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B.M. van Gelder | A. Blokstra | T.L. Feenstra

Environmental tobacco smoke in the Netherlands

First estimates of exposure, review of main health effects and overview of available interventions

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BM van Gelder, A Blokstra, TL Feenstra

Contact:

BM van Gelder

Department for Prevention and Health Services Research (PZO),

Boukje.van.Gelder@rivm.nl

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Abstract

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First estimates of exposure, review of main health effects and overview of available interventions

About 18 till 40% of non-smoking adults (age 15+) in the Netherlands are daily exposed to environmental tobacco smoke (ETS) from other people. At least 14% of pregnant women are exposed to ETS and at least 7% of unborn children have a mother who smokes. Moreover 20-36% of children in the Netherlands are to some extent exposed to passive smoking. These estimates are the result of an exploratory study of the RIVM, which supports the Dutch tobacco control policy (National Tobacco Control Programme 2006-2010). One of the three spearheads of this policy is the protection of non-smokers against tobacco smoke.

Reducing the exposure to ETS from other people could lead to health improvements in the Netherlands. A sizeable portion of the Dutch population is exposed to ETS. ETS causes morbidity and subsequent premature mortality. Exposure to ETS could be reduced by enforcing smoking bans as well as introducing educational programmes specifically aimed at decreasing exposure.

Exposure to ETS can be the cause of many health problems. Literature research shows that there is strong evidence that exposure to ETS increases the risk of lung cancer and coronary heart disease by 20-30%. Furthermore, there is evidence that the average birth weight of babies born to women who have been exposed to ETS is slightly reduced; the risk for extremely low birth weight (below 2500 grams) is increased by 20-40%. The risk for sudden infant death syndrome is increased in babies exposed to ETS in both the prenatal and postnatal periods. Passive smoking in children increases the risk by 20-50% for respiratory conditions such as infections or other symptoms. There is also an increased risk for lung dysfunction and middle ear disease.

Key words: tobacco control, passive smoking, exposure to environmental tobacco smoke, health effects, interventions

Rapport in het kort

Meeroken in Nederland

Een schatting van de blootstelling aan tabaksrook van anderen en een overzicht van de voornaamste gezondheidsschade en beschikbare interventies

In Nederland rookt naar schatting tussen de 18 en 40% van de niet-rokende volwassenen (15 jaar en ouder) dagelijks mee. Minstens 14% van de zwangere vrouwen rookt mee en minstens 7% van de foetussen heeft een rokende moeder. Tussen de 20 en 36% van de kinderen rookt in meerdere of mindere mate mee. Dit blijkt uit een verkennende studie van het RIVM, die is uitgevoerd ter ondersteuning van het Nederlandse tabaksontmoedigingsbeleid (Nationaal Programma Tabaksontmoediging 2006-2010). Een van de speerpunten daarvan is passief roken terugdringen.

De gezondheid van niet-rokers kan verbeteren door ze minder aan tabaksrook bloot te stellen. Een groot deel van de Nederlandse bevolking staat bloot aan de tabaksrook van anderen, wat ziekte en sterfte veroorzaakt. Een algeheel rookverbod in publieke ruimtes in combinatie met voorlichting om meeroken te ontmoedigen, kan de schadelijke effecten beperken.

Meeroken kan verschillende gezondheidsproblemen veroorzaken. Uit literatuuronderzoek blijkt dat meeroken de kans op longkanker en coronaire hartziekte met 20 tot 30% verhoogt. Verder leidt meeroken door zwangere vrouwen tot een iets lager gemiddeld geboortegewicht. Daarnaast is de kans op een extreem laag geboortegewicht (< 2500 gram) met 20 tot 40% verhoogd. Prenataal en postnataal meeroken door de baby verhoogt de kans op wiegendood. Als kinderen meeroken is de kans op negatieve effecten op longfunctie en middenoorontsteking groter. Ook is bij hen de kans op luchtwegaandoeningen 20 tot 50% groter (luchtweginfecties en symptomen).

Trefwoorden: tabaksontmoediging, meeroken, tabaksrook van derden, gezondheidsschade, interventies

Voorwoord

Het Nationaal Programma Tabaksontmoediging 2006-2010 heeft als één van de drie speerpunten het voorkómen dan wel terugdringen van meeroken. Daarom heeft het ministerie van Volksgezondheid, Welzijn en Sport (VWS) het RIVM gevraagd om een verkennende studie naar passief roken in Nederland.

Dit rapport geeft daartoe een eerste schatting van de blootstelling van niet-rokers aan tabaksrook in Nederland, een samenvatting van de beschikbare literatuur over gezondheidsschade door meeroken en een overzicht van beschikbare interventies om de blootstelling aan tabaksrook van derden te reduceren.

Diverse mensen binnen en buiten het RIVM hebben een belangrijke bijdrage geleverd aan het tot stand komen van dit rapport. We willen Marc Willemsen, Monique Verschuren en Jet Smit bedanken voor het gebruiken van de gegevens van respectievelijk STIVORO, de 'Doetinchem Cohort Studie' en de 'Preventie en Incidentie van Astma en Mijt Allergie (PIAMA) geboortecohortstudie'. Tevens willen we Alet Wijga en Peter Engelfriet van het RIVM bedanken voor het kritisch lezen en becommentariëren van dit rapport en Salome Scholtens voor het aanleveren van gegevens.

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Samenvatting

Het Nationaal Programma Tabaksontmoediging 2006-2010 kent drie pijlers: (1) rokers stimuleren te stoppen met roken; (2) voorkómen dat jongeren gaan roken; (3) niet-rokers beschermen tegen tabaksrook. In het kader van de derde pijler wordt een verkennende studie naar meerroken in Nederland uitgevoerd. Het doel van het huidige rapport is om een eerste schatting van de blootstelling aan tabaksrook van niet-rokers in Nederland te geven, een samenvatting van de gezondheidsschade door meerroken en een overzicht te geven van mogelijke interventies om de blootstelling aan tabaksrook te reduceren.

Met de gegevens van twee langlopende cohortstudies, gegevens van STIVORO en literatuur is geprobeerd een eerste ruwe schatting te geven van de blootstelling van niet-rokers aan tabaksrook in Nederland. Het blijkt echter niet gemakkelijk om een schatting te geven en daarom moeten de resultaten voorzichtig geïnterpreteerd worden. De beschikbare data maken niet allemaal duidelijk onderscheid tussen meerroken door niet-rokers en door rokers. Voor rokers geeft meerroken weinig toegevoegde schade. Verder is de mate van blootstelling (aantal uren per dag en hoeveelheid rook in de omgeving) niet altijd duidelijk gedefinieerd en verschilt de tijdspanne van de blootstelling tussen de verschillende databronnen. De beschikbare data zijn vooral gebaseerd op vragenlijsten waarbij mensen zelf aangeven welk deel van hun tijd ze in een rokerige omgeving zijn. De resultaten laten zien dat een groot deel van de Nederlandse bevolking meerookt. Ongeveer 18-40% van de niet-rokende volwassenen staat dagelijks bloot aan tabaksrook van anderen. Minstens 14% van de zwangere vrouwen rookt mee en minstens 7% van de foetussen heeft een rokende moeder. Tussen de 20-36% van de kinderen rookt in meerdere of mindere mate mee.

Aan de hand van drie gezaghebbende rapporten kan een goed overzicht worden gegeven van de gezondheidsgevolgen van meerroken. Meerroken blijkt meerdere gezondheidsproblemen te veroorzaken. Er is veel bewijs dat meerroken de kans op longkanker en coronaire hartziekte met 20-30% verhoogt. Deze gezondheidsrisico's zijn behoorlijk hoog. Aan de andere kant zijn de risico's die rokers zelf lopen vele malen hoger, en liggen rond de 800-2900% voor longkanker en 100-500% voor hart- en vaatziekten. Verder is er bewijs dat meerroken door de zwangere vrouw leidt tot een kleine reductie in het gemiddelde geboortegewicht en tot een 20-40% verhoogde kans op een extreem laag geboortegewicht (< 2500 gram). Prenataal en postnataal meerroken door de baby verhoogt de kans op wiegendood. Ook verhoogt meerroken door kinderen de kans op negatieve effecten op longfunctie en middenoorontsteking en is er een 20-50% verhoogde kans op luchtwegaandoeningen bij deze kinderen (luchtweginfecties en symptomen). Er zijn aanwijzingen (maar nog niet voldoende) voor een relatie met andere kankersoorten, beroerte, luchtwegaandoeningen bij volwassenen en vroegtijdige geboorte.

Interventies om mensen te beschermen tegen blootstelling aan tabaksrook richten zich zowel indirect als direct op het verminderen van de blootstelling. Indirect leidt alle beleid dat gericht is op vermindering van het aantal rokers tot een vermindering van tabaksrook. De mogelijkheden voor beleid in Nederland voor directe interventies worden aan de hand van twee rapporten verkend. Voorbeelden voor directe interventies zijn een algeheel rookverbod in openbare gelegenheden en voorlichting zoals (massamediale) publiekscampagnes om de bevolking te informeren over (de schadelijke gezondheidseffecten van) meerroken. Een belangrijke doelgroep voor interventies zijn (aanstaande) ouders, omdat kinderen een kwetsbare groep voor meerroken zijn. Met name de privé-omgeving, zoals huis en auto, is moeilijk te bereiken met een rookverbod.

De gezondheidsschade door passief roken is in de literatuur vrij uitgebreid beschreven. Voor andere kankersoorten, beroerte, luchtwegaandoeningen bij volwassenen en vroegtijdige geboorte is nog

onvoldoende bewijs en zou nader onderzoek zinvol zijn. Naast uitbreiding van de rookverboden in de horeca (per 1 juli 2008) moeten al bestaande verboden aangescherpt worden. Omdat met rookverboden de privé-omgeving moeilijk te bereiken is, zouden campagnes zich speciaal moeten richten op de privé-omgeving (huis en auto) met de (aanstaande) ouders als doelgroep. Verder onderzoek naar de blootstelling in de privé-omgeving zou nuttig zijn. Ten slotte is nader onderzoek naar de blootstelling aan passief roken in Nederland zeer gewenst, omdat beschikbare data slechts een ruwe schatting kunnen geven. Hiervoor is naast het gebruik van vragenlijsten een objectievere meetmethode, zoals cotinine-metingen, gewenst. Tevens is er behoefte aan een eenduidige maat voor alle blootstelling die vergelijkbaar is voor alle verschillende groepen personen.

Conclusie: in Nederland staat een groot deel van de niet-rokende bevolking bloot aan tabaksrook van anderen. Dit veroorzaakt ziekte en daarmee samenhangende sterfte in Nederland. Het is dus van belang om de blootstelling aan tabaksrook en hiermee het aantal ziekte- en sterfgevallen in Nederland te reduceren. Dit kan door een totaal rookverbod in openbare gelegenheden in te stellen alsmede door campagnes en interventies direct gericht op reductie van de blootstelling. Dit rapport is een verkennende studie en dient zo ook gelezen te worden.

1 Introduction

1.1 Background

In 2005, the Dutch Ministry of Health, Welfare and Sports together with the Dutch Cancer Society ('KWF Kankerbestrijding'), the Asthma Foundation ('het Astma Fonds') and the Dutch Heart Foundation ('de Nederlandse Hartstichting') jointly signed a declaration of intent. As an outcome of this declaration all these parties together set up a long-term national tobacco control programme to optimize the tobacco control policy; National Tobacco Control Programme 2006-2010 ('Het Nationaal Programma Tabaksontmoediging 2006-2010')¹ with yearly action plans. The goal is to reduce the "inflow" (preventing young people from starting smoking), to increase the "outflow" (stimulate smokers to stop smoking and assist them) and to protect non-smokers against tobacco smoke (to reduce the exposure to environmental tobacco smoke (ETS)). In previous reports we paid attention to the inflow (interventions targeted at adolescents)² and the outflow (interventions to reduce tobacco smoking)³. We have not focussed yet on the third spearhead of the Dutch tobacco control policy, the protection of non-smokers against tobacco smoke. Therefore, this report will focus on the exposure to ETS. It is meant to be a first exploratory study of the exposure to ETS in the Netherlands, the health effects, and interventions aimed at reducing exposure.

1.2 Environmental tobacco smoke (ETS)

Environmental tobacco smoke (ETS) exposure, also referred as passive smoking, or involuntary smoking, is the exposure to second-hand tobacco smoke, which is a combination of exhaled smoke from a smoker (mainstream smoke) and smoke released from the smouldering cigarette or another smoking object (cigar, pipe, etc) (side stream smoke) diluted with ambient air.

ETS contains nicotine as well as many carcinogens (which cause cancer) and many irritant and toxic agents⁴. Nicotine concentrations in the air in homes of smokers and in workplaces where smoking is permitted typically range from 2 to 10 micrograms/m³ on average. Carcinogens in second-hand tobacco smoke include benzene, 1,3-butadiene, benzo[a]pyrene, 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanone and many others⁵. No level of exposure to ETS is free of risk. The US Environmental Protection Agency⁴ has classified ETS as a group A carcinogen, which means that exposure to this substance should be prevented. And the International Agency for Research on Cancer⁶ has defined exposure to ETS as 'carcinogenic to humans'⁷. Also in several other countries tobacco smoke is classified as 'class A carcinogenic'. In the Netherlands, however, this is not the case.

Side stream smoke contains considerably higher concentrations of many carcinogens and toxic substances (due to different burning conditions) but is diluted into a larger volume of air than mainstream smoke. ETS not only causes a nasty smell and irritation, but also many health problems. Not only smoking, but also ETS exposure has a detrimental impact on public health and is associated with high societal costs, early death and loss of quality of life. Recently published literature shows that living with a smoker increases mortality risk for tobacco related diseases^{8,9}. Therefore, reducing the exposure to ETS is an important issue for policy makers and clinicians. To do so, a comprehensive tobacco control policy is needed. In addition, never-smokers exposed to ETS (in home and places other than home) are more likely to be susceptible to initiate smoking than those not exposed¹⁰.

Exposure to ETS is difficult to measure precisely and can be determined in different ways. For example by using markers in the air, in body fluids or through interviews and questionnaires. Nicotine and respirable suspended particulates (RSP) (particles with a diameter of 10 micrometers or less, which are able to reach and deposit deep in the lung) are the most widely used markers for concentrations in indoor

air. Cotinine is a metabolite of nicotine and the most common biomarker. Cotinine can be determined in plasma, saliva and urine. The half-life time in the body is about 15-19 hours.

Furthermore, the extent of the exposure depends on several factors such as the number of smokers, the amount of tobacco products smoked, ventilation conditions, size of the room, the distance to the tobacco source, etc. Not only children and adults are exposed to ETS, but also newborns of mothers who smoke.

1.3 The present report

The present report is a first exploration of the exposure to ETS in the Netherlands. We will try to give a first estimation of the exposure of non-smokers to ETS in the Netherlands. Therefore, these estimates should be interpreted with caution. Furthermore, an overview of the health impacts of ETS based on existing literature and interventions for reducing ETS exposure will be given.

Several international reviews by renowned institutions exist on the health effects of exposure to ETS, as well as many meta-analyses for each separate condition caused by exposure to ETS. The Health Council of the Netherlands has published a report on the main health effects due to ETS exposure¹¹. That report together with two other major reports were used in the present study to summarize the health effects due to exposure to ETS^{7,12}.

In addition to the above mentioned documents, we benefited from a recently published Dutch report that provided recommendations for interventions to prevent the exposure to ETS¹³. Besides the recommendations it contains an overview of available instruments which we summarize in the present report. We further supplemented it with a report by Joossens et al.¹⁴. Finally, we will try to give a first rough estimation of the exposure to ETS in the Netherlands. As available data and information are limited, it is quite complex to give an estimation of the exposure. Therefore, our estimates are still very tentative.

2 Methods

In this chapter we describe how we tried to make a first estimation of the exposure to ETS and how we collected the information on the main health effects and interventions to reduce the exposure to ETS.

2.1 Exposure to ETS

To estimate the exposure to ETS, we are only interested in passive smoking of non-smokers. Otherwise, it is not clear if the results found among smokers are due to their own smoking habits or due to ETS. Furthermore, health effects due to smoking are much stronger than due to ETS.

It is very complex to give a (precise) estimation of the exposure of non-smokers to environmental tobacco smoke in the Netherlands. This because few information about exposure to ETS in the Netherlands is available and because it is difficult to measure and determine ETS precisely.

Nevertheless, we will try to give a first rough estimation of the exposure to ETS of non-smokers in the Netherlands (for adults, pregnant women and foetuses, and children). The data of two longitudinal population-based cohort studies: the Doetinchem Cohort Study and the Prevention and Incidence of Asthma and Mite Allergy (PIAMA) birth cohort study were analyzed to give an impression of the exposure in respectively adults and in children^{15;16;17}. Additionally, the information of other sources (STIVORO and literature) was used.

2.1.1 The Doetinchem Cohort Study

The Doetinchem Cohort Study is a prospective study initially carried out among a representative sample of 12 405 men and women aged 20-59 years during the first examination (1987-1991) and living in Doetinchem, the Netherlands¹⁵. A random selection of 7768 of these participants were re-invited between 1993 and 1997¹⁶, and 6582 participants were again invited between 1998 and 2002. The fourth survey round (2003-2007) was still ongoing during the writing of this report. For our estimation of recent exposure to ETS, we used data of 3891 men and women that became recently available of the fourth survey round (2003-till 2006). The data of 2007 was not available yet. For our estimation of former exposure to ETS, we used data of the third survey round (1998-2002). A detailed description of the study population has been published elsewhere¹⁸.

Information on ETS, smoking status and demographic variables were collected with a questionnaire. Recent exposure to ETS was based on the question 'How many hours a day on average are you in a room with smoke?' (continuous variable) (fourth survey). Former exposure to ETS (five years earlier) was defined with the questions 'Does someone regularly smoke in your home? (yes/no)' and 'If you do not work in your own home, does someone regularly smoke in the room where you work? (yes/no)' (third survey). Recent smoking status was defined on the question about current cigarette smoking during the last survey round (non-smoker or smoker (including occasional smokers who smoke less than one cigarette a month (<1%)). Other demographic variables that were collected were age (in years), gender (men, women) and education (low, medium, high).

Percentages of recent and former exposure to ETS (more than zero hours a day) among non-smokers were calculated. Furthermore, differences in characteristics between smokers and non-smokers were evaluated by using the Wilcoxon test for continuous variables and Chi-square tests for categorical data.

2.1.2 The Prevention and Incidence of Asthma and Mite Allergy (PIAMA) Study

The Prevention and Incidence of Asthma and Mite Allergy (PIAMA) study is a Dutch birth cohort study that was initiated in 1996 and included 4146 pregnant women whose children were born in 1996/1997¹⁷. The women were recruited from the general population while they were pregnant by means of a validated screening questionnaire on maternal asthma and allergy, which was distributed to the pregnant women while visiting prenatal clinics in three parts of the Netherlands (western, middle, northern part). The children were born in 1996/1997 and followed up for eight years. Data on ETS, demographic and other factors were collected by yearly postal questionnaires, completed by the parents. A detailed description of the study population has been published elsewhere¹⁷.

Exposure to ETS was determined as part of the survey conducted in 2004-2005 when the children were 8 years of age, and was assessed with the following question: 'Does anyone smoke in your house? (yes, yes but less than once a week, seldom/never)'. Other demographic variables that were collected were gender (boy, girl) and educational level of the mother and the father (low, medium, high). For our analyses, we used the educational level of the parent who had received the highest level of education.

Percentages of the three levels of exposure to ETS (yes, less than once a week or seldom/never) were calculated. Furthermore, differences in characteristics between the three exposure categories were evaluated by using Chi-square tests for categorical data.

2.1.3 Other sources

Additionally, we used data of the Continuous assessment of smoking behaviour ('Continu Onderzoek Rookgewoonten 2007-I') of STIVORO¹⁹ and other literature²⁰⁻²³ for further estimation of the exposure to ETS.

The 'Continu Onderzoek Rookgewoonten' of STIVORO is a yearly survey executed by TNS-NIPO with the aim to measure the tobacco use of adults in the Netherlands¹⁹. For this survey, TNS NIPO weekly asks a random selection of the Dutch population of 15 years and older (about 200 households, both men and women, as well as smokers and non-smokers) to fill in a detailed questionnaire about their smoking habits. The exposure to ETS was assessed with several questions. For the present report we only included the exposure percentages for locations indoors (at home, workplace, school, car, shops, sporting canteen, club/community centre, café and restaurant). The participants had to fill in the mean time they were exposed to ETS from other persons. Depending on the time they spent on a particular location, the exposed time was expressed in more than zero minutes per day (for the location where they spent most of their time, such as home), week or month (for the location where they spent least of their time, like café and restaurant). Due to these different time spans, the exposure percentages for the different locations are not comparable. Also smokers answered this question, although they had to fill in the time they were exposed to ETS from other persons and not smoke exposure from their own tobacco. The exposure rates were given in percentages.

2.2 Health effects of ETS

Many epidemiological studies have already assessed the health effects of exposure to ETS. Given the limited time scope of the present study, only the three most recent and important reports containing an extensive literature review on the health effects of exposure to ETS will be discussed to reflect the state of the art.

The following reports will hence be discussed:

- 'The Health Council of the Netherlands. The impact of passive smoking on public health, 2003.'¹¹. In this advisory report, the Health Council of the Netherlands evaluated the harmfulness of exposure to ETS. Therefore, the Health Council of the Netherlands appointed a committee, with the task of

assessing the current level of knowledge concerning the damage caused to public health by ETS (literature till 2003 together with the opinion of experts).

- ‘NHS Health Scotland. International review of the health and economic impact of the regulation of smoking in public places, 2005’⁷.

This report contains the results of a review of evidence about the impact of smoking bans and restrictions. The aims were to determine the health and economic impact of smoking bans and smoking restrictions in public places. It reviews literature till 2004.

- ‘US Department of health and human services. The health consequences of involuntary exposure to tobacco smoke. A report of the Surgeon General, Atlanta, 2006’¹².

This report of the Surgeon General documents the serious and lethal health effects of involuntary exposure to tobacco smoke. The report reviewed published research since the release of a prior report of the Surgeon General in 1986²⁴. For some diseases they updated the literature review that focused on studies published since the release of prior major reports and meta-analyses were performed.

There exists overlap between the single studies on the health effects due to exposure to ETS which were used in the different reviews and between the reports discussed in the present report. Therefore, the conclusions on the health effects of different reports and reviews may be based on similar studies.

The strength of the associations between exposure to ETS and the health risks in the single studies are expressed as Relative Risks (RR). This is the risk of a particular disorder in individuals exposed to ETS, divided by the corresponding risk in non-exposed individuals. In this report the summarized strengths of the associations are expressed as excess risk or increased risk. This is the increase in the risk (due to the exposure) relative to the baseline risk (non-exposed). For example a RR of 1.30 would correspond to an excess risk of 30%. In most studies the exposure to ETS was measured by questionnaire.

The evidence for the health effects is strong when it is substantial and contains several good quality meta-analyses (of single studies) which present similar results. When there are fewer or no good quality meta-analyses available but the literature is still extensive (consists of single studies) and appropriate conclusions could be drawn regarding the quality and relevance of the evidence, then the conclusion is that there is evidence for an association. However, when there are (almost) no good quality meta-analyses available and/or few single studies (like cohort studies or case-control) and/or the results are not fully consistent, then there is an indication for an association, but not with sufficient evidence. In that case, more good quality meta-analyses with results pointing in the same direction are needed.

2.3 Interventions to reduce exposure to ETS

There are several tobacco control actions possible for reducing the exposure to ETS. Joossens et al. have quantified the implementation of the tobacco control policies at the country level with the use of the Tobacco Control Scale (TCS)¹⁴. Furthermore, they gave suggestions for improvement. Bouwens et al.¹³ have presented a report with recommendations for interventions to reduce exposure to ETS by setting. Based on both reports, we will summarize interventions to reduce the exposure to ETS in the Netherlands.

3 Results

3.1 Exposure to ETS

In the following paragraphs, a first rough estimation of the exposure to ETS of adults, pregnant women/foetuses and children will be given.

3.1.1 Adults

The Doetinchem Cohort Study

Of the 3891 men and women aged 36-75 years who participated in the Doetinchem Cohort Study during the fourth survey round, 3633 men and women answered the question on passive smoking.

Seventy-eight percent of the participating men and women of Doetinchem (n=2811) do not smoke and 22 percent do (n=808). Among the 2811 non-smokers, 18% are exposed to ETS of cigarettes for more than zero hours a day with a mean of three hours a day (Table 3.1). Non-smokers exposed to ETS are overall more often male, are younger and have a lower educational level than the non-smokers who are not exposed to ETS. There are no differences in the smoking history (if they were ex-smokers) of exposed versus non-exposed non-smokers.

During the fourth survey round (2003-2006), 18% of the non-smokers are daily exposed to ETS while during the third survey round (1998-2001) 30% of the non-smokers were daily exposed.

Table 3.1. Characteristics of the exposed and non-exposed non-smokers (n=2811)

	Non-smokers		P-value*
	Exposed to ETS (n=495)	Non-exposed to ETS (n=2316)	
Percentage (%)	18	82	
Mean hours exposed per day (hours)	3	0	
Men (%)	56	47	<0.0003
Mean age (years ± sd)	53.1 ± 9.4	56.7 ± 9.8	<0.0001
Educational level (%)			
High	17	27	<0.0001
Medium	34	28	
Low	49	46	
Smoking history (%)	59	56	0.15

Values are means or percentages

* Calculated with the Wilcoxon test for continuous variables and Chi-square test for categorical variables.

Other sources

The exposure data from STIVORO¹⁹ are given in Table 3.2 and 3.3. Table 3.2 shows the percentages of both smokers and non-smokers who were exposed to ETS of other persons at locations where they spend most of their time. In Table 3.3 percentages are presented of persons who were exposed to ETS at locations where they spend least of their time. The percentages are given for different age classes. In summary, the results show that 30% of the Dutch persons aged 15 years and older are exposed to ETS more than 0 minutes per day at home, the main location of exposure. Forty one percent of the persons

aged 15 years and older who work are exposed to ETS more than 0 minutes per week at their work. And 28% of the persons aged 15 years and older who go to school are more than 0 minutes per week exposed to ETS at school. Fourteen percent are exposed more than zero minutes per week in the car, 42% in shops, 53% at the home of friend or family, 63% in the sporting canteen and 56% in a club/community centre.

Table 3.2. Percentages of non-smokers and smokers exposed to ETS of other persons for different age classes per location where they spend most of their time

	Exposure to ETS per age class											
	15-65+		15-19 yr		20-34 yr		35-49 yr		50-64 yr		65+ yr	
	%	N	%	N	%	N	%	N	%	N	%	N
At home*	30	14638	39	677	28	4116	32	4259	33	3105	20	2482
Workplace**	41	9529	47	373	42	3528	41	3601	38	1824	29	204
School**	28	2359	42	557	29	1018	17	632	12	117	5	37
In the car**	14	12090	21	394	15	3397	16	3682	13	2586	6	2030
In shops**	42	13012	37	587	42	3693	41	3704	43	2747	42	2280
At the home of friends/ family**	53	2570	52	108	56	755	55	743	54	548	42	416
Sporting canteen**	63	2932	63	179	64	920	64	1063	64	484	58	287
Club/community centre**	56	1727	51	105	67	362	63	404	57	391	43	465

*More than 0 minutes exposed per day

**More than 0 minutes exposed per week

Source: Data from 'Continu Onderzoek Rookgewoonten 2007' made available to RIVM by STIVORO.

Ninety five percent of persons aged 15 years and older who go to a café are exposed to ETS more than 0 minutes per month in a café and 84% of the persons who go to a restaurant (Table 3.3). The latter rates are very high, however, persons spend least of their time at these locations. Due to unknown overlap and different time spans, the percentages for these different locations are not comparable and cannot be added, or combined. For estimating the exposure to ETS for adults in the Netherlands we therefore used the percentages pertaining to the location where persons spend most of their time (i.e. at home). We used the highest reported percentage at home (39%) for both non-smokers as well as smokers as a maximum exposure to ETS for non-smoking adults, because we assume that non-smokers are less exposed to ETS than smoking persons. In conclusion, a maximum of 40% of non-smoking adults is exposed to ETS for more than zero hours per day.

Table 3.3. Percentages of non-smokers and smokers exposed to ETS of other persons for different age classes per location where they spend least of their time

	Exposure to ETS per age class											
	15-65+		15-19 yr		20-34 yr		35-49 yr		50-64 yr		65+ yr	
	%	N	%	N	%	N	%	N	%	N	%	N
Café*	95	4738	93	299	96	2090	96	1257	94	698	89	394
Restaurant*	84	7905	85	197	88	2549	86	2116	84	1606	73	1437

*More than 0 minutes exposed per month

Source: Data from 'Continu Onderzoek Rookgewoonten 2007' made available to RIVM by STIVORO.

In addition, with the data of STIVORO it is possible to estimate what proportion of time (as percentage of 24 hours) someone was exposed to ETS (from all locations taken together). Both smokers and non-smokers together are exposed to ETS 10.6% of their time. For smokers this is 23.8% and for non-smokers 5.6%.

3.1.2 Pregnant women and foetuses

Other sources

Results from a birth cohort study in Utrecht, the Netherlands, which started in 2000, showed that 79.6% of the pregnant women (of a total of 456 pregnant women of whom information on lung function and blood pressure was available) were not exposed to ETS²⁰. Almost 7% (6.6%) of the women did smoke during pregnancy and almost 14% (13.8%) of the pregnant women did not smoke but were exposed to ETS from others.

3.1.3 Children

The Prevention and Incidence of Asthma and Mite Allergy (PIAMA) Study

Of the 4146 pregnant women who were originally included in the PIAMA Study, information on ETS was available for 3253 children 8 years of age.

Seventeen percent of the children live in houses where someone smokes inside at least once a week (n=548) (Table 3.4). Among 9% of the children (n=303) someone smokes inside the house sometimes, but less frequently than once a week. And in 74% of the children (n=2402) there is seldom or never smoke in the house. In summary, about 26% of 8 years old children are to a greater or lesser degree exposed to ETS in their house.

There are no differences in the percentages boys/girls between the groups. The parents of the children who are exposed to ETS are overall lower educated than parents of children who are less exposed to ETS. Parents of children who are seldom/never exposed have the highest educational level.

Table 3.4. Characteristics of the 8 years old children exposed (yes, less than once a week or seldom/never) to ETS

	Children exposed to ETS at home (n=3269)			P-value*
	Yes	Less than once a week	Seldom/never	
Percentage (%)	17	9	74	
Boys (%)	50	54	51	=0.45
Educational level parents (%)				
High	30	42	58	<0.0001
Medium	46	40	33	
Low	24	19	8	

Values are percentages

* Calculated with the Chi-square test for categorical variables.

Other sources

A study in the late 1990s shows an ETS exposure rate at home of 20% for Dutch children aged up to 4 years of age²¹.

According to Hofhuis (2003) 36% of Dutch children aged 0-1 year were exposed to ETS in their homes in 2000^{23,25}.

3.1.4 Summary

It is difficult to give a (precise) estimation of the exposure of non-smokers to environmental tobacco smoke in the Netherlands. The current research was limited to existing data for the Netherlands and therefore depends on available information. In Table 3.5 ranges (with lower and upper limits) of ETS exposure in the Netherlands for adults, pregnant women/foetuses and children are given.

Table 3.5. Rough estimates of ETS exposure in the Netherlands

Exposed group	Range of ETS exposure (%)
Adults (per day)	18-40
Pregnant women	≥14
Foetuses (exposed by smoking mother)	≥7
Children (0-4 years)	20-36
Children (8 years)	≥26

Adults

The Doetinchem Cohort Study concerns a rather healthy and higher educated study population with fewer smokers than in the general population (22% versus 28%)²⁶. The information of ETS exposure was based on daily exposure of non-smokers, expressed in hours, for cigarette smoke only and restricted to rooms. Therefore, we assume that the above mentioned exposure percentage is an underestimation of the true exposure to ETS of non-smokers in the whole Dutch population. Therefore, we expect that at least 18% of the non-smoking adults in the Netherlands are exposed daily to environmental tobacco smoke.

The data from STIVORO are representative for the Dutch population. The information on ETS exposure was based on both non-smokers and smokers. We assume that smokers are generally more exposed to ETS from other persons than non-smokers. Thus the percentages will be an overestimation of the true exposure to ETS among non-smokers. Furthermore, the exposure percentages per location were based on daily, weekly and monthly exposure depending on the time spent at that particular location. Unfortunately, due to unknown overlap, these percentages cannot be added, or combined. The exposure percentages are restricted to one location and thus are an underestimation of the total exposure. Therefore, these percentages of exposure will be the bottom of the upper limit of the true exposure in non-smoking adults in the Netherlands. For the estimation we used the exposure percentages of the location where persons spend most of their time (like in the Doetinchem Study). Therefore, we expect that a maximum of 40% of the non-smoking adults are exposed to ETS for more than zero hours per day.

In conclusion, the daily exposure to ETS for non-smoking adults may range between 18% and 40% (Table 3.5).

Pregnant women and foetuses

Since the women of a birth cohort study in Utrecht were a selected group, the exposure rates will be an underestimation of the true exposure. Furthermore, parental smoking during pregnancy may have been underreported because smoking during pregnancy is considered inappropriate behaviour in the Netherlands. Therefore, the results are an underestimation of the true exposure in the Netherlands.

In conclusion, at least 14% of the pregnant women are exposed to ETS from others and at least 7% of the foetuses is directly exposed to ETS by their mother (Table 3.5).

Children

The children in the PIAMA study are exposed to different kinds of smoke (cigarette, pipe, cigar). Their ETS exposure was only determined in the house and not in places outside the house. For children, the home is by far the most important place of exposure. Furthermore, the PIAMA Study consists of a rather higher educated study population (persons with low education and ethnic groups were underrepresented). Therefore, we assume that the above mentioned exposure percentages will be an underestimation of the real exposure to ETS in children in the whole Dutch population. We expect that in the general population the percentage of children of 8 years of age that will be exposed to ETS to greater or lesser degree will be at least 26%.

Furthermore, other sources show exposure rates of 36% for children aged 0-1 year and 20% for children up to 4 years old. These percentages are from before 2000. Since 2000, the number of smokers in the Netherlands decreased (from 33% in 2000 to 28% in 2006)^{27,28} and several tobacco control activities were introduced since 2000. Therefore, these percentages will be an overestimation of the true exposure. However, the percentages were only restricted to exposure at home.

In conclusion, exposure rates for children vary between 20-36% and depend on the age of the children (Table 3.5).

3.2 Health effects of ETS

This chapter gives an overview of the literature on the main health effects of exposure to ETS. First, the health effects for adults will be discussed. Thereafter the health effects for pregnant women and foetuses and finally for children will be reviewed. If available, excess risks will be given for a particular disorder.

3.2.1 Adults

Lung cancer

Based on five meta-analyses/reviews^{4;6;29-31}, and one large prospective cohort study^{32;33}, supplemented by expert opinion, the Health Council of the Netherlands concludes that there is sufficient evidence to conclude that passive smoking causes lung cancer with an increased risk of 20%¹¹.

The NHS Health Scotland report concluded that the excess risk of lung cancer amongst never-smoking women exposed to ETS in their homes by their husbands appears to be about 25%⁷. This conclusion was based on 21 meta-analyses/reviews^{4;29;31;34-51}, two cohort studies^{32;52}, a case-control study⁴⁹ and an authors reply⁵³. There is also an indication of a dose-response relationship between the excess risk for lung cancer and the number of cigarettes smoked by their husbands. However, evidence for a dose-response relationship between lung cancer excess risk and duration of exposure was less convincing. Most studies were performed among women. However, the literature suggests that there might be no differences in risk between men and women^{29;51}. Furthermore, the researchers state that the range of estimates for workplace exposure is similar to domestic exposure⁷.

The Surgeon General considered available evidence for a relation between ETS and the risk for lung cancer published through 2002¹². They evaluated only two meta-analyses since these two studies subsumed those of earlier reports^{29;50}. Furthermore, they updated the meta-analysis of published studies, consisting of the previously mentioned meta-analyses^{29;50} with new cohort/case-control studies⁵⁴⁻⁶⁸. According to the report of the Surgeon General there is sufficient evidence (more than 50 epidemiological studies) to infer a causal relationship between exposure to ETS and lung cancer among lifetime non-smokers¹². This conclusion extends to all kinds of ETS exposure, regardless of location (home or work). Furthermore, they state that the pooled evidence indicates a 20 to 30% increase in the risk of lung cancer from ETS exposure associated with living with a smoker¹².

In summary, literature shows that environmental tobacco smoke causes lung cancer. The excess risk varies between 20-30%.

Other cancers

Both the Health Council of the Netherlands and the Surgeon General conclude that no convincing evidence exists for passive smoking causing other cancers (like breast cancer, nasal sinus cavity, nasopharyngeal^{11;12} and cervical cancer¹²). The NHS Health Scotland study did not review other cancers⁷.

Coronary heart disease (CHD)

The Health Council of the Netherlands concludes on the basis of two meta-analyses^{69;70}, five reports^{6;71-74} and one case-control study⁷⁵ that ETS increases the risk of coronary heart disease by 20-30%. Despite less evidence for CHD than for lung cancer, the commission concludes that there is enough convincing evidence available.

With the information from six meta-analyses/reviews^{69;70;76-79} and four more recently published case-control and cohort studies^{32;75;80;81}, the NHS Health Scotland concluded that exposure to ETS is

associated with a 25% excess risk of coronary heart disease among men and women who have a spouse that smokes⁷. There appeared to be some evidence for a dose-response relationship for the intensity of ETS to which a person was exposed^{70;81} and for the duration of exposure, with risk increasing with longer duration^{70;75}.

The Surgeon General reviewed five meta-analyses for the exposure to ETS and the risk of CHD^{69;70;77-79}. Furthermore, they provided an update of the meta-analysis of He (1999)⁷⁰ and included nine more cohort studies and seven more case-control studies^{80;82-96}. With all the information available, they concluded that 'there is sufficient evidence to infer a causal relationship between exposure to ETS and increased risk of coronary heart disease morbidity and mortality among both men and women'¹². The pooled risk estimates from meta-analyses indicate a 25-30% increased risk'. Furthermore, they also indicate that there might be a slight increase in CHD risk with higher levels of ETS exposure¹².

In summary, the literature shows that environmental tobacco smoke causes coronary heart disease. The excess risk varies between 20-30%.

Stroke

There may be an indication that passive smoking increases the risk of stroke¹¹. However, there is not sufficient research available on this topic. Therefore, the Health Council of the Netherlands doesn't draw a conclusion¹¹.

According to the NHS Health Scotland, there are only seven single studies^{11;81;84;97-100} on the association between the exposure to ETS and the risk of stroke available and no meta-analyses⁷. There seems to be an association. However, there are few studies with a sufficient number of participants available. Furthermore, the studies were difficult to compare (heterogeneity of methods) and only two studies found a significant association⁷.

According to the Surgeon General, there is suggestive evidence^{84;88;97;98;101;102} but not sufficient evidence to infer a causal relationship between exposure to ETS and an increased risk of stroke¹².

In conclusion, there is suggestive evidence for an association between the exposure to ETS and an increased risk of stroke. However, there is not sufficient evidence available for drawing conclusions.

Respiratory disorders in adults

Based on two reports^{72;103}, the Health Council of the Netherlands states that there may be an association between passive smoking and chronic respiratory disorders (like asthma) in adults¹¹. The Health Council of the Netherlands also states that asthmatic adults are generally more vulnerable for exposure to ETS¹¹. However, more literature is warranted before definite statements can be made for these topics¹¹.

The NHS Health Scotland concludes that there are indications for a relationship between exposure to ETS and poor respiratory health (e.g. lung function^{4;104-106}, wheezing¹⁰⁷⁻¹¹⁰, dyspnea^{87;107-110} and adult onset asthma¹⁰⁹⁻¹¹⁴). For lung function, several meta-analyses/reviews exist^{4;104-106}. However, there are only few single studies available for specific respiratory disorders^{87;107-114}. For reaching a definite conclusion, studies are too difficult to compare and the degree to which passive smoking affects the respiratory system is not clear⁷.

The Surgeon General concludes that there is suggestive but not sufficient evidence to infer a causal relationship between the exposure to ETS and acute respiratory symptoms including cough, wheeze, chest tightness, difficulty with breathing among persons with asthma and among healthy persons, and chronic respiratory symptoms¹². The Surgeon General based her conclusion on experimental¹¹⁵⁻¹²⁴ and

observational studies^{109;110;112;125-134}. However, more research is warranted on the afore mentioned associations due to methodological limitations and inconsistent results of the available studies¹². With respect to lung function, the Surgeon General reviewed a report⁷², a meta-analysis¹⁰⁶ and several cross-sectional and cohort studies^{120;122;124;135-139}. They concluded that there is suggestive but not sufficient evidence for an association between exposure to ETS and lung function¹². The Surgeon General concludes that there is suggestive but not sufficient evidence to infer a causal relationship between exposure to ETS and adult-onset asthma or a worsening of asthma control¹². These findings are based on a report⁷² and several single studies^{136 110;111;135;140-147}.

Furthermore, the Surgeon General concludes that the evidence is suggestive but not sufficient to infer a causal relationship between ETS exposure and the risk for chronic obstructive pulmonary disease (COPD)¹². This conclusion was based on several single studies^{84;88;110;112;148-154}.

In summary, the evidence is suggestive but not sufficient that exposure to ETS causes airway disorders (like respiratory symptoms, chronic airway obstructions, lung function obstruction and chronic pulmonary disease) in adults.

3.2.2 Pregnant women and foetuses

There is a lot of epidemiologic research available on the association between exposure to ETS during and after pregnancy. We will only discuss probable or proven (main) health effects of exposure to ETS. Furthermore, the Surgeon General has based her conclusions on the health effects in newborns and children on numerous articles, which are too many to reproduce as references in the following text (sections 3.2.2 and 3.2.3). For the evidence on the health effects we therefore refer to the original report of the Surgeon General¹².

Pregnant women exposed to ETS

Both the Health Council of the Netherlands and the NHS Health Scotland state that there is some evidence for a relationship between maternal exposure to ETS during pregnancy and an increased risk of an extreme low birth weight (below 2500 grams) of the baby by 20-40%. The Health Council of the Netherlands¹¹ based her conclusion on a report⁷² and a overview article¹⁵⁵, and the NHS Health Scotland⁷ on three reviews^{104;156;157} and three single studies¹⁵⁸⁻¹⁶⁰.

The Surgeon General concludes that there is sufficient evidence to infer a causal relationship between maternal exposure to ETS during pregnancy and a small reduction in birth weight¹². The evidence that maternal exposure to ETS during pregnancy causes preterm delivery is suggestive but not sufficient.

In summary, there is evidence that maternal exposure to ETS during pregnancy is associated with a small reduction in birth weight and some evidence for an increased risk of an extreme low birth weight (below 2500 grams) by 20-40%. There is suggestive but not sufficient evidence for an association with preterm delivery.

Foetuses exposed to ETS by their smoking mothers

According to the Health Council of the Netherlands, there is some evidence that the incidence of sudden infant death syndrome is higher among babies with mothers who smoked during pregnancy than among babies of mothers who did not smoke during pregnancy¹¹. In addition, not only prenatal but also postnatal exposure of the baby to ETS might be associated with a higher risk of sudden infant death syndrome¹¹. Afore mentioned conclusions were based on two meta-analyses^{161;162}, an overview article¹⁵⁵ and a report⁷².

The NHS Scotland concludes that there was little evidence for an association between ETS exposure and sudden infant death syndrome^{7;104}.

In addition, the Surgeon General concludes that there is sufficient evidence for an association between exposure to ETS and a higher risk for sudden infant death syndrome¹².

In summary, prenatal and postnatal exposure of the baby to environmental tobacco smoke might be associated with a higher risk of sudden infant death syndrome.

3.2.3 Children

Respiratory disorders in children

Based on several meta-analyses/reviews^{101;155;163-165} and three reports^{4;72;166}, the Health Council of the Netherlands concludes that ETS (by smoking parents or other smoking persons) increases the risk of (severe) infections and more frequent airway symptoms (like wheezing, cough, blocked nose, shortness of breath, acute lower airway infections) in children with and without asthma. The extra risks are between 20-50% and depend on the kind of symptoms, kind and extent of exposure and the age of the children¹¹. There are also indications for an exposure-effect relation and an association between passive smoking and inflammation of the middle ear^{155;167}.

The NHS Health Scotland did not specifically investigate this association among children⁷.

According to the Surgeon General, children who are exposed to ETS are at an increased risk for lower respiratory infections, middle ear disease, more severe asthma, respiratory symptoms (like cough, phlegm, wheeze, breathlessness) and slowed lung growth¹². There is suggestive evidence but not sufficient to infer a causal relationship between ETS exposure from parental smoking and the onset of childhood asthma¹². Furthermore, the evidence is sufficient to infer a causal relationship between maternal smoking during pregnancy and persistent adverse effects on lung function across childhood. And the evidence is sufficient to infer a causal relationship between exposure to ETS after birth and a lower level of lung function during childhood¹².

In summary, children with and without asthma who are exposed to ETS are at an increased risk of (severe) respiratory infections and more frequent respiratory symptoms (such as wheeze, cough, blocked nose, shortness of breath, phlegm, lower airway infections). The risk increases are between 20-50%. Furthermore, exposure to ETS is associated with adverse effects on lung function, middle ear disease and more severe asthma.

3.2.4 Summary

In Table 3.5, the main health effects due to exposure to ETS with their evidence for adults, pregnant women/foetuses and children are summarized. The evidence varies between 'strong evidence' and 'indication, but not sufficient evidence'. For other cancers, stroke, respiratory disorders in adults and preterm delivery more good quality meta-analyses with results pointing in the same direction would be needed to reach a conclusion. Furthermore, there may be other, as yet unknown, health effects due to the exposure to ETS. However, we only discussed the main health effects for which several literature references were available and restricted further review of other health effects and more recently published literature.

Table 3.5 Health impact of exposure to environmental tobacco smoke

	Health impact of exposure to ETS	Evidence for a causal relation*	Excess risk (%)**
Adults			
	Lung cancer	Strong evidence	20-30
	Other cancers	Indication, insufficient evidence	-
	Coronary heart disease	Strong evidence	20-30
	Stroke	Indication, insufficient evidence	-
	Respiratory disorders (like respiratory symptoms, chronic airway obstructions, lung function and COPD)	Indication, insufficient evidence	-
Pregnant women/foetuses			
	Pregnant women exposed to ETS		
	Birth weight: <ul style="list-style-type: none"> • Small reduction • Extreme low birth weight (below 2500 grams) 	<ul style="list-style-type: none"> • Evidence • Evidence 	<ul style="list-style-type: none"> • - • 20-40
	Preterm delivery	Indication, insufficient evidence	
	Foetuses exposed to ETS by their smoking mothers		
	Sudden infant death syndrome	Evidence	-
Children			
	Respiratory disorders		
	(Severe) respiratory infections and more frequent respiratory symptoms (such as wheeze, cough, asthma, blocked nose, shortness of breath, phlegm).	Evidence	20-50
	Adverse effects on lung function and middle ear disease	Evidence	

* *Strong evidence: the evidence is substantial and contains several good quality meta-analyses presenting similar results.*

Evidence: there are fewer or no good quality meta-analyses available but the literature is still extensive and appropriate conclusions could be drawn regarding the quality and relevance of the evidence.

Indication: there are (almost) no good quality meta-analyses available and/or few single studies and/or the results are not fully consistent. Then there is an indication for an association, but not with sufficient evidence.

***This is the increase in the risk (due to the exposure) relative to the baseline risk (non-exposed).*

3.3 Interventions to reduce exposure to ETS

According to the existing literature, exposure to ETS causes many health problems to non-smokers. Therefore, reduction in ETS exposure is a primary component of national comprehensive tobacco control programmes¹. A reduction in ETS exposure can be achieved in two ways: indirectly by reducing the number of smokers in the Netherlands and directly by taking tobacco control actions aimed at reducing ETS exposure. Firstly, to reduce the number of smokers, the inflow of smokers should be reduced (prevention of young people to start smoking) and the outflow should be increased (stimulate smokers to stop smoking). Policy to reduce the inflow and to increase the outflow has been discussed in previous reports. Secondly, specific tobacco control activities directly focussing on ETS exposure could reduce the exposure to ETS for non-smokers. Policy to directly reduce exposure mainly consists of smoking bans and educational/motivational programmes such as public (mass media) campaigns. This paragraph will focus on such direct interventions.

The Tobacco Control Scale (TCS) was devised to quantify the implementation of the tobacco control policies at the country level¹⁴. This scale showed that on the European level of tobacco control policy, the position of the Netherlands had decreased from the 10th place in 2005 to the 14th place in 2007 compared with 29 other European countries. Based on the TCS, Joossens et al. (2007) concluded that the tobacco control activities in the Netherlands could be improved¹⁴. With respect to the exposure to ETS there are two areas in which tobacco control in the Netherlands can improve:

1. *Public places bans.* Smoking bans in restaurants and bars can be implemented. Furthermore smoking bans in the work place and public places (educational, health, governmental, theatres) are not optimal and can be improved.
2. *Public campaigns.* There is a need for better consumer information, including public information campaigns, media coverage and publishing research findings.

Although the best way to reduce exposure to ETS is by a complete smoking ban (in all public places), this is very difficult to achieve. In the Netherlands, there is already a smoking ban for the work place and for some of the categories of public places (such as public transport, government and other institutions and sport centres). Furthermore, new smoke-free legislation in public places (hospitality sector/industry) will be enforced in July 2008. However, smoking rooms are still allowed with no restrictions on their size¹⁴.

A recently published review indeed showed that smoking bans are effective in reducing ETS exposure and subsequent disease¹⁶⁸. They showed that a smoke free workplace resulted in a decline in ETS exposure and this was accompanied by health benefits, including reduced respiratory symptoms and acute myocardial infarction and impaired lung function¹⁶⁸.

Bouwens et al. (2007) have presented a report with recommendations for interventions to reduce the exposure to ETS¹³. Below we summarize their findings and recommendations.

General public. For reduction of ETS exposure, there already exist mass media campaigns (like ‘Hou het leuk, hou het rookvrij’) with the goal to inform the general population about passive smoking and the health risks. Since smoking bans can not reach the private setting (like the homes and the cars), there are interventions which especially focus on the private setting, like ‘Roken? Niet waar de kleine bij is’ and ‘Roken doe je buiten’ (www.STIVORO.nl). Educational and motivating programmes to emphasize the harm that may occur as a consequence of both active and passive smoking are needed to reduce smoking in the home and to create public awareness. Furthermore, it is also important to create public awareness and support for ‘non-smoking as a social standard’. Non-smokers should be informed how they could support this social standard to smokers. Furthermore, special high risk groups (like hospitality sector employees and employees in the psychiatry) should be extra informed.

Employees. Since January 2004, there is a smoking ban for the workplace. Nevertheless, several companies do not comply with the law (like the (building) industry, arable farming and fishing sector). Therefore, the existing activities for the legislation should be continued. The results of the evaluation of the compliance with the legislation should be used for a refinement of the existing interventions and for convincing companies who stayed behind.

Employees and visitors of restaurants and bars. Since January 2005 there is a self-regulation project ongoing with the goal to gradually create a smoke free hospitality sector (by smoke free areas). This self-regulation does not seem effective for most hospitality sectors. Therefore, Bouwens et al. (2007)¹³ suggest that a combination of a smoking ban, supervision and education will be a good way to reduce the exposure to ETS. To do so, the focus should be on collecting and spreading arguments (health, economic, ethical and technical arguments) with their foundations for the support of a smoking ban. Furthermore, there should also be a focus on counter-arguments. And by July 1st 2008, also the restaurants and bars will be smoke-free.

Sportsman/-women and sporting clubs. In 2004 the campaign 'Rookafspraken, da's wel zo sportief' started. Furthermore, in North-Holland is a project called 'Sport Safe', in which the sporting clubs have an active smoking policy. Also for this area, there is a self-regulation project with the goal to create a smoke free sports sector in 2006. Unfortunately, this goal is not achieved. Therefore smoke free sports will be part of the smoke free hospitality, art and culture sector from the 1st of July 2008.

Children and youth. Several interventions exist with the goal to inform (expectant) parents to create a smoke free environment for their children.

'*Roken? Niet waar de kleine bij is*'. This is an effective intervention carried out by the infant welfare centre and the countrywide implementation should be continued¹³.

'*Veilig slapen en niet roken*'. This intervention is based on '*Roken? Niet waar de kleine bij is*', however, specifically targeted to immigrants and persons with a lower socio-economic status. Results of the evaluation of the intervention are not yet available.

'*Word wijzer over roken*'. This intervention is based on '*Roken? Niet waar de kleine bij is*', however, specifically targeted to immigrants and persons with a lower socio-economic status. This program will be controlled by 'Voorlichter Eigen Taal en Cultuur'. Results of the evaluation of the intervention are not yet available.

'*Sigarayi Birakiyoruz*'. This community intervention is specifically for Turkish persons and carried out in Rotterdam. Results of the evaluation of the intervention are not yet available.

'*Kinderen kopiëren*'. This intervention is mainly addressing parents about passive smoking of their own and other children. This program seems to be effective, parents stopped smoking. Therefore, prevention of exposure to ETS is an important part in the campaign '*Kinderen kopiëren*'.

'*Hallo Wereld*'. This is an informational program by e-mail that makes pregnant women aware of a healthy lifestyle during pregnancy (www.hallowereld.nl). It includes information to make pregnant mothers aware of the health risks of their baby if they still smoke while they are pregnant (www.hallowereld.nl).

Furthermore, the health care sector should be aware of the smoking behaviour of the parents in the presence of their children. Physicians, obstetricians, midwives, obstetric and district nurses should see the reduction of exposure to ETS as an important task and as their professional responsibility. Also, the focus should be on further protocol development and practice to reduce ETS exposure (also within health care education).

In summary, next to the reduction of the number of smokers, there are two direct ways to use policy to protect non-smokers against the exposure to ETS. First, by bans. In the Netherlands, the existing policy leaves room for improvement, with a smoke free hospitality, art-, culture and sport sector (to be imposed as of July 1st 2008) and better enforcement of existing bans. Second, by educational/motivating programmes, such as public campaigns in which the general public should be informed about (the health risks of) exposure to ETS. An important target group for campaigns are parents and expectant parents,

because children are a vulnerable group for exposure to ETS and their private settings (homes and cars) could not be reached with a total smoking ban.

4 Discussion and conclusions

The present report is an exploratory study on the exposure to ETS in the Netherlands. A first rough estimation of the exposure of non-smokers to environmental tobacco smoke in the Netherlands and an overview of the health impact and available policy are given. The results showed that a sizeable part of the Dutch population is exposed to ETS. About 18-40% of the non-smoking adults are exposed to ETS daily. More than 14 percent of the pregnant women are exposed to ETS of other persons, more than 7 percent of the foetuses are exposed to ETS by having a smoking mother, and 20-36% of the children are to greater or lesser degree exposed to environmental tobacco smoke. These figures cover large ranges and are first tentative estimates. A more precise estimate requires better data than are currently available. Exposure to ETS causes many health effects. There is strong evidence that exposure to ETS increases the risk for lung cancer and coronary heart disease by 20-30%. Furthermore, there is evidence that exposure to ETS causes a small reduction in birth weight and increases the risk for a low birth weight by 20-40%. Exposure to ETS also increases the risk of sudden infant death syndrome, adverse effects on lung function, middle ear disease and is associated with a 20-50% increased risk for respiratory disorders in children (respiratory infections and symptoms). The available evidence is suggestive (but not sufficient) for other cancers, stroke, respiratory disorders in adults and preterm delivery. Furthermore, with the increase of morbidity, also the incidence of premature death will increase. To protect non-smokers from the exposure to ETS, interventions could aim to reduce the exposure to ETS either directly or indirectly by reducing the number of smokers. For a direct protection of non-smokers from the exposure to ETS, there exist two types of policy. These are, first, better enforced and more complete smoking bans, and second, educational/motivational programmes such as public campaigns. An important target group for campaigns are parents and expectant parents, because children are a vulnerable group for exposure to ETS and settings in which they spend much of their time (homes and in cars) can not be reached by smoking bans.

Discussion of methods used

Some methodological issues deserve special attention. First, it turned out difficult to give a precise estimate for the exposure to ETS in the Netherlands. The current research was limited to existing data in the Netherlands and depended on available information. These sources lacked comparable definitions of exposure and sometimes mixed smokers and non-smokers. Furthermore, all data used questionnaires to measure exposure. This is a subjective method and makes it impossible to establish for instance the intensity, frequency and quantity of the total exposure. A precise quantification of exposure to ETS is difficult to achieve and would require objective methods like the use of bodily fluids (such as cotinine measurements in plasma, saliva and urine) from passive smokers or for instance air pollution measurements. However, the relative risk estimates of health risks related to ETS also used questionnaire-based estimates to establish the presence and quantity of exposure. Therefore, a more precise estimate of exposure using air measurements or cotinine samples would not have added much value for the purpose of establishing the health risks run by the Dutch population. Using questionnaire-based figures of exposure ensures at least that both the exposure and the relative risk estimates were based on the same method.

The use of questionnaires may also cause reporting bias and this may have resulted in an over- or underestimation of the true exposure (exposure misclassification). Especially pregnant women and parents tend to underreport their smoking behaviour, because smoking during pregnancy or in the presence of children is considered inappropriate behaviour in the Netherlands. This may have led to an underestimation of the exposure estimates for pregnant women, foetuses and children presented in this report. However, from the PIAMA Birth Cohort Study, nicotine measurements in the homes of the children were available to validate parental reports of indoor air smoke^{169;170}. The results showed that

the exposure classification based on questionnaire data in the PIAMA Birth cohort Study was likely to be reasonably valid and that questionnaire reports are a valid estimate of residential ETS exposure among preschool and school children.

The present report summarized the main health effects due to exposure to ETS based on recent reports from three authoritative bodies which included a synthesis from results of an extensive literature search on the health effects. Due to time limits, we did not do a further review of other (less known) health effects or literature published after 2004. Therefore, the results summarized in our report regarding the health effects due to ETS are not completely exhaustive. However, other reports and more recently published literature for a large part showed overlap with the sources used.

Some overlap exists between the various reviews/meta-analyses with regards to the single studies they included. Their conclusions on the health effects were partly based on similar studies. Thus, it is not true that the conclusions for a condition that was only investigated by one of the three reports are weaker than the conclusions for a condition investigated in all three reports. Ideally, for each condition, a single meta-analysis/review should cover all different single studies identified in the three reports as well as possibly recently published single studies. This would, however, be a very time consuming approach with little added value for most conditions. It might be worthwhile though for those conditions that could not be quantified now (see Table 3.5).

Discussion of results

The exposure range for children and adults is rather similar. This is in contrast with what was expected (a higher exposure to ETS for adults). The time spans on which the exposures were based (exposure more and less frequently than once per week for children versus daily exposure for adults) differ between the studies. That is, the percentages do not refer to similar levels of exposure and are not very well comparable. Furthermore, the exposure location was the home for children, by far the most important place. For adults, the location of exposure varied from one specific location (like the home or work) for STIVORO data, to two or more locations (like 'a room with smoke') for the Doetinchem data. Therefore, the exposure rates per location of the STIVORO data are an underestimation of the total exposure. Furthermore, the extent and kind of exposure (only cigarettes for adults in Doetinchem versus all tobacco products for children) varied. This may have led to an underestimation of the true exposure (all tobacco products) among adults in Doetinchem. Among the adults from the Doetinchem Cohort Study, the exposure rate decreased from 30% during the third survey round (1998-2001) to 18% during the fourth survey round (2003-2006). This may be a result of a decrease in the number of smokers and several tobacco control actions that had already been implemented in the Netherlands (such as mass media campaigns, smoking bans for the workplace and part of the public places, rules and other tobacco control actions) over the past years.

Exposure to ETS causes many health problems, although it should be mentioned that the risk estimates are much smaller than for the health problems caused by active smoking. Active smoking increases the risk of lung cancer by 800-2900% and of coronary heart disease by 100-500%.¹⁷¹ As mentioned above, the present report summarized the main health effects due to exposure to ETS based on three recent authoritative bodies with an extensive literature search on the health effects. For the most important conditions, lung cancer and cardiovascular diseases, the amount of available evidence is so large that it can not be expected that additional studies add much to it. For other cancers, stroke, respiratory disorders in adults (like respiratory symptoms, chronic airway obstructions, lung function and COPD) and preterm delivery the evidence was suggestive. For conclusive evidence regarding these conditions, more good quality meta-analyses with results pointing in the same direction are needed. There is little literature available for several other health effects which were not mentioned in this report and for which the evidence is insufficient and sometimes even inadequate. For these effects, such as perinatal mortality, miscarriages, congenital deficits, abnormalities in children's height/growth, cognitive

functioning and behavioural problems among children and different types of childhood cancer, more research is warranted before any statements can be made.

To reduce the exposure to ETS, several indirect and direct policies exist. Indirect policies focus on the reduction of the number of smokers and direct policies on bans and educational/motivating programmes such as campaigns. By sharpening of the tobacco law, the ETS exposure in public places will be reduced. However, exposure to ETS in the homes and cars of children and adults can not be reached by a total smoking ban. Because their respiratory, immune and nervous systems are still developing, children are especially vulnerable to the health effects of ETS¹². In addition, young children typically are exposed to ETS involuntary and have limited options for avoiding exposure (at home and in the car). They depend on their parents and on adults around them for protection. Therefore, parents and (expectant) parents are an important target group for campaigns. Educational/motivating programmes should specifically focus on the private setting (homes and cars). Furthermore, never-smokers exposed to ETS (in home and places other than home) are also more likely to be susceptible to initiating smoking than those not exposed¹⁰. Therefore, also youth are a valuable group for implementing tobacco control actions.

Recommendations for policy and further research

Exposure to ETS should be measured more often and with valid measurement methods. There is a need for one total exposure estimate based on a well defined time span and including all exposure locations. This estimate should be comparable for all different groups of persons and preferably be validated with for instance cotinine measurements. Furthermore, the present rough estimation was based on easily available information. Future research should also include information derived from other datasets. Second, for each of the health risks of passive smoking, ideally a meta-analysis should be performed consisting of all single studies including recently published data and preferably based on cotinine validated measurements of exposure. Especially, more research is needed on the health effects for which there is only suggestive but not firm evidence, and on the health effects for which the evidence is not sufficient and sometimes even inadequate. Third, the tobacco control activities in the Netherlands can be improved. For the direct policies this implies better enforced and more elaborate bans and more educational/motivational programmes. There is room for improvement of the smoking ban with a hospitality sector ban (to be imposed as of July 1st 2008) and better enforcement of existing bans. And there is a need for continued educational/motivating programmes to inform the general public about (the health risks of) exposure to ETS with parents and expectant parents as an important target group.

It is important to monitor the exposure to ETS in the Netherlands in the following years, especially in private settings like homes and cars. Particularly after improvement of tobacco control activities such as the smoking ban in the hospitality sector for instance, it would be interesting to monitor the effect on exposure to ETS. Furthermore, with a reduction in ETS exposure, also the health effects due to the exposure should reduce and therefore this should also be a special area for attention (by monitoring the health effects). In the present report, first estimates for the exposure of non-smokers to ETS in the Netherlands and an overview of the health impact and available policy measures are given. Combining this information, the potential health benefits due to a reduction in ETS exposure could be estimated, however this would require more detailed information on exposure than is currently available.

In conclusion, this exploratory study shows that a sizeable part of the non-smokers in the Netherlands is to smaller or larger degree exposed to ETS, which causes many health problems. Specific tobacco control actions can reduce the exposure to ETS in non-smokers and this will not only lead to improved air quality, but also to reduced morbidity and subsequent premature mortality in the Netherlands.

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National Institute
for Public Health
and the Environment

P.O. Box 1
3720 BA Bilthoven
The Netherlands
www.rivm.com