not only the quantity of exposure (i.e. how many persons exposed) but also the severity of it.

The NOCCA registry is a unique and vast material of cancer cases that covers up to 45 years of cancer incidence in the population of the five Nordic countries. With almost 100,000 waiters included and about 20,000 cancer cases occurring through the study period, it is the largest study ever reported on occupational cancer incidence among restaurant workers. The size of the population is big enough and the number of cancer cases high enough to detect excess in the risk of cancer. Also the use of cancer incidence data instead of mortality data cuts out bias caused by occupational variation in cancer survival and in mortality from competing causes of death. This type of data is extremely difficult to obtain.

The response rate of the questionnaire surveys remained low in all stages of the study (25-56%) although a covering letter signed by the trade union officers was included in the inquiry, and

reminding letters were sent to the restaurant workers. The low response rate may partially be understood by the fact that the turnover rate among restaurant workers is relatively high, which may make it harder to reach them via mail. However, the background of the participants well represents the general population of the restaurant workers. In addition, the sample size is sufficient.

It may be suggested that some of the results can be explained by the decrease of smoking prevalence among the respondents (34% daily smokers in 1999, 26% in 2010). However, the decrease of work related exposure to SHS is far too great (over one hour's exposure in 1999 declined from 66% to 11% in 2010) for this to be considered a serious argument against the results. In addition, the indoor air monitoring results strongly support the results found in the questionnaires.

In the present study, the incidence of cancer offers an overall estimation of the risk of cancer among male and female waiters. Although statistics on restaurant workers' behavior on smoking and alcohol consumption are available, no data on the amount of waiters' exposure to SHS at work exist for the study period (1961-2005). Thus, it is premature to try to draw conclusions on increased cancer risk and the impact of work related exposure to SHS among waiters. Cancers that are related to tobacco smoke in general and alcohol consumption, however, definitely are overrepresented in the results.

6.6. Towards better health among restaurant workers

Tobacco legislation concerning restaurants in Finland has been an exceptional instrument that has given an opportunity for researchers to assess the impact of tobacco restrictions in the field of the industry. Furthermore, the progression of the Finnish tobacco legislation has now been investigated so that the effectiveness of both partial restriction and the total ban on smoking can be evaluated. To the present knowledge, neither this type of partial smoking prohibition nor research focusing on comparing a partial and total smoking prohibition has been launched in any other country.

The present study provides further evidence on the fact that only a strict tobacco legislation that totally prohibits smoking in restaurants is effective enough in protecting restaurant workers

from work- related exposure to SHS. On the other hand, as far as occupational health and safety are concerned, restaurants that allow smoking seem to be hazardous occupational environments. This emphasizes the importance of occupational health and safety, which have a central role in the prevention of SHS exposure in restaurants as workplaces.

In the present 10-year follow-up, restaurant workers' exposure to SHS has decreased from a heavy exposure to practically no exposure at work. This may be considered as a significant improvement in the prevention of occupational health risks in this field of industry. However, although a total ban on smoking now exists in Finnish restaurants, a limited number of designated smoking rooms – without service - can still be found in them. To fully protect all workers in restaurants including housekeeping and cleaning personnel, these smoking rooms should also be totally banned as well.

An increased cancer risk was detected in waiters in the present study. Especially the types of cancer that were related to alcohol consumption and smoking were significantly more common in restaurant workers than in the general population. Clearly diminished exposure to SHS is likely to partially protect waiters against cancer. The elevated levels of smoking and alcohol use, though, suggest that there is an imminent need to develop and launch active programs aimed to change the lifestyle, especially smoking and other use of tobacco products, and alcohol consumption among the waiters.

7 CONCLUSIONS

Based on the findings in the present study I conclude that:

1. The reform of the Finnish tobacco legislation in 2000 partially prohibited customers' smoking in restaurants until 2007 and therefore decreased restaurant workers' occupational exposure to SHS. The total prohibition of smoking in restaurants' service areas in 2007 further significantly decreased restaurant workers' exposure to SHS. A total ban on smoking in restaurants has also decreased the prevalence of work-related respiratory and eye symptoms among restaurant workers, which most likely was associated with the decrease of exposure to SHS at work.

2. The results suggest that only an enactment of strict tobacco legislation that totally prohibits smoking in restaurants immediately decreases the occupational exposure to SHS among restaurant workers, and seems to maintain that low level. A strict general tobacco legislation may partly be associated with the decrease in daily smoking among restaurant workers.

3. The risk of cancer among waiters is higher than in the general population. This may be related to the high prevalence of smoking, heavy occupational exposure to tobacco smoke in history, and high alcohol consumption among waiters.

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ORIGINAL PUBLICATIONS

Study I

Study II

Study III

Study IV

APPENDIX
Questionnaire

Note: The following questionnaire was conducted in Finnish; as some words do not have an exact translation, some are left in Finnish for clarification.

Työterveyslaitos

Questionnaire to restaurant workers

Please answer the questions by filling in empty spaces and by drawing a circle around the number of the correct option. Please choose only one option.

BACKGROUND INFORMATION

1. Gender

1. Female
2. Male

2. Age _____ years

3. Education

1. No education
2. Elementary school (former school system; ”kansakoulu”)
3. Comprehensive school/lower secondary school
4. High school/Upper secondary school
5. Vocational school
6. Lowest tertiary level education
7. College
8. University

4. Main position as a restaurant worker

1. Waiter
2. Bar keeper
3. Main hostess/ restaurant manager
4. Butler
5. Cook/chef (kitchen work)
6. Doorman
7. Some other, what?

_____

5. In the restaurant, do you work as a manager/superior?

1. Yes
2. No

6. I have worked in the restaurant business for _____ years

7. Workplace, where you mainly work

1. Dining restaurant
2. Pub
3. Nightclub or discotheque
4. Cafeteria
5. Staff restaurant

8. Size of the restaurant

1. Under 50 m^2
2. 50 - 100 m^2
3. Over 100 m^2
4. I don’t know

PERSONAL CIGARETTE HABITS

9. Do you smoke daily?

1. Yes
2. No (please move to question 12)

10. Do you mainly smoke?

1. Light cigarettes
2. Regular (high tar) cigarettes
3. Self-rolled cigarettes
4. Pipe
5. Cigars

11. How many cigarettes a day do you smoke on average?

_____ cigarettes (cigars, pipefuls)
(if you are a daily smoker, please move to question 14)

12. Smoking

1. I have quit smoking
2. I have never smoked regularly (please move to question 18)
3. I only smoke every now and then (please move to question 14)

13. When did you quit smoking?

1. Less than 1 month ago
2. 1 – 6 months ago
3. Over 6 months ago

(If you have quit smoking, please move to question 18)

14. At the moment, would you like to quit smoking, smoke less or continue without changes concerning smoking habits?

1. I would like to quit smoking
2. I would like to smoke less

3. I don't want to change my smoking habits
4. I can't say / I don't know

15. During the previous year, have you made a serious attempt to quit smoking (i.e. tried smoking cessation)?

1. Yes
2. No

16. Has your occupational health physician or nurse recommended nicotine patches, nicotine gum or other nicotine products to you during the past year?

1. Yes
2. No

17. During the past year, have there been any courses or any other actions on helping employees to quit smoking at your workplace?

1. Yes
2. No, there haven't
3. I don't know

SMOKING AT WORK

18. Concerning employees' break- and social facilities at my workplace, there are following rules/restrictions on smoking in indoor premises:

1. Smoking is not allowed in any of the previously mentioned work premises
2. Smoking is allowed only in separate smoking facilities indoors
3. Smoking is allowed also in break facilities
4. Smoking is generally allowed excluding some rare facilities
5. Smoking is allowed only outdoors

19. Are these rules/restrictions being obeyed?

1. Yes
2. No
3. I don't know

20. Are the smoke free premises (kitchen/break facilities) at your workplace practically smoke free or does the smoke spread to other premises from customer and smoking premises?

1. They are practically smoke free
2. Smoke spreads from separate smoking facilities to other premises.
3. Smoke spreads from customer premises to the employees' recreational premises.
4. Smoke spreads from somewhere else (i.e. from outside)
5. I don't know

21. How much of the restaurant premises is smoke free?

1. _____%
2. The restaurant I am working at is completely smoke free (In this case, please move to question 24)

22. At your restaurant's bar desk, is smoking

1. Prohibited
2. Allowed, no other arrangements
3. Allowed, but a specified air ventilation or other mechanism (what?_____) is arranged in order to block the smoke from spreading
4. There is no bar desk at the restaurant

23. On the restaurant's customer's premises, is smoking allowed on the game premises (i.e. an area with game tables provided by Finland's Slot Machine Association (RAY),), working area for the staff)

1. No, it is not allowed
2. Yes, it is allowed
3. There are no game premises in the restaurant

24. Is there a separate smoking room (smoking booth) in your restaurant?

1. Yes
2. No (please move to question 26)

25. If a separate smoking room (smoking booth) has been built, what of the following has occurred afterwards? (You may select more than one option)

1. General disturbance
2. Customers take drinks into the smoking rooms
3. Smoke spreads to other premises from the smoking room
4. No trouble whatsoever
5. I don't know

26. What of the following has occurred because of the customers smoking outside?

1. It has increased general disturbance
2. It has made your job more difficult
3. It has caused more stress and/or tiredness
4. It has caused no trouble
5. Smoking outside is not allowed in our restaurant
6. I don't know

27. Do you feel that the new tobacco legislation (launched on 1.6.2007) has generally (You may select more than one option)

1. increased violence/threats/disturbance on you
2. decreased violence/threats/disturbance on you

3. increased a feel of insecurity
4. decreased a feel of insecurity
5. I don't think that the legislation has changed the working atmosphere
6. I don't know

28. How well do the customers obey the tobacco restrictions on the restaurant's indoor premises?

1. Very well
2. Well
3. Moderately
4. Badly
5. Not at all
6. I don't know

29. Does tobacco smoke spread on the <u>customer's premises</u>?

1. Tobacco smoke spreads and can be sensed on the non-smoking premises
2. Tobacco smoke does not spread to the non-smoking premises
3. Tobacco smoke spreads to customer's premises from elsewhere (i.e. from outside)
4. The restaurant is completely smoke free

30. At your workplace, how many hours a day do you spend at premises where tobacco smoke is present?

1. Not at all
2. Less than 1 hour
3. 1 - 4 hours
4. More than 4 hours

31. Do you personally smoke <u>indoors</u> at your workplace?

1. Yes
2. I am a smoker but I don't smoke at the indoor premises of the workplace (please move to question 33)
3. I don't smoke (please move to question 34)

32. Do you usually/mainly smoke?

1. At common facilities of the workplace
2. In my own workspace or office
3. In a separate smoking room

(If you smoke at workplace, please move to question 34)

33. Does one of the following have an effect on your decision of not smoking at your workplace?

1. Smoking is totally prohibited on the indoor premises of the workplace
2. Smoking has not been totally prohibited, but it has been restricted
3. My workmates and/or my superior asked me not to smoke
4. It was completely my own decision
5. Some other reason, what?

_____

_____

34. If you could decide about the staff's smoking yourself, how would you do the arrangements?

1. Completely smoke free workplace
2. There would be separate smoking premises indoors, but smoking would be prohibited elsewhere
3. No restrictions on smoking at workplace
4. I don't know

35. What would be the <u>best</u> stakeholder to make sure that no involuntary exposure to tobacco smoke occurs at workplace?

1. The management of the workplace
2. The employees by themselves
3. The management and employees together
4. Occupational health care
5. Occupational safety and health committee
6. Some other, what/who?

_____

7. I don't know

36. If there is tobacco smoke at your workplace, does it cause?

1. Considerable discomfort
2. Some amount of discomfort
3. Tobacco smoke does not affect work comfort
4. There is no tobacco smoke at my restaurant
5. I don't know

37. Has the tobacco restrictions had an effect on your working atmosphere?

1. Very positively
2. Quite positively
3. No effect on the working atmosphere
4. Quite negatively
5. Very negatively
6. There are no restrictions on smoking at my workplace
7. I don't know

38. Has the tobacco restrictions had an effect on your customers?

1. Very positively
2. Quite positively
3. No effect on the customers
4. Quite negatively
5. Very negatively
6. I don't know

39. How do you think the new legislation has affected your health?

1. It has had a positive effect
2. No effect
3. Negatively
4. I don't know

40. Do you feel that the tobacco smoke at your workplace has caused you (you may choose more than one option)

1. respiratory symptoms
2. eye symptoms
3. headache
4. nausea
5. other symptoms, what?

_____

6. no symptoms
7. there is no tobacco smoke at the workplace

Thank you for your time and effort!

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